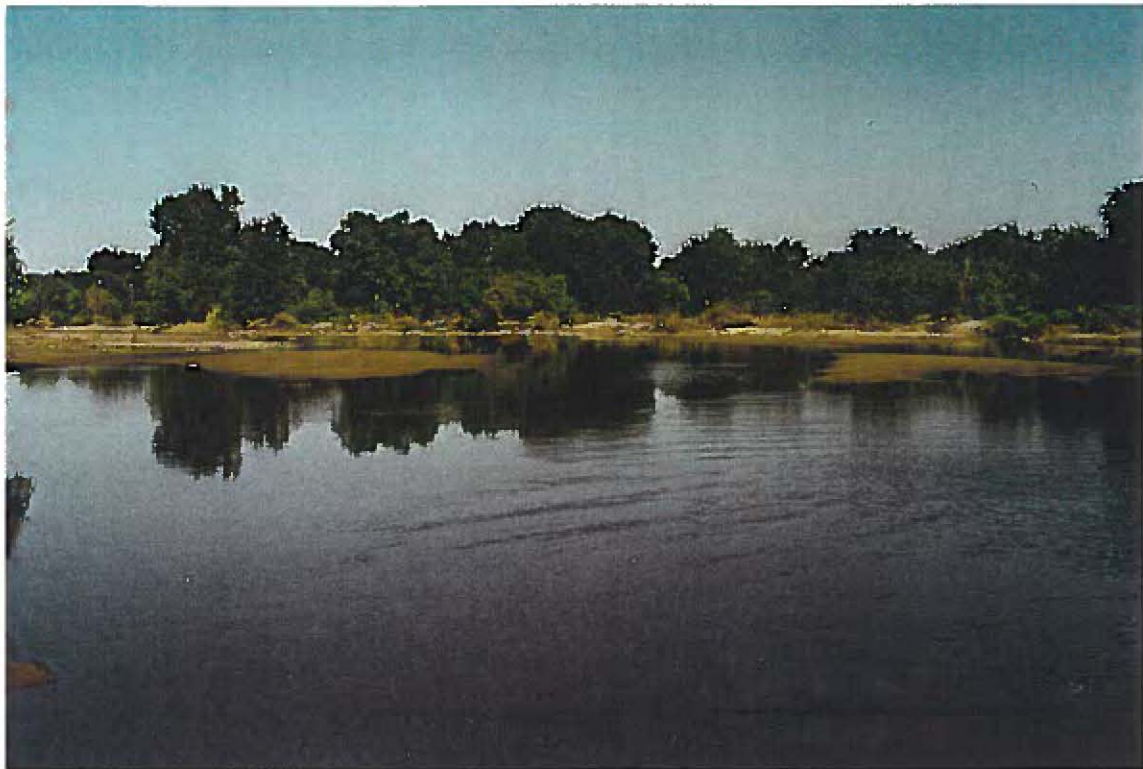


*A Classification of the Riparian Vegetation  
of the Lower South Platte  
and parts of the  
Upper Arkansas River Basins, Colorado*



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Submitted to the  
Colorado Department of Natural Resources  
and the  
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Cover: South Platte River near Ovid, CO (photo by G. Kittel).

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## SUMMARY

In this report we present results from field surveys conducted in 1995 in the lower South Platte and parts of the upper Arkansas River Basins. We collected vegetation and environmental data from more than 175 plots found along intact, relatively undisturbed stretches of rivers and streams. We classified these stands into alliances and plant associations based on their dominant plant species, similar species composition, and environmental setting. Three new plant associations were newly described from the main stem of the South Platte River, and several high quality foothill riparian areas were located in the upper Arkansas River Basin. The riparian classification presented here has been placed in the context of the UNESCO Physiognomic-Ecological Classification of Plant Formations of the Earth (Mueller-Dombois and Ellenberg 1974, as revised by Driscoll *et al.* 1984 and The Nature Conservancy by Bourgeron and Engelking 1994), and the Classification of Wetland and Deepwater Habitats of the United States (Cowardin *et al.* 1979).

For each riparian plant association we describe the regional and state wide distribution, and provide a general description including elevation, stream channel type, geomorphic setting, and vegetative characteristics. A brief soil description is also included. The relationship of each plant association to previously described riparian associations is also discussed. Succession and management issues are discussed where successional trends and/or land use impacts were observed, or where information was available from the literature.

This classification is subject to peer review, field testing, and revision. This report is part of an ongoing project to develop a state wide classification of riparian vegetation. As new data are collected from different basins, information will be incorporated into the classification. Information pertaining to rare or high quality occurrences of common plant associations will be incorporated into the Biological and Conservation Database of Rare and Imperiled Natural Communities, updated and maintained by the Colorado Natural Heritage Program (CNHP), and the Preliminary Vegetation Classification of the Western United States (Bourgeron and Engelking 1994) maintained by The Nature Conservancy's Western Heritage Task Force.

This project is a cooperative effort of the Riparian Task Force, a group of state and federal government agency representatives, which in cooperation with The Nature Conservancy's Colorado Program and the Colorado Natural Heritage Program, supports the project through in-kind services, financial support, and technical assistance. The Riparian Task Force, formalized in 1993 by a Memorandum of Understanding (MOU), consists of steering and technical committees that meet once a year to review methods, results, yearly planning, and to discuss the continued support of the state wide classification project.

## INTRODUCTION

Riparian areas, highly threatened in Colorado, are of great importance for maintaining water quality and quantity, stabilizing stream banks, and providing habitat for fish and other wildlife species (Hansen *et al.* 1988, Brinson *et al.* 1981). Riparian areas are the biological and physical link between terrestrial and aquatic ecosystems (Youngblood *et al.* 1985). These areas provide critical habitat for wildlife, and are also used extensively for domestic livestock grazing, gravel mining, recreational purposes, and as transportation corridors. The ecology of riparian areas and their response to various land management practices is poorly understood. Consequently, resource management and conservation decisions for many riparian areas are often far from optimal.

Our knowledge of riparian plant associations in Colorado has been both limited and fragmented. Patchy and scattered inventory work, using a variety of methodologies, has been conducted in the Piceance Basin (Baker 1982), along the more accessible portions of the main stem of the Yampa River (by the Colorado Natural Areas Program), and the Yampa River within Dinosaur National Monument (Fisher *et al.* 1983). The Nature Conservancy has funded classification and surveys of riparian vegetation in west-central and southwestern Colorado (Baker 1986), and the northern Front Range (Cooper and Cottrell 1990). Plant community and habitat classification by the National Forests (Hess and Alexander 1986, Hess and Wasser 1982, Komarkova 1979, Komarkova *et al.* 1988, DeVelice *et al.* 1985) have not specifically focused on riparian areas. In the Rocky Mountain Region, riparian classification has been conducted in eastern Idaho and western Wyoming (Youngblood *et al.* 1985), eastern Wyoming (Jones 1990, Jones and Walford 1995), New Mexico (Muldavin 1992, Durkin *et al.* 1994, 1995), Montana (Hansen *et al.* 1988, 1989, 1995), Nevada (Manning and Padgett 1989, 1995), and Utah (Padgett *et al.* 1989).

This project constitutes the first state wide comprehensive riparian classification effort for Colorado. Since 1990, basin-wide, systematic riparian classification has been conducted in the Yampa and San-Miguel/Dolores River basins (Kittel and Lederer 1993), the White and Colorado River basins (Kittel *et al.* 1994), and in the Gunnison River Basin (Kittel *et al.* 1995) (Figure 1). In addition, the same methods have been applied toward Forest wide riparian classifications for the Routt National Forest (Kettler and McMullen 1996), the San Juan National Forest (Richard *et al.* 1996), the Rio Grande National Forest (CNHP 1995) and the Comanche National Grassland (Culver *et al.* 1996). The three major river basins draining eastern Colorado were divided into smaller, more manageable units or sub-basins. These are: 1) the upper South Platte (I-25 west to the Continental Divide), 2) the lower South Platte (I-25 east to the state line), 3) the upper Arkansas (Pueblo west to the Continental Divide), 4) the lower Arkansas (Pueblo east to the state line), and 5) the Rio Grande River Basin (Figure 2). In this report, we present a classification of riparian vegetation from the lower South Platte River Basin, and parts of the upper Arkansas River Basin.

We classified representative homogeneous stands of riparian vegetation found along

intact, relatively undisturbed reaches of perennial and ephemeral rivers and streams, and placed them in the context of the UNESCO Physiognomic-Ecological Classification of Plant Formations of the Earth (Mueller-Dombois and Ellenberg 1974), and the Classification of Wetland and Deepwater Habitats of the United States (Cowardin *et al.* 1979). This classification is subject to peer review, field testing, and revision. As new data are collected from different basins, information will be incorporated into the classification. Information pertaining to rare or high quality occurrences of common plant associations will be incorporated into the Biological and Conservation Database of Rare and Imperiled Natural Communities, updated and maintained by the Colorado Natural Heritage Program (CNHP), and the Preliminary Vegetation Classification of the Western United States (Bourgeron and Engelking 1994) maintained by The Nature Conservancy's Western Heritage Task Force.

This project is a cooperative effort by the Riparian Task Force, a group of state and federal government agency representatives, which in cooperation with The Nature Conservancy's Colorado Program and the Colorado Natural Heritage Program, supports the project through in-kind services, financial support, and technical assistance. The Riparian Task Force, formalized in 1993 by a Memorandum of Understanding (MOU), consists of steering and technical committees that meet once a year to review methods and results, and to discuss the continued support for the statewide classification project.

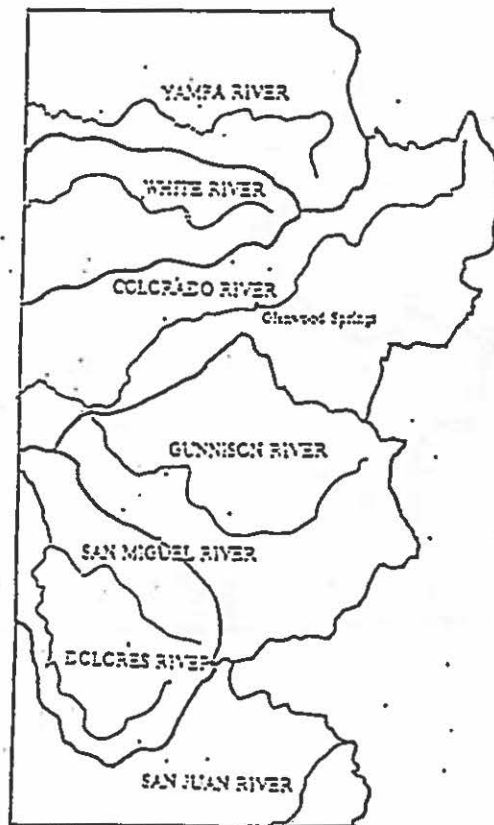


Figure 1. Map of the Major River Basins of the Colorado Western Slope.

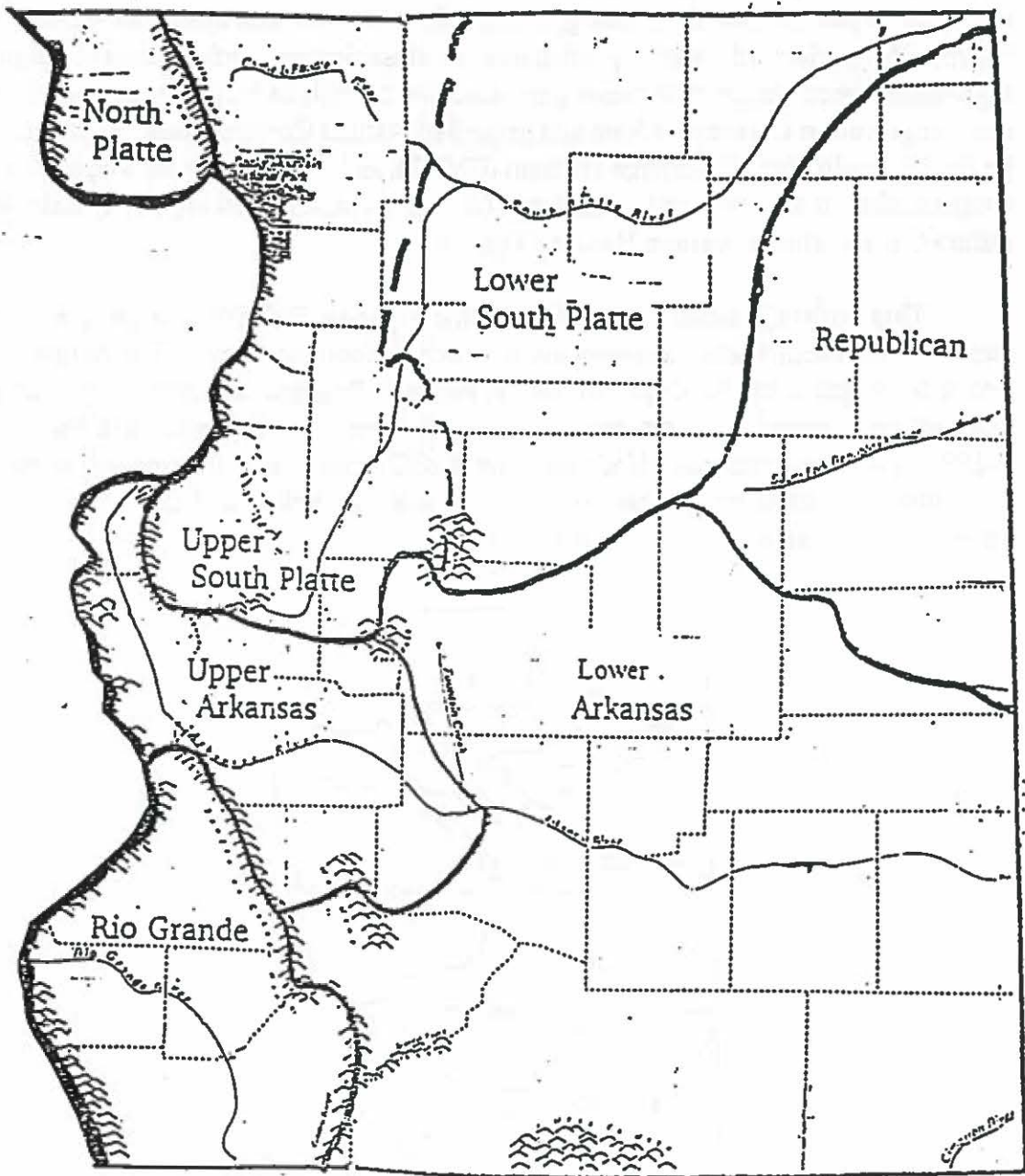


Figure 2. Map of the Major River Basins of the Colorado Eastern Slope.

## STUDY AREAS

### Lower South Platte

This study focuses on the lower South Platte River on the high plains, including the mainstem and its plains and foothill tributaries (Figure 3). The study area excluded higher, mountainous regions except for a few plots taken along S. Boulder Creek. The South Platte River and its tributaries drain nearly one-fifth of Colorado, an area of approximately 12,138 square miles (USGS 1993). The high plains area of Colorado is relatively flat with gently rolling topography and is underlain by layers of the Cretaceous Pierre Shale Formation with thin layers of Tertiary sands and gravels that make up the Colorado Piedmont (Chronic 1980). Close to Denver and the Palmer Divide, tributaries are underlain by more consolidated sandstones and shales. Here, near-surface bedrock constrains lateral stream flow and keeps water from seeping into deeper aquifers, causing stream flow to be intermittent as it passes through areas of different geologic formations. Bedrock types used to stratify perennial stream reaches are given in Figure 4.

Low annual precipitation and strong seasonal temperature changes characterize the high plains climate (Woodward-Clyde 1981). Precipitation increases with distance away from the mountains, ranging from 12 inches at Denver to roughly 20 inches in the far eastern counties (Colorado Climate Center 1984). Hydrology of the South Platte River is primarily driven by spring and early summer snow-melt runoff from the mountains. The hydrology has been altered by several off-channel reservoirs, mainstem flood control reservoirs, irrigation ditches, and channelized reaches. Some large annual flooding can still occur (a 25 year return interval flood occurred in the spring of 1995, Colorado Riparian Association 1995) but peak floods in March, during ice-break up, have been eliminated (USFWS 1994). In addition, transcontinental basin imports have added 300,000 acre-feet into the basin augmenting late-summer flows. Flows from plains tributaries result primarily from summer thunderstorms and can cause severe flooding, although these systems do not provide significant flows into the basin water supply (Woodward-Clyde 1981).

Natural vegetation of the plains prior to European settlement was nearly all short grass prairie interrupted by low sandstone hills and patches of cottonwood and willows along the South Platte River (Mutel and Emerick 1984). Today much of the area has been converted to cropland or is used as range land. Forty percent of all Colorado agricultural production occurs along the Front Range. Irrigated acreage is increasing in eastern Colorado, adding demands on the shrinking Ogallala aquifer and in-stream water of the South Platte River (Woodward-Clyde 1981). Natural gas, petroleum, and coal represent important energy resources in the basin. Oil and gas production occurs primarily between Denver and Julesburg, with some coal production in northern Larimer and Weld counties (Woodward-Clyde 1981).

Water quality of the South Platte River is severely degraded as it flows through Colorado's most populated corridor, Denver and the urban-industrial corridor to the north (USGS

1993). Concentrations of dissolved oxygen, fecal coliform bacteria, ammonia, and trace elements frequently do not meet water-quality standards (USGS 1993). These pollutants are diluted by several mountain tributaries that enter the river north of Denver. However, nitrates, nitrites, dissolved solids, selenium, and suspended sediments soon become concentrated in the stream flow below Greeley due to agricultural runoff (USGS 1993).

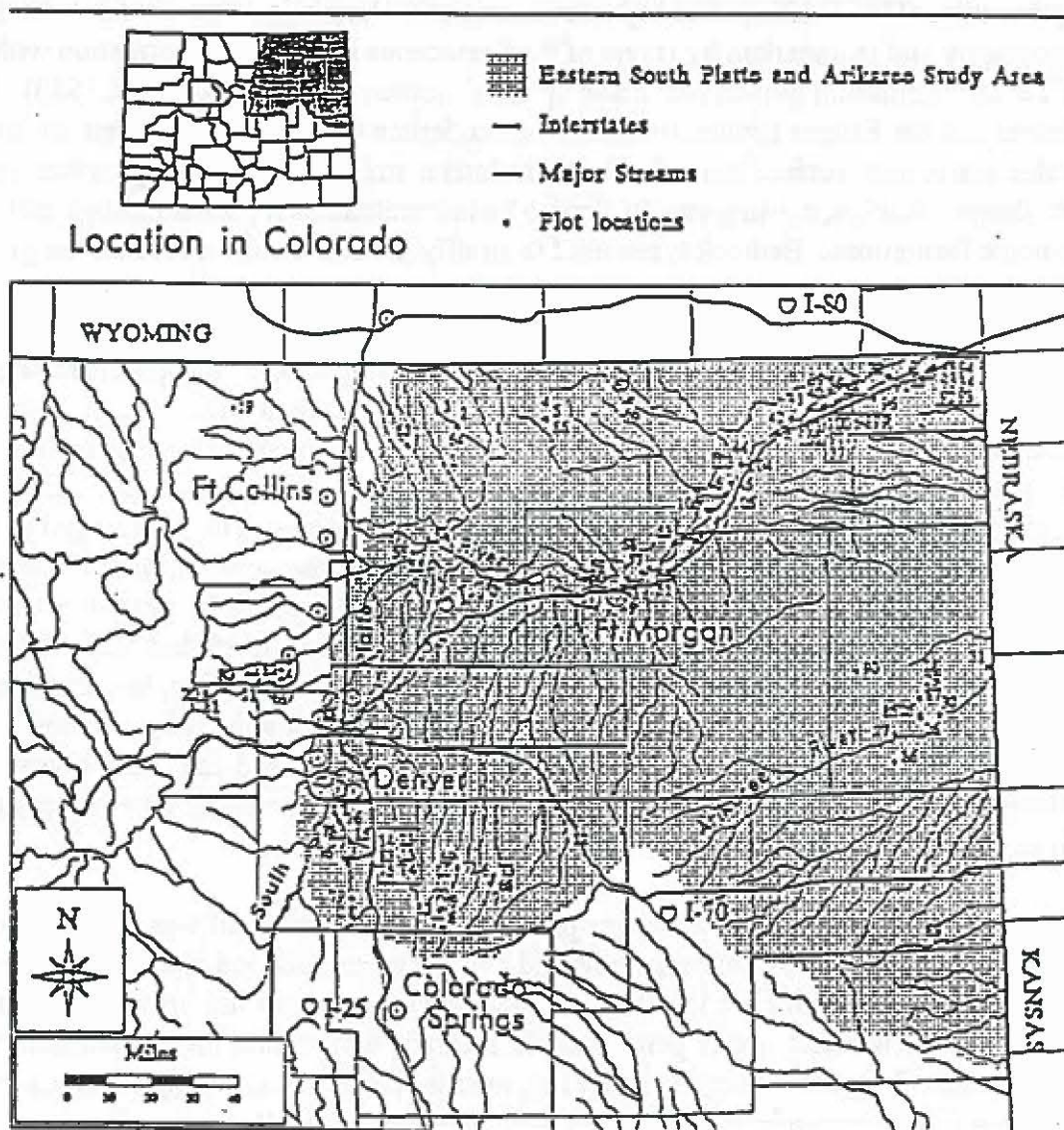


Figure 3. Map of the Lower South Platte watershed with plot locations. See Table 1 for Creek name, Township, Section and Range locations.

Table 1. Lower South Platte River Basin Plot Locations and Land Ownership. Private land locations are withheld to protect landowner privacy. Abbreviations used are: DOW= Colorado Division of Wildlife, NG= National Grassland, USFS= U.S. Forest Service. Map Numbers Correspond to the Map in Figure 3.

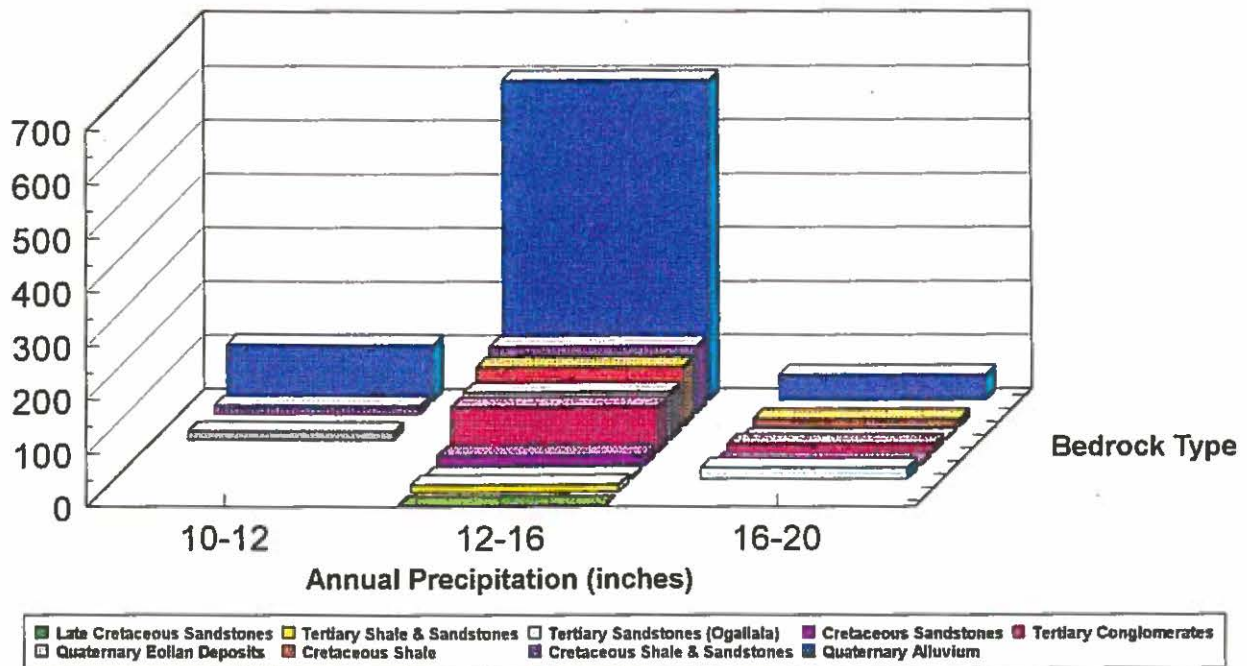
| Map# | Plot # | Creek Name          | County   | Township/Range/Section | Owner               |
|------|--------|---------------------|----------|------------------------|---------------------|
| 1    | 95GK01 | Coal Creek          | Weld     | T08N R64W SEC 11       | Pawnee NG           |
| 2    | 95GK02 | Willow Creek        | Weld     | T10N R63W SEC 29       | Pawnee NG           |
| 3    | 95GK03 | Willow Creek        | Weld     | T10N R64W SEC 09       | Pawnee NG           |
| 4    | 95GK04 | Dave's Draw         | Weld     | T10N R60W SEC 24       | Pawnee NG           |
| 5    | 95GK05 | Dave's Draw         | Weld     | T10N R60W SEC 24       | Pawnee NG           |
| 6    | 95GK06 | West Bijou Creek    | Elbert   | Location Withheld      | Private             |
| 7    | 95GK07 | West Bijou Creek    | Elbert   | Location Withheld      | Private             |
| 8    | 95GK08 | West Kiowa Creek    | Elbert   | Location Withheld      | Private             |
| 9    | 95GK09 | West Kiowa Creek    | Elbert   | Location Withheld      | Private             |
| 10   | 95GK10 | Kiowa Creek         | Elbert   | Location Withheld      | Private             |
| 11   | 95GK11 | Kiowa Creek         | Elbert   | Location Withheld      | Private             |
| 12   | 95GK12 | East Bijou Creek    | Elbert   | Location Withheld      | Private             |
| 13   | 95GK13 | West Plum Creek     | Douglas  | T08S R68W SEC 14       | Colorado Open Lands |
| 14   | 95GK14 | West Plum Creek     | Douglas  | T08S R68W SEC 11       | Colorado Open Lands |
| 15   | 95GK15 | Plum Creek          | Douglas  | Location Withheld      | Private             |
| 16   | 95GK16 | Plum Creek          | Douglas  | Location Withheld      | Private             |
| 17   | 95GK17 | Plum Creek          | Douglas  | Location Withheld      | Private             |
| 18   | 95GK18 | West Plum Creek     | Douglas  | Location Withheld      | Private             |
| 19   | 95GK19 | Elkhorn Creek       | Larimer  | T09N R73W SEC 08       | Larimer County      |
| 20   | 95GK20 | South Boulder Creek | Gilpin   | T02S R74W SEC 02       | USFS                |
| 21   | 95GK21 | South Boulder Creek | Boulder  | T01S R72W SEC 25       | USFS                |
| 22   | 95GK22 | Winiger Gulch       | Boulder  | T01S R71W SEC 19       | USFS                |
| 23   | 95GK23 | Garber Creek        | Douglas  | T08S R68W SEC 11       | Colorado Open Lands |
| 24   | 95GK24 | South Boulder Creek | Boulder  | T01S R71W SEC 27       | Boulder County      |
| 25   | 95GK25 | Arikaree River      | Yuma     | Location Withheld      | Private             |
| 26   | 95GK26 | Arikaree River      | Yuma     | Location Withheld      | Private             |
| 27   | 95GK27 | Arikaree River      | Yuma     | Location Withheld      | Private             |
| 28   | 95GK28 | Arikaree River      | Yuma     | Location Withheld      | Private             |
| 29   | 95GK29 | Arikaree River      | Yuma     | Location Withheld      | Private             |
| 30   | 95GK30 | Arikaree River      | Yuma     | Location Withheld      | Private             |
| 31   | 95GK31 | Arikaree River      | Yuma     | Location Withheld      | Private             |
| 32   | 95GK32 | South Platte River  | Sedgwick | T11N R46W SEC 16       | DOW                 |
| 33   | 95GK33 | South Platte River  | Sedgwick | T11N R45W SEC 04       | DOW                 |
| 34   | 95GK34 | South Platte River  | Sedgwick | T11N R44W SEC 05       | DOW                 |
| 35   | 95GK35 | South Platte River  | Sedgwick | T11N R44W SEC 07       | DOW                 |
| 36   | 95GK36 | South Platte River  | Logan    | T10N R48W SEC 10       | DOW                 |
| 37   | 95GK37 | South Platte River  | Logan    | T10N R48W SEC 08       | DOW                 |
| 38   | 95GK38 | South Platte River  | Logan    | T10N R49W SEC 13       | DOW                 |
| 39   | 95GK39 | South Platte River  | Logan    | T10N R49W SEC 14       | DOW                 |
| 40   | 95GK40 | South Platte River  | Logan    | T10N R49W SEC 16       | DOW                 |

Table 1. Continued.

| Map# | Plot # | Creek Name          | County     | Township/ Range/Section | Owner               |
|------|--------|---------------------|------------|-------------------------|---------------------|
| 41   | 95GK41 | South Platte River  | Logan      | T10N R49W SEC 17        | DOW                 |
| 42   | 95GK42 | South Platte River  | Logan      | T10N R50W SEC 34        | DOW                 |
| 43   | 95GK43 | South Platte River  | Logan      | T10N R50W SEC 34        | DOW                 |
| 44   | 95GK44 | South Platte River  | Logan      | T08N R52W SEC 14        | DOW                 |
| 45   | 95GK45 | South Platte River  | Logan      | T07N R52W SEC 05        | DOW                 |
| 46   | 95GK46 | South Platte River  | Logan      | T07N R52W SEC 19        | DOW                 |
| 47   | 95GK47 | South Platte River  | Logan      | T06N R53W SEC 04        | DOW                 |
| 48   | 95GK48 | South Platte River  | Washington | T05N R54W SEC 09        | DOW                 |
| 49   | 95GK49 | South Platte River  | Morgan     | T04N R56W SEC 30        | DOW                 |
| 50   | 95GK50 | South Platte River  | Morgan     | T04N R56W SEC 30        | DOW                 |
| 51   | 95GK51 | South Platte River  | Morgan     | T04N R56W SEC 12        | DOW                 |
| 52   | 95GK52 | South Platte River  | Morgan     | T04N R56W SEC 12        | DOW                 |
| 53   | 95GK53 | South Platte River  | Morgan     | T05N R55W SEC 13        | DOW                 |
| 54   | 95GK54 | Cache la Poudre R.  | Weld       | T05N R64W SEC 06        | DOW                 |
| 55   | 95GK55 | South Platte River  | Weld       | T05N R65W SEC 21        | DOW                 |
| 56   | 95GK56 | South Platte River  | Weld       | T05N R65W SEC 21        | DOW                 |
| 57   | 95GK57 | South Platte River  | Morgan     | T04N R56W SEC 14        | DOW                 |
| 58   | 95GK58 | South Platte River  | Morgan     | T04N R56W SEC 14        | DOW                 |
| 59   | 95GK59 | South Platte River  | Morgan     | T04N R58W SEC 28        | DOW                 |
| 60   | 95GK60 | South Platte River  | Morgan     | T04N R58W SEC 28        | DOW                 |
| 62   | 95LS01 | Little Owl Creek    | Weld       | T09N R65W SEC 20        | Pawnee NG           |
| 63   | 95LS02 | Willow Creek        | Weld       | T10N R63W SEC 32        | Pawnee NG           |
| 64   | 95LS03 | David's Draw        | Weld       | T10N R60W SEC 24        | Pawnee NG           |
| 65   | 95LS04 | Two Mile Creek      | Weld       | T11N R56W SEC 32        | Pawnee NG           |
| 66   | 95LS05 | Two Mile Creek      | Weld       | T11N R56W SEC 32        | Pawnee NG           |
| 67   | 95LS06 | West Bijou Ranch    | Elbert     | Location Withheld       | Private             |
| 68   | 95LS07 | Kiowa Creek         | Elbert     | Location Withheld       | Private             |
| 69   | 95LS08 | West Kiowa Creek    | Elbert     | Location Withheld       | Private             |
| 70   | 95LS09 | Kiowa Creek         | Elbert     | Location Withheld       | Private             |
| 71   | 95LS10 | Kiowa Creek         | Elbert     | Location Withheld       | Private             |
| 72   | 95LS11 | West Bijou Creek    | Elbert     | Location Withheld       | Private             |
| 73   | 95LS12 | West Plum Creek     | Douglas    | T08S R68W SEC 14        | Colorado Open Land  |
| 74   | 95LS13 | West Plum Creek     | Douglas    | T08S R68W SEC 14        | Colorado Open Land  |
| 75   | 95LS14 | West Plum Creek     | Douglas    | Location Withheld       | Private             |
| 76   | 95LS15 | West Plum Creek     | Douglas    | Location Withheld       | Private             |
| 77   | 95LS16 | Plum Creek          | Douglas    | Location Withheld       | Private             |
| 78   | 95LS17 | West Plum Creek     | Douglas    | Location Withheld       | Private             |
| 79   | 95LS18 | South Boulder Creek | Gilpin     | T01S R73W SEC 34        | USFS                |
| 80   | 95LS19 | South Boulder Creek | Gilpin     | T02S R74W SEC 02        | USFS                |
| 81   | 95LS20 | South Boulder Creek | Boulder    | T01S R72W SEC 25        | USFS                |
| 82   | 95LS21 | Garber Creek        | Douglas    | T08S R68W SEC 10        | Colorado Open Space |
| 83   | 95LS22 | South Boulder Creek | Boulder    | T01S R71W SEC 26        | Denver Water Board  |
| 84   | 95LS23 | Arikaree River      | Yuma       | Location Withheld       | Private             |

### A. TOTAL RIVER MILES

River Miles



### B. RIVER MILES SAMPLED

River Miles

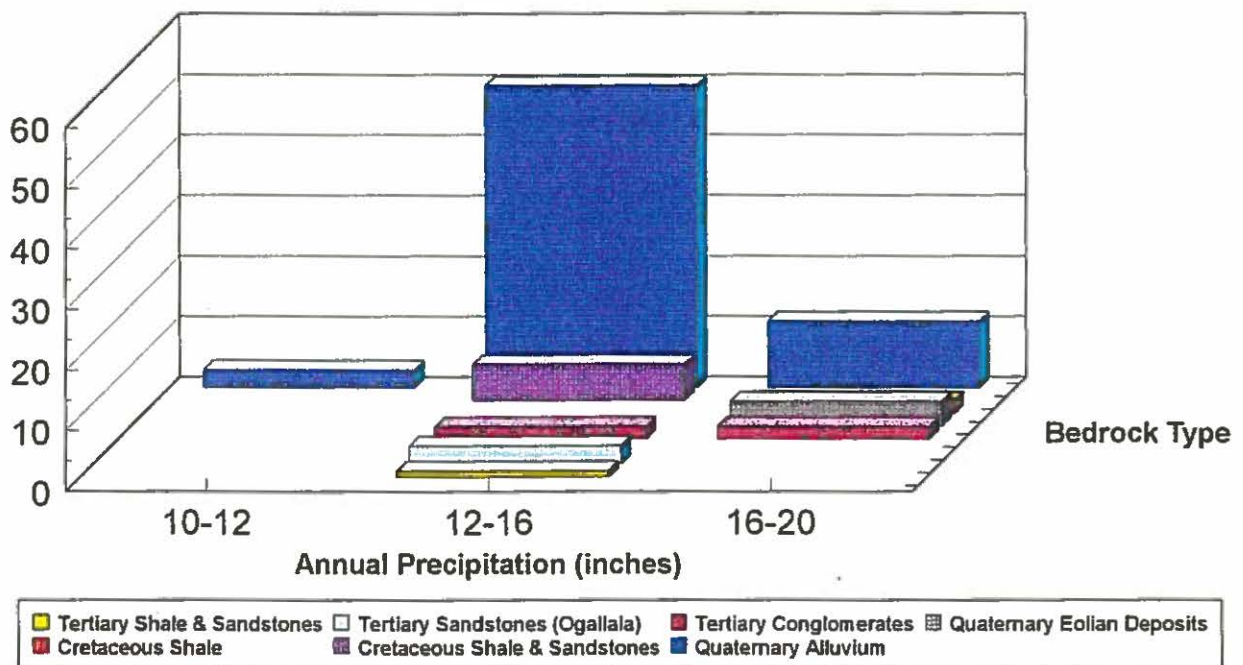


Figure 4. Riparian habitats of the lower South Platte River Basin stratified by geology and annual precipitation. A) All perennial stream miles by stratification type and B) total number of stream miles sampled in 1995. The relative distribution of habitats of sampled streams is comparable to that of the entire basin.

Table 1. Continued.

| Map# | Plot # | Creek Name         | County     | Township/ Range/Section | Owner   |
|------|--------|--------------------|------------|-------------------------|---------|
| 85   | 95LS24 | Arikaree River     | Yuma       | Location Withheld       | Private |
| 86   | 95LS25 | Arikaree River     | Yuma       | Location Withheld       | Private |
| 87   | 95LS26 | Arikaree River     | Yuma       | Location Withheld       | Private |
| 88   | 95LS27 | Arikaree River     | Yuma       | Location Withheld       | Private |
| 89   | 95LS28 | Arikaree River     | Yuma       | Location Withheld       | Private |
| 90   | 95LS29 | South Platte River | Sedgwick   | T11N R46W SEC 16        | DOW     |
| 91   | 95LS30 | South Platte River | Sedgwick   | T11N R44W SEC 05        | DOW     |
| 92   | 95LS31 | South Platte River | Sedgwick   | T11N R44W SEC 05        | DOW     |
| 93   | 95LS32 | South Platte River | Sedgwick   | T11N R44W SEC 06        | DOW     |
| 94   | 95LS33 | South Platte River | Sedgwick   | T11N R44W SEC 07        | DOW     |
| 95   | 95LS34 | South Platte River | Logan      | T10N R48W SEC 10        | DOW     |
| 96   | 95LS35 | South Platte River | Logan      | T10N R48W SEC 08        | DOW     |
| 97   | 95LS36 | South Platte River | Logan      | T10N R49W SEC 13        | DOW     |
| 98   | 95LS37 | South Platte River | Logan      | T10N R49W SEC 14        | DOW     |
| 99   | 95LS38 | South Platte River | Logan      | T10N R49W SEC 16        | DOW     |
| 100  | 95LS39 | South Platte River | Logan      | T10N R50W SEC 27        | DOW     |
| 101  | 95LS40 | South Platte River | Logan      | T10N R50W SEC 27        | DOW     |
| 102  | 95LS41 | South Platte River | Logan      | T08N R52W SEC 14        | DOW     |
| 103  | 95LS42 | South Platte River | Logan      | T08N R52W SEC 14        | DOW     |
| 104  | 95LS43 | South Platte River | Logan      | T07N R52W SEC 19        | DOW     |
| 105  | 95LS44 | South Platte River | Logan      | T06N R53W SEC 04        | DOW     |
| 106  | 95LS45 | South Platte River | Washington | T05N R54W SEC 09        | DOW     |

## Upper Arkansas

The upper Arkansas watershed, as defined for this study, includes the headwaters at the Continental Divide near Leadville down to Pueblo, encompassing a drainage area of approximately 4,050 square miles (USGS 1993). Only BLM and private lands were inventoried in 1995 due to funding limitations. U.S. Forest Service lands were not surveyed, excluding much of the watershed above 9,000 feet (Figures 5 and 6a,b).





The Upper Arkansas River is bordered by the Sawatch Range to the west, the Mosquito Range to the east, the Sangre de Cristo Mountains to the southwest, and the Wet Mountains to the southeast. The Rampart Range separates the South Platte from the Arkansas drainage west of Colorado Springs. Glaciers have deposited large amounts of outwash material that form large moraines pushing the Arkansas River east. Here it has carved its way into the Precambrian gneiss and granites below the valley floor, forming Browns Canyon and the Royal Gorge (Chronic 1980). Broad U-shaped valleys with slow moving meandering streams trapped behind glacial moraines characterize tributaries from the Sawatch Range. In contrast, the non-glaciated southern end of the Mosquito Range has layers of Tertiary lava and Paleozoic sedimentary rocks that create steep narrow canyons and valleys (Benedict 1991). Further east, beyond the Royal Gorge, the Arkansas flows over fossil bearing sedimentary sandstones and limestones of the Mesozoic and Paleozoic Eras (Chronic 1980).

The climate of the upper Arkansas valley is dry, with cold winters and hot dry summers. Most of the annual precipitation comes as snow in the higher mountains (Colorado Climate Center 1984). The hydrology of the Arkansas River is driven by spring and early summer snow-melt runoff. Flows have been modified by multiple small reservoirs on smaller tributaries, and by a major dam on the mainstem, the Pueblo Reservoir. Annual peak flows have been reduced and the late summer flows augmented, reducing the variability in seasonal flow and annual flood levels year to year. The Arkansas River has over 100 miles of popular kayaking and rafting reaches, and affords many challenging rapids below Leadville, in the Browns Canyon, and the nearly impassible Class V rapids of the Royal Gorge.

Native vegetation of the upper Arkansas River valley is dry desert-steppe with scattered piñon pine woodlands, greasewood and sagebrush shrublands on the valley floor, low ridges, and foothills. Higher elevations have lodgepole pine and spruce-fir forests, with alpine tundra on the highest peaks above tree-line. The area has a rich history of mining and early explorations. Today the water quality of many tributaries and the mainstem are in severely degraded condition due to acid mine runoff (USGS 1993). In addition, heavy livestock usage has had its toll on water quality and vegetation. A few miles upstream of Pueblo high levels of fecal coliform bacteria, dissolved sulfates, solids, nitrates and nitrates have been detected (USGS 1993). Downstream of Pueblo, the amount of irrigated crop acreage increases, accompanied by large increases of dissolved solids and selenium are reported in the Arkansas River at the Nebraska state line (USGS 1993). Land use in the upper basin is largely recreation, grazing, mining, and irrigated hay production.



Location in Colorado

-  Upper Arkansas Study Area
-  Interstates
-  Major Streams
-  Site Locations

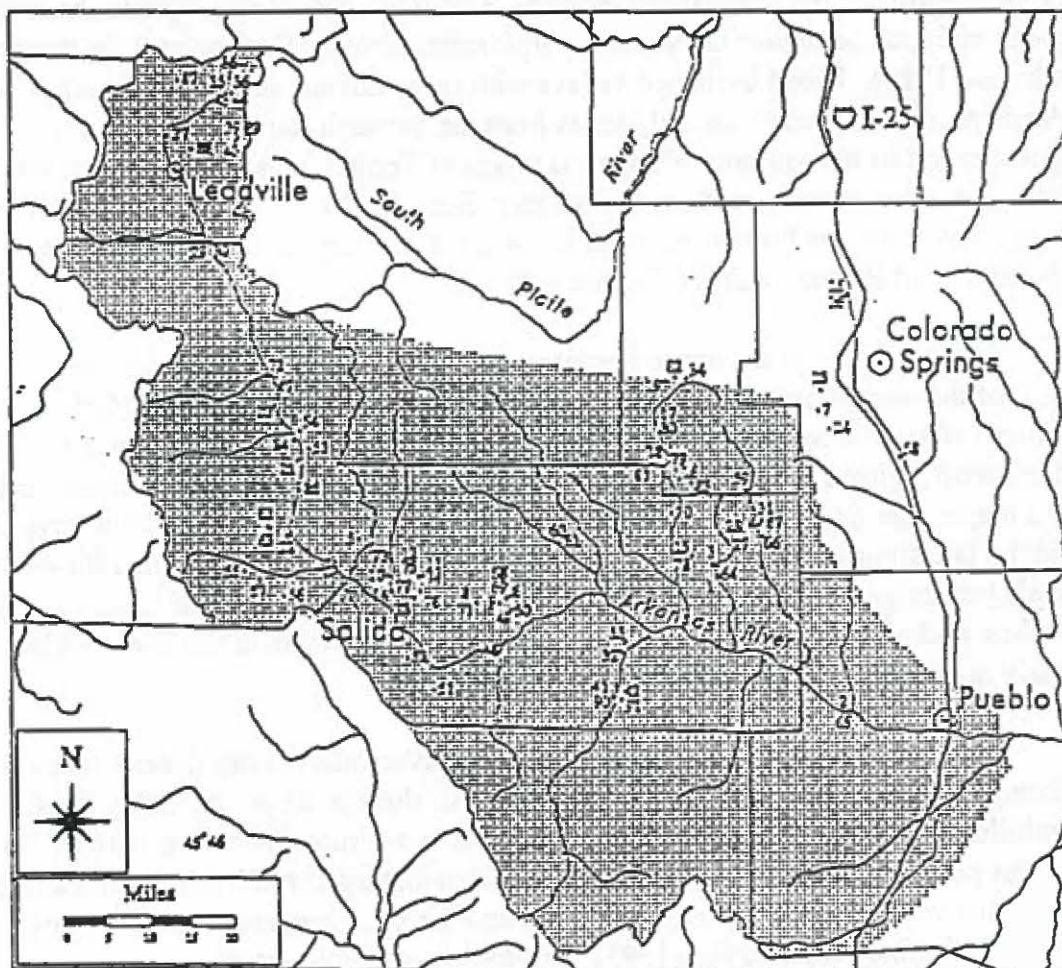


Figure 5. Map of the upper Arkansas watershed, with plot locations. See Table 2 for Creek names, Township, Section, and Range locations.

Table 2. Upper Arkansas River Basin Plot Locations and Land Ownership. Private land locations are withheld to protect landowner privacy. Abbreviations used are: BLM= Bureau of Land Management, USFS= U.S. Forest Service, DOW= Colorado Division of Wildlife, AFA= U.S. Air Force Academy. Map Numbers Correspond to Map in Figure 5.

| Map# | Plot # | Creek Name            | County  | Township/Range/Section | Owner            |
|------|--------|-----------------------|---------|------------------------|------------------|
| 1    | 95AM01 | Eightmile Creek       | Fremont | T18S R69W SEC 4        | BLM              |
| 2    | 95AM02 | Pueblo Reservoir      | Pueblo  | T20S R67W SEC 24       | DOW              |
| 3    | 95AM03 | Eightmile Creek       | Fremont | T17S R69W SEC 32       | BLM              |
| 4    | 95AM04 | Beaver Creek          | Fremont | T17S R68W SEC 5        | BLM              |
| 5    | 95AM05 | Beaver Creek          | Fremont | T17S R68W SEC 17       | DOW              |
| 6    | 95AM06 | East Gulch            | Fremont | T18S R73W SEC 17       | BLM              |
| 7    | 95AM07 | North Cheyenne Canyon | El Paso | T14S R67W SEC 33       | Colorado Springs |
| 8    | 95AM08 | Long Gulch            | Fremont | T49N R12E SEC 28       | BLM              |
| 9    | 95AM09 | Bull Gulch            | Fremont | T18S R73W SEC 19       | BLM              |
| 10   | 95AM10 | Badger Creek          | Fremont | T49N R10E SEC 10       | BLM              |
| 11   | 95AM11 | Little Badger Creek   | Fremont | Location Withheld      | BLM/Private      |
| 12   | 95AM12 | Little Badger Creek   | Fremont | T49N R11E SEC 8        | BLM              |
| 13   | 95AM13 | Sand Gulch            | Fremont | T49N R11E SEC 19       | BLM              |
| 14   | 95AM14 | Unnamed Tributary     | Fremont | T49N R10E SEC 22       | BLM              |
| 15   | 95AM15 | Felch Creek           | Fremont | T17S R70W SEC 26       | BLM              |
| 16   | 95AM16 | Cripple Creek         | Teller  | T16S R70W SEC 10       | BLM              |
| 17   | 95AM17 | Barnard Creek         | Teller  | T15S R70W SEC 8        | BLM              |
| 18   | 95AM18 | Fourmile Creek        | Fremont | T16S R70W SEC 6        | BLM              |
| 19   | 95AM19 | Fourmile Creek        | Teller  | T14S R70W S EC16       | State Park/DOW   |
| 20   | 95AM20 | Arkansas River Island | Chaffee | Location Withheld      | Private          |
| 21   | 95AM21 | Browns Creek          | Chaffee | T15S R78W SEC 36       | State Park/BLM   |
| 22   | 95AM22 | Arkansas River        | Chaffee | T50N R08E S EC22       | STATE            |
| 23   | 95AM23 | Bear Creek            | El Paso | T14S R67W SEC 21       | Colorado Springs |
| 24   | 95AM24 | North Cheyenne Creek  | El Paso | T14S R67W SEC 34       | Colorado Springs |
| 25   | 95AM25 | Monument Creek        | El Paso | T12S R67W SEC 36       | AFA              |
| 26   | 95AM26 | Monument Creek        | El Paso | T12S R67W SEC 13       | AFA              |
| 27   | 95AM27 | Eightmile Creek       | Teller  | T17S R69W SEC 15       | BLM              |
| 28   | 95AM28 | Eightmile Creek       | Teller  | T17S R69W SEC 10       | BLM              |
| 29   | 95AM29 | Lowpass Gulch         | Lake    | T11S R79W SEC 30       | BLM              |
| 30   | 95AM30 | Lowpass Gulch         | Lake    | T11S R79W SEC 30       | BLM              |
| 31   | 95AM31 | East Beaver Creek     | Fremont | T17S R68W SEC 5        | BLM              |
| 32   | 95AM32 | Grape Creek South     | Fremont | T19S R71W SEC 16       | DOW              |
| 33   | EOR    | Grape Creek North     | Fremont | T19S R71W SEC 10       | Canon City Park  |
| 34   | 95AM33 | Fourmile Creek        | Park    | T14S R70W SEC 14       | State Park/DOW   |
| 35   | 95AM34 | East Fork Arkansas R. | Lake    | T08S R79W SEC 33       | BLM              |
| 36   | 95AM35 | East Fork Arkansas R. | Lake    | T08S R79W SEC 16       | BLM              |
| 37   | 95AM36 | Arkansas River        | Lake    | Location Withheld      | Private          |
| 38   | 95AM37 | Lower Iowa Gulch      | Lake    | T10S R80W SEC 2        | BLM              |
| 39   | 95AM38 | Dyer Amphitheater     | Lake    | T09S R79W SEC 26       | BLM              |
| 40   | 95AM39 | Iowa Gulch            | Lake    | T09S R79W SEC 35       | BLM              |

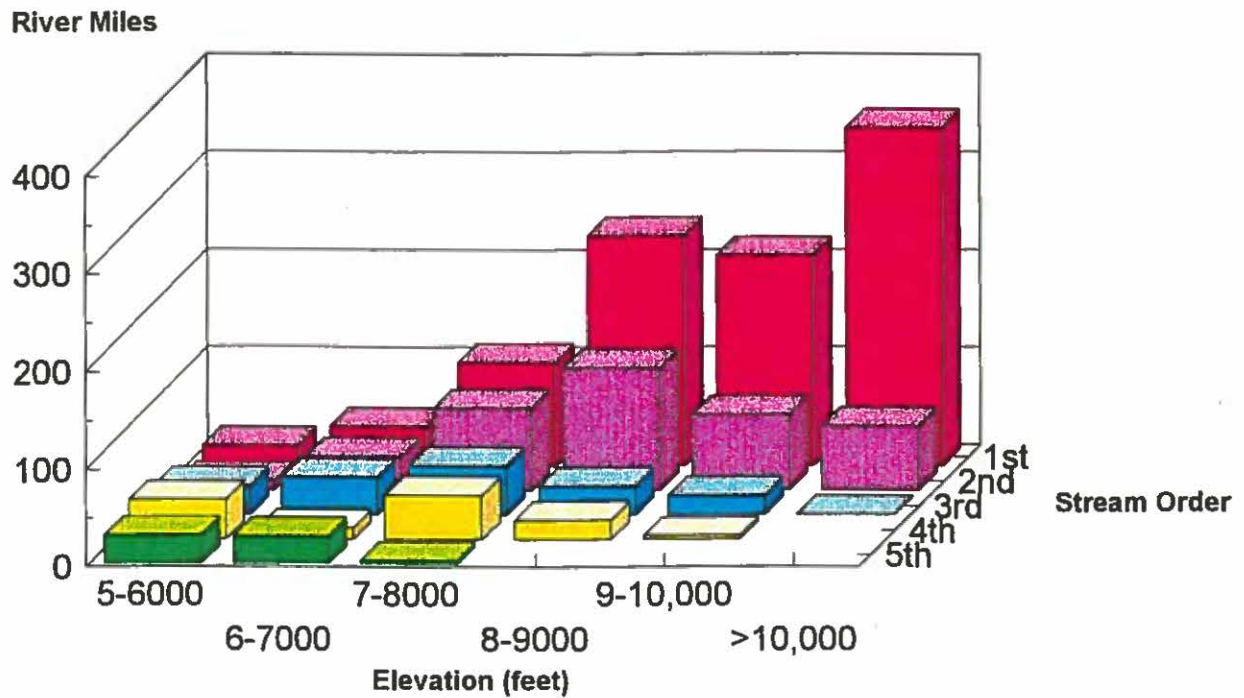
Table 2. Continued.

| Map# | Plot # | Creek Name              | County  | Township/ Range/Section | Owner               |
|------|--------|-------------------------|---------|-------------------------|---------------------|
| 41   | 95AM40 | Grape Creek             | Fremont | T20S R71W SEC 8         | BLM                 |
| 42   | 95AM41 | Bear Gulch              | Fremont | T20S R71W SEC 17        | BLM                 |
| 43   | 95AM42 | Birdseye Gulch          | Lake    | T08S R79W SEC 34        | BLM                 |
| 44   | 95AM43 | Birdseye Gulch          | Lake    | T08S R79W SEC 34        | BLM                 |
| 45   | 95AM44 | Spring Creek            | Lake    | T11S R79W SEC 19        | BLM                 |
| 46   | 95AM45 | Spring Creek            | Lake    | T11S R79W SEC 19        | BLM                 |
| 47   | 95AM46 | Arkansas River          | Chaffee | T14S R78W SEC 9         | Buena Vista         |
| 48   | 95AM47 | Arkansas River          | Fremont | T48N R12E SEC 21        | BLM                 |
| 49   | 95AM48 | Lower East Gulch        | Fremont | T18S R73W SEC 28        | BLM                 |
| 50   | 95AM49 | Lower East Gulch        | Fremont | T18S R73W SEC 20        | BLM                 |
| 51   | 95AM50 | Big Cottonwood Creek    | Fremont | T47N R11E SEC 15        | BLM                 |
| 52   | 95AM51 | Hamilton Creek          | Fremont | T48N R10E SEC 25        | BLM                 |
| 53   | 95AM52 | Cottonwood Creek        | Chaffee | T15S R77W SEC 30        | BLM                 |
| 54   | 95AM53 | Little Cottonwood Creek | Chaffee | T15S R78W SEC 13        | BLM                 |
| 55   | 95AM54 | Green Creek             | Chaffee | T49N R07E SEC 10        | BLM                 |
| 56   | 95AM55 | Poncha Creek            | Chaffee | T49N R08E SEC 21        | BLM                 |
| 57   | 95AM56 | Pass Creek              | Chaffee | T49N R07E SEC 13        | BLM                 |
| 58   | 95AM57 | Fountain Creek          | El Paso | T15S R65W SEC 30        | Fountain Creek Park |
| 59   | 95AM58 | Upper Beaver Creek      | Teller  | T16S R69W SEC 13        | BLM                 |
| 60   | 95AM59 | Cottonwood Creek        | Fremont | T17S R72W SEC 17        | BLM                 |
| 61   | 95AM60 | Cottonwood Creek        | Fremont | T17S R72W SEC 17        | BLM                 |
| 62   | 95AM61 | Squaw Creek             | Chaffee | T50N R08E SEC 18        | BLM                 |
| 63   | 95AM62 | Droney Gulch            | Chaffee | T50N R08E SEC 18        | BLM                 |
| 64   | 95RR01 | Eightmile Creek         | Fremont | T18S R69W SEC 4         | BLM                 |
| 65   | 95RR02 | Pueblo Reservoir        | Pueblo  | T20S R67W SEC 24        | DOW                 |
| 66   | 95RR03 | Beaver Creek            | Fremont | T17S R68W SEC 8         | BLM                 |
| 67   | 95RR04 | Beaver Creek            | Fremont | T17S R68W SEC 5         | BLM                 |
| 68   | 95RR05 | East Gulch              | Fremont | T18S R73W SEC 17        | BLM                 |
| 69   | 95RR06 | East Gulch              | Fremont | T49N R73W SEC 20        | BLM                 |
| 70   | 95RR07 | Fourmile Creek Gulch    | Fremont | T16S R70W SEC 27        | BLM                 |
| 71   | 95RR08 | Long Gulch              | Fremont | T48N R12E SEC 4         | BLM                 |
| 72   | 95RR09 | Cottonwood Creek        | Chaffee | T14S R78W SEC 16        | Buena Vista         |
| 73   | 95RR10 | Badger Creek            | Fremont | Location Withheld       | Private/USFS        |
| 74   | 95RR11 | Little Badger Creek     | Fremont | T49N R11E SEC 8         | BLM                 |
| 75   | 95RR12 | Little Badger Creek     | Fremont | T49N R11E SEC 8         | BLM                 |
| 76   | 95RR13 | Sand Gulch              | Fremont | T49N R11E SEC 20        | BLM                 |
| 77   | 95RR14 | Unnamed Tributary       | Fremont | T49N R10E SEC 22        | BLM                 |
| 78   | 95RR15 | Felch Creek             | Fremont | T17S R70W SEC 25        | BLM                 |
| 79   | 95RR16 | Cripple Creek           | Teller  | T16S R70W SEC 3         | BLM                 |
| 80   | 95RR17 | Barnard Creek           | Teller  | T15S R70W SEC 8         | BLM                 |
| 81   | 95RR18 | Little High Creek       | Teller  | T15S R70W SEC 31        | BLM                 |
| 82   | 95RR19 | Fourmile Creek          | Teller  | T14S R70W SEC 15        | State Park          |
| 83   | 95RR20 | Wilson Creek            | Teller  | T16S R70W SEC 14        | BLM                 |

Table 2. Continued.

| Map# | Plot # | Creek Name               | County  | Township/ Range/Section | Owner   |
|------|--------|--------------------------|---------|-------------------------|---------|
| 84   | 95RR21 | Arkansas River           | Chaffee | Location Withheld       | Private |
| 85   | 95RR22 | Arkansas River           | Chaffee | T51N R8E SEC 26         | BLM     |
| 86   | 95RR23 | East Fork Arkansas River | Lake    | T08S R79W SEC 16        | BLM     |
| 87   | 95RR24 | Tennessee Creek          | Lake    | T08S R80W SEC 28        | BLM     |
| 88   | 95RR25 | Lower Iowa Gulch         | Lake    | T10S R80W SEC 2         | BLM     |
| 89   | 95RR26 | Dyer Amphitheater        | Lake    | T09S R79W SEC 26        | BLM     |
| 90   | 95RR27 | Grape Creek              | Fremont | T19S R71W SEC 32        | BLM     |
| 91   | 95RR28 | Bear Gulch               | Fremont | T20S R71W SEC 17        | BLM     |
| 92   | 95GK65 | Monument Creek           | El Paso | T12S R67W SEC 2         | AFA     |
| 93   | 95GK66 | Deadman's Creek          | El Paso | T12S R67W SEC 12        | AFA     |
| 94   | 95GK67 | Deadman's Creek          | El Paso | T12S R67W SEC 12        | AFA     |
| 95   | 95GK69 | Monument Creek           | El Paso | T12S R66W SEC 19        | AFA     |
| 96   | 95GK70 | Monument Creek           | El Paso | T12S R67W SEC 36        | AFA     |
| 97   | 95GK71 | Kettle Creek             | El Paso | T12S R67W SEC 31        | AFA     |
| 98   | 95GK72 | Kettle Creek             | El Paso | T12S R67W SEC 31        | AFA     |
| 99   | 95GK73 | Kettle Creek             | El Paso | T12S R66W SEC 31        | AFA     |
| 100  | 95GK74 | West Monument Creek      | El Paso | T12S R67W SEC 31        | AFA     |
| 101  | 95GK75 | West Monument Creek      | El Paso | T12S R66W SEC 31        | AFA     |

### A. TOTAL RIVER MILES



### B. RIVER MILES SAMPLED

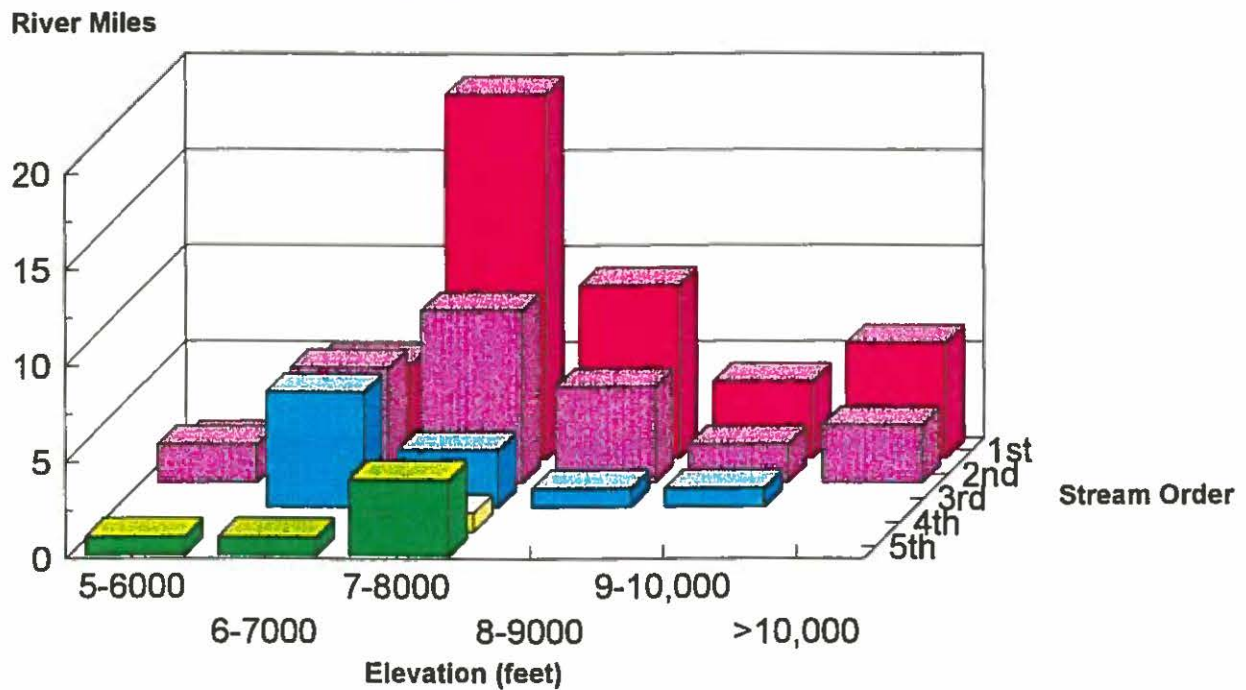


Figure 6. Riparian habitats of the upper Arkansas River Basin stratified by elevation and stream order. A) All perennial stream miles found in the upper basin by stratification type and B) total number of stream miles sampled in 1995. The relative distribution of habitats of sampled streams is comparable to that of the entire basin, except for the lack of adequate sampling of higher elevation 1st and 2nd order streams due to funding limitations.

## METHODS

For the purposes of this project, riparian areas are defined as the interface between the riverine aquatic ecosystem and the adjacent upland ecosystem (Gregory *et al.* 1991, Risser 1990, Knopf *et al.* 1988, Brinson *et al.* 1981). These areas are frequently flooded, or are at least seasonally saturated by a fluctuating water table, and have plant species, soils, and topography that differ considerably from those of the adjacent uplands (Elmore and Beschta 1987, Jones 1990). Riparian areas in this project include vegetation occurring along natural water courses, poorly drained overflow areas, and associated natural bodies of water, such as oxbow lakes. This classification focuses on lands along perennial streams as defined on U.S. Geological Survey 1:24,000 and 1:100,000 topographic maps.

### Representative site selection

To sample as much of the diversity within each basin as possible in one field season, we used a stratified-random approach based on Austin and Heyligers (1989) gradsect concept. We chose two major environmental gradients thought to influence riparian vegetation to stratify the study area. Each mile of all perennial streams within the study area are placed within a cell-type, a combination of the two stratifying variables. For example, one cell type could be a second order stream at 9,000 ft elevation. The potential vegetation on each stream is driven (in part) by the size of the stream, the length of the growing season and minimum and maximum temperatures at that elevation. Another example from the lower South Platte study area is a cell type of a river running through Pierre Shale, which constricts lateral movement of the river and annual precipitation of 16 inches per year, influencing species composition along the stream. In this way we can sample the breadth of diversity of riparian habitats within the study area or watershed.

In the upper Arkansas watershed we used elevation and stream order as stratifying variables. Stream order is a surrogate for basin size, channel size and stream volume (Schumm 1977, Knighton 1984), and elevation is an important predictor of climate. Using USGS 1:100,000 topographic maps we denoted 300 meter (1000 ft) elevation bands from 1,525 m (5,000 ft) to over 3,050 m (10,000 ft) and first through fifth order stream classes, calculated for each mile of perennial stream using Strahler's (1952) system.

In the lower South Platte watershed we used annual precipitation and bedrock geology to stratify the study area. Annual precipitation increases significantly west to east across the eastern plains, influencing upland species composition as well as stream flow. We used three categories: 10-12, 12-16, and 16-20 inches annually. The underlying bedrock influences stream channel type, direction of flow and the amount of in-stream flow. In addition, near-surface bedrock constrains lateral stream flow and keeps water from seeping into deeper aquifers, causing stream flow to be intermittent as it passes through areas of different geologic formations. Some of the geologic categories used include Quaternary Alluvium, the Ogallala Formation, Cretaceous sandstones, Tertiary shale and sandstones and Eolian Deposits (Tweto 1979).

For both study areas we tallied the total perennial stream miles in the basin and the total miles within each cell type and calculated their percentage. Next we studied aerial photographs (methods follow) to eliminate areas of heavy disturbance. With heavily degraded riparian areas blocked out, we randomly selected more than 200 one-mile long stream reaches in each study area, representing all the classification cell types, weighted by their abundance in the basin. For example, if 20% of the stream miles above 3,050 m (10,000 ft) were first order streams, then 20% of the randomly selected one-mile sites would be of that type. The actual number of stream miles sampled per cell type was representative of the basin (Figures 4 and 6).

We included only riparian areas which have not been drastically altered by human activity in the sampling regime. In this way, the classification will be limited to plant associations native to Colorado, whose descriptions can serve as reference points for management and restoration needs. All perennial riparian corridors were delineated as tree, shrub, or herbaceous dominated riparian areas (Batson *et al.* 1987). Riparian vegetation appears bright red relative to dry hillside vegetation and has a texture unlike irrigated monoculture crop areas. In addition, conifer dominated riparian reaches, which do not stand out as red, were also delineated. We used 1989 and 1990 NAPP 1:40,000, and 1983 1:24,000 color infrared 9 x 9 inch photographs to delineate riparian corridors and determine their condition. Condition was ranked by the degree of disturbance (i.e., deviation from pristine) both within and surrounding the riparian corridor. From aerial photograph interpretation and field verification work in 1993, we determined that disturbance of surrounding lands can be a strong predictor of the amount of non-native species in the understory within the riparian corridor.

Ranking criteria used were: 1) evidence of drastic human disturbance such as agricultural conversion, adjacent irrigated fields, square-edged fields, road and railroad embankments, power line maintenance roads, gravel mining, logging, mining, dams, reservoir developments, etc., 2) heavy recreational use, such as off-road vehicle use, etc., 3) heavy livestock use such as over grazing (hillside trailing), or livestock holding sites, etc., and 4) road maintenance sand and gravel piles or other dumping grounds.

Riparian condition was tallied in four categories: 1) Excellent-- riparian corridor and the surrounding area appear natural with no major disturbances. Within the corridor itself, the area appears unfragmented and the vegetation follows a natural alluvial pattern; 2) Good--riparian corridor exhibits excellent vegetative cover but the surrounding area is altered; 3) Fair-- the riparian corridor is fragmented, and/or the surrounding lands disturbed; 4) Poor-- riparian corridor disturbed, vegetation that is sparse or highly fragmented and the surrounding land slightly to drastically altered. Deep canyons are an exception to the above criteria, as they tend to have naturally low amounts of riparian vegetation. If the surrounding land looked undisturbed, a canyon reach would be ranked "good" also.

By visually overlaying BLM 1:100,000 topographic and land ownership maps with the aerial photographs, we also tallied the amount of federal, state and private land by their riparian condition for all perennial streams in the basin.

In the field, we further evaluated random sites for evidence of disturbance and eliminated sites that were dominated by non-native plant species such as tamarisk or salt cedar (*Tamarix ramosissima*) or Russian-olive (*Elaeagnus angustifolia*). However, we included areas with non-natives present in the understory, such as Kentucky bluegrass (*Poa pratensis*), but only where native flora dominated the overstory vegetation, and when the degree of disturbance was minimal. If the site was acceptable, stand data were collected from homogeneous stands of riparian vegetation.

### Classification Basis

By eliminating disturbed and degraded sites, the classification is based on existing, relatively undisturbed, or naturally disturbed native vegetation. A plant association, the most specific level 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 existing communities, rather than perceived climax vegetation types. Plant associations are a product of the prevailing environmental setting (where possible, barring human influence or pre-European settlement) including past natural disturbances (such as fire, flooding, or bison grazing) and are "real, extant ... kinds of vegetation, rather than a theoretical end point that is seldom reached on most sites" (Baker 1984). Along riparian corridors, flooding and sediment deposition and scouring, create an environment that is frequently disturbed. Thus most riparian communities are frequently set back in successional time, and the floodplain mosaic is often a series successional stages. Most of the plant associations described in this report may be considered "community types" by the Daubenmire Habitat Typing system, in that they are frequently disturbed, and rarely reach a climatic climax.

### Collection of vegetation and environmental data

Prior to visiting sites for collection of field data, landowners or managing agencies were notified and permission obtained for all private properties visited. Plots and transects were subjectively located within a homogeneous portion of each stand to best represent the vegetation of the site. Data collected is designed to be representative, not statistically rigorous. The following data was collected at each plot location:

- \* elevation (from 7.5 min. topographic maps)
- \* aspect and stream bearing
- \* valley floor width (from topographic maps)
- \* stream gradient (measured with a hand level and stadia rod)
- \* channel depth and width (measured at bankfull or average annual high water mark) *Bankfull stage* or *Bankfull channel* is the height of the average 1-3 year return flow, also called the average annual high water mark of the active channel (Knighton 1984, Wolman and Leopold 1957). We use this demarcation along the bank as a reference point for measuring stream channel width and depth, and the height and distance of a riparian community from the active channel.

- \* Stream reaches were placed into Rosgen's Stream channel classification. The system is based on the channel width to depth ratio, available floodplain width, and channel gradient. For a full description and explanation, see Rosgen (1994).
- \* hydrologic and geomorphic features (beaver dams, point bars, etc.)
- \* history of use (from landowner or manager) when obtainable
- \* Each site was ranked A (highest) through D (poorest) for quality, condition, defensibility, and viability, using the following criteria:

quality--overall size, connectedness to surrounding natural ecosystems, degree of alteration.

condition--abundance of non-native plant species, degree of soil compaction, amount of species composition change by livestock grazing, degree of human disturbance, appropriateness of current management for riparian ecosystem health.

viability--extrinsic factors: are natural hydrological processes in place, will the site improve, or remain in current condition with current management?

defensibility--extrinsic and intrinsic factors affecting the long term existence of the ecosystem; any known threats or site specific problems are defined; adjacent land use compatibility is included.

Woody vegetation was quantitatively sampled for percent cover using 30-50 m long line-intercept transects, oriented parallel to the stream channel. Transects were subjectively located within a homogeneous portion of each stand to best represent the vegetation of the site.

Herbaceous vegetation was sampled using 10-20 0.10 m<sup>2</sup> micro-plots, located about every third meter along the transect and 1 meter to the side, alternating sides. Data collected at each site included:

- \* Percent canopy cover by vascular plant species to the nearest 10% in the following cover classes: 5-15%, 16-25%, 26-35%, 36-45%, 46-55%, 56-65%, 66-75%, 76-85%, 86-95%, and >95%. Plant cover 5% or less was estimated into two categories, <1% and 1-5%.
- \* Total canopy cover by life-form (trees, shrubs, graminoids, and forbs). Overhead tree cover was measured along the transect using a clinometer to find the vertical intercept of the tree canopy.
- \* Ground cover of bare soil, litter, wood, gravel, rock, bryophyte, and non-vascular plants
- \* Soils were described from a single pit within each stand sampled. Pit depth varied according to the amount of coarse fragments present (average depth 70 cm). Noted from each horizon: thickness, texture, color, % mottling/gleying, matrix color, % coarse fragments, % organic matter, overall thickness, and parent material, when possible.
- \* Height above the active channel using a hand held level and stadia rod.
- \* Distance from transect to active channel (using a measuring tape or hip-chain).
- \* Landscape position (point bar, floodplain, abandoned channel, terrace, etc.).
- \* Signs of wildlife or domestic livestock utilization.

- \* Signs of disturbance (flooding, fire, wind throw, logging, etc.).
- \* Successional relationships where trends could be inferred.
- \* Adjacent riparian and upland vegetation.
- \* Reference site and plot 35 mm color slides.
- \* Size of occurrence mapped on 7.5 min. USGS topographic maps with aid of 9 x 9 in. 1:40,000 NAPP color infra red aerial photos.

All plants not identified in the field, particularly of difficult genera such as *Salix*, *Carex*, and *Juncus*, were collected, pressed, and identified (to species level when possible) at the University of Colorado and Colorado State University Herbaria. Voucher specimens will be deposited at the University of Colorado Herbarium, the University of Wyoming Rocky Mountain Herbarium, and the Colorado State University Herbarium. Nomenclature in this report follows Kartesz (1994). A list of scientific plant names for the lower S. Platte and upper Arkansas River Basins are provided in Appendix C and D, respectively.

#### Data Analysis and Classification Criteria

Agglomerative cluster analysis programs were employed using Euclidean distance and average clustering method to determine groups of plots with similar species abundance. Associations derived from the cluster analyses were compared with riparian plant association stand data and descriptions from riparian classification work in Colorado, New Mexico, Arizona, Utah, Montana, Idaho and Wyoming (Johnston 1987, Muldavin 1992, Durkin *et al.* 1994, 1995, Szaro 1989, Padgett *et al.* 1989, Hansen *et al.* 1988, 1989, 1995, and Youngblood *et al.* 1985, respectively). Associations were considered either 1) synonymous --where associations matched in species composition, constancy, average cover, environmental setting, 2) similar --when canopy structure, genera, and physical setting were similar, but species composition was different, 3) a new type not described in the literature, or 4) unclassifiable due to insufficient data.

Association names were based on each canopy stratum dominant and codominant plant species, characterized by high constancy (frequency of species occurrence) and high relative abundance (percent canopy cover) values. A slash separates canopy layers (e.g., tree/shrub/herb). A dash indicates codominance within a given canopy layer (e.g., *Populus angustifolia-Pseudotsuga menziesii*). Plant associations that appear synonymous with those in the literature (by stand table and description comparison) are given the same names. Some published names are long and awkward; we propose shorter names herein.

Riparian plant associations were placed into the United Nations Educational, Scientific, and Cultural Organization (UNESCO) Physiognomic-Ecological Classification of Plant Formations of the Earth (Mueller-Dombois and Ellenberg 1974, as revised by The Nature Conservancy's Western Regional Office), and the Classification of Wetland and Deepwater Habitats of the United States (Cowardin *et al.* 1979) (Table 3).

The UNESCO system is currently used by The Nature Conservancy throughout the United States. This hierarchical system uses physiognomy and environment to distinguish vegetation units:

- I, II, etc.      Formation Class (Physiognomic type: closed forests, woodlands, shrublands, dwarf-shrublands, terrestrial herbaceous communities, deserts, and aquatic plant formations)
- A,B, etc.      Formation subclass (evergreen or deciduous)
- 1,2, etc.      Formation Group (e.g., temperate vs. tropical)
- a,b, etc.     Formation (e.g., forests with conical crowned, giant vs. non-giant trees, etc.)
- Alliance (dominant characteristic species,  
   e.g., *Abies lasiocarpa*)
- Plant association (e.g., *Abies lasiocarpa/Alnus incana*)

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

Table 3. Cross-reference of the UNESCO Plant Formations (Roman numerals) and Cowardin Wetland Types.

| UNESCO   | Cowardin                         |
|--|----------------------------------|
| I. Closed forests (interlocking crowns)                      | Palustrine system-Forested class |
| A. Mainly evergreen forests                                  | Needle-leaved evergreen subclass |
| 9. Temperate coniferous forests                              |                                  |
| c. Evergreen (non-giant) conifer forests with conical crowns |                                  |
| I. (Alliance)  |                                  |
| a. (Plant Association)                                       | (Dominance type)                 |
| B. Mainly deciduous forests                                  | Broad-leaved deciduous subclass  |
| 2. Cold-deciduous forests with evergreen trees admixed       |                                  |
| c. Cold-deciduous forest with needle-leaved evergreen trees  |                                  |
| I. (Alliance)  |                                  |
| a. (Plant Association)                                       | (Dominance type)                 |
| 3. Cold-deciduous forests without evergreen trees            |                                  |
| b. Montane or boreal cold-deciduous forests                  |                                  |
| 1. Mainly broad-leaved                                       |                                  |

Table 3. Continued.

| UNESCO   | Cowardin                                |
|--|---|
| <ul style="list-style-type: none"> <li>1. (Alliance) <ul style="list-style-type: none"> <li>a. (Plant Association)</li> </ul> </li> </ul>  | (Dominance type)                        |
| III. Shrublands  | Palustrine-Scrub-Shrub Shrubland        |
| <ul style="list-style-type: none"> <li>B. Mainly deciduous shrubland</li> </ul>  | Deciduous--class                        |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>3. Cold-deciduous shrublands</li> </ul> </li> </ul>   |   |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>a. temperate (montane)</li> </ul> </li> </ul> </li> </ul>   |   |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>1. (Alliance)</li> </ul> </li> </ul> </li> </ul> </li> </ul>  |   |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>a. (Plant Association)</li> </ul> </li> </ul> </li> </ul> </li> </ul> </li> </ul> | (Dominance type)                        |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>b. Subalpine shrublands</li> </ul> </li> </ul> </li> </ul>  |   |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>1. (Alliance)</li> </ul> </li> </ul> </li> </ul> </li> </ul>  |   |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>a. (Plant Association)</li> </ul> </li> </ul> </li> </ul> </li> </ul> </li> </ul> | (Dominance type)                        |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>c. Deciduous alluvial shrubland</li> </ul> </li> </ul>  |   |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>1. (Alliance)</li> </ul> </li> </ul> </li> </ul>  |   |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>a. (Plant Association)</li> </ul> </li> </ul> </li> </ul> </li> </ul> </li> </ul> | (Dominance type)                        |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>d. Deciduous peat shrubland</li> </ul> </li> </ul>  |   |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>1. (Alliance)</li> </ul> </li> </ul> </li> </ul>  |   |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>a. (Plant Association)</li> </ul> </li> </ul> </li> </ul> </li> </ul> </li> </ul> | (Dominance type)                        |
| IV. Terrestrial herbaceous communities   | Palustrine-Emergent Persistent Wetlands |
| <ul style="list-style-type: none"> <li>C. Meadows</li> </ul>   |   |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>1. Below tree-line</li> </ul> </li> </ul>   |   |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>f. Sedge-rush meadow (closest class, although ours are not anthropogenic)</li> </ul> </li> </ul> </li> </ul> </li> </ul>  |   |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>1. (Alliance)</li> </ul> </li> </ul> </li> </ul> </li> </ul> </li> </ul>          |   |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>2. (Plant Association)</li> </ul> </li> </ul> </li> </ul> </li> </ul> </li> </ul> |   |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>2. Above tree-line</li> </ul> </li> </ul>   | (Dominance type)                        |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>a. Closed alpine mats</li> </ul> </li> </ul> </li> </ul>  |   |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>1. (Alliance)</li> </ul> </li> </ul> </li> </ul> </li> </ul>  |   |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>a. (Plant Association)</li> </ul> </li> </ul> </li> </ul> </li> </ul> </li> </ul> |   |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>c. Snow-bed formation</li> </ul> </li> </ul>  | (Dominance type)                        |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>1. (Alliance)</li> </ul> </li> </ul> </li> </ul>  |   |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>a. (Plant Association)</li> </ul> </li> </ul> </li> </ul> </li> </ul> </li> </ul> |   |
| <ul style="list-style-type: none"> <li>E. Salt swamps</li> </ul>   | (Dominance type)                        |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>2. Salt meadows</li> </ul> </li> </ul>  |   |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>b. Inland salt meadow</li> </ul> </li> </ul> </li> </ul>  |   |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>1. (Alliance)</li> </ul> </li> </ul> </li> </ul> </li> </ul>  |   |
| <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li> <ul style="list-style-type: none"> <li>a. (Plant Association)</li> </ul> </li> </ul> </li> </ul> </li> </ul> </li> </ul> |   |
| VII. Aquatic Plant formations  | (Dominance type)                        |

Table 3. Continued.

| UNESCO  | Cowardin  |
|---|---|
| B. Reed-swamps<br>3. Reed-swamps of flowing water<br>b. Temperate reed swamps of river banks<br>1. (Alliance)<br>a. (Plant Association) | Riverine System-Upper Perennial<br>Persistent-Emergent Wetlands<br><br>(Dominance type) |

Determination of Ecologically-Significant Sites

The Colorado Natural Heritage Program is responsible for gathering and updating information on features of natural diversity in Colorado. Each of these significant natural features (rare plant and animal species, significant plant associations) is a unit, or element, of natural diversity. Each element is assigned a global and a state rank that indicates its relative rarity on a five-point scale (1 = extremely rare; 5 = abundant; Table 4). By using the element ranks and the quality of each occurrence, priorities can be established for the management and/or protection of the most imperilled elements of biodiversity.

Each geographical location of any element is called an Element Occurrence. Element occurrences are ranked on four areas of overall quality. These are 1) quality-- overall size, vigor, health of population, degree of connectedness to surrounding natural ecosystems, etc.; 2) condition or naturalness of the habitat, abundance of non-native species present, degree of human-induced disturbance, degree of soil compaction, degree species composition alteration by grazing, 3) viability are natural pollinators in place, is the hydrologic regime altered, will site improve or be maintained by current management practices; 4) defensibility-- ease or difficulty of protecting the occurrence from external threats, site specific problems, adjacent land use compatibility. Each criteria is given a rank (A, B, C, or D) and are they are summed for a final, overall Occurrence Rank: A= Pristine or undisturbed, B= Undisturbed to slightly altered, C= Disturbed to highly altered, D= barely functioning.

For example, an 'A' ranked occurrence of a riparian plant association has no, or very few, non-native plant species present, the channel and banks are stable and show no signs of trampling or sloughing, the soils are not compacted. The association is surrounded by other riparian associations of similar quality, creating a connected, high quality mosaic. The surrounding hillslopes and areas up and down stream are in natural condition and have not been drastically altered (no dams or diversions upstream, no logging or mining up stream of adjacent hillslopes). A 'B' ranked occurrence of a riparian plant association may have all of the above 'A' criteria but is very small in size, or has a higher abundance of non-native plant species present, or may be an

area in high condition with surrounding land use that fragments the occurrence. A 'C' ranked occurrence is of poor condition, generally with abundant non-native plant species present and/or the area is highly fragmented, and/or the area is very small. Again surrounding land use and condition plays a role in the overall riparian occurrence rank.

Colorado Natural Heritage Program uses the Global/State Rarity and Occurrence Ranks to assess the overall significance of a Site, which may include one or many element occurrences. Based on these ranks, each site, or suite of elements, is assigned a Biodiversity (or "B") Rank:

- B1 Outstanding Significance: only site known for an element or an excellent occurrence of a G1 species or plant association.
- B2 Very High Significance: one of the best examples of a plant association, good occurrence of a G1 species, or excellent occurrence of a G2 or G3 species or plant association.
- B3 High Significance: excellent example of any plant association, good occurrence of a G3 species, or a large concentration of good occurrences of state rare species/associations.
- B4 Moderate Significance: good example of an association, excellent or good occurrence of state-rare species/association.
- B5 General Biodiversity Significance: good or marginal occurrence of an association type, S1, or S2 species/association.

In this way ecologically significant sites are recognized as the highest-ranked community or species occurrences, including both common and globally rare riparian ecosystems. Sites that contain high-quality (excellent condition) examples of globally rare plant associations, or sites that contain a mosaic of rare and/or more common elements in good to excellent condition quickly rise to the top of the list of sites important to the conservation of riparian biodiversity. These sites can be used as reference reaches for restoration and future research.

Riparian areas recommended for special management or protection are examples of "A" or "B" ranked occurrences. These ecologically significant sites are valuable as reference areas for long-term research and comparison with impacted areas.

High-quality riparian areas found in the upper Arkansas and lower South Platte study areas are proposed as some of the best examples of rare or common riparian plant associations in the State. The Colorado Natural Heritage Program will be entering these areas into the Biological and Conservation Database and ranking these sites for final protection recommendation.

Table 4. Definition of Natural Heritage Global and State Rarity Ranks. Global ranks (G) refer to the worldwide range of the plant, animal, or natural community. State ranks (S) refer to the abundance within state boundaries. Note that GA and GN are not used. These ranks should not be interpreted as legal designations.

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- G/S1 Extremely rare: usually 5 or fewer occurrences in the state; or may be few remaining individuals; especially vulnerable to extirpation.
- G/S2 Very rare; usually between 5 and 20 occurrences; or with many individuals in fewer occurrences; often susceptible to becoming endangered.
- G/S3 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 or chronic disturbances.
- G/S4 Common; usually > 100 occurrences, but may be fewer with many large populations; may be restricted to only a portion of the state; usually not susceptible to immediate threats.
- G/S5 Very common; demonstrably secure under present conditions.
- SA Accidental in the state.
- G/SH Historically known from the state, but not verified for an extended period, usually > 15 years; this rank is used primarily when inventory has been attempted recently.
- G/S#B Refers to the breeding season rarity of migrants.
- S#N Refers to the non-breeding season rarity of migrants; where no consistent location can be discerned for migrants or non-breeding populations, a rank of SZN is used.
- G/SU Status uncertain, often because of low search effort or cryptic nature of the element.
- 
- G/SX Apparently extirpated from the state, or extinct.
-

## RESULTS and DISCUSSION

Forty-one plant associations within thirty alliances were identified from both study areas (Table 5, Figures 8 and 9). Complete descriptions of each plant association come at the end of this section. Three associations found along the main stem of the S. Platte River have not been previously described in the literature and were ranked as rare. These are: 1) Plains cottonwood-(peached-leaved willow)/sloughgrass riparian woodland (*Populus deltoides* spp. *monilifera*-*Salix amygdaloides*)/*Spartina pectinata*), 2) Plains cottonwood/wooly sedge riparian woodland (*Populus deltoides* spp. *monilifera*/*Carex lanuginosa*), and 3) Sloughgrass riparian meadow (*Spartina pectinata*) (Table 5). Six associations previously known from Colorado but poorly described were clarified, and two associations received new names (Table 5).

Overlap in plant associations from the two study areas occur at transitional foothill elevations found at the eastern edge of the upper Arkansas study area and the western edge of the lower South Platte watershed. Most of the associations found along S. Boulder Creek within the South Platte watershed also occur at similar elevations within the upper Arkansas drainage.

### Lower South Platte River

The key finding from the lower South Platte watershed was the occurrence of a continuous broad canopy of native cottonwoods and willows along the South Platte River from Greeley to the Nebraska state line. Within this canopy, we observed several native plant associations that represent various successional stages and micro-habitats of the floodplain. While this large riparian woodland is likely a product of human-induced change to the South Platte River ecosystem, the associations are dominated entirely by native species and exhibit signs of a diverse floodplain ecosystem.

In the late 1800's and early 1900's the North, South and main Platte Rivers had broad, braided river channels with little riparian vegetation along their banks (Williams 1978, Johnson 1994, Knopf 1988, Snyder and Miller 1991, USFWS 1994). The amount of vegetation on stream banks and islands of the historical river is debated (Johnson 1994). However, it is fairly clear that what was there was not the continuous band of deciduous trees from Colorado to the Missouri River that occurs today.

This change in the amount of floodplain vegetation is thought to be a product of major alterations in hydrology of the Platte Rivers through several large dams on the North Platte River, off-channel storage and flood control reservoirs along the South Platte River, transcontinental inflows, countless irrigation dams, miles of channelized reaches and floodplain development near large towns and cities (Williams 1978, USFWS 1994). Hydrologic alterations have resulted in three important factors that affect vegetative growth: (1) elimination of late winter (e.g., March) ice break up and ice flows that would have damaged plants rooted on low islands or in the stream channel, (2) a reduction in the magnitude and duration of late-spring and early-summer peak flows, whose main impact was inundation of surfaces, scouring and sediment

deposition which disrupted existing vegetation while creating new surfaces for establishment, both close and away from the main channel, and (3) the augmentation of late-summer flows, such that no-flow months that would have limited the establishment and growth of riparian vegetation no longer occur (Johnson 1994, Williams 1978, USFWS 1994). These changes in combination have allowed native cottonwood and willows to encroach into the shallow braided channels of the Platte Rivers.

While it is fairly certain the current riparian vegetation is a direct result of these hydrologic alterations, river ecosystems are very dynamic. One-shot-in-time assessments (such as the turn of this century) do not tell the whole story. Other river systems such as the San Pedro in Arizona and the Arikaree in eastern Colorado have undergone non-anthropogenic induced broad scale geomorphic changes and dramatic shifts in the type and amount of riparian vegetation (Mike Scott, NBS, and Brian Richter, TNC, personal communication). A paucity of vegetation on the S. Platte River at the turn of this century does not necessarily mean that large patches of riparian forest never existed on its banks (Johnson 1994). It seems probable that broad scale climate cycles of drought and flood may have caused fluctuations in the amount of riparian vegetation. Because the riparian forest of the S. Platte River in Colorado is composed of native woody species, it seems possible these plant associations may have existed in the past (i.e., 200-500 years ago). This forest was not likely a continuous canopy for hundreds of miles, but would have occurred in patches, some large (a few miles) and some small (single oxbow lakes). Native willows and cottonwoods were certainly present 100+ years ago (Johnson 1994). In 1843, Fremont observed "...timber appears to have been much more extensive formerly than now. There were but few trees... In many similar places I had occasion to remark an apparent progressive decay in the timber..." (Williams 1978, Johnson 1994). It seems probable that these plant associations are a product of plains river ecosystems and have come back on a broad scale due to human-altered hydrology.

While these plant associations represent the potential natural vegetation of the South Platte River, it is unlikely they ever formed a continuous riparian forest from the western edge of the Colorado Plains east to the Missouri River as they do today. Several bird and fish species native to the Platte River ecosystem are distinct species from their eastern counterparts (Knopf 1988). This is strong evidence that there never was a continuous riparian canopy and that there were significant barriers to species migration. Today, western bird species hybridize with the eastern species because of movement up and down the now continuous riparian corridor (Knopf 1988).

In addition, the local diversity in riparian habitats has been reduced. The large wet meadows, broad shallow braided channels, and isolated mid-channel islands are being lost due to a reduction in geomorphic processes. These habitats are critical to migratory bird species, including the endangered Whooping Crane, one of the oldest bird species in North America (Johnsgard 1991). Also, the current broad riparian forest may be a one-time cohort resulting from changes in the hydrology. This forest may be narrowing, that is, trees at the outer edge of the floodplain are dying and are not being replaced (Johnson 1994; M. Scott, NBS, personal

communication). With time the corridor may become a narrow riparian forest along a channelized river, an new stable system as a result of the new hydrologic regime, one that lacks the diversity of habitats and dynamic nature of the historic ecosystem.

We need to focus our conservation and restoration efforts on restoring the dynamic nature of the Platte River ecosystem, including the broad braided channel and open wet meadow habitats critical to maintaining fish and bird species (Johnsgard 1991). Native riparian plant associations will also benefit from such efforts, as they too evolved within a more dynamic environment. Preserves that protect the diversity of riparian habitats (open meadows, shrublands, cottonwood forests, and a broad shallow braided channel) in conjunction with hydrologic restoration (flooding flows, ice damage, and late summer drawn downs) are necessary to preserve bird, fish, and plant association biodiversity of the Platte River ecosystem.

Examples of this native-dominated riparian mosaic can be seen at the Tamarack Ranch State Wildlife Area and from the town of Sedgwick to the Nebraska state line on DOW lands. These areas are in good condition as they are not over-grazed and non-native species are not abundant (see Appendix B). Discussions with Kansas and Nebraska State Heritage ecologists indicate that these communities probably occur along river floodplains in those states. Detailed inventories of the South and North Platte Rivers in Nebraska and other riparian habitats in Kansas have yet to be conducted. Due to the uncertain origin (natural or anthropogenic) of Colorado's South Platte floodplain ecosystem, and the need for more inventories in neighboring states, the plant association names and rarity ranks presented here are considered preliminary.

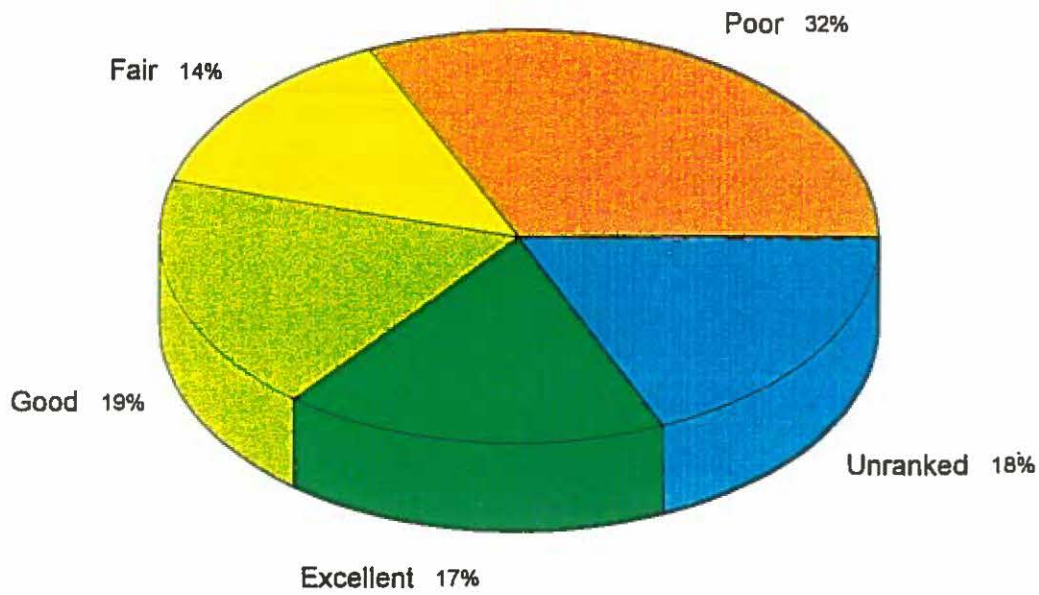
### Upper Arkansas

The upper Arkansas watershed has several foothill riparian areas in good to excellent condition. In addition, several plant associations previously poorly described and known from only a few areas in Colorado (<10 locations) where found in abundance. These are: (1) the river birch/mesic wildflower riparian shrubland (*Betula occidentalis*/mesic forb), (2) the narrowleaf cottonwood/river birch riparian woodland (*Populus angustifolia*/*Betula occidentalis*), (3) the narrowleaf cottonwood-Douglas fir riparian woodland (*Populus angustifolia*-*Pseudotsuga menziesii*), and (4) the Douglas fir/hazelnut riparian forest (*Pseudotsuga menziesii*/*Corylus cornuta*) plant associations (Table 5). Several excellent condition examples of these types were located. Steep canyon walls and a desert-like climate provide difficult access for recreation and low forage production for livestock, allowing some riparian areas to remain undisturbed for much of the growing season. Indeed, the best sites in the Upper Arkansas area were not grazed or only lightly grazed, and were areas off-limits to all-terrain vehicular use (see Appendix B).

Aerial photography assessment shows that riparian areas at lower elevations and on larger rivers were more heavily altered by human impacts compared to the upper watershed (Figure 7). We eliminated more than 50% ("fair" and "poor", see Methods for definitions) of the perennial stream reaches in the watershed from the sampling regime (Figure 7a). The most impacted areas

occurred at lower elevations along larger streams (Figure 7d). These areas were too degraded to adequately represent native riparian vegetation. Areas excluded from sampling appeared to be over-grazed, had altered hydrologic regimes, were cleared for intensive agriculture, such as irrigated hay, were impacted by coal and gravel mining, or by urban development. Land ownership within the basin reflects this pattern. Much of the private land has been altered by the above uses, while public lands (BLM, USFS, State Land Board) are used primarily for range and non-irrigated pastures (Figure 7b). Occurrences of native riparian plant associations in good to excellent condition at lower elevations were rare and limited to small, isolated patches.

### A. OVERALL RIPARIAN CONDITION



### B. RIPARIAN CONDITION BY LAND OWNERSHIP

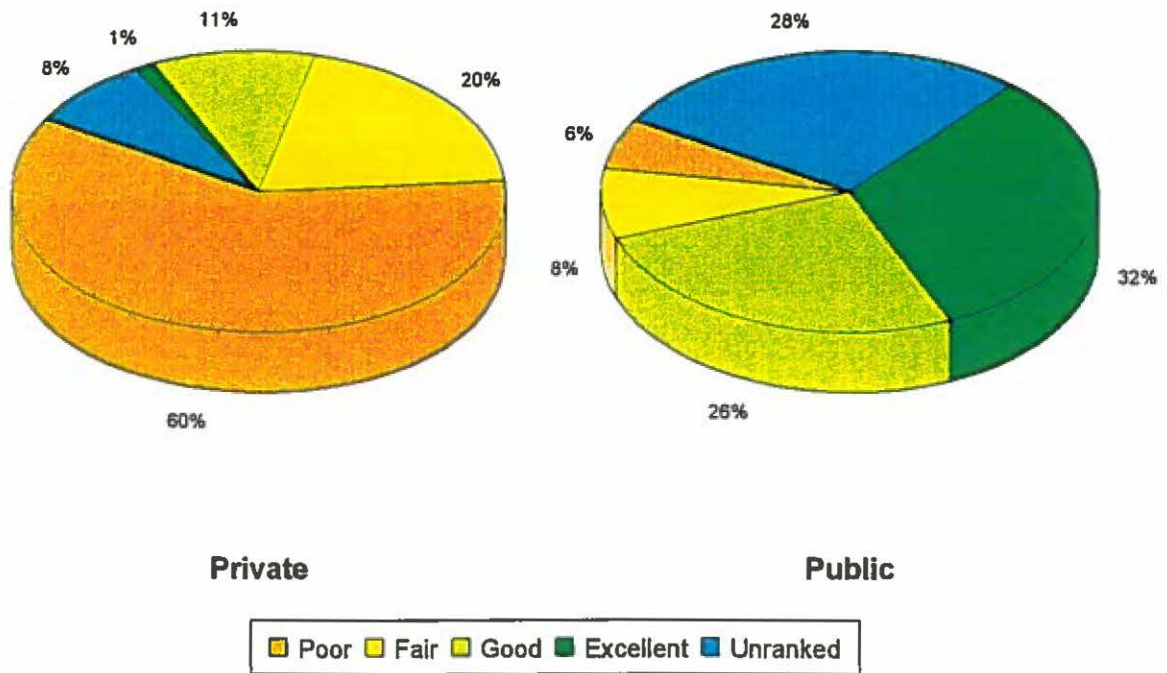
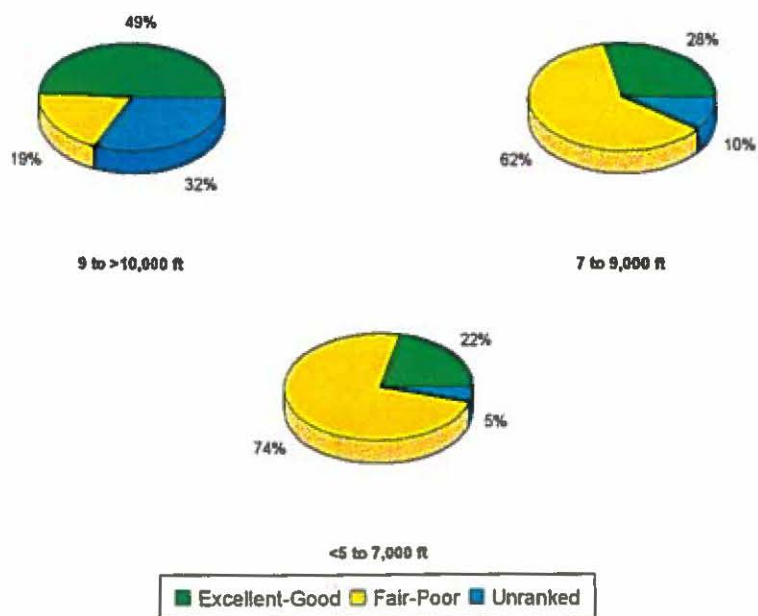


Figure 7. Condition of Upper Arkansas River Basin riparian areas, based on 1:40,000 NAPP Color IR Photos (see METHODS for details). A) Overall riparian condition. B) Riparian condition by land ownership.

### C. RIPARIAN CONDITION BY ELEVATION



### D. RIPARIAN CONDITION BY STREAM ORDER

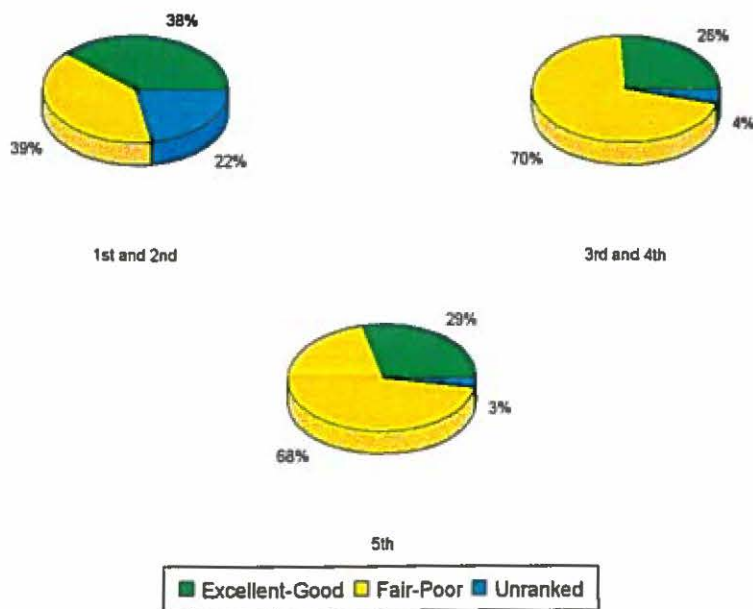


Figure 7. Continued C) Riparian condition by elevation and D) Riparian condition by stream order.

Table 5. Riparian Plant Associations of the Lower South Platte and parts of the Upper Arkansas River Basins. Plant association names reflect the number of vegetation canopies present. A slash ("/") indicates a change in the canopy level, either a dominate tree species followed by a shrub species, or a shrub species followed by an herbaceous species. A dash ("-") represents a co-dominance of two species within the same canopy layer, and parenthesis "()" indicate a species that is characteristic but not always present.

CONFEROUS AND MIXED-CONFEROUS WOODLANDS

*Abies lasiocarpa* Alliance

*Abies lasiocarpa*/*Salix drummondiana*

*Pseudotsuga menziesii* Alliance

*Pseudotsuga menziesii*/*Betula occidentalis*

*Pseudotsuga menziesii*/*Corylus cornuta*\*\*

*Picea pungens* Alliance

*Picea pungens*/*Equisetum arvense*

*Populus angustifolia* Alliance

*Populus angustifolia*-*Juniperus scopulorum*\*\*

*Populus angustifolia*-*Pseudotsuga menziesii*\*\*

*Juniperus scopulorum* Alliance

*Juniperus scopulorum*

Unclassified *Juniperus scopulorum* Stands

DECIDUOUS WOODLANDS

*Populus angustifolia* Alliance

*Populus angustifolia*/*Alnus incana*

*Populus angustifolia*/*Betula occidentalis*

*Populus angustifolia*/*Salix exigua*

*Populus angustifolia*/*Salix irrorata*\*

Other *Populus angustifolia* stands

*Populus x acuminata* Alliance

Unclassified *Populus x acuminata* stands

*Populus deltoides* Alliance

*Populus deltoides*/*Bromus inermis*

*Populus deltoides*/*Carex lanuginosa*\*

*Populus deltoides*/*Panicum virgatum*\*\*

*Populus deltoides*/*Prunus virginiana*\*\*

*Populus deltoides*/*Symphoricarpos occidentalis*\*\*

*Populus deltoides*-(*Salix amygdaloides*)/*Salix exigua*

*Populus deltoides*-(*Salix amygdaloides*)/*Spartina pectinata*\*

Other *Populus deltoides* stands

*Salix amygdaloides* Alliance

Unclassified *Salix amygdaloides* stands

Table 5., Continued

ALLUVIAL SHRUBLANDS

*Alnus incana* Alliance

*Alnus incana*/mesic graminoid

*Alnus incana*/mesic forb

*Alnus incana*-*Cornus sericea*

*Alnus incana* Alliance, continued

Unclassified *Alnus incana*-*Salix* spp.

*Betula occidentalis* Alliance

*Betula occidentalis*/Mesic forb

*Salix drummondiana* Alliance

*Salix drummondiana*/mesic forb

*Salix eriocephala* var. *ligulifolia* Alliance

Unclassified *Salix eriocephala* var. *ligulifolia* Standst

*Salix exigua* Alliance

*Salix exigua*/bare ground

*Salix exigua*/mesic graminoides

*Salix geyeriana* Alliance

*Salix geyeriana*/*Carex aquatilis*

*Salix geyeriana*-*Salix monticola*/mesic graminoid

*Salix monticola* Alliance

Unclassified *Salix monticola* Stands

*Symphoricarpos occidentalis* Alliance

*Symphoricarpos occidentalis*

*Prunus virginiana*-*Symphoricarpos occidentalis*

PEAT SHRUBLANDS

*Salix brachycarpa* Alliance

Unclassified *Salix brachycarpa* Stands

*Salix planifolia* Alliance

*Salix planifolia*/*Carex aquatilis*

*Salix planifolia*/*Caltha leptosepala*

*Salix wolfii* Alliance

*Salix wolfii*/*Carex aquatilis*

HERBACEOUS ASSOCIATIONS

*Andropogon gerardii* Alliance

*Andropogon gerardii*-*Sorghastrum nutans*

*Carex aquatilis* Alliance

*Carex aquatilis*

*Carex praegracilis* Alliance

*Carex praegracilis*

*Carex nebrascensis* Alliance

Table 5., Continued

HERBACEOUS ASSOCIATIONS, continued

*Carex nebrascensis*

*Carex lanuginosa* Alliance

*Carex lanuginosa*

*Carex utriculata* Alliance

*Carex utriculata*

*Eleocharis palustris* Alliance

*Eleocharis palustris*

*Scirpus* spp. Alliance

*Scirpus acutus*-*Scirpus tabernaemontani*†

*Spartina pectinata* Alliance

*Spartina pectinata*\*

*Typha angustifolia* Alliance

*Typha angustifolia*

\* New association, previously undescribed from Colorado

\*\* Previously known, but not well documented in Colorado

† New name for previously described type

Figure 8. Cluster analysis Dendrogram for 105 stands from the Lower South Platte River Basin. Individual plots (e.g., SPGK01) are listed on the left. The axis across the top is Euclidean Distance, indicating the degree of dissimilarity in species composition. Vertical dashed lines indicate the levels of similarity at which plots were grouped. Groups of plots were joined in the same manner. Groups that comprise Plant Associations are shaded and labeled. Starred stands were placed in different groups due to environmental differences, or for other reasons. In addition, some groups that were split in the dendrogram due to differences in the relative amount of canopy cover have been combined because they have similar species composition. A "u" indicates the stand was classified to the Alliance level only.

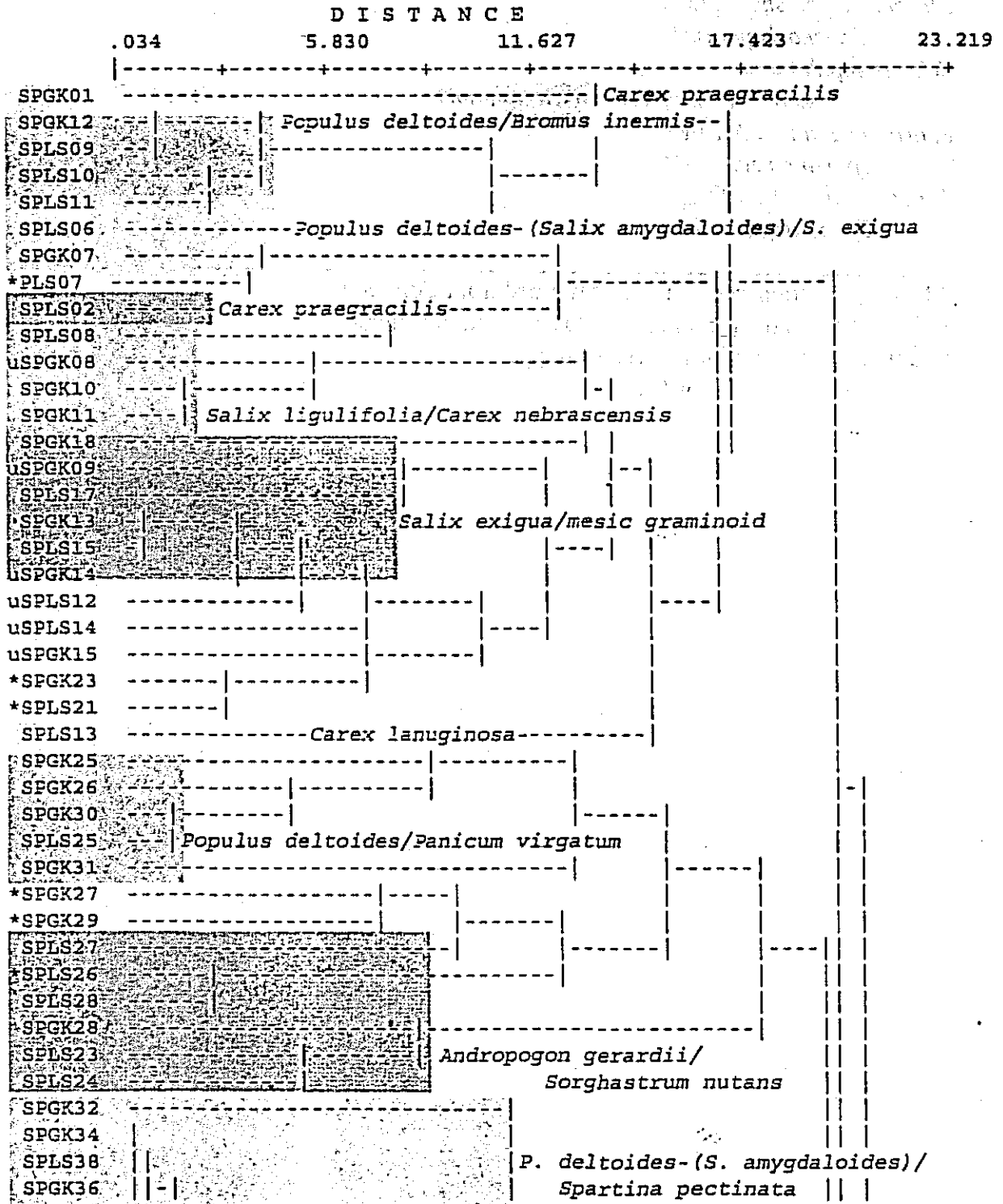


Figure 8. Continued.

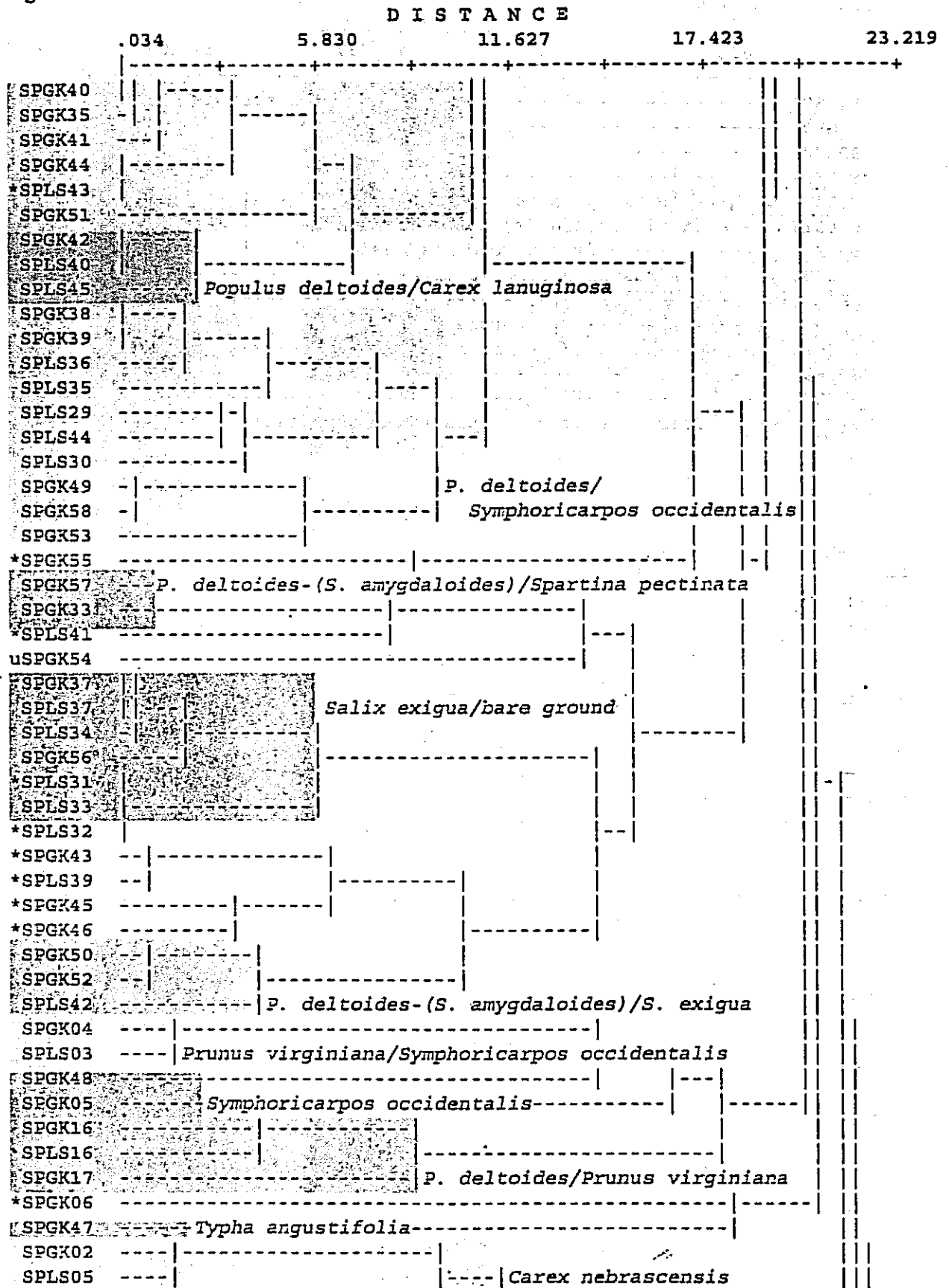


Figure 8. Continued.

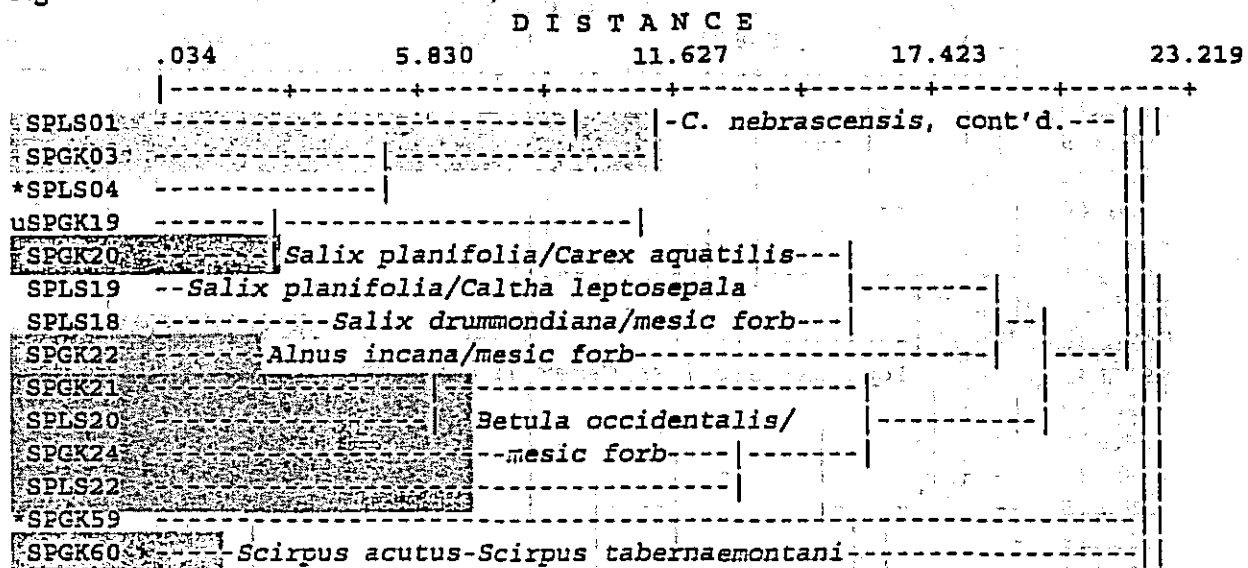


Figure 9. Cluster Analysis Dendrogram for 99 stands from the Upper Arkansas River Basin. Individual plots (e.g., AM01) are listed on the left. The axis across the top is Euclidean Distance, indicating the degree of dissimilarity in species composition. Vertical dashed lines indicate the levels of similarity at which plots were grouped. Groups of plots were joined in the same manner. Groups that comprise Plant Associations are shaded and labeled. Starred stands were placed in different groups due to environmental differences, or for other reasons. In addition, some groups that were split in the dendrogram due to differences in the relative amount of canopy cover have been combined because they have similar species composition. A "u" indicates the stand was classified to the Alliance level only.

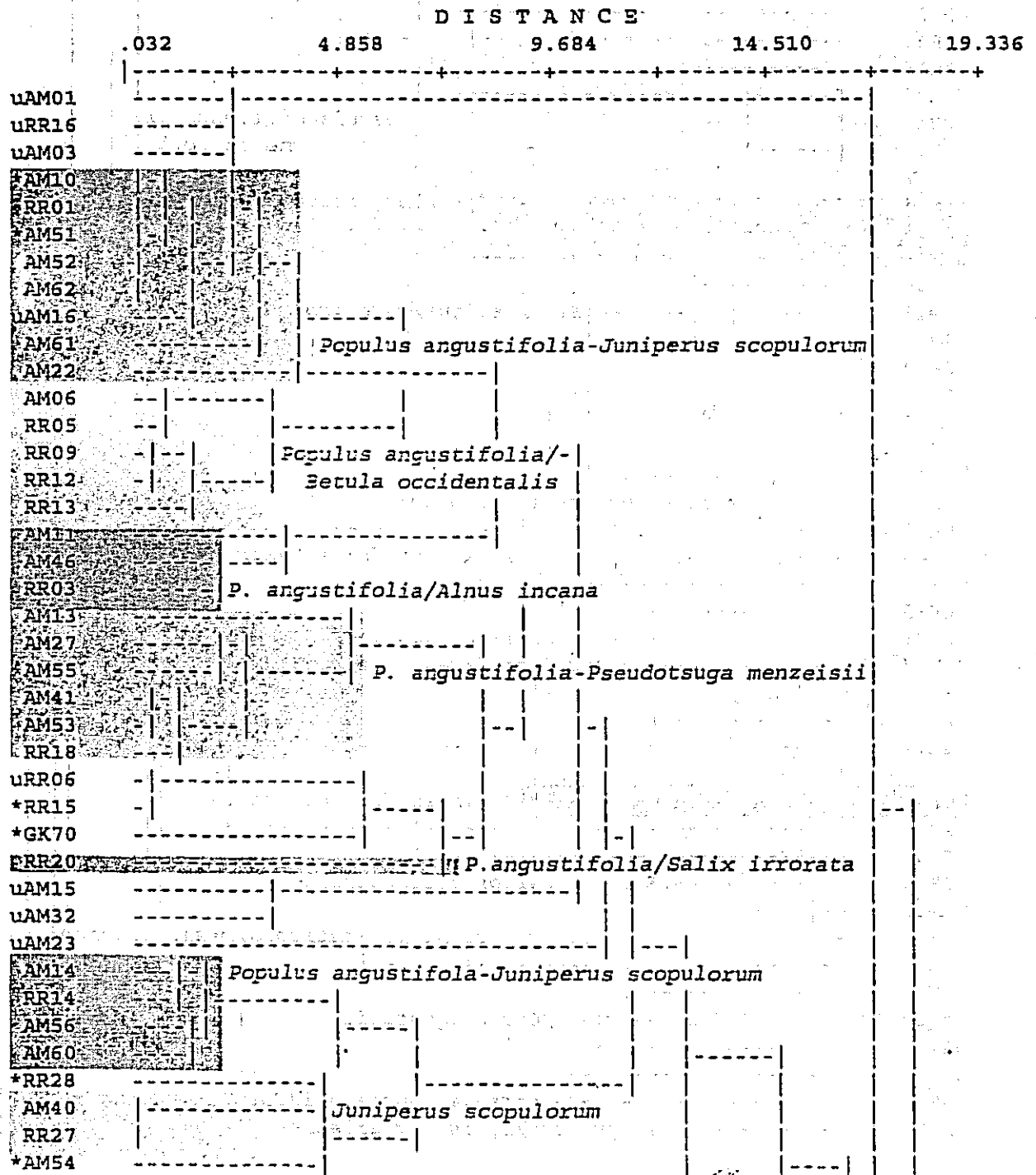


Figure 9. Continued.

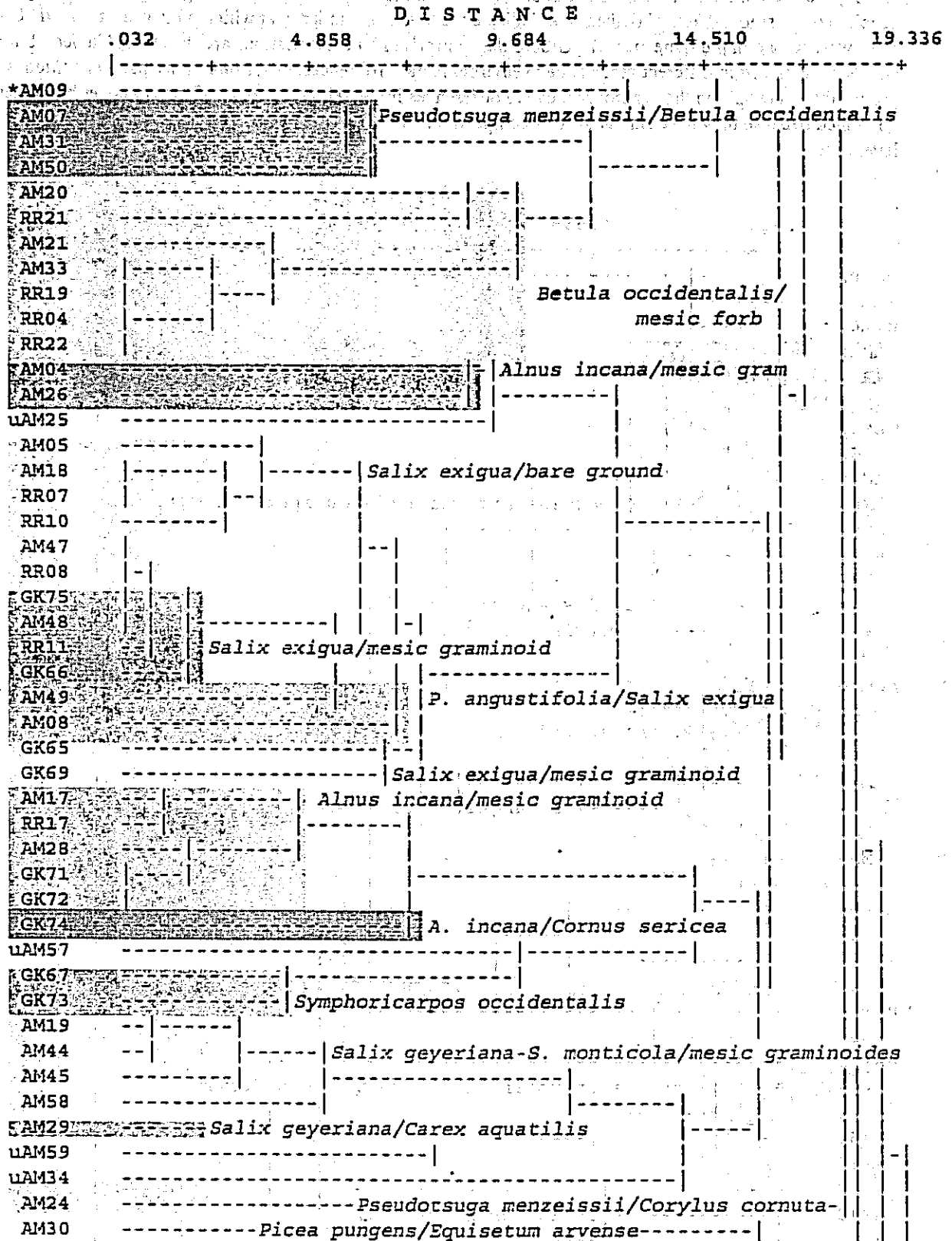
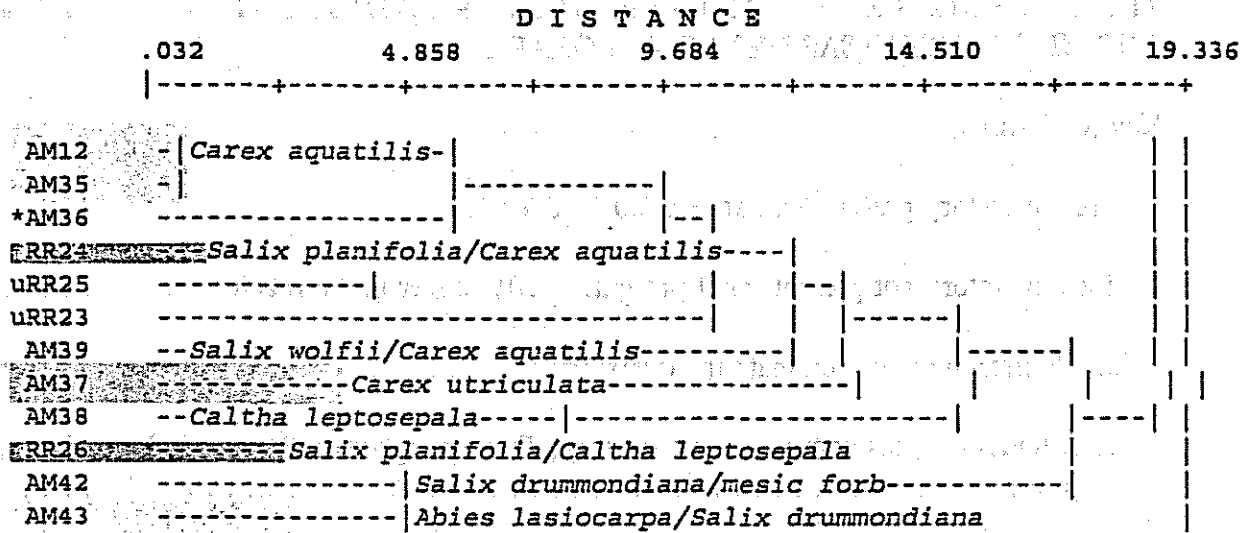


Figure 9. Continued.



KEY TO THE RIPARIAN PLANT ASSOCIATIONS OF THE LOWER SOUTH PLATTE  
AND UPPER ARKANSAS BASINS, COLORADO

Key to Groups:

1. Tree overstory present with at least 20% cover ..... 2
1. Tree overstory not present, or if present, <20% cover in the reach ..... 4
  2. Coniferous trees dominate the overstory. .... Group A
  2. Deciduous trees dominate the overstory; *Picea pungens* or *Picea engelmannii* may be present ..... 3
    3. *Picea pungens* and *Populus angustifolia* present ..... Group B
    3. *Populus angustifolia* dominates the overstory, *Picea pungens* absent ... Group C
4. Shrubs dominate the overstory ..... 5
4. Shrubs do not dominate the overstory; plant association dominated by herbaceous species ..... Group F
  5. *Salix* spp. dominate the overstory with at least 30% cover ..... Group D
  5. Other shrubs dominate the overstory (*Salix* spp. may be present) ..... Group E

Group A. Evergreen Forests

- 1. *Picea pungens* or *Pseudotsuga menziesii* dominate the overstory ..... 2
- 1. *Abies lasiocarpa* and/or *Picea engelmannii*, or *Juniperus scopulorum* dominate the overstory ..... 5
- 2. *Pseudotsuga menziesii* dominates the tree canopy ..... 3
- 3. *Betula* is the dominant shrub along the stream bank .....  
 ..... *Pseudotsuga menziesii*/*Betula occidentalis* p.a.
- 3. *Corylus* is the dominant understory shrub .....  
 ..... *Pseudotsuga menziesii*/*Corylus cornuta* p.a.
- 2. *Picea pungens* dominates the overstory, the shrub understory is sparse and *Equisetum arvense* is the dominant herbaceous species ... *Picea pungens*/*Equisetum arvense* p.a.
- 5. *Abies lasiocarpa* and/or *Picea engelmannii* dominate the overstory, and *Salix drummondiana* is the dominant shrub. *Alnus incana* may be present, but not dominant .....  
 ..... *Abies lasiocarpa*/*Salix drummondiana* p.a.
- 5. Tree cover is very sparse, *Juniperus scopulorum* the scattered but most abundant tree along the reach. *Populus angustifolia*, if present, is in very small amounts .....  
 ..... *Juniperus scopulorum* Alliance

## Group B. Mixed Deciduous-Evergreen Forests

1. *Populus angustifolia* dominates the overstory with *Pseudotsuga menziesii* .....  
..... *Populus angustifolia*-*Pseudotsuga menziesii* p.a.
1. *Populus angustifolia* dominates the overstory with *Juniperus scopulorum* .....  
..... *Populus angustifolia*-*Juniperus scopulorum* p.a.

## Group C. Deciduous Dominated Forests

1. *Populus x acuminata* is the dominant tree canopy component (>20%) .....  
..... *Populus x acuminata* Alliance
1. *Populus angustifolia* or *Populus deltoides* dominate the overstory ..... 2
2. *Populus angustifolia* dominates the tree canopy (if all saplings and seedlings, go to 5) 3
3. *Alnus incana* or *Betula occidentalis* dominates the shrub layer ..... 4
4. *Alnus incana* lines the stream banks (>30%) .....  
..... *Populus angustifolia*/*Alnus incana* p.a.
4. *Betula occidentalis* dominates the understory, *Alnus incana* may be present .....  
..... *Populus angustifolia*/*Betula occidentalis* p.a.
3. *Salix exigua* and/or *Salix irrorata* present with at least 20% cover, few other shrubs  
present ..... 5
5. *Salix exigua* or *Salix irrorata* is the understory dominant with or without saplings  
and seedlings of *Populus angustifolia* ..... 6
6. *Salix exigua* is the dominant shrub . . . *Populus angustifolia*/*Salix exigua* p.a.
6. *Salix irrorata* more abundant than *S. exigua*  
..... *Populus angustifolia*/*Salix irrorata* p.a.
5. Mature *Populus angustifolia* trees present with no shrub understory, or not as  
above ..... Unclassified *Populus angustifolia* Stands
2. *Populus deltoides* ssp. *monilifera* is the dominant cottonwood ..... 7

- 7. Mature, widely spaced, large *Populus deltoides* trees, with or without a shrub understory . . . . . 8
- 8. Stands have little to no shrub understory, the ground covered in herbaceous growth . . . . . 9
- 9. Native grasses and grass-like plants dominate the herbaceous layer . . . . . 10
- 10. *Carex lanuginosa* or *Spartina pectinata* dominate the undergrowth and forms a near mono-typic stratum . . . . . 11
- 11. *Carex lanuginosa* dominates the undergrowth . . . . . *Populus deltoides/Carex lanuginosa* p.a.
- 11. *Spartina pectinata* dominated the undergrowth in near mono-typic stands . . . . . *Populus deltoides-(Salix amygdaloides)/Spartina pectinata* p.a.
- 10. Tall-grass species such as *Andropogon gerardii*, *Sorghastrum nutans*, and *Panicum virgatum* dominate the undergrowth . . . . . *Populus deltoides/Panicum virgatum* p.a.
- 9. Non-native introduced hay meadow grasses and other weeds dominate the undergrowth . . . . . 12
- 12. *Bromus inermis* is very abundant, forming near mono-typic lawn under the cottonwood canopy . . . . . *Populus deltoides/Bromus inermis* p.a.
- 12. Not as above in all respects, see . . . . . Unclassified *Populus deltoides* Stands
- 8. Native shrub species create an understory canopy . . . . . 13
- 13. A low (0.5-1 m tall) shrub layer consisting of *Symphoricarpos occidentalis* that occurs in large patches under the canopy of the cottonwoods . . . . . *Populus deltoides/Symphoricarpos occidentalis* p.a.
- 13. Medium tall stands of *Prunus virginiana* occur in small to large patches under the cottonwood canopy . . . . . *Populus deltoides/Prunus virginiana* p.a.
- 7. Younger stands, either saplings and seedlings or medium aged trees several meters apart, but not large and widely spaced. . . . . 14

14. Stands consist of seedling and sapling sized *Populus deltoides* mixed with similar sized *Salix amygdaloides* and *Salix exigua* stems, occurring on recently flooded point bars and overflow channels . . . . .  
 . . . . . *Populus deltoides*-(*Salix amygdaloides*)/*Salix exigua* p.a.

14. Not as above in all respects, see Unclassified *Populus deltoides* Stands or  
 . . . . . Unclassified *Salix amygdaloides* Stands

**Group D. Willow Dominated Shrublands**

1. Willows of low stature, 0.5-1.5 m tall, upper subalpine and alpine environments . . . . . 2
1. Willows of tall stature, 1.5-3 m or more, lower subalpine, montane, or foothill environments . . . . . 5
2. *Salix brachycarpa* dominates the willow cover, occupying drier habitats than the next . . . . . Unclassified *Salix brachycarpa* Stands
2. *Salix planifolia* and/or *Salix wolfii* present . . . . . 3
3. *Salix planifolia* dominates the shrub canopy, herbaceous undergrowth is dominated by many forbs, *Caltha leptosepala* usually the most abundant species, >10% . . . . . *Salix planifolia*/*Caltha leptosepala* p.a.
3. *Salix planifolia* or *S. wolfii* dominate the canopy, herbaceous undergrowth is dominated by graminoids, *Carex aquatilis* usually the most abundant species, >20% . . . . . 4
4. *Salix planifolia* is the dominant shrub . . . . . *Salix planifolia*/*Carex aquatilis* p.a.
4. *Salix wolfii* is the dominant shrub . . . . . *Salix wolfii*/*Carex aquatilis* p.a.
5. *Salix exigua* is present (10-90%) cover, usually a narrow band along stream margins and cobble bars. Montane and foothill environments. . . . . 6
6. Mostly bare exposed alluvium with little to no herbaceous undergrowth . . . . .  
 . . . . . *Salix exigua*/bare ground p.a.
6. The undergrowth is dominated by at least 50% of graminoid and forb growth . . . . .  
 . . . . . *Salix exigua*/mesic graminoid p.a.

- 5. Tall *Salix* spp. other than *Salix exigua* are dominant in the stand ..... 7
- 7. *Salix geyeriana* is the dominant shrub; *S. monticola* may be present or co-dominant . 8
  - 8. *Salix geyeriana* with or without *Salix monticola* overstory with thick grassy understory, no one herbaceous species dominant over others .....  
..... *Salix geyeriana-S. monticola*/mesic graminoid p.a.
  - 8. *Salix geyeriana* the sole dominant shrub, with a thick undergrowth of *Carex aquatilis* ..... *Salix geyeriana/Carex aquatilis* p.a.
- 7. *Salix drummondiana*, *S. monticola*, or *S. eriocephala* dominant. .... 9
- 9. *Salix drummondiana* or *Salix monticola* dominate the shrub canopy ..... 10
  - 10. *Salix drummondiana* forms a thick band along the stream edge with an undergrowth of mixed forb species ... *Salix drummondiana*/mesic forb p.a.
  - 10. *Salix monticola* is dominant in wide willow carrs (shrublands) .....  
..... Unclassified *Salix monticola* Stands
- 9. *Salix eriocephala* dominates the shrub canopy .....  
..... Unclassified *Salix eriocephala* Stands

**Group E. Non-Willow Dominated Shrublands**

- 1. *Betula occidentalis* dominates the shrub canopy .... *Betula occidentalis*/mesic forb p.a.
- 1. *Alnus incana*, *Prunus virginiana*, or *Symphoricarpos occidentalis* contribute at least 20% cover ..... 2
  - 2. *Alnus incana* is the dominant shrub, either alone or with *Salix* spp., or *Cornus sericea* ..... 3
  - 3. *Alnus incana* forms a tall (2-3 m) canopy with few other shrubs present. The undergrowth is a thick carpet of tall mesic forbs or grasses ..... 4
    - 4. Tall forbs dominate the understory, total forb cover is at least 30%, grasses are present, but not more than 20% cover .....  
..... *Alnus incana*/mesic forb p.a.

- 4. The herbaceous undergrowth is dominated by non-native grasses, such as *Poa pratensis* or *Agrostis stolonifera* . . . . . *Alnus incana*/mesic graminoid p.a.
- 3. *Cornus sericea* or *Salix* spp. are co-dominant (> 10% cover) . . . . . 5
- 5. *Cornus sericea* occurs as a co-dominant . *Alnus incana*-*Cornus sericea* p.a.
- 5. Various *Salix* species are present or co-dominate . . . . .  
 . . . . . Unclassified *Alnus incana*-*Salix* spp. Stands
- 2. *Prunus virginiana* and/or *Symphoricarpos occidentalis* dominate the shrub canopy 6
- 6. *Prunus virginiana* creates a thicket in draws and narrow stream benches, *Symphoricarpos* may be present, even co-dominant . . . . .  
 . . . . . *Prunus virginiana*-*Symphoricarpos occidentalis* p.a.
- 6. No *Prunus virginiana* occurs along the reach, *Symphoricarpos* forms large, low stature (0.5-1.0 m tall) thickets . . . *Symphoricarpos occidentalis* p.a.

Group F. Herbaceous Plant Associations

- 1. *Carex* species dominate the herbaceous growth, generally one species having > 25% cover  
2
- 1. Herbaceous species other than *Carex* are dominant . . . . . 6
- 2. *Carex aquatilis*, *C. utriculata*, or *C. lanuginosa* are dominant, singly or together . . . 3
- 3. *Carex lanuginosa* the only *Carex* species present, and often the only graminoid in the stand . . . . . *Carex lanuginosa* p.a.
- 3. *Carex aquatilis* and/or *C. utriculata* present in abundance . . . . . 4
- 4. *Carex aquatilis* contributes at least 50% cover, if *Carex utriculata* present, it contributes not more than one third of the total cover . . . . *Carex aquatilis* p.a.
- 4. *Carex utriculata* present with at least 50% cover, if *C. aquatilis* present, than with not more than one third of the total cover . . . . . *Carex utriculata* p.a.

- 2. *Carex praegracilis* or *Carex nebrascensis* are dominant . . . . . 5
  - 5. Low elevation creeks on the plains, *Carex praegracilis* is the dominant graminoid . . . . . *Carex praegracilis* p.a.
  - 5. *Carex nebrascensis* dominant along creeks of the foothills and mountains, few other graminoides present . . . . . *Carex nebrascensis* p.a.
- 6. Wetlands with standing water for much of the year with, *Typha*, *Scirpus*, or *Eleocharis* dominant in or near standing water . . . . . 7
  - 7. Small stands along the margins of ponds and slow moving reaches of streams, *Eleocharis palustris* dominant, some scattered *Scirpus* may occur, but not more than 10% cover . . . . . *Eleocharis palustris* p.a.
  - 7. Large wetlands stands, or small swales on the floodplain of larger rivers, *Typha angustifolia* or *Scirpus* spp. dominant tall graminoid . . . . . 8
    - 8. Tall mono-typic stands of *Typha angustifolia* . . . . . *Typha angustifolia* p.a.
    - 8. Little to no *Typha* present, *Scirpus acutus* or *S. tabernaemontani* dominant or co-dominant in any combination . . . *Scirpus acutus-S. tabernaemontani* p.a.
- 6. Terrestrial or Palustrine stands, little to no standing water, or if so than is occurs only for short durations seasonally, and otherwise not as above . . . . . 9
  - 9. Tall-grass species such as *Andropogon gerardii*, *Sorghastrum nutans*, and *Panicum virgatum* dominate the herbaceous layer . . . . . *Andropogon gerardii-Sorghastrum nutans* p.a.
  - 9. Tall grass species, *Spartina pectinata*, occurs in nearly mono-typic stands, often large areas on mud flats of larger rivers, or in small swales where there are pockets of clay . . . . . *Spartina pectinata* p.a.

UNESCO: I.A.9.c. EVERGREEN FORESTS (non-giant conical crowned trees)  
COWARDIN: PALUSTRINE NEEDLE-LEAVED EVERGREEN FORESTED

*Abies lasiocarpa* Alliance

Sub-alpine fir/Drummond's willow (*Abies lasiocarpa*/*Salix drummondiana*) Plant Association

CNHP Rank: G5/S5

1 Plot--95AM43

**Reference Reaches:** No excellent examples of this type were found in the upper Arkansas River Basin because much of the higher elevation streams were not sampled. One good condition occurrence was located on the Birdseye Gulch, T8S, R79W, Sec 34, on BLM land.

**General Description and Comments:** The *Abies lasiocarpa*/*Salix drummondiana* plant association is a common type found along steep, narrow first order streams above 9,000 ft. At the lower end of its elevation range it grades into the *Abies lasiocarpa*/*Alnus incana*-*Salix drummondiana* plant association. Only one stand was sampled because few first-order streams at high elevations were sampled during this study. This association is expected to be abundant within the upper Arkansas River Basin.

**Regional Distribution:** The *Abies lasiocarpa*/*Salix drummondiana* plant association has many closely related plant associations and community types that are common throughout the Rocky Mountains. These similar types are reported from eastern Idaho, northern Wyoming, Montana northern Utah, and Colorado (Youngblood *et al.* 1985, Hansen *et al.* 1995, Baker 1989, Reid and Bourgeron 1991, and Kittel *et al.* 1995).

**Distribution in Colorado:** This plant association is common on first order streams on the Colorado western slope, and has been documented from the San Juan Mountains and the Gunnison River basin (Richard *et al.* 1996, Reid and Bourgeron 1991, Kittel *et al.* 1995), as well as from the Arkansas River drainage (this report). It is likely to occur throughout the high montane regions of Colorado.

*The following characteristics are based on plots and observations from parts of the upper Arkansas River Basin, Colorado.*

**Vegetation:** This association is characterized by thick stands of *Picea engelmannii* (30%) and *Abies lasiocarpa* (1%) with a narrow distinct band of *Salix drummondiana* (70%) (Table 6).

**Elevation:** 3,232 m (10,600 ft).

**Site Geomorphology:** This association is commonly found on narrow, first-order streams in moderate to deep V-shaped valleys. The thick shrub canopy is restricted to a narrow strip along the rocky stream bank.

**Rosgen's Stream Classification:** Stream channels are narrow (<10 m), steep (>5%), and rocky (A2).

**Soil:** Soils are typically thin (<50 cm) with angular coarse fragments and a thin layer of partially decomposed organic matter under the litter layer. Most profiles consist of sand or loamy sand packed between large angular boulders and cobbles.

**Adjacent Riparian Vegetation:** This is usually the only riparian community along the stream, although pockets of *Salix drummondiana* may occur under canopy openings along wider, less steep reaches.

**Adjacent Upland Vegetation:** *Abies lasiocarpa* and *Picea engelmannii* forests usually blanket the surrounding hill slopes.

**Successional and Ecological Processes:** This appears to be a late-seral, or at least a long-lived, riparian plant association. Padgett *et al.* (1989) suggest this type will eventually become dominated by *Abies lasiocarpa* in moist settings. While *Picea engelmannii* and *Abies lasiocarpa* are not obligate riparian species, many first-order streams above 2450 m (8000 ft) run through spruce-fir forests, where the overstory canopy is dense. With a more open forest canopy, shrubs such as *Alnus incana* or *Salix drummondiana* may be present. Stands with high cover of *Salix drummondiana* may be transitional in elevation, as *Alnus incana* appears to drop out with increasing elevation, and *Salix drummondiana* becomes abundant.

**Management:** Forage value is high when forb growth is abundant, however grazing during wet periods can churn wet soil, destroy plant cover, and limit conifer establishment (Hansen *et al.* 1995).

**Related types:** Baker (1989) describes a similar plant association from the western slope of Colorado, under the name *Abies lasiocarpa-Picea engelmannii/Alnus incana ssp. tenuifolia-Lonicera involucrata-Salix drummondiana*. This type was renamed to *Abies lasiocarpa/Alnus incana ssp. tenuifolia-Salix drummondiana* by Reid and Bourgeron (1991). Kittel *et al.* (1995) split this type into two closely related plant associations, one with *Alnus incana* present in the understory at lower elevations, the *Abies lasiocarpa/Alnus incana-Salix drummondiana* type, and one with very little to no *Alnus incana* present, at higher elevations, the *Abies lasiocarpa/Salix drummondiana* type. The *Picea/Cornus sericea* community type described by Youngblood *et al.* (1985) is similar in overstory species (*Picea engelmannii* and *Abies lasiocarpa*) and a dense shrub layer, including *Alnus incana* and occasionally *Salix drummondiana*. Hansen *et al.* (1995) describe two similar Habitat Types, the *Picea/Cornus stolonifera* type and the *Picea/Equisetum arvense* type that can have abundant *Salix*

*drummondiana* and *Alnus incana* but otherwise are much more diverse than the Colorado type described here.

Table 6. Percent Canopy Cover of Important Species in the *Abies lasiocarpa*/*Salix drummondiana* Plant Association. See Table 2 for Plot Location.

| Plot No. (95___)                  | AM43 |
|-----------------------------------|------|
| Riparian Condition Rank           | B    |
| <b>TREES</b>                      |      |
| <i>Picea engelmannii</i>          | 30   |
| <b>SHRUBS</b>                     |      |
| <i>Lonicera involucrata</i>       | 10   |
| <i>Pentaphylloides floribunda</i> | 1    |
| <i>Ribes inerme</i>               | 1    |
| <i>Salix drummondiana</i>         | 70   |
| <i>Salix monticola</i>            | 10   |
| <i>Sambucus racemosa</i>          | 1    |
| <b>GRAMINOIDES</b>                |      |
| <i>Calamagrostis canadensis</i>   | 1    |
| <i>Carex</i> sp.                  | 3    |
| <b>FORBS</b>                      |      |
| <i>Achillea millefolium</i>       | 1    |
| <i>Asteraceae</i> sp.             | 3    |
| <i>Astragalus</i> sp.             | 3    |
| <i>Epilobium angustifolium</i>    | 3    |
| <i>Erigeron</i> sp.               | 3    |
| <i>Fragaria virginiana</i>        | 3    |
| <i>Mertensia ciliata</i>          | 20   |
| <i>Pyrola minor</i>               | 1    |
| <i>Pyrola</i> sp.                 | 1    |

## *Juniperus scopulorum* Alliance

### Rocky Mountain Juniper (*Juniperus scopulorum*) Plant Association

--Tentative Type

CNHP: G4Q/S3Q

2 Plots--95AM40, 95RR27

**Reference Reaches:** No excellent examples of this type were found, however one somewhat degraded example of this association can be seen along Grape Creek, within the Grape Creek Wilderness Study Area, T19S R71W Sec 32 and T20S R71W Sec 8.

**General Description and Comments:** This association is tentatively named. Only one stream, Grape Creek, had an occurrence of this type (two plots above) and the hydrology is altered by an upstream reservoir. The riparian community is an open canopy of *Juniperus scopulorum* with an occasional up slope species, such as *Juniperus monosperma*. The understory has few shrubs and little herbaceous growth.

**Regional Distribution:** Similar *Juniperus scopulorum* Dominance Types have been reported from Montana (Hansen *et al.* 1988, 1989, 1995), Wyoming, and western Colorado (Johnston 1987, Kittel 1994). This association may be regionally widespread, however, it appears to be limited in local abundance.

**Distribution within Colorado:** A similar type, the *Populus angustifolia-Juniperus scopulorum* plant association, has been reported from the Colorado River, Eagle County (Kittel *et al.* 1994). In the Arkansas River basin, only two occurrences of this type were located.

*The following characteristics are based on plots and observations from parts of the upper Arkansas River Basin, Colorado.*

**Vegetation:** The upper canopy of this plant association is dominated by *Juniperus scopulorum* (38-41%) with a few individuals of *Populus angustifolia* (0-1%). No shrub cover occurs along the stream bank. The undergrowth is mesic and consists of a high cover of weedy grasses such as *Poa pratensis*, *Elytrigia repens*, and *Agrostis stolonifera*. Some native grass and grass-like plants occur as well, such as *Eleocharis palustris*, *Equisetum arvense*, and *Panicum virgatum* (5-10%, individually). Forb cover is low and consists of a few scattered individuals (Table 7).

**Elevation:** 2,000 m (6550 ft).

**Site Geomorphology:** This plant association appears to be limited to a distinct band at the high water mark of a gently meandering stream with little floodplain development. The mesic herbaceous undergrowth occurs beneath the tree canopy as well as on exposed point bars.

**Rosgen's Channel Type:** The stream is a gently meandering, moderate gradient channel with a moderate floodplain (C3).

**Soil:** The soils are derived from coarse alluvial substrates and are shallow (approx. 45 cm). One profile had signs of flooding with 30% mottles at 11 cm depth. Soil textures are sandy clay loams to sandy loams, and they have a high percentage of coarse fragments within 40 cm of the surface.

**Adjacent Riparian Vegetation:** Small pockets of *Equisetum arvense* and other herbaceous plants occur along moist streams.

**Adjacent Up slope Vegetation:** Dry woodlands of *Pinus edulis* and *Juniperus monosperma* occupy south facing slopes. Scattered *Pinus ponderosa* may also occur on adjacent hill slopes.

**Successional and Ecological Processes:** *Juniperus scopulorum* generally occurs with an overstory of *Populus angustifolia*. In narrow V-shaped canyons and at the margins of older terraces, it can occur as the single dominant tree species. *Juniperus scopulorum* is intolerant of flooding, and its dominance indicates a late seral stage of the riparian community (Hansen *et al.* 1988). Young trees are susceptible to fire kill, while older trees with thick bark can survive moderate fires (Hansen *et al.* 1988).

**Management:** Stands dominated by *Juniperus scopulorum* have low forage productivity but provide excellent habitat and forage for birds (Hansen *et al.* 1988).

**Related Types:** Hansen *et al.* (1988, 1989, and 1995) describe a *Juniperus scopulorum* Dominance Type, a Riparian Site Type, and a *Juniperus scopulorum*/*Cornus sericea* Habitat Type from Montana. These stands generally have other trees in the upper canopy, but they describe a few stands dominated only by *Juniperus scopulorum*. No other *Juniperus scopulorum* dominated communities are described by name in the literature, although the species is mentioned as a sub-dominant in several *Populus angustifolia* dominated types (see Johnston 1987, Kittel *et al.* 1994, Padgett *et al.* 1989, and Durkin *et al.* 1995). For further discussion of similar plant associations, please refer to the Related Types section of the *Populus angustifolia*-*Juniperus scopulorum* type in this report.

Table 7. Percent Canopy Cover for Important Species in the *Juniperus scopulorum* Plant Association. See Table 2 for Plot Locations. \* = Non-native Species.

| No. (95 )  | AM40 | RR27 |
|--|------|------|
| Occurrence Rank                                      | B    | B    |
| <b>TREES</b>   |      |      |
| <i>Juniperus scopulorum</i>                          | 38   | 41   |
| <i>Juniperus scopulorum</i> --saplings               |      | 5    |
| <i>Juniperus scopulorum</i> --seedlings              |      | 1    |
| <i>Pinus edulis</i>                                  |      | 5    |
| <i>Populus angustifolia</i>                          | 1    |      |
| <b>GRAMINOIDES</b>                                   |      |      |
| <i>Agrostis stolonifera</i> *                        | 15   | 14   |
| <i>Eleocharis palustris</i>                          | 3    |      |
| <i>Elymus elymoides</i>                              | 3    |      |
| <i>Elytrigia repens</i> *                            | 6    |      |
| <i>Juncus balticus</i> var. <i>montanus</i>          | 3    | 1    |
| <i>Panicum virgatum</i>                              | 8    | 1    |
| <i>Poa pratensis</i> *                               | 10   | 1    |
| <b>FORBS</b>   |      |      |
| <i>Achillea millefolium</i> var. <i>occidentalis</i> | 1    | 1    |
| <i>Lepidium virginicum</i>                           | 2    | 1    |
| <i>Medicago lupulina</i> *                           | 7    | 2    |
| <i>Melilotus officinalis</i> *                       |      | 4    |
| <i>Potentilla</i> sp.                                | 2    |      |
| <i>Taraxacum officinale</i> *                        | 1    | 1    |
| <i>Trifolium repens</i> *                            | 3    | 2    |
| <b>HORSETAILS</b>                                    |      |      |
| <i>Equisetum arvense</i>                             | 7    | 1    |
| <i>Equisetum hyemale</i>                             | 8    | 1    |

**Unclassified *Juniperus scopulorum* Stands:**

One stand sampled (95AM54), on Green Creek in Chaffee county, has a co-dominance of *Populus angustifolia* (25%) and *Juniperus scopulorum* (32%). The shrub layer is very thick, with 65% total canopy cover. *Salix lucida* ssp. *caudata* is the most abundant species (36%). Also present are *Alnus incana* (23%), *Salix bebbiana* (5%), *Salix exigua* (3%), and *Salix monticola* (2%). This stand could be classified within the *Populus angustifolia*-*Juniperus scopulorum* group but differs by having a substantial shrub component. Green Creek has a steep and rocky stream bed, however, recent beaver activity has raised the water table, and may explain the presence of abundant shrub growth.

## *Picea pungens* Alliance

Colorado Blue spruce/Field horsetail (*Picea pungens*/*Equisetum arvense*) Plant Association

CNHP Rank: G3/S3?

1 Plot--95AM30

**Reference Reaches:** No reference of this type was located. One fairly good occurrence can be observed on BLM land, on Low Pass Gulch, T11S, R79W, Sec 30, Lake County.

**General Description and comments:** This association is restricted to narrow canyons and cool ravines. Thick stands of *Picea pungens* with few shrubs and a thick carpet of *Equisetum arvense* characterizes the vegetation. Occurrences tend to be narrow and limited to stream benches and banks.

**Regional Distribution:** This plant association is common throughout the Rocky Mountains and has been reported from eastern Idaho, western Wyoming, Montana, and Utah (Youngblood *et al.* 1985, Hansen *et al.* 1995, and Padgett *et al.* 1989).

**Distribution in Colorado:** This association has not been previously reported in Colorado but is expected to occur along the Front Range in narrow, moist canyons.

*The following characteristics are based on plots and observations from parts of the upper Arkansas River Basin, Colorado.*

**Vegetation:** *Picea pungens* (44%) shares dominance with *Pinus contorta* (24%) and *Pseudotsuga menziesii* (29%). Shrub cover is minor and scattered yet diverse. Species present include *Betula glandulosa* (2%), *Salix geyeriana* (1%), *Salix monticola* (1%), and *Rosa woodsii* (6%). The herbaceous undergrowth consists of a few grass-like species such as *Carex aquatilis* (4%), *Juncus balticus var. montanus* (2%), and *Equisetum arvense* (11%) (Table 8).

**Elevation:** 2,780 m (9,120 ft).

**Site Geomorphology:** This plant association occurs on narrow canyons and V-shaped valleys with cold-air drainage. Generally stands are narrow stringers that line the stream bank. On north-facing sides of the valley floor, a stand may occupy entire small benches and flood plains.

**Rosgen's Channel Type:** Stream channels are generally wide with small developed, flood plains (B) but can be very steep (G3). Most sites have coarse stream bed material (boulders and cobbles).

**Soil:** Soils are relatively heavy and somewhat poorly drained clay loams and silty clay loams, alternating with layers of sandy loams. Soils showed signs of inundation to 23 cm (with 20% mottles).

**Adjacent Riparian Vegetation:** Pockets of *Salix geyeriana* and *Salix exigua* shrublands may occur on south-facing sides of the valley floor.

**Adjacent Upland Vegetation:** Steep adjacent up slopes have *Pseudotsuga menziesii* on northern aspects and *Artemisia tridentata* and open grasslands on southern aspects.

**Successional and Ecological Processes:** Colorado stands appear to be constantly flooded or otherwise naturally disturbed, or if not disturbed then in persistently wet areas of the floodplain. While many of the trees within sampled plots are fairly large, the understory of *Equisetum arvense* indicates recent and frequent flooding (Johnston 1987). This association is considered an indicator of a frequent floods, and with less disturbance, may gradually change to a *Picea pungens/Alnus incana* plant association. *Picea pungens/Equisetum arvense* is considered a late-seral and near climax riparian type by Youngblood *et al.* (1985), Hansen *et al.* (1995) and Padgett *et al.* (1989).

**Management:** There is little forage production and therefore little use for livestock other than shading (Youngblood *et al.* 1985). Typically wet soils are easily compacted or displaced (Padgett *et al.* 1989). Isolated stands are used by wildlife such as black bear in the summer months, and large game may use this type during the rutting season (Youngblood *et al.* 1985).

**Related Types:** Johnston (1987) lists a *Picea pungens-Picea engelmannii/Equisetum arvense* plant association with Riparian and Other High-water Table Associations, however no description or source is provided. Hansen *et al.* (1995), Padgett *et al.* (1989), and Youngblood *et al.* (1985) all describe a *Picea/Equisetum arvense* community type that has abundant *Picea pungens* in the upper canopy. Previous studies from the Colorado western slope mention the similar *Picea pungens/Alnus incana* type (Kettler and McMullen 1996, Kittel and Lederer 1993, Kittel *et al.* 1994, and Kittel *et al.* 1995). Walford (1993) discusses a *Picea pungens/Alnus incana/Equisetum arvense* type that occurs along the Animas River in Colorado in patches of persistently moist areas.

Table 8. Percent Canopy Cover of Important Species in the *Picea pungens*/*Equisetum arvense* Plant Association. See Table 2 for Plot Location. \* = Non-native Species.

| Plot No. (95__)                             | AM30 |
|---|------|
| Riparian Condition Rank                     | B    |
| <b>TREES</b>                                |      |
| <i>Juniperus scopulorum</i>                 | 3    |
| <i>Picea pungens</i>                        | 44   |
| <i>Pinus contorta</i>                       | 24   |
| <i>Populus tremuloides</i>                  | 1    |
| <i>Pseudotsuga menziesii</i>                | 29   |
| <b>SHRUBS</b>                               |      |
| <i>Betula glandulosa</i>                    | 2    |
| <i>Rosa woodsii</i>                         | 6    |
| <i>Salix geyeriana</i>                      | 1    |
| <i>Salix ligulifolia</i>                    | 2    |
| <i>Salix monticola</i>                      | 1    |
| <b>GRAMINOIDES</b>                          |      |
| <i>Agrostis stolonifera</i> *               | 1    |
| <i>Carex aquatilis</i>                      | 8    |
| <i>Juncus balticus</i> var. <i>montanus</i> | 4    |
| <i>Poa</i> sp.                              | 2    |
| <b>FORBS</b>                                |      |
| <i>Antennaria parvifolia</i>                | 1    |
| <i>Epilobium angustifolium</i>              | 1    |
| <i>Fragaria virginiana</i>                  | 1    |
| <i>Maianthemum stellatum</i>                | 1    |
| <i>Pseudocymopterus montanus</i>            | 3    |
| <i>Sedum lanceolatum</i>                    | 1    |
| <i>Stellaria</i> sp.                        | 1    |
| <i>Taraxacum officinale</i> *               | 1    |
| <b>HORSETAILS</b>                           |      |
| <i>Equisetum arvense</i>                    | 11   |

*Pseudotsuga menziesii* Alliance

**Douglas Fir/River birch (*Pseudotsuga menziesii*/*Betula occidentalis*) Plant Association**

CNHP Rank: G4/S3?

3 plots-- 95AM07, 95AM31, 95AM50.

**Reference Reaches:** An excellent example of this plant association can be found on East Beaver Creek, T17S, R68W, Sec 5, within the Beaver Creek BLM Wilderness Study Area.

**General Descriptions and Comments:** This association occurs in narrow valley bottoms and steep canyons with cold-air drainage. The riparian area is narrow and dominated almost entirely by one plant association. This type is differentiated from the *Populus angustifolia*-*Pseudotsuga menziesii* plant association by the variety and abundance of shrub species.

**Regional Distribution:** Similar plant associations have been described from Idaho, Nevada, Montana, and Utah (Bourgeron and Engelking 1994, Manning and Padgett 1995, Hansen *et al.* 1988, and Padgett *et al.* 1989).

**Distribution in Colorado:** This association has not been previously reported from Colorado. It is likely to occur further north in narrow foothill canyons of the Colorado Front Range.

*The following characteristics are based on plots and observations from parts of the upper Arkansas River Basin, Colorado.*

**Vegetation:** This plant association is characterized by a tall upper canopy of *Pseudotsuga menziesii* (20-35%) with some *Populus angustifolia* (0-19%). The shrub canopy is fairly thick and diverse with *Betula occidentalis* (20-40%), *Alnus incana* (0-37%), *Acer glabrum* (0-13%), and *Rosa woodsii* (3-20%). Herbaceous undergrowth is open and limited by heavy shade (Table 9).

**Elevation:** 2,015-2,200 m (6,600-7,240 ft.).

**Site Geomorphology:** The *Pseudotsuga menziesii*/*Betula occidentalis* plant association occurs in narrow canyons with small streams and is limited to a narrow band along stream banks.

**Rosgen's Stream Classification:** Stream channels are narrow and steep with mostly rocky beds (A2-A3). One stream was slightly less steep (B3).

**Soil:** Soils are derived from alluvial and colluvial deposits. Surface layers are sandy loams, clay loams, and loams. Subsurface layers are sandy loams with 10-30% cobbles and gravels. Soils are fairly shallow, ranging from 25 to 53 cm thick. Organic matter appears to be concentrated in the upper layers from litter, and the soil becomes skeletal with depth.

**Adjacent Riparian Vegetation:** In general this is the only riparian community along the narrow stream. Occasionally stands of *Betula occidentalis* or *Alnus incana* may occur on adjacent stream benches and overflow areas.

**Adjacent Up slope Vegetation:** Steep colluvial slopes and canyon walls have *Juniperus monosperma* and *Pinus edulis* woodlands mixed with patches of *Quercus gambelii*.

**Successional and Ecological Processes:** The *Pseudotsuga menziesii*/*Betula occidentalis* plant association appears to be late-seral, as *Pseudotsuga* is successfully reproducing. Cold-air drainage and perennial stream flow provides a cool and moist environment to support a diverse shrub canopy. This plant association appears to be limited to perennial streams while the *Populus angustifolia*-*Pseudotsuga menziesii* plant association occurs mainly on ephemeral streams (C. Richard, CNHP ecologist, *personal communication*).

**Management:** The thick shrub cover and multiple vertical canopy layers make excellent wildlife habitat for hiding and thermal cover. Season-long grazing will compact the soil and reduce shrub cover (Hansen *et al.* 1988).

**Related Types:** A Conifer/*Betula occidentalis* plant association with *Pseudotsuga menziesii* in the upper canopy has been described from Nevada (Manning and Padgett 1995). A consistently dominant tree, however, is *Abies concolor*. Similar types dominated by *Pseudotsuga* in the overstory without *Betula* in the understory have been described from the San Juan mountains, and the White and Gunnison River basins, Colorado, and Montana (Richard *et al.* 1996, Kittel *et al.* 1994, Hansen *et al.* 1988). A *Pseudotsuga menziesii*/*Acer glabrum* listed from Idaho may also be similar (Bourgeron and Engelking 1994). Several *Betula occidentalis* dominated shrublands have been described from Nevada and Utah (Manning and Padgett 1995, Padgett *et al.* 1989), but these have little if any *Pseudotsuga menziesii* in the upper canopy.

Table 9. Percent Canopy Cover of Important Species in the *Pseudotsuga menziesii*/*Betula occidentalis* Plant Association. See Table 2 for specific plot locations. \* = Non-native Species.

| Plot No. (95___)                           | AM07 | AM31 | AM50 |
|--|------|------|------|
| Riparian Condition Rank                    | B    | A    | B    |
| <b>TREES</b>                               |      |      |      |
| <i>Juniperus scopulorum</i>                |      | 3    | 20   |
| <i>Populus angustifolia</i>                |      | 19   | 10   |
| <i>Pseudotsuga menziesii</i>               | 27   | 35   | 20   |
| <i>Pseudotsuga menziesii</i> --seedlings   | 1    |      | 3    |
| <i>Quercus gambelii</i>                    |      | 25   | 10   |
| <b>SHRUBS</b>                              |      |      |      |
| <i>Acer glabrum</i>                        | 13   |      | 10   |
| <i>Alnus incana</i> ssp. <i>tenuifolia</i> | 19   | 37   |      |
| <i>Betula occidentalis</i>                 | 30   | 20   | 40   |
| <i>Jamesia americana</i>                   | 3    |      |      |
| <i>Prunus americana</i>                    | 9    |      |      |
| <i>Rosa woodsii</i>                        | 20   | 3    | 3    |
| <i>Rubus deliciosus</i>                    |      | 6    |      |
| <i>Rubus idaeus</i>                        | 3    |      |      |
| <i>Salix bebbiana</i>                      | 19   |      |      |
| <i>Salix exigua</i>                        |      |      | 3    |
| <i>Symphoricarpos rotundifolius</i>        |      |      | 3    |
| <i>Toxicodendron rydbergii</i>             | 1    | 2    |      |
| <b>GRAMINOIDES</b>                         |      |      |      |
| <i>Agrostis stolonifera</i> *              |      | 1    | 1    |
| <i>Carex filifolia</i>                     |      |      | 3    |
| <i>Poa pratensis</i> *                     |      | 7    | 3    |
| <b>FORBS</b>                               |      |      |      |
| <i>Clematis ligusticifolia</i>             |      |      | 10   |
| <i>Galium trifidum</i>                     |      | 1    | 3    |
| <i>Maianthemum stellatum</i>               | 3    |      |      |
| <i>Melilotus officinalis</i> *             |      |      | 10   |
| <i>Pyrola</i> sp.                          | 1    |      | 1    |
| <i>Taraxacum officinale</i> *              | 1    | 1    | 3    |
| <b>HORSETAILS</b>                          |      |      |      |
| <i>Equisetum arvense</i>                   |      | 1    | 1    |

**Douglas Fir/Hazelnut (*Pseudotsuga menziesii*/*Corylus cornuta*) Plant Association**

**CNHP Rank: G3/S2**

**1 Plot--95AM24**

**Reference Reaches:** One small example of this type can be seen on North Cheyenne Creek, T14S R67W, Sec 34, on BLM land. The reach has a road running down the valley that may negatively impact the stream migration and flooding patterns.

**General Description and Comments:** This is an uncommon type in Colorado that occurs only in the narrowest and coolest portions of foothill canyons. *Corylus cornuta* is an eastern and northern relict species that survives in the arid west by living in cool, mesic canyon ravines (Weber 1990). It occurs in the Northeast and northwest, south to Georgia, and has patchy distribution across lower Canada and the northern U.S. Great Plains states (Weber 1990, Gleason and Conquest 1963). Stands in Colorado may indicate the southwestern border of its range. Occurrences of this riparian association are generally quite small.

**Regional Distribution:** Similar associations have been reported from Oregon, Washington (Bourgeron and Engelking 1994), and Colorado (Cooper and Cottrell 1990, Kittel 1994).

**Distribution in Colorado:** This association occurs only in narrow foothill canyon ravines of the Colorado Front Range (Cooper and Cottrell 1990, Kittel 1994).

*The following characteristics are based on plots and observations from parts of the upper Arkansas River Basin, Colorado.*

**Vegetation:** This association is characterized by tall, small stands of *Pseudotsuga menziesii* (19%) with a dense understory of *Corylus cornuta* (65%). Other shrub species include *Prunus virginiana* (26%) and *Rubus idaeus* (7%) (Table 10). Few herbaceous species occur in the undergrowth due to the heavy cover, thick coniferous litter (53%), and rocky soils (28%).

**Elevation:** One occurrence of this type was observed at 2,000 m (6,500 ft).

**Site Geomorphology:** This association occurs on steep, well defined stream banks, in very narrow (<50 m) valley bottoms.

**Rosgen's Channel Type:** Stream channels are generally quite steep (5%) and rocky and have little sinuosity.

**Soil:** The top layer of the soil is 40% organic matter, covered with a thick litter layer. Subsurface horizons are loamy sands, with many thick roots and 10% gravel.

**Adjacent Riparian Vegetation:** Other stands of *Pseudotsuga menziesii* with various shrub understories occur along adjacent stream banks.

**Adjacent Upland Vegetation:** Up slopes have stands of *Pinus ponderosa* and *Quercus gambelii* on south facing slopes, and usually *Pseudotsuga menziesii* on north facing slopes.

**Successional and Ecological Processes:** *Pseudotsuga menziesii* dominated riparian areas are generally thought to be transitional between the wet stream-side habitat and the drier up slope habitat. Nearly all riparian stands observed have an adjacent north-facing slope with *Pseudotsuga menziesii*. It is reported to be intolerant of overly wet soils (Hansen *et al.* 1988). In riparian areas it may be restricted to moist toe slopes, benches, and bottom lands adjacent to streams and rivers (Hansen *et al.* 1988). In Montana it is considered the climax dominant tree species where it can successfully reproduce (Hansen *et al.* 1995).

**Management:** With disturbance the shrub understory may shift to more xeric species such as *Symphoricarpos* and *Prunus* (Hansen *et al.* 1995). However, with severe disturbance all shrubs may be eliminated and the understory may become dominated by herbaceous species such as *Poa pratensis* (Hansen *et al.* 1995).

**Related Types:** Kittel (1994) describes one stand of nearly identical composition from the South Fork of the Cache la Poudre River in North-central Colorado. Cooper and Cottrell (1990) describe a *Corylus cornuta*/*Viola canadensis* community that is nearly pure *Corylus*. One stand had 70% *Pseudotsuga menziesii*, and several stands had some coniferous species in the upper canopy. An *Acer macrophyllum*-*Pseudotsuga menziesii*/*Corylus cornuta* plant association is reported to occur in Oregon and Washington (Bourgeron and Engelking 1994). A similar Habitat Type, *Pseudotsuga menziesii*/*Cornus stolonifera*, has been described from Montana (Hansen *et al.* 1995), although the shrub understory consists of different species. The *Pseudotsuga menziesii*/*Acer glabrum* plant association (Johnston 1987) is similar in habitat but has a different shrub species composition. *Corylus cornuta* occurs as an important shrub component in a *Betula papyrifera*/*Corylus cornuta* plant association reported from southwestern North Dakota (Johnston 1987).

Table 10. Percent Canopy Cover of Important Species in the *Pseudotsuga menziesii*/*Corylus cornuta* Plant Association. See Table 2 for Plot Location.

|                                  |      |
|----------------------------------|------|
| Plot No. (95 )                   | AM24 |
| Riparian Condition Rank          | B    |
| <b>TREES</b>                     |      |
| <i>Pseudotsuga menziesii</i>     | 19   |
| <b>SHRUBS</b>                    |      |
| <i>Acer glabrum</i>              | 19   |
| <i>Corylus cornuta</i>           | 65   |
| <i>Parthenocissus</i> sp.        | 1    |
| <i>Prunus americana</i>          | 26   |
| <b>FORBS</b>                     |      |
| <i>Rubus idaeus</i>              | 7    |
| <i>Apocynum androsaemifolium</i> | 1    |

UNESCO: I.B.2.b. COLD DECIDUOUS FOREST WITH NEEDLE-LEAVED  
EVERGREEN TREES  
COWARDIN: PALUSTRINE BROAD-LEAVED DECIDUOUS FORESTS

*Populus angustifolia* Alliance

Narrow-leaf cottonwood-Rocky Mountain juniper (*Populus angustifolia*-*Juniperus scopulorum*) Plant Association

CNHP Rank: G4Q/S3Q

10 plots--95AM22, 95AM14, 95RR14, 95AM56, 95AM60, 95RR28, 95AM61, 95AM62, 95RR01, 95AM52.

**Reference Reaches:** There are two excellent examples of the *Populus angustifolia*-*Juniperus scopulorum* plant association in the upper Arkansas River Basin, both on BLM lands: 1) Cottonwood Creek, a tributary to Brown's Canyon, T15S R77W Sec. 29 and 30, and 2) an unnamed ephemeral tributary to Badger Creek, about 2 miles north of the Arkansas mainstem, T49N, R10E, Sec 22 and 23.

**General Description and Comments:** This plant association occurs along lower foothill streams that have perennial to intermittent stream flows. Total biomass and canopy cover is usually low. The association is characterized by an open canopy of *Populus angustifolia* and *Juniperus scopulorum*, often with little else growing along the stream. The species composition and cover of the shrub canopy is variable and depends on aspect, elevation, and amount of stream flow, in addition to degree of disturbance to the reach by recreation and livestock grazing.

**Regional Distribution:** *Populus angustifolia* and *Juniperus scopulorum* dominated riparian areas are uncommon and limited to the lower elevation, narrow foothill streams. They have been reported from Montana, Idaho, Wyoming, Utah, New Mexico, and Colorado (Hansen *et al.* 1995, Youngblood *et al.* 1985, Gerard *et al.* 1995, Padgett *et al.* 1989, Durkin *et al.* 1995, Cooper and Cottrell 1990, and Kittel *et al.* 1994.) .

**Distribution in Colorado:** This plant association was first described in Colorado by name from the main stem of the Colorado River between State Bridge and Dotsero (Kittel *et al.* 1994). Similar associations have been reported from lower elevations of the White River National Forest (Johnston 1987) and along the Colorado Front Range (Cooper and Cottrell 1990). Within the Arkansas River drainage this type appears limited to narrow foothill streams of Fremont and Chaffee counties.

*The following characteristics are based on plots and observations from parts of the upper Arkansas River Basin, Colorado.*

**Vegetation:** This plant association is characterized by an open to closed canopy of *Populus angustifolia* (20-91%) with scattered to abundant *Juniperus scopulorum* (3-86%). Often there is

no shrub canopy and little to no herbaceous undergrowth due to dry conditions. Other streams with stronger perennial flows or protected northern aspects will have additional conifer trees, such as *Pseudotsuga menziesii*, and a diversity of shrubs, for example, *Acer glabrum*, *Rhus trilobata*, and *Quercus gambelii*. Eight of ten stands sampled had *Clematis ligusticifolia*, and nine of ten stands had *Poa pratensis* (Table 11).

**Elevation:** 1,820-2,500 m (5,960-8,160 ft).

**Site Geomorphology:** This plant association is usually restricted to stream banks of narrow washes and creeks on steep-sided canyons but can occur on upper terraces of wider, meandering rivers. Valley widths are typically 200 m or less. Stream gradients are generally low to moderate (0.5-2.3%). *Juniperus* trees are usually situated at the high water line and above, while the *Populus* grades into the active flood area.

**Rosgen's Channel Type:** Streams are typically narrow, rocky to sandy ephemeral channels confined to narrow V-shaped valleys (A1-A5). Some streams are sinuous within the narrow valley bottom (B4-B5). Along the main stem of the Arkansas River, the floodplain is wide with developed islands and terraces (C3).

**Soil:** Soils of this plant association have surface textures of loamy sand, clay loams, silty clays or organic matter ranging from 6 to 42 cm thick. About half of the profiles sampled had fine clay loam and sandy clay loam subsurface layers, with no more than 20-30% gravels. Other profiles were predominantly coarse sandy loams and loamy sands at the surface and at depth, and had between 40-50% gravel and cobbles. Soil depths ranges from 40 to 65 cm. All soils are derived from alluvial deposits.

**Adjacent Riparian Vegetation:** Often this plant association will be the only riparian community along a stream, however *Eleocharis palustris* wetlands can occur in mesic swales, and stands of *Salix exigua* can occur in adjacent perennial stream channels.

**Adjacent Upland Vegetation:** Woodlands of *Pinus edulis* and *Juniperus monosperma* occur on dry, south-facing hill slopes. Stands of *Pseudotsuga menziesii* and *Quercus gambelii* can occur on northern slopes.

**Successional and Ecological Processes:** *Juniperus scopulorum* appears to be able to successfully reproduce in these stands. Without continued flooding or with aggradation above the current flood levels, this association will lose the *Populus angustifolia* overstory. Stands of mixed *Populus* spp. and *Juniperus scopulorum* are considered seral to a *Juniperus scopulorum*/*Cornus sericea* plant association in Montana (Hansen *et al.* 1995).

**Management:** Biomass and forage production is low to moderate, and *Juniperus* is not palatable to livestock (Hansen *et al.* 1995). Structural diversity (when shrubs are present) make excellent

hiding and thermal cover for wildlife, and the berries of *Juniperus* are a good food source for small mammals and birds (Hansen *et al.* 1995).

**Related Types:** In Colorado Johnston (1987) describes a *Populus angustifolia/Amelanchier alnifolia* plant association that has *Juniperus scopulorum* as a dominant to associate member of the upper canopy. Other associated tree species are *Pseudotsuga menziesii*, *Picea pungens* and *Acer negundo*. This plant association has been reported only from Colorado's western slope, where *Amelanchier alnifolia* is an important component of the shrub canopy. Cooper and Cottrell (1990) report *Juniperus scopulorum* in their *Populus angustifolia/Poa pratensis* type from the Colorado Front Range, but it has only 0-7% canopy cover. Kittel *et al.* (1994) describe a *Populus angustifolia-Juniperus scopulorum* plant association that occurs along the mainstem of the Colorado River between State Bridge and Dotsero. In Utah and Idaho Padgett *et al.* (1989) do not describe any *Juniperus scopulorum* within their *Populus angustifolia* dominated stands. However, *Juniperus scopulorum* does appear as a weak canopy component of the *Betula occidentalis* plant associations. Hansen *et al.* (1988, 1995) describe a *Juniperus scopulorum* Dominance Type and a *Juniperus scopulorum/Cornus sericea* type that occur at lower elevations along narrow canyons and on older terraces of broad alluvial rivers. The *Populus angustifolia-Juniperus scopulorum* plant association described here may be more closely aligned with the *Populus angustifolia/Physocarpus monogynus-Padus virginia* plant association reported from the foothills of the Big Horn Mountains in North-central Wyoming (Gerard *et al.* 1995). Again *Juniperus scopulorum* is an important, if not dominant, upper canopy component. The elevation range of this type is more closely aligned to stands sampled within the Arkansas drainage. In addition, a *Populus angustifolia-Juniperus scopulorum* community type has been reported from the Rio Grande River in New Mexico (Durkin *et al.* 1995).

Table 11. Percent Canopy Cover for Important Species in the *Populus angustifolia*-*Juniperus scopulorum* Plant Association. See Table 2 for Plot Locations. \* = Non-native Species.

| Plot No. (95 _____)                         | AM22 | AM14 | RR14 | AM56 | AM60 | AM61 | AM62 | RR28 | RR01 | AM52 |
|---|------|------|------|------|------|------|------|------|------|------|
| Riparian Condition Rank                     | B    | A    | A    | B    | B    | A/B  | B    | B    | B    | A    |
| <b>TREES</b>                                |      |      |      |      |      |      |      |      |      |      |
| <i>Juniperus scopulorum</i>                 | 86   | 40   | 27   | 29   | 39   | 21   | 17   | 31   | 9    | 3    |
| <i>Juniperus scopulorum</i> -saplings       |      | 3    | 3    |      |      |      |      | 1    | 4    |      |
| <i>Populus angustifolia</i>                 | 80   | 25   | 27   | 28   | 30   | 60   | 83   | 20   | 65   | 91   |
| <i>Populus angustifolia</i> -saplings       |      | 6    | 12   |      |      |      |      | 5    | 3    |      |
| <i>Populus angustifolia</i> -seedlings      |      | 5    | 2    |      |      |      |      | 1    |      |      |
| <i>Pseudotsuga menziesii</i>                |      |      | 4    |      |      | 12   |      |      |      |      |
| <i>Quercus gambelii</i>                     |      |      | 6    |      | 8    |      |      |      |      |      |
| <b>SHRUBS and VINES</b>                     |      |      |      |      |      |      |      |      |      |      |
| <i>Acer glabrum</i>                         |      |      |      | 18   |      |      |      | 1    |      | 1    |
| <i>Clematis ligusticifolia</i>              | 1    | 27   | 2    | 14   | 2    |      |      | 1    | 1    | 11   |
| <i>Ptelea trifoliata</i>                    |      |      |      |      | 1    |      |      |      | 1    |      |
| <i>Rhus trilobata</i> var. <i>trilobata</i> |      |      |      | 2    |      | 2    |      |      |      | 1    |
| <i>Rosa woodsii</i>                         |      |      | 1    | 2    |      | 5    |      | 2    |      |      |
| <i>Symphoricarpos rotundifolius</i>         |      |      | 1    | 1    | 1    | 2    |      |      |      |      |
| <i>Yucca glauca</i>                         |      |      |      | 2    |      |      |      |      |      |      |
| <b>GRAMINOIDES</b>                          |      |      |      |      |      |      |      |      |      |      |
| <i>Agrostis stolonifera</i> *               |      |      |      |      | 6    | 1    | 1    | 17   |      | 1    |
| <i>Carex filifolia</i>                      |      |      |      |      | 1    | 4    |      |      |      |      |
| <i>Carex praegracilis</i>                   |      |      |      |      |      | 22   |      |      |      |      |
| <i>Carex utriculata</i>                     |      |      |      |      |      | 24   |      | 7    |      |      |
| <i>Eleocharis palustris</i>                 |      | 5    |      |      |      |      |      |      |      |      |
| <i>Juncus balticus</i> var. <i>montanus</i> | 6    |      |      | 1    |      |      |      | 1    |      |      |
| <i>Poa pratensis</i> *                      | 2    | 1    |      | 6    | 15   | 17   | 1    | 29   | 9    | 9    |
| <b>FORBS</b>                                |      |      |      |      |      |      |      |      |      |      |
| <i>Cirsium arvense</i> *                    |      |      |      |      |      | 7    |      |      |      |      |
| <i>Maianthemum stellatum</i>                | 30   |      |      |      |      | 5    |      |      |      |      |
| <i>Melilotus officinalis</i> *              |      |      |      | 1    |      |      | 5    | 12   |      | 4    |
| <i>Sonchus arvensis</i> *                   |      |      |      |      |      |      |      | 14   |      |      |
| <i>Taraxacum officinale</i> *               |      | 1    | 1    |      |      | 1    |      | 1    | 3    | 1    |
| <b>HORSETAILS</b>                           |      |      |      |      |      |      |      |      |      |      |
| <i>Equisetum arvense</i>                    |      | 3    |      | 1    |      | 3    | 2    |      |      |      |
| <i>Equisetum hyemale</i>                    | 1    | 1    |      |      | 6    | 1    |      |      |      |      |

**Narrow-leaf cottonwood-Douglas Fir (*Populus angustifolia*-*Pseudotsuga menziesii*) Plant Association**

**CNHP Rank:** G4Q/S3Q

**7 Plots--**95AM13, 95AM27, 95AM55, 95AM41, 95AM53, 95RR18, 95AM09.

**Reference Reaches:** There are two good examples of the *Populus angustifolia*-*Pseudotsuga menziesii* plant association in the upper Arkansas River Basin: 1) Little Cottonwood Creek at Browns Canyon, T15S R78W Sec 13 and 18, owned by BLM, and 2) Little High Creek, 1 mile south of Booger Red Hill, at the Teller/Fremont county line, T15S, R70W, Sec 31, owned by BLM.

**General Description and Comments:** The *Populus angustifolia*-*Pseudotsuga menziesii* plant association is limited to very narrow canyon bottoms and V-shaped valleys where a strong northern or protected aspect creates a cool micro-environment. This association represents a transition from lower montane to upper montane habitats. Nearly all stands observed have an adjacent north facing slope with *Pseudotsuga menziesii* that continues down into the riparian area.

**Regional Distribution:** Similar plant associations have been reported from Oregon, Montana, Wyoming, and Colorado (Kovalchik 1987, Hansen *et al.* 1995, Gerard *et al.* 1995, Kittel *et al.* 1994).

**Distribution in Colorado:** This is the first time *Populus angustifolia* and *Pseudotsuga menziesii* have been reported to occur together in Colorado. Within the Arkansas River basin stands are small and limited to narrow, low elevation foothill streams. Other similar *Pseudotsuga menziesii* plant associations have been reported from the White River basin on the western slope and from north-central and north eastern Colorado (Kittel *et al.* 1994).

*The following characteristics are based on plots and observations from parts of the upper Arkansas River Basin, Colorado.*

**Vegetation:** This plant association has a narrow canopy of tall *Pseudotsuga menziesii* (8-27%) and *Populus angustifolia* (3-56%) with a scattered shrub canopy of various species, although typically *Acer glabrum* and *Ribes cereum* are present (0-18%). Herbaceous cover is low and consists of an occasional native forb and many non-native weeds such a *Poa pratensis*, *Agrostis stolonifera*, and *Trifolium repens* (Table 12).

**Elevation:** 2,170-2,439 m (7,120-8,000 ft).

**Site Geomorphology:** This association is confined to narrow canyon bottoms and V-shaped valleys with small streams and limited floodplain development. This association grows in wash bottoms and on immediate stream banks.

**Rosgen's Channel Type:** Streambeds can be bedrock, sand, or silt but are generally steep (A1-A5). A few sites occurred on slightly broader valleys with somewhat wider, more sinuous streams (B3).

**Soil:** Soils of this association are sandy loams and loamy sands from 40 to 75 cm depths. Most become skeletal at 30 cm. In general the soils are well drained and have no hydric indicators.

**Adjacent Riparian Vegetation:** For the most part the *Populus angustifolia*-*Pseudotsuga menziesii* plant association occurs by itself along narrow streams. Occasionally *Populus angustifolia*/*Salix exigua* or *Salix exigua* stands occur up and down stream along wider reaches.

**Adjacent Upland Vegetation:** South-facing up slopes are typically *Juniperus monosperma* and *Pinus edulis* woodlands. North-facing slopes may have nearly pure stands of *Pseudotsuga menziesii* which often continues right into the riparian area.

**Successional and Ecological Processes:** The *Populus angustifolia*-*Pseudotsuga menziesii* plant association is mid-seral. Without further flooding and sedimentation, the *Populus* will drop out. Narrow canyons and steep slopes create pockets of cooler, moister air by directing cold-air downwards and creating a microsite for *Pseudotsuga menziesii*.

**Management:** Low shrub productivity can be a sign of disturbance and heavy grazing (Hansen *et al.* 1995). Reaches within the Arkansas River basin are dry, ephemeral streams that have low productivity even under the best management practices.

**Related Types:** No *Populus angustifolia*-*Pseudotsuga menziesii* plant associations have been described in the literature. However, stands dominated by *Populus angustifolia* with *Pseudotsuga menziesii* in the upper canopy have been reported. In Utah, Padgett *et al.* (1989) describe a Conifer/*Actea rubra* community type with some *Populus angustifolia* and *Pseudotsuga menziesii* in the upper canopy. Padgett *et al.*'s (1989) *Populus angustifolia*/*Betula occidentalis* community type has about 10% *Pseudotsuga menziesii*, and the *Betula occidentalis*/mesic forb community type has some *Pseudotsuga menziesii* present as well. Johnston (1987) describes *Populus angustifolia*/*Amelanchier alnifolia* and *Populus angustifolia*/*Salix exigua*-*Betula occidentalis* habitat types that have *Pseudotsuga menziesii* in the upper canopies. Kittel *et al.* (1994) describe two *Pseudotsuga menziesii* dominated riparian areas, but these do not have any *Populus angustifolia*.

Table 12: Percent Canopy Cover of Important Species in the *Populus angustifolia*-*Pseudotsuga menziesii* Plant Association. See Table 2 for Plot Locations. \* = Non-native Species.

| Plot No. (95 ___)                                    | AM13 | AM27 | AM55 | AM41 | AM53 | RR18 |
|--|------|------|------|------|------|------|
| Occurrence Rank                                      | B    | B    | B    | B    | A    | A    |
| <b>TREES</b>   |      |      |      |      |      |      |
| <i>Juniperus scopulorum</i>                          |      |      | 3    | 7    | 8    |      |
| <i>Populus angustifolia</i>                          | 20   | 40   | 30   | 34   | 56   | 30   |
| <i>Populus angustifolia</i> --saplings               | 12   |      |      | 5    | 3    | 6    |
| <i>Pseudotsuga menziesii</i>                         | 27   | 25   | 21   | 20   | 19   | 16   |
| <i>Pseudotsuga menziesii</i> --saplings              | 6    |      |      |      |      | 4    |
| <i>Pseudotsuga menziesii</i> --seedlings             |      |      |      |      | 2    | 1    |
| <b>SHRUBS</b>  |      |      |      |      |      |      |
| <i>Acer glabrum</i>                                  | 1    | 13   | 18   |      | 7    |      |
| <i>Alnus incana</i> ssp. <i>tenuifolia</i>           |      | 4    |      |      |      |      |
| <i>Cercocarpus montanus</i>                          |      |      | 5    |      |      |      |
| <i>Ribes cereum</i>                                  |      | 2    | 14   |      | 1    |      |
| <i>Ribes inerme</i>                                  |      | 1    | 1    |      |      |      |
| <i>Salix exigua</i>                                  | 11   |      |      |      |      | 3    |
| <i>Salix lucida</i> ssp. <i>caudata</i>              | 10   |      |      |      |      |      |
| <b>GRAMINOIDES</b>                                   |      |      |      |      |      |      |
| <i>Agrostis stolonifera</i> *                        |      |      | 1    | 6    | 1    |      |
| <i>Bromus inermis</i> *                              |      | 2    | 3    |      |      |      |
| <i>Elytrigia repens</i> *                            | 3    | 2    |      |      |      |      |
| <i>Oryzopsis</i> sp.                                 |      | 6    |      |      |      |      |
| <i>Poa pratensis</i> *                               | 4    | 13   | 1    | 5    | 1    | 1    |
| <b>FORBS</b>   |      |      |      |      |      |      |
| <i>Achillea millefolium</i> var. <i>occidentalis</i> | 1    | 1    |      | 1    | 1    |      |
| <i>Artemisia frigida</i>                             |      |      | 9    |      |      |      |
| <i>Artemisia ludoviciana</i>                         |      |      | 10   |      |      |      |
| <i>Aster</i> sp.                                     |      |      | 1    |      |      |      |
| <i>Asteraceae</i> sp.                                |      |      | 8    |      |      |      |
| <i>Clematis ligusticifolia</i>                       |      |      |      | 17   | 5    |      |
| <i>Melilotus officinalis</i> *                       |      |      |      | 10   |      | 1    |
| <i>Opuntia polyacantha</i>                           |      |      | 4    |      |      |      |
| <i>Taraxacum officinale</i> *                        | 2    | 4    |      | 1    |      | 1    |
| <i>Trifolium repens</i> *                            | 15   | 5    |      | 9    |      |      |

UNESCO: I.B.3.b. MAINLY COLD-DECIDUOUS FORESTS WITHOUT  
EVERGREEN TREES

COWARDIN: PALUSTRINE BROAD-LEAVED DECIDUOUS FORESTS

*Populus angustifolia* Alliance

Narrow-leaf cottonwood/Thin-leaf alder (*Populus angustifolia*/*Alnus incana*) Plant  
Association

CNHP Rank: G3/S3

4 Plots-- 95AM11, 95AM46, 95RR03, 95AM51

Reference Reaches: An excellent example of the *Populus angustifolia*/*Alnus incana* plant  
association can be seen on Beaver Creek, part of a BLM Wilderness Study Area, about 1.25  
miles north of Clark Ranch, T17S, R68W, Sec 8.

General Description and Comments: This plant association is restricted to narrow and  
moderately wide stream benches in narrow canyons along fast moving streams. It is  
characterized by a thick stand of alders lining the stream bank with an open to nearly closed  
canopy of *Populus angustifolia*. This association is not well documented in the literature and  
may be included in other plant associations such as *Populus angustifolia*/*Cornus sericea*  
(Padgett *et al.* 1989 and Hansen *et al.* 1995), or *Populus angustifolia*/*Alnus incana*-*Cornus*  
*sericea* (Johnston 1987).

Regional Distribution: Similar plant associations have been described from western Wyoming  
and central and southern Colorado (Johnston 1987, Kittel *et al.* 1994).

Distribution in Colorado: This plant association has been reported from the Gunnison and San  
Juan River Basins of the western slope (Johnston 1987 and Kittel *et al.* 1994), and in this report  
from the Colorado front range.

*The following characteristics are based on plots and observations from parts of the upper  
Arkansas River Basin, Colorado.*

Vegetation: This plant association is characterized by a dense overstory of *Populus angustifolia*  
(17-84%) occasionally with *Pseudotsuga menziesii* (0-12%) and *Juniperus scopulorum* (0-10%).  
A thick band of *Alnus incana* (23-40%) is typical, while a few other shrubs may be present such  
as *Betula occidentalis* (0-10%), *Salix exigua* (0-32%), and *Salix lucida* spp. *caudata* (0-18%).  
The herbaceous undergrowth is sparse due to the thick overstory shading (Table 13). One  
heavily disturbed stand had 29% *Poa pratensis*.

Elevation: 2,220-2,512 m (7,250-8,240 ft).

Site Geomorphology: Narrow floodplains within narrow canyons (<30 m) characterize the

setting of this plant association, and it occupies a narrow thick band along stream banks and benches.

**Rosgen's Channel Type:** Stream channels are relatively steep (0.5-6%) with little sinuosity, and sometimes occupy the entire canyon floor (A4-F3). Stream beds are mostly rocky. One stand occurred along a slightly meandering reach with a lower gradient (2.2%) (B3).

**Soil:** Soils are mostly coarse textured ranging from deep sands (>58 cm) to shallow sandy loams (~23 cm). Some profiles show high stratification with loams to clay loams alternating with sands. Most profiles become skeletal at an average depth of 30 cm.

**Adjacent Riparian Vegetation:** Due to the narrow canyon bottom environment, the *Populus angustifolia/Alnus incana* plant association is often the only community along the stream banks. Wider reaches may have patches of *Pseudotsuga menziesii* or *Quercus gambelii*.

**Adjacent Upland Vegetation:** South facing up slopes have *Pinus edulis* and *Juniperus monosperma* woodlands. North facing slopes often have thick to scattered stands of *Pseudotsuga menziesii* and *Quercus gambelii*.

**Successional Trends and Ecological Processes:** The *Populus angustifolia/Alnus incana* plant association is considered mid-seral. *Populus angustifolia* requires fresh, bare alluvium for seedling growth and establishment, and it is well documented that this species does not reproduce with the shade of mature stands (Hansen *et al.* 1995). Alluvial deposition and scouring from flooding in the narrow canyons may maintain the riparian corridor in early and mid-seral stages. *Alnus* is an excellent bank stabilizer with rhizomatous roots, and young stands can re-sprout after flood damage or fire (Hansen *et al.* 1995). Without flooding the stream banks may become dominated by north-facing up slope communities such as *Pseudotsuga menziesii* and *Juniperus* spp.

**Management:** This plant association provides little herbaceous forage for livestock. Cattle have been known to browse the nitrogen rich *Alnus* leaves. Cattle can browse the shrubs to the point of elimination if they remain on the reach season long, year after year. This riparian type provides excellent hiding and thermal cover for wildlife and birds (Hansen *et al.* 1995).

**Related Types:** Johnston (1987) describes a *Populus angustifolia/Alnus incana -Cornus sericea* from western Wyoming, and central Colorado. Kittel *et al.* (1994) describe a *Populus angustifolia/Alnus incana* plant association from the Gunnison and San Juan River Basins.

Table 13. Percent Canopy Cover of Important Species in the *Populus angustifolia*/*Alnus incana* Plant Association. See table 2 for Plot Locations. \* = Non-native Species.

| Plot No. (95 _____)                         | AM11 | AM46 | RR03 | AM51 |
|---|------|------|------|------|
| Riparian Condition Rank                     | C    | B    | A    | B    |
| <b>TREES</b>                                |      |      |      |      |
| <i>Juniperus monosperma</i>                 |      | 10   |      |      |
| <i>Juniperus scopulorum</i>                 |      |      |      | 10   |
| <i>Populus angustifolia</i>                 | 45   | 50   | 17   | 84   |
| <i>Populus angustifolia</i> --saplings      |      | 3    |      |      |
| <i>Populus angustifolia</i> --seedlings     |      | 3    | 1    |      |
| <i>Pseudotsuga menziesii</i>                |      |      |      | 12   |
| <b>SHRUBS</b>                               |      |      |      |      |
| <i>Alnus incana</i> ssp. <i>tenuifolia</i>  | 34   | 40   | 32   | 23   |
| <i>Betula occidentalis</i>                  |      |      | 10   |      |
| <i>Rosa woodsii</i>                         |      | 3    |      | 1    |
| <i>Salix exigua</i>                         | 32   |      | 1    |      |
| <i>Salix lucida</i> ssp. <i>caudata</i>     | 18   |      |      |      |
| <i>Symphoricarpos rotundifolius</i>         |      | 1    |      | 2    |
| <i>Toxicodendron rydbergii</i>              |      | 3    | 2    |      |
| <b>GRAMINOIDES</b>                          |      |      |      |      |
| <i>Agrostis stolonifera</i> *               |      | 3    |      | 1    |
| <i>Carex aquatilis</i>                      | 1    |      | 1    |      |
| <i>Elytrigia repens</i> *                   | 6    |      |      |      |
| <i>Juncus balticus</i> var. <i>montanus</i> | 1    | 1    |      |      |
| <i>Poa pratensis</i> *                      | 29   | 1    | 1    | 6    |
| <b>FORBS</b>                                |      |      |      |      |
| <i>Achillea millefolium</i>                 | 1    |      |      | 3    |
| <i>Artemisia ludoviciana</i>                |      | 1    | 2    |      |
| <i>Clematis ligusticifolia</i>              | 1    |      |      | 3    |
| <i>Heracleum sphondylium</i>                | 1    |      | 1    |      |
| <i>Taraxacum officinale</i> *               | 5    |      | 1    | 2    |
| <i>Trifolium repens</i> *                   | 10   |      |      | 1    |
| <b>HORSETAILS</b>                           |      |      |      |      |
| <i>Equisetum arvense</i>                    | 3    |      | 4    |      |
| <i>Equisetum hyemale</i>                    |      | 3    | 6    |      |

**Narrow-leaf cottonwood-River birch (*Populus angustifolia*/*Betula occidentalis*) Plant Association**

CNHP Rank: G3G4/S3S4

5 Plots--95AM06, 95RR05, 95RR09, 95RR12, 95RR13.

**Reference Reaches:** A good example can be seen on East Gulch, 1 mile WSW of Wild Oat Reservoir, T18S, R73W Sec 17, on BLM land.

**General Description and Comments:** This plant association is a narrow, lush deciduous community of *Populus angustifolia* with a thick band of *Betula occidentalis* growing along the stream banks. This is one of the wetter narrow-leaf cottonwood plant associations and indicates a perennial source of water, and possibly a lateral seepage. Some stands may occur on hillside seeps.

**Regional Distribution:** The *Populus angustifolia*/*Betula occidentalis* plant association is known from Utah and Colorado (Padgett *et al.* 1989, Kittel *et al.* 1994). Similar associations have been reported from Nevada, Montana, Idaho, Wyoming (Manning and Padgett 1995, Hansen *et al.* 1995, Youngblood *et al.* 1985, and Gerard *et al.* 1995).

**Distribution in Colorado:** This plant association is known from the White and Gunnison National Forests on the western slope, as well as from the Colorado Front Range (Kittel *et al.* 1994, Kittel *et al.* 1995, Cooper and Cottrel 1990).

-- *The following characteristics are based on plots and observations from parts of the upper Arkansas River Basin, Colorado.*

**Vegetation:** An upper canopy of *Populus angustifolia* (35-80%) with a thick shrub understory of *Betula occidentalis* (23-67%) and *Alnus incana* (0-59%) characterizes this plant association (Table 14).

**Elevation:** 2,260-2,560 m (7,420-8,400 ft.).

**Site Geomorphology:** This community typically occurs along narrow, somewhat steep streams with little to moderate floodplain development, occupying stream banks and benches. It also occurs along larger streams with well developed flood plains, occupying the immediate stream banks or steep sided overflow channel areas.

**Rosgen's Channel Type:** This association occupies narrow, steep stream channels with rocky beds (A3,A4) and broader, meandering rivers (B3, C3).

**Soil:** Soils of the *Populus angustifolia*/*Betula occidentalis* have a surface layer of partially decomposed organic matter between 5 and 10 cm thick. Subsurface layers are very coarse with 10-60% gravel or cobbles. One profile had 40% mottles at 10 cm depth with a strong anoxic

odor. Subsurface textures ranged from clay loams to loamy sands.

**Adjacent Riparian Vegetation:** This plant association rarely forms within a mosaic of other riparian communities. It is usually the only type along the stream due to the narrow nature of the reach. Other sites may have stands of *Pseudotsuga menziesii* or shrublands of *Alnus incana* or *Salix exigua*.

**Adjacent Upland Vegetation:** South facing canyon slopes have *Pinus edulis* and *Juniperus monosperma* woodlands, while north-facing slopes have *Pinus ponderosa* or *Pseudotsuga menziesii* forests.

**Succession Trends and Ecological Processes:** *Betula occidentalis* becomes abundant along stream banks with perennial stream flow and well aerated soils. *Populus angustifolia* appears to be successfully reproducing in two of the stands sampled, however, it may be limited to root sprouting. This plant association is considered early to mid-seral. Continued aggradation of the alluvial surface and shading from a thick shrub canopy may preclude continued successful *Populus angustifolia* reproduction, and the stand may become a *Betula occidentalis* dominated shrubland with a graminoid undergrowth (Hansen *et al.* 1995).

**Management:** Moist soils make this community susceptible to soil compaction. With heavy grazing pressures, the shrubs will be browsed and can be severely reduced. Stands of *Betula occidentalis* provide important cover and food for wildlife (Hansen *et al.* 1995).

**Related Types:** Rondeau (1995) describes a *Populus angustifolia/Betula occidentalis* association from the North Boulder Creek drainage. Cooper and Cottrell (1990) describe a *Populus angustifolia/Poa pratensis* association from the Front Range that is nearly identical to stands described here. Komarkova (1986) describes a similar *Populus angustifolia/Salix exigua-Betula occidentalis* in the Gunnison River Basin of Colorado. Kittel *et al.* (1994) describe a *Populus angustifolia/Cornus sericea--Betula occidentalis* Phase, that has a high *Betula* component. Gerard *et al.* (1995) describe a *Populus angustifolia/Prunus virginiana* community type that has some *Betula* in the understory but is not a dominant, and a *Betula occidentalis/Cornus stolonifera* community type that has 1-5% cover by *Populus angustifolia* from the eastern slope of the Big Horn Mountains, Wyoming. Padgett *et al.* (1989) describe a *Populus angustifolia/Betula occidentalis* community from Utah that seems nearly identical in species composition and variation. A *Populus angustifolia/Betula occidentalis* type described by Manning and Padgett (1995) is very similar, although some stands are mixed with *Populus trichocarpa*. Similar *Betula occidentalis* community types have been described from Utah, Montana, and Idaho (Padgett *et al.* 1989, Hansen *et al.* 1995, and Youngblood *et al.* 1985), however these lack a tree dominated overstory.

Table 14. Percent Canopy Cover of Important Species in the *Populus angustifolia*/*Betula occidentalis* Plant Association. See Table 2 for Plot Locations. \* = Non-native Species.

| Plot No. (95 )                                       | AM06 | RR05 | RR09 | RR12 | RR13 |
|--|------|------|------|------|------|
| Riparian Condition Rank                              | A/B  | A/B  | C    | B    | B    |
| <b>TREES</b>   |      |      |      |      |      |
| <i>Juniperus scopulorum</i>                          | 3    | 14   |      |      |      |
| <i>Juniperus scopulorum</i> --seedlings              | 2    | 1    |      | 1    | 1    |
| <i>Populus angustifolia</i>                          | 34   | 34   | 75   | 65   | 78   |
| <i>Populus angustifolia</i> --saplings               | 21   |      |      |      | 1    |
| <i>Populus angustifolia</i> --seedlings              |      |      |      |      | 1    |
| <i>Pseudotsuga menziesii</i>                         | 5    |      |      |      | 5    |
| <i>Pseudotsuga menziesii</i> --saplings              | 3    |      |      |      | 1    |
| <i>Pseudotsuga menziesii</i> --seedlings             |      | 3    |      | 1    | 18   |
| <b>SHRUBS</b>  |      |      |      |      |      |
| <i>Acer glabrum</i>                                  |      |      |      | 7    | 1    |
| <i>Alnus incana</i> ssp. <i>tenuifolia</i>           |      |      | 11   | 59   | 6    |
| <i>Betula occidentalis</i>                           | 37   | 67   | 36   | 49   | 23   |
| <i>Rosa woodsii</i>                                  | 4    |      | 7    | 1    | 1    |
| <i>Rubus deliciosus</i>                              | 2    |      |      |      |      |
| <i>Salix bebbiana</i>                                |      |      | 18   |      |      |
| <i>Salix irrorata</i>                                |      |      | 13   |      |      |
| <i>Salix eriocephala</i>                             |      |      |      |      | 6    |
| <i>Salix scouleriana</i>                             | 3    |      |      |      |      |
| <b>GRAMINOIDES</b>                                   |      |      |      |      |      |
| <i>Poa pratensis</i> *                               | 13   | 1    | 6    | 5    | 1    |
| <b>FORBS</b>   |      |      |      |      |      |
| <i>Achillea millefolium</i> var. <i>occidentalis</i> | 2    |      |      | 1    | 2    |
| <i>Heracleum sphondylium</i>                         |      |      |      | 5    |      |
| <i>Taraxacum officinale</i> *                        | 5    | 1    | 11   | 1    | 2    |
| <i>Trifolium repens</i> *                            | 7    | 2    |      |      | 14   |
| <i>Viola adunca</i>                                  | 3    | 3    |      |      |      |
| <b>HORSETAILS</b>                                    |      |      |      |      |      |
| <i>Equisetum arvense</i>                             |      |      | 11   |      |      |
| <i>Equisetum hyemale</i>                             |      |      | 1    |      |      |

**Narrow-leaf cottonwood/Coyote willow (*Populus angustifolia*/*Salix exigua*) Plant Association**

**CNHP Rank: G4/S4**

**2 Plots--95AM16, 95GK70.**

**Reference Reaches:** No excellent examples of this plant association were located, but a good example can be seen on BLM land along Lower East Gulch, T18S, R73W, Sec 20.

**General Description and Comments:** This is a very common plant association of young seedling and sapling *Populus angustifolia* intermixed with a dense stand of *Salix exigua*. It often occupies point bars, gravel bars, beaches and low areas that are flooded annually. In the literature, stands with abundant *Salix exigua* were often included with stands with other shrub cover, hence the variety of names in the Related Types section. Because *Salix exigua* occupies the low-water line of a channel, it is easily visible in riparian areas and often has the appearance of co-dominance with mature *Populus angustifolia* (or *Alnus*, or *Betula*, or whatever) in the background. Upon closer inspection researchers have found the "background" stand is a separate plant association occupying an environment quite different from the point bar. For this reason, most of the literature does not describe the plant association we describe here: a pure seedling, sapling, and young tree *Populus angustifolia* with *Salix exigua*, all contained on the immediate stream bank or point bar.

**Regional Distribution:** The *Populus angustifolia*/*Salix exigua* plant association has been reported from Montana, Idaho, Wyoming, Utah, New Mexico, and Colorado (Hansen *et al.* 1995, Youngblood *et al.* 1985, Johnston 1987, Padgett *et al.* 1989, Durkin *et al.* 1994, 1995, Kittel and Lederer 1993, Kittel *et al.* 1994).

**Distribution in Colorado:** This type has been reported from the Yampa, White, and Gunnison River Basins, and from mountain areas of north eastern Colorado (Kittel and Lederer 1993, Kittel *et al.* 1994, Johnston 1987).

*The following characteristics are based on plots and observations from parts of the upper Arkansas River Basin, Colorado.*

**Vegetation:** Open to somewhat dense stands of *Populus angustifolia* (15-61%) with a nearly pure undergrowth of *Salix exigua* (12-48%) characterize this plant association. The herbaceous undergrowth is generally sparse due to recent flooding disturbance and coarse substrates and includes weedy species such as *Poa pratensis* (0-14%), *Agrostis stolonifera* (0-19%), *Linaria vulgaris* (0-14%), and *Trifolium repens* (0-38%) (Table 15).

**Elevation:** 1,920- 2,195 m (6,300-7,190 ft).

**Site Geomorphology:** This plant association occurs on recently flooded point bars, low terraces, and stream benches. It usually is well within the flood-prone area of the stream channel and

never occurs more than 1-2 m above the high-water mark.

**Rosgen's Channel Type:** This type commonly occupies meandering stream channel floodplains (C4), and is also found along steeper reaches (B3).

**Soil:** Soils are shallow (~35 cm deep) sandy loam or sand, and skeletal (40% gravel and 10-20% cobbles) over coarse alluvial material.

**Adjacent Riparian Vegetation:** Thick stands of *Salix exigua* shrublands often occur within the same reach, and older, more mature *Populus angustifolia* stands, without *Salix exigua*, occur on higher terraces of wider reaches.

**Adjacent Upland Vegetation:** *Pinus edulis* and *Juniperus monosperma* woodlands occur on adjacent rocky valley slopes.

**Successional Trends and Ecological Processes:** This is an early-seral plant association that represents the establishment of *Populus angustifolia* stands. Larger tree sizes coupled with a reduction in *Salix exigua* canopy indicate a transition to late-seral floodplain types, such as *Populus angustifolia/Alnus incana* or *P. angustifolia/Cornus sericea*. The *Populus angustifolia/Salix exigua* plant association becomes established on freshly deposited alluvium. Continued flooding and sedimentation coupled with channel migration will allow the site to aggrade, and change the site to a relatively more stable (less frequently flooded) floodplain environment which favors the invasion of new species. Narrow floodplains along less sinuous rivers have less pronounced, if any, channel migration, and the vegetation generally lacks the spacial complexity of broader floodplains. Succession and change can be observed up and downstream, and through time.

**Management:** This type has low herbaceous productivity, providing little forage for livestock. Cattle have been known to heavily browse and even eliminate willows from the area. Periods of rest are recommended (Hansen *et al.* 1995). *Salix exigua* is an excellent stream bank stabilizer that can be planted as stems or wattles for restoration purposes. Cattle will browse young shoots in the winter, killing newly planted poles (personal observation by the authors). Thick stands of *Salix exigua* provide excellent thermal and hiding cover for many species of wildlife, and stands with addition canopy structure of young *Populus angustifolia* provide excellent bird habitat.

**Related Types:** Johnston (1987) describes a *Populus angustifolia/Salix exigua-Betula fontinalis* plant association. This includes stands where *Salix exigua* is a clear dominant, but not the only shrub present, and includes in this list the following plant association from various sources: *Populus angustifolia/Salix* habitat type, *Populus angustifolia/Salix exigua-Salix* spp. plant association, *Populus angustifolia/Salix exigua* habitat type, *Populus angustifolia/Cornus sericea* plant association. Other types similar to the one described here include *Populus angustifolia/Salix scouleriana* (Baker 1984) and *Populus angustifolia/Salix exigua* (Kittel and Lederer 1993 and Kittel *et al.* 1994) from western Colorado, and the *Populus angustifolia/Salix*

*exigua* types described from New Mexico's Rio Grande and Pecos River basins (Durkin *et al.* 1994, 1995).

Table 15. Percent Canopy Cover of Important Species in the *Populus angustifolia*/*Salix exigua* Plant Association. See Table 2 for Plot Locations. \* = Non-native Species.

| Plot No. (95 ___)                                 | GK70 | AM10 | AM08 | AM49 |
|---|------|------|------|------|
| Riparian Condition Rank                           | B    | D    | C    | B    |
| <b>TREES</b>                                      |      |      |      |      |
| <i>Juniperus scopulorum</i>                       |      |      | 4    |      |
| <i>Populus acuminata</i>                          | 8    |      |      |      |
| <i>Populus angustifolia</i>                       | 31   | 61   | 35   | 15   |
| <i>Populus angustifolia</i> -saplings             | 11   |      |      |      |
| <i>Populus angustifolia</i> -seedlings            |      | 2    | 3    |      |
| <i>Pseudotsuga menziesii</i>                      |      |      |      | 9    |
| <i>Salix fragilis</i>                             | 6    |      |      |      |
| <b>SHRUBS</b>                                     |      |      |      |      |
| <i>Salix exigua</i>                               | 12   | 25   | 48   | 43   |
| <b>GRAMINOIDES</b>                                |      |      |      |      |
| <i>Agrostis stolonifera</i> *                     |      |      |      | 28   |
| <i>Bromus inermis</i> *                           | 19   |      |      |      |
| <i>Carex lanuginosa</i>                           | 5    |      |      |      |
| <i>Elymus lanceolatus</i> ssp. <i>lanceolatus</i> | 8    |      |      |      |
| <i>Elytrigia repens</i> *                         |      | 6    |      |      |
| <i>Poa pratensis</i> *                            | 7    | 7    |      | 14   |
| <i>Poa</i> sp.                                    |      |      | 13   |      |
| <b>FORBS</b>                                      |      |      |      |      |
| <i>Cirsium</i> sp.                                |      | 1    |      | 5    |
| <i>Clematis ligusticifolia</i>                    |      | 1    | 6    | 1    |
| <i>Heterotheca villosa</i>                        | 2    |      | 2    |      |
| <i>Linaria vulgaris</i> *                         | 14   |      |      |      |
| <i>Medicago lupulina</i> *                        |      | 3    | 1    |      |
| <i>Taraxacum officinale</i> *                     |      | 1    | 1    | 4    |
| <i>Trifolium repens</i> *                         |      |      | 38   | 3    |

**Narrow-leaf cottonwood/bluestem willow (*Populus angustifolia*/*Salix irrorata*) Plant Association-- Tentative**

CNHP Rank: G3Q/S3Q

1 Plot--95RR20

**Reference Reaches:** No reference reaches were located of this plant association, however one occurrence was observed on BLM lands in fair to good condition. This site is on Wilson Creek about 7 mi. south of the town of Cripple Creek, just downstream of Victor. T16S, R70W, Sec14. Please respect private landowners rights when accessing this location.

**General Description and Comments:** This plant association is a new tentative type. It represents young, early-seral stands of *Populus angustifolia*, and may be a southwest or southeastern version of the more common *Populus angustifolia*/*Salix exigua* plant association, as *Salix irrorata* begins to replace *Salix exigua* in this region of Colorado.

**Regional Distribution:** This plant association has been described from the Rio Grande River Valley in New Mexico (Durkin *et al.* 1995), and for the first time with this report, from Colorado.

**Distribution in Colorado:** The *Populus angustifolia*/*Salix irrorata* plant association has only been observed along foothill streams of the southern part of the Colorado Front Range. It is likely to occur further south and east along the Arkansas and Purgatory Rivers.

- *The following characteristics are based on plots and observations from parts of the upper Arkansas River Basin, Colorado.*

**Vegetation:** This and the similar *Populus angustifolia*/*Salix exigua* plant association is characterized by a thick to open stand of *Populus angustifolia* of all age classes. One stand has 19% mature trees, 17% saplings, and 3% seedlings. *Salix irrorata* (35%) creates a thick band along the stream edge, intermixed with *Salix exigua* (16%) and some *Alnus incana* (5%) at the stand edge. The undergrowth is sparse due to recent flooding activity (Table 16).

**Elevation:** 2,220 m (7,280 ft).

**Site Geomorphology:** This plant association occupies immediate stream banks and especially point bars of meandering rivers. It can also be found along irrigation ditches. It is usually located very close to the high water line and often well within the annual high-water area of a stream.

**Rosgen's Channel Type:** The one stand located in the Arkansas River watershed occurs along a moderately steep (8.2%) and sinuous stream with a narrow but distinct floodplain (B4).

**Soil:** The soil is shallow and skeletal (30-50% cobbles by 13 cm depth) sandy clay loams

alternating with loamy sands. The water table was at a depth of 28 cm on July 16, 1995.

**Adjacent Riparian Vegetation:** Stands of older *Populus angustifolia* can occur on higher terraces, and patches of *Salix exigua* or *S. irrorata* shrublands may occur up and downstream.

**Adjacent Upland Vegetation:** Steep south facing canyon slopes typically have *Pinus edulis* and *Juniperus monosperma* woodlands.

**Successional Trends and Ecological Processes:** This is considered an early-seral plant association and represents the establishment of *Populus angustifolia* plant associations. The thick cover of *Salix irrorata* or *S. exigua* indicate frequent flooding. Thick vegetation on the floodplain will decrease flood velocities and cause deposition of fine materials, allowing for site aggradation. With continued flooding and sediment deposition, the plant association begins to shift to a more mature, floodplain plant association, like the *Populus angustifolia/Rhus trilobata* plant association.

**Management:** This plant association can be heavily browsed by cattle in the winter, reducing the number of willow stems. This can keep the stand in an early-seral stage, and may cause stream erosion instead of deposition. This plant association has low herbaceous productivity due to the coarse substrate and frequent flooding disturbance. The dense cover and multi-layered canopy of the *Populus angustifolia* make excellent wildlife thermal cover and bird habitat (Hansen *et al.* 1995).

-- **Related Types:** Durkin *et al.* (1995) described one plot of this type from the Rio Grande River Valley in New Mexico.

Table 16: Percent Canopy Cover of Important Species in the *Populus angustifolia*/*Salix irrorata* Plant Association. See Table 2 for Plot Location. \* = Non-native Species.

|  |      |
|--|------|
| Plot No. (95___)                                     | RR20 |
| Riparian Condition Rank                              | B    |
| TREES  |      |
| <i>Populus angustifolia</i>                          | 19   |
| <i>Populus angustifolia</i> --saplings               | 20   |
| SHRUBS   |      |
| <i>Alnus incana</i> ssp. <i>tenuifolia</i>           | 5    |
| <i>Salix exigua</i>                                  | 16   |
| <i>Salix irrorata</i>                                | 35   |
| GRAMINOIDES  |      |
| <i>Agrostis stolonifera</i> *                        | 13   |
| <i>Poa pratensis</i> *                               | 11   |
| FORBS  |      |
| <i>Achillea millefolium</i> var. <i>occidentalis</i> | 1    |
| <i>Clematis ligusticifolia</i>                       | 1    |
| <i>Oenothera elata</i>                               | 1    |
| <i>Taraxacum officinale</i> *                        | 1    |
| <i>Thermopsis rhombifolia</i> var. <i>montana</i>    | 2    |
| <i>Trifolium pratense</i> *                          | 1    |
| <i>Trifolium repens</i> *                            | 7    |

### Unclassified *Populus angustifolia* Dominated Stands:

East Gulch (plot 95RR06) is a steep (12%) pool-drop first order stream with several cascades up to 20 ft tall. The stream bed is very rocky and composed mainly of large boulders from landslides and debris flows. Along its narrow banks *Populus angustifolia* saplings and seedlings occur in small groups, providing 20-40% canopy cover at most. Very few shrubs grow among the boulders, including *Salix eriocephala* (5%), *S. exigua* (1%), and *Rubus deliciosus* (3%). Forbs and grasses are very few and scattered (Table 17). The vegetation is difficult to place in a plant association due to its patchy cover. It may be placed in the *Populus angustifolia*/recent alluvial bar plant association described by Jones and Walford (1995), although this type is known from a finer sediment point-bar environment of larger, meandering rivers. The site receives an "A" condition ranking, however, because the disturbance is natural. The condition of the vegetation and stream banks are expected given the amount of flooding, debris flows, and colluvial deposits.

Cripple Creek (plot 95AM16) is a moderately steep creek in a narrow canyon confined by canyon walls and a roadway. The stream banks contain small patches of *Populus angustifolia*/*Alnus incana* (see plot 95RR16), however much of the reach has poor condition *Populus angustifolia* stands with mostly non-native invasive weeds in the undergrowth (Table 17). In addition, the water quality of Cripple Creek is severely degraded by drainage from mine tailings upstream, an unfortunate part of our historic heritage.

Bear Creek (plot 95AM23), within Bear Creek Regional Park, runs near subdivisions of Colorado Springs. The creek is dominated by *Robinia pseudoacacia* (91%), black locust, planted by early settlers in the area and used today as a shade tree along city streets. It escapes cultivation and can establish itself in irrigated areas, such as Bear Creek. The stream is in good condition with vigorous plant growth and stable stream banks. Dominance by non-native woody species precludes this site from classification (Table 17).

Eightmile Creek (plot 95AM03) within lower Phantom Canyon has a narrow riparian strip of *Populus angustifolia* (65%), *Salix amygdaloides* (12%), *Populus deltoides* (1%) and *Juniperus scopulorum* (1%). The undergrowth is nearly devoid of shrubs, and the herbaceous growth is entirely replaced by *Poa pratensis* (36%) (Table 17). This stand could be placed in the *Populus angustifolia*/*Poa pratensis* anthropomorphic plant association, as described by Bourgeron and Engelking (1994), Jones and Walford (1995), Padgett *et al.* (1989), and Cooper and Cottrell (1990). A dirt road runs along the creek, constricting it in places. Closure of this road would allow riparian recovery and further floodplain development.

Monument Creek (plot 95AM25) is dominated by a mosaic of *Populus angustifolia*/*Salix fragilis* on the floodplain and terraces, and thick shrub communities on the immediate stream banks. In this stand, the non-native tree, *Salix fragilis* (crack willow), is dominant (38%), and intermixes with *Populus angustifolia* (12%). The shrub undergrowth is fairly thick, with *Salix exigua* (15%), *S. monticola* (17%), and *Symphoricarpos occidentalis* (14%). This stand may be transitional between the early-seral thick shrub (*Salix exigua*) and sapling *Populus angustifolia*

stands to the older *P. angustifolia/Symphoricarpos occidentalis* plant association. The herbaceous undergrowth is dominated by non-native invasive weeds (Table 17).

Table 17. Percent Canopy Cover of Important Species in Unclassified *Populus angustifolia* Dominated Stands. See Table 2 for Plot Locations. \* = Non-native Species.

| Plot No. (95___)                        | RR06 | AM16 | AM23 | AM03 | AM25 |
|---|------|------|------|------|------|
| Occurrence Rank                         | A    | C    | D    | B    | B    |
| <b>TREES</b>                            |      |      |      |      |      |
| <i>Juniperus scopulorum</i>             |      |      |      | 1    |      |
| <i>Pinus ponderosa</i>                  |      |      | 4    |      |      |
| <i>Populus acuminata</i>                |      | 10   |      |      |      |
| <i>Populus angustifolia</i>             | 30   | 76   | 42   | 65   | 21   |
| <i>Populus angustifolia</i> --saplings  | 15   | 10   |      |      |      |
| <i>Populus angustifolia</i> --seedlings | 2    | 1    |      |      | 3    |
| <i>Populus deltoides</i>                |      | 5    |      | 1    |      |
| <i>Robinia pseudoacacia</i> *           |      |      | 91   |      |      |
| <i>Salix amygdaloides</i>               |      |      |      | 12   |      |
| <i>Salix fragilis</i> *                 |      |      |      |      | 38   |
| <b>SHRUBS</b>                           |      |      |      |      |      |
| <i>Acer glabrum</i>                     |      |      | 4    | 6    |      |
| <i>Alnus incana</i>                     |      |      |      |      | 4    |
| <i>Physocarpus monogynus</i>            |      |      | 7    |      |      |
| <i>Ptelea trifoliata</i>                |      |      |      | 2    |      |
| <i>Salix exigua</i>                     |      |      |      |      | 15   |
| <i>Salix eriocephala</i>                | 5    | 1    |      |      |      |
| <i>Salix monticola</i>                  |      |      |      |      | 17   |
| <i>Symphoricarpos occidentalis</i>      |      |      |      |      | 14   |
| <b>GRAMINOIDES</b>                      |      |      |      |      |      |
| <i>Bromus inermis</i> *                 |      |      | 3    | 13   |      |
| <i>Elytrigia repens</i> *               |      | 10   |      |      |      |
| <i>Poa pratensis</i> *                  | 6    | 6    | 9    | 36   | 17   |
| <b>FORBS</b>                            |      |      |      |      |      |
| <i>Solidago canadensis</i>              |      |      | 15   |      | 7    |
| <b>HORSETAILS</b>                       |      |      |      |      |      |
| <i>Equisetum arvense</i>                |      | 33   |      | 10   | 1    |

## Populus x acuminata Alliance

No plant associations were found in this alliance in the lower South Platte or the upper Arkansas River basins. However, three stands sampled along streams in the transition zone between the plains and the mountains are dominated by a mixture of *Populus x acuminata*, *Populus angustifolia* and *Populus deltoides* (Table 18). While it is difficult to justify a plant association based on a crossed species, the presence of *Populus x acuminata* is indicative of the foothill-transition area, which has been documented to contain unique natural communities and rare animal species, such as the Preble's jumping mouse (*Zapus hudsonius preblei*, Corn *et al.* 1995). These areas are briefly described below.

Along West Kiowa Creek (plot 95GK09) within the lower South Platte watershed at 2,040 m (6,760 ft) in elevation a large stand of young pole-sized (~12 cm dia.) *Populus x acuminata* occurs (58% canopy cover). This stand has a diverse understory of *Salix lutea* (12%), *S. exigua* (18%), *S. monticola* (4%), and *Symphoricarpos occidentalis* (4%). The herbaceous undergrowth is mesic and was under flood waters at the time of sampling. *Poa pratensis* is abundant (56%), but native graminoids, such as *Carex lanuginosa* (10%) *C. nebrascensis* (1%), *Juncus balticus* (16%), and *Eleocharis palustris* (1%) (Table 18), are also present. The abundance of *Poa pratensis* and *Juncus balticus* suggests heavy grazing by horses or cattle.

Within the Arkansas River watershed, Eightmile Creek in Lower Phantom Canyon, (plot 95AM01) 1,820 m (5,963 ft) in elevation, contains a long narrow riparian area dominated by *Populus x acuminata* (45%) and *Populus angustifolia* (10%) with a scattering of *Salix amygdaloides* (1%). The understory of shrubs is open (<5%) with *Rhus trilobata* (3%) and *Rubus deliciosus* (1%). Weedy undergrowth characterizes the herbaceous layer, with *Bromus tectorum* (12%) and *Poa pratensis* (3%) (Table 18). Eightmile Creek is a narrow, sinuous stream with a BLM scenic by-way running alongside it in the canyon bottom.

Cripple Creek (plot 95RR16), at 2,190 m (7,200 ft) in elevation, downstream of the historic mining town, has a narrow fragmented riparian area of *Populus acuminata* (57%), *Populus angustifolia* (1%), and *Alnus incana* (26%). The undergrowth is sparse (Table 18). Cripple Creek is steep and narrow through this section and is classified as a Rosgen Channel Type A2. The water quality is poor due to acid mine drainage upstream.

Table 18. Percent Canopy Cover for Important Species in the *Populus x acuminata* Alliance. See Table 2 for Plot Locations. \* = Non-native Species.

| Plot No. (95 ___)                            | AM01 | RR16 | GK09 |
|--|------|------|------|
| Occurrence Rank                              | B    | C    | C    |
| <b>TREES</b>                                 |      |      |      |
| <i>Populus acuminata</i> --saplings          |      | 12   |      |
| <i>Populus acuminata</i> --seedlings         | 2    | 4    |      |
| <i>Populus acuminata</i>                     | 45   | 57   | 58   |
| <i>Populus angustifolia</i>                  | 10   |      |      |
| <i>Pseudotsuga menziesii</i>                 |      | 1    |      |
| <b>SHRUBS</b>                                |      |      |      |
| <i>Alnus incana</i> ssp. <i> tenuifolia</i>  |      | 26   |      |
| <i>Rhus trilobata</i> var. <i> trilobata</i> | 2    |      |      |
| <i>Salix exigua</i>                          |      |      | 18   |
| <i>Salix lutea</i>                           |      |      | 13   |
| <i>Salix monticola</i>                       |      |      | 4    |
| <i>Symphoricarpos occidentalis</i>           |      |      | 4    |
| <i>Symphoricarpos rotundifolius</i>          | 1    |      |      |
| <b>GRAMINOIDES</b>                           |      |      |      |
| <i>Bromus inermis</i> *                      | 3    |      | 4    |
| <i>Bromus tectorum</i> *                     | 11   |      |      |
| <i>Carex lanuginosa</i>                      |      |      | 11   |
| <i>Juncus balticus</i> var. <i> montanus</i> |      |      | 16   |
| <i>Poa pratensis</i> *                       | 4    | 1    | 56   |
| <i>Poa</i> sp.                               | 2    | 6    |      |
| <b>FORBS</b>                                 |      |      |      |
| <i>Artemisia ludoviciana</i>                 | 1    |      |      |
| <i>Eriogonum</i> sp.                         | 2    |      |      |
| <i>Heterotheca villosa</i>                   | 3    |      |      |
| <i>Maianthemum stellatum</i>                 |      |      | 1    |
| <i>Osmorhiza depauperata</i>                 |      | 1    |      |
| <i>Rumex crispus</i> *                       |      |      | 1    |
| <i>Scrophularia lanceolata</i>               |      |      | 3    |
| <i>Taraxacum officinale</i> *                | 1    |      | 1    |

*Populus deltoides* spp. *monilifera* Alliance

Plains cottonwood/smooth brome (*Populus deltoides* spp. *monilifera*/*Bromus inermis*) Plant Association

CNHP Rank: not ranked (anthropogenic disturbance-induced type)

3 Plots--95LS09, 96LS10, 95GK12.

Reference Reaches: N/A.

**General Description and Comments:** The *Populus deltoides*/*Bromus inermis* plant association is a grazing-induced type of riparian woodland with a closed to open canopy of large plains cottonwood trees (*Populus deltoides*). There is little to no shrub understory canopy, and a near mono-typic carpet of smooth brome (*Bromus inermis*). The native undergrowth has been completely replaced by introduced hay-meadow grasses.

**Regional Distribution:** This plant association is a common disturbance-induced type reported to occur throughout the western edge of the Great Plains (Midwest Heritage Task Force 1994, Hansen *et al.* 1995, Jones and Walford 1995).

**Distribution in Colorado:** Several stands occur along perennial streams and rivers of the eastern foothills and plains (Cooper and Cottrell 1990, Bourgeron and Engelking 1994).

*The following characteristics are based on plots and observations from the lower South Platte River Basin, Colorado.*

**Vegetation:** This plant association is characterized by a dominance of non-native hay-meadow grasses, namely *Bromus inermis* (19-52%), under a canopy of widely spaced to nearly closed *Populus deltoides* (30-80%). Few other species are present; shrubs are sparse, and forbs are insignificant. When other shrubs and forbs are present in some abundance (>10%), the stand may be a degraded occurrence of a different *Populus deltoides* plant association (Table 19).

**Elevation:** 1,650-2,075 m (5,435-6820 ft).

**Site Geomorphology:** This plant association occupies broad alluvial floodplains and upper terraces of meandering streams.

**Rosgen's Channel Type:** This association occurs on narrow to broad meandering streams as well as ephemeral washes (C4, G4).

**Soil:** The soils of this plant association are deep, pale in color, and have mostly sandy loam to silty clay textures, alternating with slightly coarser sands. No coarse fragments were observed.

**Adjacent Riparian Vegetation:** This plant association occurs with thin bands of *Salix exigua*

along the immediate stream channel. Usually this is the only plant association in the riparian corridor.

**Adjacent Upland Vegetation:** Uplands are generally open range lands or agricultural fields.

**Successional and Ecological Processes:** This plant association is an early seral type. The cottonwoods will not reproduce without significant flooding and sediment deposition. *Populus deltoides* lives for 100-150 years. The site will eventually become a *Bromus inermis* meadow. The undergrowth of this association is a product of altered hydrology (usually a lowered water table) combined with season-long livestock grazing. With grazing pressure native grasses lose their competitive advantage in the presence of *Bromus inermis* and drop out entirely from the area.

**Management:** Unless the area has been seeded with *Bromus inermis* or other hay-meadow grasses, changing the grazing regime to winter-only, short-duration, or rotation, may allow native grasses, forbs and shrubs to return.

**Related Types:** Identical types have been described from Wyoming, Nebraska, Kansas, Oklahoma, and Colorado (Hansen *et al* 1991, Jones 1995, Padgett *et al.* 1989, Bourgeron and Engelking 1994, Midwest Heritage Task Force 1994, Cooper and Cottrell 1990).

Table 19. Percent Canopy Cover for Important Species in the *Populus deltoides*/*Bromus inermis* Plant Association. See Table 1 for Plot Locations. \* = Non-native Species.

| Plot Numbers (95 ____)   | LS09 | LS10 | GK12 |
|--|------|------|------|
| Occurrence Rank  | D/C  | C    | D    |
| <b>TREES</b>   |      |      |      |
| <i>Populus deltoides</i> spp. <i>monilifera</i> --mature trees | 85   | 29   | 83   |
| <i>Populus x acuminata</i> --mature trees                      |      | 19   |      |
| <i>Salix amygdaloides</i> --mature trees                       | 11   | 13   | 1    |
| <b>SHRUBS</b>  |      |      |      |
| <i>Rosa woodsii</i>  |      | 2    |      |
| <i>Salix lucida</i> ssp. <i>caudata</i>                        |      | 25   |      |
| <i>Symphoricarpos occidentalis</i>                             | 2    |      |      |
| <b>GRAMINOIDES</b>   |      |      |      |
| <i>Bromus inermis</i> *  | 42   | 19   | 52   |
| <i>Poa pratensis</i> *   | 43   | 37   | 26   |
| <b>FORBS</b>   |      |      |      |
| <i>Ambrosia dumosa</i>   |      | 2    | 2    |
| <i>Artemisia ludoviciana</i>                                   | 2    | 4    |      |
| <i>Glycyrrhiza lepidota</i>                                    | 2    |      |      |
| <i>Ipomopsis</i> sp.   | 2    | 1    |      |
| <i>Medicago lupulina</i>                                       | 2    | 1    |      |
| <i>Medicago sativa</i> *                                       | 2    |      | 7    |
| <i>Melilotus officinalis</i> *                                 |      |      | 2    |
| <i>Rudbeckia lacinata</i> var. <i>ampla</i>                    |      |      | 4    |
| <i>Taraxacum officinale</i> *                                  | 16   | 2    | 2    |
| <i>Trifolium repens</i> *                                      | 11   |      |      |
| <i>Urtica dioica</i> ssp. <i>gracilis</i>                      |      | 2    |      |
| <i>Verbascum thapsus</i>                                       |      | 2    |      |
| <b>HORSETAILS</b>  |      |      |      |
| <i>Equisetum arvense</i>                                       |      | 2    |      |
| <i>Equisetum laevigatum</i>                                    | 1    | 3    | 1    |

**Plains cottonwood/wooly sedge (*Populus deltoides* spp. *monilifera*/*Carex lanuginosa*) Plant Association**

**CNHP Rank:** G12/S1S2

**4 Plots--** 95LS40, 95LS45, 95GK42, 95GK55.

**Reference Reaches:** Small pockets of this unusual type occur within a mosaic of other cottonwood dominated communities along the South Platte River on DOW land. Good examples can be seen on the Tamarack Ranch State Wildlife Area, T10N, R50W, Sec 27.

**General Description and Comments:** The *Populus deltoides*/*Carex lanuginosa* plant association is an open to closed-canopy woodland of large plains cottonwood (*Populus deltoides*) trees occurring in swales and other depressions on the floodplain, with a dense layer of 0.5-1 m tall wooly sedge (*Carex lanuginosa*) covering the ground.

**Regional Distribution:** This association has been observed as part of the riparian mosaic of the North Platte River near Scottsbluff, Nebraska (Nebraska Heritage Program Ecologist, *personal communication*). It may occur in similar habitats in Kansas, but it is not been inventoried.

**Distribution in Colorado:** This association is only known from the floodplain of the lower South Platte River from Greeley to Julesburg (this report).

*The following characteristics are based on plots and observations from the lower South Platte River Basin, Colorado.*

**Vegetation:** This plant association is characterized by a nearly closed canopy of mature *Populus deltoides* trees (51-86%) with a near pure undergrowth of *Carex lanuginosa* (14-76%). When in degraded condition non-native grasses may have abundant cover. Few other herbaceous species are present (Table 20).

**Elevation:** 1,150-1,415 m (3,765-4,630 ft).

**Site Geomorphology:** This plant association is found in low-lying swales and overflow channels that are slightly less well drained than *Spartina* dominated areas. It occurs in small patches easily overlooked but can form long bands in the bottoms of overflow troughs.

**Rosgen's Channel Type:** Broad braided channels (D5).

**Soil:** The soils of this plant association are heavier than the *Populus deltoides*-(*Salix amygdaloides*)/*Spartina pectinata* type. Clay is the predominate texture with signs of mottling often present.

**Adjacent Riparian Vegetation:** *Populus deltoides*-(*Salix amygdaloides*)/*Spartina pectinata* often occurs on adjacent areas of the same swale or overflow channel. Older stands of *Populus*

*deltoides* occur on higher ridges.

**Adjacent Upland Vegetation:** Adjacent non-riparian communities bordering the South Platte River are sand-*Salix geyeriana* rolling hills, native mixed short-grass prairies, and agricultural fields.

**Successional and Ecological Processes:** Little is known about this plant association. It occurs in identical habitats as the *Spartina* dominated areas, except for the heavier soil textures. This association appears to be a product of over-bank flooding that deposits very fine clays and silts.

**Management:** *Carex lanuginosa* can sprout from long rhizomes and is palatable to livestock (Hermann 1970). Its presence in abundance may indicate a lack of heavy grazing by livestock.

**Related Types:** This plant association is new to the literature, however, it has been observed by Wyoming and Nebraska Heritage Ecologists (personal *communication*).

Table 20. Percent Canopy Cover for Important Species in the *Populus deltoides*/*Carex lanuginosa* Plant Association. See Table 1 for Plot Locations. \* = Non-native Species.

| Plot Number (95__)   | LS40 | LD45 | GK42 | GK55 |
|--|------|------|------|------|
| Occurrence Rank  | A/B  | C    | B    | C/D  |
| <b>TREES</b>   |      |      |      |      |
| <i>Acer negundo</i> --mature trees                             |      |      |      | 1    |
| <i>Populus deltoides</i> spp. <i>monilifera</i> --mature trees | 76   | 86   | 59   |      |
| <i>Populus deltoides</i> spp. <i>monilifera</i> --saplings     |      |      |      | 51   |
| <i>Populus deltoides</i> spp. <i>monilifera</i> --seedlings    |      |      |      | 1    |
| <i>Salix amygdaloides</i> --mature trees                       |      |      |      | 4    |
| <i>Ulmus pumila</i> *  |      |      |      | 1    |
| <b>SHRUBS</b>  |      |      |      |      |
| <i>Vitis riparia</i>   | 2    |      | 3    |      |
| <b>GRAMINOIDES</b>   |      |      |      |      |
| <i>Carex lanuginosa</i>  | 69   | 52   | 76   | 14   |
| <i>Elymus lanceolatus</i>                                      |      | 42   |      | 3    |
| <i>Phalaris arundinacea</i> *                                  |      |      |      | 5    |
| <i>Scirpus pungens</i>   |      |      | 2    |      |
| <i>Spartina pectinata</i>                                      | 1    | 2    | 2    | 1    |
| <b>FORBS</b>   |      |      |      |      |
| <i>Apocynum androsaemifolium</i>                               | 2    |      |      |      |
| <i>Cirsium arvense</i> *                                       | 3    |      |      |      |
| <i>Glycyrrhiza lepidota</i>                                    |      | 8    |      |      |
| <i>Plantago major</i>  |      |      |      | 2    |
| <i>Polygonum pennsylvanicum</i>                                |      | 4    |      | 2    |
| <i>Veronica</i> sp.  |      |      |      | 1    |

**Plains cottonwood/switch grass (*Populus deltoides* spp. *monilifera*/*Panicum virgatum*) Plant Association**

**CNHP Rank:** GIG2/S1

**5 Plots--**95LS25, 95GK25, 95GK26, 95GK30, 95GK31.

**Reference Reaches:** The only known occurrence in Colorado is along the Arikaree River, Yuma County (specific location withheld in respect of landowner privacy).

**General Description and Comments:** This is a mature plains cottonwood (*Populus deltoides*) woodland with close to widely spaced trees and little to no shrub canopy. The undergrowth is a thick prairie of several tall-grass species.

**Regional Distribution:** This plant association is known from the North Platte River in eastern Wyoming, south to the Republican River Basin in eastern Colorado (Jones and Walford 1995, Colorado Natural Heritage Program Database, 1994). Historically, the range may have included western Nebraska, Kansas, and Oklahoma.

**Distribution in Colorado:** This association is known only from the Arikaree River in north-eastern Colorado (Colorado Natural Heritage Program Database, 1994).

*The following characteristics are based on plots and observations from known occurrences along the Arikaree River, Colorado.*

**Vegetation:** This plant association is characterized by scattered *Populus deltoides* (14-76%), either as individuals or small and large stands. *Salix amygdaloides* is always present (1-87%), although it can be widely spaced, and in some stands it is outnumbered by cottonwoods 50:1. The most distinguishing feature, however, is the lush undergrowth of *Panicum virgatum* (2-47%). Other graminoides present may include *Carex lanuginosa* (0-34%), *C. nebrascensis* (0-12%), and *Spartina pectinata* (0-18%) (Table 21). *Schizachyrium scoparium* is reported to occur in drier stands and *Bouteloua curtipendula* in drier stands in Colorado near the Nebraska and Kansas border and in Wyoming. Kansas and Nebraska ecologists report that *Schizachyrium scoparium* is more common within this plant association further east (Steve Kettler, personnel communication).

**Elevation:** 1,030-1,200 m (3,370-3,925 ft).

**Site Geomorphology:** This plant association occurs on low floodplain ridges, slightly elevated point bars, and along stream banks.

**Rosgen's Channel Type:** This association occurs along strongly meandering rivers with moderate to low gradients (C6). Channel substrates range from heavy clays to sandy banks. In Wyoming this association occurs on sandy river banks.

**Soil:** Soil textures of this association range from fine sandy loams to silty clay. The soils are deep (80 cm +) and stratified by depositional layers. One profile had mottling from 21 to 89 cm depth. pH. is high at 8. The soil with the heaviest texture (silt clay to 83 cm) had the highest *Spartina pectinata* cover (25%), although other stands had sandy clay loams and silt loams.

**Adjacent Riparian Vegetation:** Other riparian types within the floodplain mosaic are *Salix exigua* stands, patches of nearly pure *Salix amygdaloides*, and *Scirpus* wetlands. Open meadows of the tall-grass prairie species (*Panicum virgatum* and *Sorghastrum nutans*) also occur on the floodplain.

**Adjacent Upland Vegetation:** Uplands consist of short grass prairies, dominated by *Bouteloua gracilis* and *Buchloë dactyloides*, and sandsage prairies (Daley 1972).

**Successional and Ecological Processes:** This plant association occurs at the transition of short grass and sandsage prairie and more mesic riparian areas dominated by mixed tall and short grass prairie species. The moist environment of the Arikaree River floodplain supports a tall-grass prairie on the floodplain surface. The tall-grass prairie species are likely to remain if periodic fire is allowed to occur (Nebraska Heritage ecologist, *personal communication*) and the current management of winter-only grazing is maintained. Other sites in northeastern Colorado that experience season-long grazing have shown a strong reduction in the native tall-grass species (*personal observation* and plot 95GK31). The hydrology of the Arikaree River in northeastern Colorado is driven by summer thunderstorms, and flooding events are episodic. The current cohort of cottonwoods dates back to the 1930's from a huge flood. Landowners note that there were very few trees prior to 1935 flood, and that they hay the rich floodplain meadows. It is likely that the current cottonwood groves may reach maturity and die before another regenerating storm event occurs given the cyclical nature of this disturbance driven ecosystem.

**Management:** Winter-only grazing by livestock works very well in maintaining the native tall-grass species vigor.

**Related Types:** An identical type has been described from one location in Wyoming (Jones 1995). Originally described from Colorado by Kettler (Colorado Natural Heritage Program Database, 1994).

Table 21. Percent Canopy Cover for Important Species in the *Populus deltoides*/*Panicum virgatum* Plant Association. See Table 1 for Plot Locations. \* = Non-native Species.

| Plot Number (95 )  | LS25 | GK25 | GK26 | GK30 | GK31 |
|--|------|------|------|------|------|
| Occurrence Rank  | A    | A    | B    | B    | C    |
| <b>TREES</b>   |      |      |      |      |      |
| <i>Elaeagnus angustifolia</i> *                          |      |      |      |      | 2    |
| <i>Populus deltoides</i> spp. <i>monilifera</i> --mature | 14   | 32   | 76   | 40   | 64   |
| <i>Salix amygdaloides</i> --mature                       | 69   | 31   | 87   | 37   | 48   |
| <i>Salix amygdaloides</i> --seedlings                    | 1    |      |      |      |      |
| <b>SHRUBS and VINES</b>                                  |      |      |      |      |      |
| <i>Toxicodendron rydbergii</i>                           | 5    | 1    | 7    | 6    | 2    |
| <b>GRAMINOIDES</b>                                       |      |      |      |      |      |
| <i>Agrostis stolonifera</i> *                            |      |      |      |      | 23   |
| <i>Bromus japonicus</i>                                  | 3    | 8    |      | 1    |      |
| <i>Carex lanuginosa</i>                                  |      | 11   | 34   |      |      |
| <i>Carex microptera</i>                                  | 1    |      |      |      |      |
| <i>Carex nebrascensis</i>                                |      | 12   |      |      |      |
| <i>Carex</i> sp.   | 1    |      |      | 40   |      |
| <i>Eleocharis palustris</i>                              |      | 11   | 1    |      | 33   |
| <i>Elymus lanceolatus</i> ssp. <i>lanceolatus</i>        | 1    |      |      | 19   | 10   |
| <i>Leersia oryzoides</i> *                               |      | 10   |      |      |      |
| <i>Panicum virgatum</i>                                  | 33   | 22   | 47   | 41   | 2    |
| <i>Poa palustris</i>                                     |      | 8    | 2    |      |      |
| <i>Poa pratensis</i> *                                   |      | 3    | 43   | 29   | 1    |
| <i>Scirpus americanus</i>                                |      | 18   | 1    |      |      |
| <i>Scirpus microcarpus</i>                               |      |      |      |      | 22   |
| <i>Spartina pectinata</i>                                | 4    | 7    | 18   | 6    | 25   |
| Unknown graminoid  | 3    | 5    | 12   | 3    |      |
| <b>FORBS</b>   |      |      |      |      |      |
| <i>Glycyrrhiza lepidota</i>                              | 2    |      | 1    | 10   |      |
| <i>Taraxacum officinale</i> *                            |      | 1    |      | 1    | 2    |

**Plains cottonwood/choke cherry (*Populus deltoides* spp. *monilifera*/*Prunus virginiana*) Plant Association**

CNHP Rank: G3Q/S2Q

3 Plots--95LS16, 95GK16, 95GK17.

**Reference Reaches:** No reference reaches were located in the study area.

**General Description and Comments:** This is a mature plains cottonwood (*Populus deltoides*) association with large, widely spaced trees and a closed to open canopy. Open grassy areas dotted with small but thick pockets of shrubs characterize the understory.

**Regional Distribution:** Similar communities (see above) have been reported from Montana (Hansen *et al.* 1988) and northeastern Colorado (Cooper and Cottrell 1990, Knopf 1985).

**Distribution in Colorado:** This association is only known from northeastern Colorado (Cooper and Cottrell 1990, Knopf 1985).

*The following characteristics are based on plots and observations from the lower South Platte River Basin, Colorado.*

**Vegetation:** This plant association is characterized by an open canopy of tall, mature *Populus deltoides* (19-77%). The shrub understory occurs in clumps that are about 5 feet tall and 10 to 25 feet long with *Prunus virginiana* 27-36%, *Celtis laevigata* 0-11%, and *Symphoricarpos occidentalis* 4-44%. The *Symphoricarpos* occurs under the other shrubs. The shrub patches are interspersed with meadow of mostly non-native grasses, such as *Bromus inermis* (3-26%), *Elytrigia intermedia* (0-23%), and *Elymus canadensis* (0-53%) (Table 22).

**Elevation:** 1,700 m (5,600 ft)

**Site Geomorphology:** This plant association occurs on upper terraces and elevated stream banks. We found this type only once, along the Plum Creek, on a terrace that ranged from 1.75 to 3.75 meters above the channel.

**Rosgen's Channel Type:** Plum creek is a narrow, braided channel with shifting islands and point bars (D5).

**Soil:** The soil is deep (70-80+ cm) loamy sands with alternating layers of coarse sands and silty clays with high organic content.

**Adjacent Riparian Vegetation:** Open stands of *Populus deltoides*/*Bromus inermis* and the introduced crack-willow, *Salix fragilis*, also occupy the upper terraces. Within the riparian mosaic closer to the stream are stands of *Salix exigua*, and open dry meadows of *Pascopyrum smithii*, *Dactylis glomerata*, and other introduced grasses.

**Adjacent Upland Vegetation:** Surrounding uplands consist of rolling hills of *Quercus gambelii* shrublands and open dry grasslands.

**Successional and Ecological Processes:** Other plant associations reported from Montana, *Fraxinus pennsylvanica/Prunus virginiana* and *Acer negundo/Prunus virginiana*, indicate that the *Populus deltoides/Prunus virginiana* may be a southern extension of this association with *Populus deltoides* replacing the overstory tree species. The large tree size and elevated position above the current stream channel indicate this is a late-seral association. The area appears historically disturbed, and the presence of *Salix fragilis* confirms the area was once a homestead (Dupont plant-manager, personal communication). *Prunus* may have been planted at that time, and the terraces graded and planted for hay.

**Management:** Thick stands of *Prunus virginiana* may preclude use by livestock (Hansen *et al.* 1989). Open stands may provide grazing opportunities, however season-long grazing increases the abundance and vigor of non-native grasses and, with excessive browsing, may reduce shrub densities.

**Related Types:** Knopf (1985) studied riparian bird populations within the Platte River watershed, and reported a riparian area near Livermore with *Populus sargentii* (= *P. deltoides* ssp. *monilifera*), scattered willows, and *Prunus virginiana*. Hansen *et al.* (1988) report that the *Prunus virginiana* dominance type can occur as an understory layer within stands of *Populus deltoides*. Cooper and Cottrell (1990) reported a *Populus deltoides/Bromopsis inermis* plant association that has two stands with 5 and 20% cover of *Prunus virginiana*.

Table 22. Percent Canopy Cover for Important Species in the *Populus deltoides*/*Prunus virginiana* Plant Association. See Table 1 for Plot Locations. \* = Non-native Species.

| Plot Number (95___)  | LS16 | GK16 | GK17 |
|--|------|------|------|
| Occurrence Rank  | B/C  | B    | B/C  |
| <b>TREES</b>   |      |      |      |
| <i>Populus deltoides</i> spp. <i>monilifera</i> --mature   | 76   | 77   | 19   |
| <i>Populus deltoides</i> spp. <i>monilifera</i> --saplings | 2    |      |      |
| <i>Populus x acuminata</i> --tree                          |      |      | 70   |
| <i>Salix amygdaloides</i> --mature trees                   |      | 1    |      |
| <i>Salix fragilis</i> *                                    | 6    |      | 53   |
| <b>SHRUBS</b>  |      |      |      |
| <i>Celtis laevigata</i> var. <i>reticulata</i>             |      |      | 11   |
| <i>Parthenocissus quinquefolia</i>                         | 1    | 3    | 2    |
| <i>Prunus americana</i>                                    |      | 7    | 1    |
| <i>Prunus virginiana</i>                                   | 27   | 29   | 36   |
| <i>Rhus trilobata</i> var. <i>trilobata</i>                | 1    |      | 1    |
| <i>Ribes aureum</i>  |      |      | 1    |
| <i>Ribes cereum</i>  |      |      | 1    |
| <i>Rosa woodsii</i>  |      | 18   |      |
| <i>Symphoricarpos occidentalis</i>                         | 13   | 44   | 4    |
| <b>GRAMINOIDES</b>   |      |      |      |
| <i>Bromus inermis</i> *                                    | 12   | 26   | 3    |
| <i>Carex lanuginosa</i>                                    |      | 8    |      |
| <i>Elymus canadensis</i>                                   |      | 16   |      |
| <i>Elytrigia intermedia</i>                                |      |      | 53   |
| <i>Pascopyrum smithii</i>                                  | 23   |      |      |
| <i>Poa pratensis</i> *                                     | 3    | 10   |      |
| <b>FORBS</b>   |      |      |      |
| <i>Cynoglossum officinale</i> *                            | 8    | 21   | 13   |
| <i>Galium triflorum</i>                                    | 2    |      | 19   |
| <i>Glycyrrhiza lepidota</i>                                |      | 2    |      |

**Plains cottonwood/snowberry (*Populus deltoides* spp. *monilifera*/*Symphoricarpos occidentalis*) Plant Association**

**CNHP Rank: G2G3/S2**

12 Plots--95LS29, 95LS30, 95LS35, 95LS36, 95LS39, 95LS43, 95LS44, 95GK38, 95GK39, 95GK49, 95GK53, 95GK58.

**Reference Reaches:** Several large stands of this association can be observed on the floodplain of the South Platte River between Sterling and Julesburg, on DOW land.

**General Description and Comments:** This is a mature plains cottonwood (*Populus deltoides*) association with widely-spaced large trees and low stature (0.5-1 m) thickets of *Symphoricarpos*. Open areas of dry weedy grasses occur between the shrubs, and dips and swales of the floodplain may hold other, wetter plant associations such as stands of coyote willow (*Salix exigua*) or woolly sedge (*Carex lanuginosa*).

**Regional Distribution:** This plant association is known from the western edge of the Great Plains, in eastern Montana, Wyoming, and Colorado (Hansen *et al.* 1989, Jones 1995, Knopf 1985, Johnston 1987).

**Distribution in Colorado:** In Colorado, it is only found along the South Platte River-floodplain (Christy 1973 and this report).

*The following characteristics are based on plots and observations from the scope of this study, the lower South Platte River Basin, Colorado.*

**Vegetation:** This plant association has widely spaced large mature trees of *Populus deltoides*, (31-89%) with an occasional *Salix amygdaloides* (0-14%). The ground cover is relatively open, and the low shrub cover is almost entirely *Symphoricarpos occidentalis* (3-66%). The herbaceous cover is low and scattered (Table 23). Many weeds and non-natives can be present due to the open and relatively dry nature of this type.

**Elevation:** 1,085-1,280 m (3,555-4,210 ft).

**Site Geomorphology:** This plant association occupies elevated ridges and flat areas of the floodplain that are well drained and slightly higher than most of the other surfaces. These sites also tend to be further from the main channel. However, due to the anastomosing character of the S. Platte, this vegetation type can occur close to the active channel but is always on an elevated surface.

**Rosgen's Channel Type:** Broad, braided channels (D5).

**Soil:** Soils of this plant association show the most development of all the floodplain vegetation types. Typically the profile is highly stratified, but with distinct soil development (B) layers.

Most of the area has fresh sediment on the surface (from the 1995 flood). Five of the sampled pit profiles had mottling at a depth of 30-40 cm. Three had mottling at the surface (2-25 cm) associated with this year's flooding. Textures ranged from silty clays to loam sands. While all soils sampled had many layers and various textures, all had thin clay lens, indicating that floods often reach heights above the active channel.

**Adjacent Riparian Vegetation:** Adjacent overflow channels have *Salix exigua*/mesic graminoid stands or open meadows of *Spartina pectinata*.

**Adjacent Upland Vegetation:** Adjacent non-riparian communities bordering the South Platte River are sand-*Salix geyeriana* rolling hills, native mixed short-grass prairies, or agricultural fields.

**Successional and Ecological Processes:** This plant association appears to be one of the last stages of the cottonwood dominance on the S. Platte floodplain. The trees are large and widely spaced. As they topple and die *Symphoricarpos occidentalis* becomes the remaining dominant woody species. This late-seral plant association is located on the highest surfaces within the floodplain. Its lateral position varies greatly. Presumably as islands throughout the wide braided channel become more stable and vegetated, thereby aggregating more sediments and experiencing fewer floods, succession advances to this late stage.

**Management:** *Symphoricarpos occidentalis* occurs on the floodplain of the South Platte River under a light to no grazing management regime. In Wyoming it has been noted that *Symphoricarpos* becomes abundant in ungrazed areas (Thilenius and Brown 1990, as cited in Jones 1995). In Montana, however, *Symphoricarpos* understories are thought to be grazing induced phases of wetter riparian woodland community types (Hansen *et al.* 1991).

**Related Types:** This association appears to be identical to types described in Montana and Wyoming under the same name (Hansen *et al.* 1989, and Jones 1995, respectively). Knopf (1985) reported a similar combination of *Populus deltoides*, *Symphoricarpos occidentalis* and *Salix exigua* along the South Platte River in the vicinity of our study plots. Johnston (1987) reports a *Populus sargentii* (= *P. deltoides* ssp. *monilifera*) / *Symphoricarpos occidentalis*-*Leymus cinereus* plant association from Thunder Basin National Grassland in eastern Wyoming, central Montana, south central South Dakota, and south-western North Dakota. However, this association has a very diverse woody overstory and a dominance of *Leymus cinereus* in the undergrowth, unlike the stands on the South Platte River.

Table 23. Percent Canopy Cover for Important Species in the *Populus deltoides*/  
*Symphoricarpos occidentalis* Plant Association. See Table 1 for Plot Locations. \* = Non-native  
 Species.

| Plot Number (95 _____)                                     | LS29 | LS30 | LS35 | LS36 | LS39 | LS43 | LS44 | GK38 | GK39 | GK49 | GK53 | GK58 |
|--|------|------|------|------|------|------|------|------|------|------|------|------|
| Occurrence Rank  | B/C  | B    | B    | B    | A    | B    | C    | B    | B    | C    | D    | B/C  |
| <b>TREES</b>   |      |      |      |      |      |      |      |      |      |      |      |      |
| <i>Fraxinus pennsylvanica</i> -trees                       | 16   | 8    |      |      |      |      | 8    |      |      |      | 11   |      |
| <i>Populus deltoides</i> spp.<br><i>monilifera</i> --trees | 33   | 52   | 30   | 47   | 19   | 31   | 70   | 58   | 34   | 54   | 89   | 81   |
| <i>Salix amygdaloides</i> --trees                          | 1    |      |      |      | 1    | 14   |      |      |      | 10   |      |      |
| <b>SHRUBS and VINES</b>                                    |      |      |      |      |      |      |      |      |      |      |      |      |
| <i>Rosa woodsii</i>  |      |      | 3    | 7    |      |      |      | 1    | 1    |      |      | 1    |
| <i>Salix exigua</i>  |      | 4    | 7    |      | 8    | 16   | 1    |      | 1    |      |      |      |
| <i>Symphoricarpos occidentalis</i>                         | 15   | 8    | 12   | 32   | 23   | 28   | 66   | 32   | 49   | 40   | 3    | 22   |
| <i>Vitis riparia</i>                                       | 2    | 35   | 4    |      |      |      | 6    |      |      |      |      |      |
| <b>GRAMINOIDES</b>   |      |      |      |      |      |      |      |      |      |      |      |      |
| <i>Carex brevior</i>                                       | 25   | 6    | 1    | 1    |      |      |      | 1    | 2    |      |      |      |
| <i>Cyperus strigosus</i>                                   |      |      |      |      | 22   | 2    |      |      |      |      |      |      |
| <i>Elymus lanceolatus</i>                                  | 1    | 2    |      |      |      | 38   | 2    | 12   |      | 1    | 33   | 38   |
| <i>Panicum sp.</i>   | 1    | 1    | 25   |      |      |      |      |      | 5    |      |      |      |
| <i>Pascopyrum smithii</i>                                  |      | 16   | 1    |      |      |      | 3    |      | 3    | 11   | 8    | 20   |
| <i>Poa pratensis</i> *                                     | 5    | 1    |      | 12   |      |      | 26   | 1    |      | 37   | 15   | 21   |
| <b>FORBS</b>   |      |      |      |      |      |      |      |      |      |      |      |      |
| <i>Cirsium arvense</i> *                                   | 12   |      |      |      | 12   | 1    | 9    |      | 1    |      |      |      |
| <i>Glycyrrhiza lepidota</i>                                |      | 3    |      |      |      |      |      |      | 1    | 1    | 9    |      |

Plains cottonwood-(Peach-leaved willow)/Coyote willow (*Populus deltoides* spp. *monilifera*-*(Salix amygdaloides)/Salix exigua*) Plant Association

CNHP Rank: G3/S3

9 Plots--95LS06, 95LS11, 95LS31, 95LS41, 95LS42, 95GK07, 95GK43, 95GK50, 95GK52

**Reference Reaches:** Several excellent examples of this association be seen on DOW land on the South Platte River, between Sterling and Julesburg.

**General Description and Comments:** This is an early seral association that has a mix of sapling and pole sized plains cottonwood (*Populus deltoides*) and peached-leaved willow (*Salix amygdaloides*) intermixed with multiple stems of coyote willow (*Salix exigua*). It is often located on low stream banks and islands, but can also occur on overflow channels away from the main stream channel. It typically has fairly dense tree canopy cover with little herbaceous ground cover. It is recognized as the younger stage of older, more widely spaced plains cottonwood associations.

**Regional Distribution:** This plant association appears to be limited to the western Great Plains ranging from northeastern Wyoming to northeastern New Mexico, and eastward to central Nebraska, Kansas and Oklahoma (Jones and Walford 1995, Dick-Peddie 1993, Midwestern Heritage Task Force 1994).

**Distribution in Colorado:** In Colorado this plant association occurs along streams at the base of the front range foothills east to the Nebraska state line (Johnston 1987, Christy 1973, and this report).

*The following characteristics are based on plots and observations from the lower South Platte River Basin, Colorado.*

**Vegetation:** This association is characterized by an open canopy of sapling to pole-sized *Populus deltoides* and *Salix amygdaloides* trees (1-5% cover). *Salix exigua* is always present in the understory (1-75%). The undergrowth can be scarce and is characterized by scattered cover of a variety of graminoid species. If the stand is very moist *Carex lanuginosa* may be abundant (0-23%). Forb cover is usually insignificant (Table 24).

**Elevation:** 1,059-1,790 m (3,469-5,880 ft).

**Site Geomorphology:** This plant association occurs on young alluvial surfaces such as point bars, low stream banks, and overflow areas. Along smaller washes and incised reaches (for example along Kiowa and W. Bijou Creeks) this association occurs on higher terraces as well as the immediate steam banks, where periodic summer flash floods disturb the entire floodplain, allowing this early seral riparian type to persist on most fluvial surfaces. On the mainstem of the S. Platte River, this riparian association occurs only on immediate stream banks and low overflow areas, and never far from the main channel.

**Rosgen's Channel Type:** This type is found along incised, flat-bottomed, sand-bed arroyo-type streams with sandy substrates (F5), as well as broad braided channels (D5).

**Soil:** Soils of this plant association are typically fresh alluvial material showing little soil development. Textures are predominately loose friable sands interspersed with narrow bands of clay loams and sandy clays.

**Adjacent Riparian Vegetation:** Older stands of *Populus deltoides* often occur on higher terraces, while pure stands of other *Salix* and *Carex* spp. occur within the riparian mosaic of the channel and floodplain.

**Adjacent Upland Vegetation:** Foothill streams often have stands of *Pinus ponderosa* or *Quercus gambelii* shrublands on outcrops. The mainstem of the S. Platte River has sand-*Salix geyeriana* shrublands and grasslands on adjacent rolling hills or is bordered by agricultural fields.

**Successional and Ecological Processes:** This plant association is considered an early to mid-seral stage. With time and tree growth *Salix exigua* becomes less important. Christy (1973) suggests that this vegetation type may be transitional between an all *Salix exigua* dominated community to an all *Populus deltoides* dominated type. However, he considers this plant association to be a response to intermediate environmental conditions, namely intermediate soil moisture (*Salix* dominated being the wettest, and *Populus* dominated the driest). In riparian areas the environmental site parameters often change dramatically with continued disturbance by flooding, and the maturation of the pioneer species often affects a corresponding physical change with flooding (e.g. increased sedimentation and subsequent elevation above the channel). The pattern within a riparian mosaic is a combination of successional types, physical change, and continued fluvial disturbances. Different patch types should not be thought of as simple time-for-space substitutions (Friedman 1993).

**Management:** This plant association offers low forage productivity. Thick stands may prevent livestock use. Heavy browsing may reduce the vigor of woody species and lessen the degree of stream bank stabilization (Hansen *et al.* 1995).

**Related Types:** A similar type called by the same name has been described from eastern Wyoming (Jones and Walford 1995). The *Populus fremontii*-*Salix amygdaloides*/mesic shrub/mesic graminoid-forb type from the eastern Plains of New Mexico (Dick-Peddie 1993) is similar in structure and species, however the dominant cottonwood is not the same species that occurs on the S. Platte River. Christy (1973) describes a "mixed community" consisting of *Populus sargentii*, *Salix amygdaloides* and *Salix interior* from the S. Platte River in Colorado. A *Populus deltoides*/*Salix amygdaloides*-*Salix nigra* type is listed from eastern Nebraska (Midwestern Heritage Task Force 1994). A similar type has been described from Oregon under the name *Salix amygdaloides*-*Salix exigua*-*Salix lasiandra* (Bourgeron and Engelking 1994). Johnston (1987) reports a *Populus sargentii* (= *P. deltoides* ssp. *monilifera*) /*Salix* spp. plant association from northeastern Colorado and lists *Salix amygdaloides* and *S. exigua* as co-

dominants.

Table 24. Percent Canopy Cover of Important Species in the *Populus deltoides*-(*Salix amygdaloides*)/*Salix exigua* Plant Association. See Table 1 for Plot Locations, \* = Non-native Species.

| Plot Number (95 )   | LS06 | LS11 | LS31 | LS41 | LS42 | GK07 | GK43 | GK50 | GK52 |
|---|------|------|------|------|------|------|------|------|------|
| Occurrence Rank   | C    | C    | B    | B/C  | B/C  | C    | B    | C    | C    |
| <b>TREES</b>  |      |      |      |      |      |      |      |      |      |
| <i>Fraxinus pennsylvanica</i> --mature trees                |      |      | 5    | 19   |      |      | 1    |      |      |
| <i>Populus deltoides</i> spp. <i>monilifera</i> --mature    | 5    | 45   |      |      |      | 46   | 41   |      |      |
| <i>Populus deltoides</i> spp. <i>monilifera</i> --saplings  |      |      | 1    | 36   | 38   |      |      | 32   | 20   |
| <i>Populus deltoides</i> spp. <i>monilifera</i> --seedlings |      |      |      |      | 11   |      | 1    | 8    | 1    |
| <i>Salix amygdaloides</i> --mature trees                    | 2    | 9    | 27   |      | 2    | 17   | 5    |      |      |
| <i>Salix amygdaloides</i> --saplings                        |      |      |      |      |      |      |      | 18   |      |
| <b>SHRUBS</b>   |      |      |      |      |      |      |      |      |      |
| <i>Salix exigua</i>   | 19   | 34   | 52   | 20   | 10   | 22   | 30   | 33   | 47   |
| <i>Vitis riparia</i>  |      |      | 8    |      |      |      |      |      |      |
| <b>GRAMINOIDES</b>  |      |      |      |      |      |      |      |      |      |
| <i>Bromus inermis</i> *                                     | 14   | 16   |      |      |      | 2    |      |      |      |
| <i>Bromus tectorum</i> *                                    | 19   | 2    |      |      |      |      |      |      |      |
| <i>Carex lanuginosa</i>                                     |      |      |      |      |      |      | 17   |      | 1    |
| <i>Carex nebrascensis</i>                                   |      |      |      |      |      | 22   |      |      |      |
| <i>Eragrostis pilosa</i> *                                  |      |      |      | 5    | 6    |      | 7    |      |      |
| <i>Pascopyrum smithii</i>                                   | 3    |      | 5    |      |      |      |      |      |      |
| <i>Poa pratensis</i> *                                      | 1    | 19   |      |      |      | 7    |      |      |      |
| <i>Scirpus pungens</i>                                      |      | 1    |      |      |      | 12   |      | 2    |      |
| <i>Spartina pectinata</i>                                   |      |      | 5    |      |      |      | 3    |      |      |
| <b>FORBS</b>  |      |      |      |      |      |      |      |      |      |
| <i>Bidens frondosa</i>                                      |      |      |      |      |      |      | 5    | 1    | 1    |
| <i>Chenopodium glaucum</i>                                  |      |      |      |      |      |      | 1    | 8    | 1    |
| <i>Glycyrrhiza lepidota</i>                                 |      | 3    |      |      |      | 17   |      |      |      |
| <i>Melilotus officinalis</i> *                              | 1    | 26   |      |      |      |      |      |      |      |
| Unknown forb  | 1    | 11   | 5    |      |      |      | 1    | 1    | 1    |
| <i>Urtica dioica</i> ssp. <i>gracilis</i>                   |      | 21   |      |      |      |      |      |      |      |
| <i>Xanthium strumarium</i> *                                |      |      | 4    | 10   | 1    |      | 1    |      | 10   |

Plains cottonwood-(Peach-leaved willow)/Prairie slough grass (*Populus deltoides* spp. *monilifera*-(*Salix amygdaloides*)/*Spartina pectinata* Plant Association

CNHP Rank: G1G2/S2

12 Plots--95LS32, 95LS38, 95GK32, 95GK33, 95GK34, 95GK35, 95GK36, 95GK4, 95GK41, 95GK44, 95GK51, 95GK57.

Reference Reaches: Good examples of this association can be seen along the South Platte River on the Tamarack Ranch State Wildlife Area, DOW land, T8N, R52W, Sec 14.

General Description and Comments: This is a mature plains cottonwood (*Populus deltoides*) association with widely spaced trees including and occasional peach-leaved willow (*Salix amygdaloides*). It is largely confined to swales and low areas on the floodplain where soils are fine-textured and water accumulates in early summer. There is little to no shrub canopy present, and the herbaceous undergrowth is a luxuriant layer of tall (0.5-1 m) slough grass (*Spartina pectinata*).

Regional Distribution: This plant association is known only from the North and South Platte Rivers in western Nebraska and eastern Colorado (Midwest Heritage Task Force 1994, Knopf 1985, Christy 1973). It may have been historically present but is now degraded in Kansas (personnel communication, Kansas Heritage ecologist).

Distribution in Colorado: This combination of species has been reported previously from the lower South Platte River in northeastern Colorado by Knopf (1985), Christy (1973), and Benin (1986).

The following characteristics are based on plots and observations from the lower South Platte River Basin, Colorado.

Vegetation: This plant association is characterized by a nearly closed canopy of mostly mature *Populus deltoides* trees (32-78%) with *Salix amygdaloides* in the mature canopy (1-53%), and a nearly pure undergrowth of *Spartina pectinata* (2-55%). *Carex lanuginosa* may be present in some abundance (0-36%), but for the most part, canopy cover by other herbaceous species is insignificant (Table 25).

Elevation: 1,060-1,280 m (3,470-4,180 ft).

Site Geomorphology: This plant association occurs on wet but well drained low-lying areas such as swales and low spots within overflow channels on broad floodplains, often alternating between higher ridges.

Rosgen's Channel Type: Broad shallow braided channels (D5).

Soil: Soils of this plant association show signs of continual flooding and fine sediment

deposition. They are stratified with alternating layers of fine and coarse layers. Nearly all of the profiles sampled had between 14-26 cm of silty loam, clay loam, or fine sandy loam at the surface. Most soils had signs of faint to moderate mottling with moderate soil development.

**Adjacent Riparian Vegetation:** In adjacent lower and wetter areas where water tends to pond, *Typha latifolia* or *T. angustifolia* stands can be found, along with *Phragmites australis*. This plant association may grade into the *Populus deltoides*/*Carex lanuginosa* type, and dryer ridges may have open stands of *Populus deltoides*/*Symphoricarpos occidentalis*. Other areas may have stands of *Salix exigua*.

**Adjacent Upland Vegetation:** Adjacent non-riparian communities bordering the South Platte River are sand-*Salix geyeriana* rolling hills, native mixed short-grass prairies, or agricultural fields.

**Successional and Ecological Processes:** *Spartina pectinata* is adapted to wet soils and can grow quickly after burial by sedimentation (Weaver 1965). This plant association appears to be secondary successional with both the cottonwoods and the slough grass surviving burial through re-growth. In 1995, a 25-year return flood left a layer of silt from a few centimeters to several decimeters deep on the soil surface. By late August, the *Spartina* had grown vigorously. It is likely that other herbaceous species will invade this new substrate, and the importance of *Spartina* may be diminished with time.

**Management:** Stands of *Spartina pectinata* have high production rates, however the rough-edged leaves create poor forage quality, and it is not readily eaten by livestock or wildlife. Its tall height and thick growth provide shade and cover for wildlife and certain bird species (Hansen *et al.* 1988). It can make excellent hay if cut two or three times each growing season, thereby reducing forage coarseness (Weaver 1965, Hansen *et al.* 1988).

**Related Types:** This combination of species has been reported previously from the lower South Platte River in northeastern Colorado by Knopf (1985), Christy (1973), and Bunin (1975). This association is also similar to the *Populus deltoides*-(*Salix nigra*)/*Spartina pectinata*-*Carex* spp. plant association described from eastern Nebraska (Midwest Heritage Task Force 1994). *Salix amygdaloides* apparently replaces *S. nigra* in western Nebraska (Great Plains Flora 1977, and *personal communication* with the Nebraska Heritage ecologist).

Table 25. Percent Canopy Cover Values for Important Species in the *Populus deltoides*-(*Salix amygdaloides*)/*Spartina pectinata* Plant Association. See Table 1 for Plot Locations. \* = Non-native Species.

| Plot Number (95___)                                       | LS32 | LS38 | GK32 | GK33 | GK34 | GK35 | GK36 | GK40 | GK41 | GK44 | GK51 | GK57 |
|---|------|------|------|------|------|------|------|------|------|------|------|------|
| Occurrence Rank   | B    | B    | C    | C    | B    | B    | B    | B    | B    | B/C  | C    | C    |
| <b>TREES</b>  |      |      |      |      |      |      |      |      |      |      |      |      |
| <i>Celtis laevigata</i> var. <i>reticulata</i>            |      |      | 15   | 5    |      |      |      |      |      |      |      |      |
| <i>Fraxinus pennsylvanica</i> -trees                      |      |      |      | 7    |      |      |      | 3    | 12   |      |      | 1    |
| <i>Populus deltoides</i> spp. <i>monilifera</i> -trees    |      | 59   | 32   | 49   | 78   | 42   | 56   | 65   | 68   | 69   | 59   |      |
| <i>Populus deltoides</i> spp. <i>monilifera</i> -saplings | 1    |      |      |      |      |      | 2    |      |      |      |      | 49   |
| <i>Salix amygdaloides</i> --trees                         | 53   | 1    | 4    | 1    | 1    | 1    | 2    | 15   | 5    | 4    | 2    | 3    |
| <b>SHRUBS</b>   |      |      |      |      |      |      |      |      |      |      |      |      |
| <i>Salix exigua</i>                                       | 10   | 2    |      | 8    | 1    | 6    | 6    | 3    |      | 1    |      |      |
| <i>Symphoricarpos occidentalis</i>                        |      |      | 1    |      | 1    |      |      |      | 2    |      | 4    | 3    |
| <i>Vitis riparia</i>                                      | 1    | 7    | 1    | 2    | 2    | 17   |      | 3    |      |      |      |      |
| <b>GRAMINOIDES</b>  |      |      |      |      |      |      |      |      |      |      |      |      |
| <i>Carex lanuginosa</i>                                   | 12   | 36   |      |      | 12   |      |      |      | 15   |      | 7    | 3    |
| <i>Curex</i> sp.  | 5    | 4    |      |      |      | 7    | 1    | 1    | 1    |      |      |      |
| <i>Elymus lanceolatus</i>                                 |      |      | 1    |      |      |      |      | 1    | 2    | 35   |      | 42   |
| <i>Poa pratensis</i> *                                    |      |      | 7    |      |      |      |      |      |      |      | 1    | 9    |
| <i>Spartina pectinata</i>                                 | 47   | 25   | 26   | 21   | 39   | 27   | 37   | 37   | 31   | 32   | 55   | 26   |
| Unknown graminoid   |      |      | 2    | 14   |      | 5    | 1    |      | 4    |      |      |      |
| <b>FORBS</b>  |      |      |      |      |      |      |      |      |      |      |      |      |
| <i>Glycyrrhiza lepidota</i>                               |      | 3    |      |      | 1    |      |      |      |      |      | 26   | 4    |
| Unknown forb  | 3    | 1    | 1    | 5    | 1    | 2    | 2    | 2    | 2    |      | 2    |      |
| <i>Xanthium strumarium</i>                                | 3    |      | 2    | 7    |      | 4    | 2    | 2    |      |      | 1    |      |

### Other *Populus deltoides* ssp. *monilifera* Stands

Several stands dominated in part by *Populus deltoides* ssp. *monilifera* were in severely degraded condition, and remain unclassified. These are described below.

One stand along the Cache la Poudre River (plot 95GK54) occurs just upstream of the confluence with the South Platte River. The Poudre River is entrenched at this point and tiny stands of *Populus deltoides* (35%) and *Salix amygdaloides* (43%) were widely scattered along the narrow and steep banks. The undergrowth is largely weedy with non-natives like *Agropyron cristatum* (34%) and *Phalaroides arundinacea* (11%) (Table 26). Agricultural fields (mostly corn) were planted within 10 meters of the stream bank.

One stand along Fountain Creek in Fountain Creek Regional Park (plot 95AM57) appears to be a degraded occurrence of the similar *Populus deltoides*/*Symphoricarpos occidentalis* plant association described from the lower South Platte River. The Fountain Creek site has many non-native woody species such as Siberian elm (*Ulmus pumila*), Russian olive (*Eleagnus angustifolia*), and crack willow (*Salix fragilis*), as well as an abundant ground cover of non-native grasses, such as red-top (*Agrostis stolonifera*) and smooth brome (*Bromus inermis*) (see Table 26).

A stand along Cottonwood Creek (plot 95AM59) had a few scattered individuals of *Populus deltoides* (9%) with marshy areas in between large boulders. Cottonwood Creek is a steep and narrow stream (A1) with small pockets of riparian vegetation. Patches of wet herbaceous vegetation have *Juncus balticus* (24%), *Carex aquatilis* (6%), *Eleocharis Palustris* (5%), and *Elymus lanceolatus* (2%) (Table 26).

A stand sampled on Felch Creek, (1,970 m/6,448 ft, plot 95AM15), and one on Bear Creek, (2,040 m/6,700 ft, plot 95AM32) represent the transition between the lower montane and plains environments with a mixture of *Populus angustifolia* (19-37%) and *Populus deltoides* (35-39%). The shrub understory is open, and one stand has 32% Hoptree (*Ptelea trifoliata*), a shrub found only in the gulches and canyon bottoms of the lower Arkansas River drainage (Weber 1990). The herbaceous undergrowth is weedy and sparse with *Poa pratensis* (7-26%) and *Agrostis stolonifera* (11%) (Table 26).

Table 26. Percent Canopy Cover of Important Species in *Populus deltoides* ssp. *monilifera* Dominated Stands. See Tables 1 and 2 for Plot Locations. \* = Non-native Species.

| Plot No. (95( ))                                  | GK54 | AM57 | AM59 | AM15 | AM32 |
|---|------|------|------|------|------|
| Riparian Condition Rank                           | D    | C    | B    | B    | B    |
| <b>TREES</b>                                      |      |      |      |      |      |
| <i>Juniperus scopulorum</i> *                     |      |      | 5    | 5    |      |
| <i>Pinus ponderosa</i>                            |      |      |      | 18   |      |
| <i>Populus angustifolia</i>                       |      |      |      | 19   | 37   |
| <i>Populus angustifolia</i> --saplings            |      |      | 2    | 12   |      |
| <i>Populus angustifolia</i> --seedlings           |      |      |      | 5    | 4    |
| <i>Populus deltoides</i>                          | 35   | 25   | 9    | 35   | 39   |
| <i>Salix amygdaloides</i>                         | 43   |      |      |      |      |
| <i>Salix fragilis</i> *                           |      | 79   |      |      |      |
| <i>Ulmus pumila</i> *                             | 5    | 23   |      |      |      |
| <b>SHRUBS</b>                                     |      |      |      |      |      |
| <i>Ptelea trifoliata</i>                          |      |      |      |      | 32   |
| <i>Rhus trilobata</i> var. <i>trilobata</i>       |      |      |      |      | 5    |
| <i>Ribes cereum</i>                               |      |      |      |      | 2    |
| <i>Rubus deliciosus</i>                           |      |      |      | 3    |      |
| <i>Salix exigua</i>                               |      |      | 8    | 3    |      |
| <i>Symphoricarpos occidentalis</i>                |      | 42   |      |      |      |
| <b>GRAMINOIDES</b>                                |      |      |      |      |      |
| <i>Agrostis stolonifera</i> *                     |      | 32   | 14   | 3    | 11   |
| <i>Bromus inermis</i> *                           | 7    | 14   |      |      |      |
| <i>Bromus japonicus</i>                           |      |      | 10   |      |      |
| <i>Carex aquatilis</i>                            |      |      | 6    |      | 1    |
| <i>Eleocharis palustris</i>                       |      |      | 5    |      |      |
| <i>Elymus lanceolatus</i> ssp. <i>lanceolatus</i> |      | 9    | 2    |      |      |
| <i>Juncus balticus</i> var. <i>montanus</i>       |      |      | 24   |      | 4    |
| <i>Poa pratensis</i> *                            |      | 4    | 9    | 26   | 7    |
| <i>Phalaroides arundinacea</i> *                  | 11   |      |      |      |      |
| <b>FORBS</b>                                      |      |      |      |      |      |
| <i>Medicago lupulina</i> *                        |      |      |      | 5    | 3    |
| <i>Mentha arvensis</i>                            |      |      | 2    |      |      |
| <b>HORSETAILS</b>                                 |      |      |      |      |      |
| <i>Equisetum arvense</i>                          |      |      | 14   |      | 5    |

### *Salix amygdaloides* Alliance

No plant associations were found within this Alliance. *Salix amygdaloides* becomes more common on small tributary streams draining the Black Forest, however, these are for the most part scattered individuals or small clumps. Large stands of any significant size are rare, and in general, when the creek becomes large enough to support many trees, *Populus deltoides* or *Populus x acuminata* are also present.

Two stands sampled along West Kiowa Creek (plots 95GK08, 95GK09) have a diverse overstory canopy of *Salix amygdaloides* (55-60%), *Populus angustifolia* (0-14%), and *Salix fragilis* (0-6%). A sparse canopy of shrubs consists of *Salix eriocephala* (12%), *S. lucida* ssp. *caudata* (17%), *Symphoricarpos occidentalis* (2%), and *Ribes inerme* (1%) (Table 27). The floodplain was under about 6 inches of water during sampling, and a significant amount of *Carex lanuginosa* (10-31%) in the undergrowth indicates this site is wet for much of the growing season. The stands are located near the confluence of West Kiowa Creek with Kiowa Creek. A nearby rock outcrop to the west may contribute run off, as the site is a low, entrenched floodplain pooling runoff from several directions before draining to the north.

Table 27. Percent Canopy Cover for important species in the *Salix amygdaloides* Alliance. See Table 1 for Plot Locations. \* = Non-native Species.

| Plot Number (95 _____)                           | GK08 | LS12 |
|--|------|------|
| Occurrence Rank                                  | C    | B/C  |
| <b>TREES</b>                                     |      |      |
| <i>Populus angustifolia</i> --mature trees       |      | 14   |
| <i>Salix amygdaloides</i> --mature trees         | 55   | 61   |
| <i>Salix amygdaloides</i> --seedlings            |      | 3    |
| <i>Salix fragilis</i> *                          | 6    |      |
| <b>SHRUBS and VINES</b>                          |      |      |
| <i>Ribes inerme</i>                              | 1    | 1    |
| <i>Salix lucida</i> ssp. <i>caudata</i>          | 17   |      |
| <i>Salix eriocephala</i> var. <i>ligulifolia</i> | 12   |      |
| <i>Symphoricarpos occidentalis</i>               |      | 2    |
| <b>GRAMINOIDES</b>                               |      |      |
| <i>Bromus inermis</i> *                          | 9    | 32   |
| <i>Carex lanuginosa</i>                          | 31   | 38   |
| <i>Carex nebrascensis</i>                        | 5    |      |
| <i>Pascopyrum smithii</i>                        |      | 5    |
| <i>Poa pratensis</i> *                           | 26   | 3    |

UNESCO: III.B.3.c. DECIDUOUS ALLUVIAL SHRUBLANDS  
COWARDIN: PALUSTRINE SYSTEM-SCRUB-SHRUB, DECIDUOUS SHRUBLAND

*Alnus incana* spp. *tenuifolia* Alliance

Thin-leaf alder/mesic graminoid (*Alnus incana*/mesic graminoid) Plant Association

CNHP Rank: G2G3/S3

7 Plots--95AM17, 95AM28 95RR17, 95GK71, 95GK72, 95AM04, 95AM26.

**Reference Reaches:** No reference or high quality reaches exist because this type appears to be a grazing induced association. Examples can be seen on BLM lands along Barnard Creek in Box Canyon, T15S, R70W, Sec 8, and on Eightmile Creek in Phantom Canyon along State Highway 67, T17S, R69W, Sec 15.

**General Description and Comments:** The *Alnus incana*/mesic graminoid plant association is comprised of medium tall deciduous shrub/tree stands with thick herbaceous cover of mostly introduced grasses. Forbs usually include increaser species such as *Heracleum sphondylium*. Undisturbed stands have abundant native forbs and grasses, while stands disturbed by season-long grazing have much reduced forb cover and an increase in non-native grasses, for example, *Poa pratensis* and *Agrostis stolonifera*. The *Alnus incana*/mesic graminoid type described by Padgett *et al.* (1989), Manning and Padgett (1995), and Jones (1992) is considered a grazing induced community, derived from the *Alnus incana*/mesic forb plant association. An understory dominated by native, wetland indicator species, such as *Calamagrostis canadensis*, *Glyceria*, *Carex*, and *Equisetum* spp. may comprise the *Alnus incana* dominated Closed Tall Shrub Swamp plant association as described by Viereck *et al.* (1992).

**Regional Distribution:** This plant association is reported from Nevada (Manning and Padgett 1995), Oregon (Kovalchik 1987), Utah (Padgett *et al.* 1989), Wyoming (Jones 1992), Montana (Hansen *et al.* 1995), and Colorado (Johnston 1987, Kettler and McMullen 1996). Stands dominated by *Alnus tenuifolia* (= *A. incana*) have been reported from Alaska (Viereck *et al.* 1992), but these occur in very wet swampy areas with an understory of *Calamagrostis canadensis* and *Equisetum* spp.

**Distribution in Colorado:** This association has been observed on the western slope (Kittel *et al.* 1994) and along the Colorado Front Range (Copper and Cottrell 1990). Other closely related *Alnus incana* plant associations also occur throughout the montane region of Colorado (Johnston 1987, Kittel and Lederer 1993, Kittel *et al.* 1994, 1995). Occurrences of *Alnus* stands with the same name have been reported from Routt National Forest (Kettler and McMullen 1996), however these stands have native graminoides in the undergrowth and are probably represent a different association.

*The following characteristics are based on plots and observations from parts of the upper Arkansas River Basin, Colorado.*

**Vegetation:** *Alnus incana* dominates the upper canopy with 11-88% canopy cover. Other shrubs present may also include *Betula occidentalis* (0-8%), *Cornus sericea* (0-33%), and *Rubus* spp. (0-22%). The undergrowth is a thick carpet of grasses and forbs, most of the biomass dominated by introduced, non-native grasses, such as *Bromus inermis* (0-23%), *Poa pratensis* (0-45%), and *Agrostis stolonifera* (0-25%). Native graminoids present include *Glyceria striata*, *Festuca rubra*, and *Carex lamuginosa* (Table 28).

**Elevation:** 1,950-2,440 m (6,400-8,000 ft).

**Site Geomorphology:** Thick *Alnus* stands with developed herbaceous undergrowth tend to occur on narrow to moderately wide floodplains and stream benches that are flat with little microtopography. More open stands with stronger willow components occur on more frequently flooded pointbars and recently deposited fluvial deposits, or along dredged stream banks.

**Rosgen's Channel Type:** Stream channels tend to be fast moving (3-8% gradient) and straight to somewhat sinuous (A3, B2). This type can occur on streams of lesser gradients (1%) with greater sinuosity (C5), where it occurs on point bars.

**Soil:** Soils of this plant association are mostly coarse alluvium, but characteristically have silt loams or sandy clay loams at the surface with a high amount of organic matter. Soils are shallow (35-53 cm) and become increasingly skeletal with depth. Most profiles sampled had 10-50% mottles between 18 and 25 cm depth.

**Adjacent Riparian Vegetation:** Adjacent riparian communities can be stands of *Populus angustifolia*, *Betula occidentalis*, or *Salix exigua*.

**Adjacent Upland Vegetation:** Adjacent up slope communities include *Pinus ponderosa*, *Pseudotsuga menziesii* or *Pinus edulis* woodlands.

**Successional Trends and Ecological Processes:** *Alnus incana* becomes established on fresh, coarse alluvial deposits and along naturally disturbed reaches. Stands often have little soil development and are frequently flooded. Stands on Monument Creek (plot 95AM26) may represent this scenario. Alder is often one of the first woody species to colonize stream dredge pilings. With continued flooding after establishment, finer soils can develop and forbs increase. The *Alnus incana*/mesic graminoid type described by Padgett *et al.* (1989), Manning and Padgett (1995), and Jones (1992) is considered a grazing induced community, derived from the *Alnus incana*/mesic forb plant association.

**Management:** Season-long grazing by livestock reduces the native forb cover and allows non-native grasses to increase. With rotation and rest, this type can be reverted back to the *Alnus incana*/mesic forb plant association.

**Related Types:** The *Alnus incana*/mesic graminoid plant association has been described by

Jones (1992) Padgett *et al.* (1989), Manning and Padgett (1995) and by Kettler and McMullen (1996). The *Alnus incana*/mesic graminoid type described here appears to be a grazing induced type from the *Alnus incana*/mesic forb plant association. Stands of the *Alnus incana*/mesic graminoid type described by Kettler and McMullen (1996) occur on seeps and gleyed soils of the North Platte River, show no signs of disturbance, and are dominated by native grasses in the undergrowth, mainly *Calamagrostis canadensis*, several *Carex* species, and *Equisetum* spp.. This type may be more closely related to the stands of the Closed Tall Shrub Swamp described from Alaska (Viereck *et al.* 1992), which is dominated by *Alnus tenuifolia* (= *A. incana*) and occur in very wet swampy areas.

Table 28. Percent Canopy Cover of Important Species in the *Alnus incana*/mesic graminoid Plant Association. See Tables 1 and 2 for Plot Locations. \* = Non-native Species.

| Plot No. ( )                                       | AM17 | RR17 | AM28 | GK71 | GK72 | AM04 | AM26 |
|--|------|------|------|------|------|------|------|
| Occurrence Rank                                    | B    | B    | B    | C    | C    | B    | B    |
| <b>TREES</b>                                       |      |      |      |      |      |      |      |
| <i>Populus angustifolia</i>                        |      |      |      |      |      | 7    |      |
| <i>Populus deltoides</i> spp.<br><i>monilifera</i> |      |      |      |      | 22   | 1    |      |
| <i>Salix fragilis</i> *                            |      |      |      | 14   | 20   |      |      |
| <b>SHRUBS</b>                                      |      |      |      |      |      |      |      |
| <i>Acer glabrum</i>                                |      |      | 6    |      |      |      |      |
| <i>Alnus incana</i> ssp. <i>tenuifolia</i>         | 52   | 66   | 88   | 85   | 84   | 11   | 22   |
| <i>Holodiscus dumosus</i>                          |      | 8    |      |      |      |      |      |
| <i>Rubus deliciosus</i>                            | 3    | 22   |      |      |      | 1    |      |
| <i>Rubus idaeus</i>                                |      | 1    |      |      |      | 1    |      |
| <i>Salix exigua</i>                                | 15   |      |      | 6    |      | 15   | 17   |
| <i>Salix monticola</i>                             |      |      |      | 1    | 7    |      | 16   |
| <i>Symphoricarpos occidentalis</i>                 |      |      |      | 12   | 1    |      |      |
| <b>GRAMINOIDES</b>                                 |      |      |      |      |      |      |      |
| <i>Agrostis stolonifera</i> *                      |      |      | 1    | 16   | 25   |      | 4    |
| <i>Bromus inermis</i> *                            |      |      |      | 4    | 23   |      |      |
| <i>Carex lanuginosa</i>                            |      |      |      |      |      |      | 31   |
| <i>Carex microptera</i>                            |      |      |      |      |      |      | 3    |
| <i>Elytrigia repens</i> *                          | 18   | 5    |      |      |      |      |      |
| <i>Festuca rubra</i>                               |      | 23   |      |      |      |      |      |
| <i>Glyceria striata</i>                            |      |      | 26   |      |      |      |      |
| <i>Poa pratensis</i> *                             | 13   | 12   | 37   | 16   | 17   | 2    |      |
| <b>FORBS</b>                                       |      |      |      |      |      |      |      |
| <i>Geum macrophyllum</i>                           |      | 1    | 3    | 1    | 1    |      |      |
| <i>Heracleum sphondylium</i>                       | 11   | 6    |      |      |      |      |      |
| <i>Ranunculus</i> sp.                              |      |      | 5    |      |      | 2    |      |
| <i>Solidago</i> sp.                                |      |      |      | 9    |      |      | 5    |
| <i>Taraxacum officinale</i> *                      | 1    | 1    | 5    | 1    | 1    | 2    |      |
| <i>Trifolium repens</i> *                          | 1    |      | 1    |      |      | 6    |      |
| <b>HORSETAILS</b>                                  |      |      |      |      |      |      |      |
| <i>Equisetum arvense</i>                           |      | 1    |      | 1    |      | 6    | 14   |

**Thin-leaf Alder/mesic forb (*Alnus incana*/mesic forb) Plant Association**

CNHP Rank: G3/S3

1 plot--95GK22

**Reference Reaches:** A good, yet small example of this type can be seen in Winger Gulch, just before it drains into Gross Reservoir in Boulder County, T1S, R71W, Sec 19.

**General Description and Comments:** The *Alnus incana*/mesic forb plant association is comprised of medium tall deciduous shrub/tree stands with thick herbaceous cover rich in forbs and wetland-indicator grasses. A low canopy of smaller shrubs may also be present, with *Ribes* spp., *Salix* spp. or *Cornus sericea*. Undisturbed stands have abundant forbs and native grasses, while stands disturbed by season-long grazing have much reduced forb cover and an increase in non-native grasses, such as *Poa pratensis* and *Agrostis stolonifera*.

**Regional Distribution:** This plant association is reported from Nevada (Manning and Padgett 1995), Oregon (Kovalchik 1987), Utah (Padgett *et al.* 1989), Wyoming (Youngblood *et al.* 1985), Montana (Hansen *et al.* 1995), and Colorado (Johnston 1987, Kettler and McMullen 1996, Kittel and Lederer 1993, Kittel *et al.* 1994, 1995). Stands dominated by *Alnus tenuifolia* (= *A. incana*) have been reported from Alaska (Viereck *et al.* 1992), but these occur in very wet swampy areas with an understory of *Calamagrostis canadensis* and *Equisetum* spp.

**Distribution in Colorado:** The *Alnus incana*/mesic forb plant association is abundant in the north central mountains of Routt National Forest (Johnston 1987, Kettler and McMullen 1996, Kittel and Lederer 1993). Other stands have been reported from the White, Colorado and Gunnison River basins (Johnston 1987, Kittel *et al.* 1994, 1995). It has also been reported from the Colorado Front Range as *Alnus incana*/*Rudbeckia lanciniata* (Cooper and Cottrell 1990).

*The following characteristics are based on plots and observations from the South Platte River Basin.*

**Vegetation:** *Alnus incana* is a tall shrub to small tree, dominating the canopy with 70% cover. Other low shrubs present include *Salix monticola* and *Betula occidentalis* (5% each). The ground is very wet and covered in tall (1-2 m) forbs and graminoids. Species include *Glyceria* spp. (25%), *Heracleum lanatum* (22%), *Rudbeckia lanciniata* (16%), *Angelica parryi* (16%) and *Viola canadensis* (13%) (Table 29).

**Elevation:** 2,300 m (7,560 ft).

**Site Geomorphology:** This plant association occurs along narrow to moderately wide stream benches and floodplains. The one stand sampled in Boulder County occurs in a fairly steep and narrow gulch, with several small, unnamed tributaries flowing into it. The stream channel is very narrow (3 m) and the narrow, flat floodplain is wet from lateral seepage.

**Rosgen's Channel Type:** Stands of *Alnus incana* are usually along steep streams with little floodplain development (A3).

**Soil:** The soil is a shallow sandy loam with 40% organic matter in the surface layer. The water table was at 16 cm on July 18, 1995. Coarse fragments approached 90 % at 25 cm depth and included both rounded and angular pieces.

**Adjacent Riparian Vegetation:** Small pockets of *Populus angustifolia* occur up and down the stream. Winger Gulch had *Alnus incana* running most of its length.

**Adjacent Upland Vegetation:** Open woodlands of *Pinus ponderosa* and *Juniperus osteosperma* occur on south facing slopes, while thick forests of *Pseudotsuga menziesii* and *Pinus contorta* occur on north facing slopes.

**Successional Trends and Ecological Processes:** *Alnus incana* becomes established on fresh, coarse alluvial deposits and along disturbed reaches. Stands often have little soil development and are frequently flooded. Alder is often one of the first woody species to colonize stream dredge pilings. With continued flooding after establishment, finer soils can develop and forbs increase.

**Management:** Season-long grazing by livestock reduces the native forb cover and allows non-native grasses to increase, and may change the site to an *Alnus incana*/mesic graminoid community. With rotation and rest, this type may be reverted back to the *Alnus incana*/mesic forb plant association (Padgett *et al.* 1989, Hansen *et al.* 1995).

**Related Types:** The *Alnus incana*/mesic forb plant association has been reported by a variety of names that appear to all be very similar. These are: *Alnus incana*/mesic forb community type (Manning and Padgett 1995, Padgett *et al.* 1989), *Alnus incana* and *Alnus incana* Springs associations (Kovalchik 1987), *Alnus incana*/*Ribes hudsonianum* community type (Youngblood *et al.* 1985), *Alnus incana* community type (Hansen *et al.* 1995), *Alnus incana*-*Betula fontinalis*/*Salix* spp. and *Alnus incana*-*Salix drummondiana*/*Equisetum arvense* plant associations (Johnston 1987), and the *Alnus incana*/mesic forb plant association (Kittel and Lederer 1993, Kittel *et al.* 1994, 1995, and Kettler and McMullen 1996). Stands dominated by *Alnus tenuifolia* (= *A. incana*) have been reported from Alaska (Viereck *et al.* 1992), but these occur in very wet swampy areas with an understory of *Calamagrostis canadensis* and *Equisetum* spp.

Table 29. Percent Canopy Cover of Important Plant Species in the *Alnus incana*/Mesic Forb Plant Association. See Table 1 for Plot Location. \* = Non-native Species.

| Plot No. ( )                                 | GK22 |
|--|------|
| Occurrence Rank                              | B    |
| <b>SHRUBS</b>                                |      |
| <i>Alnus incana</i> ssp. <i>tenuifolia</i>   | 71   |
| <i>Betula occidentalis</i>                   | 6    |
| <i>Ribes inerme</i>                          | 1    |
| <i>Salix bebbiana</i>                        | 5    |
| <i>Salix monticola</i>                       | 16   |
| <b>GRAMINOIDES</b>                           |      |
| <i>Carex microptera</i>                      | 1    |
| <i>Elytrigia intermedia</i> *                | 1    |
| <i>Glyceria</i> sp.                          | 26   |
| <b>FORBS</b>                                 |      |
| <i>Angelica</i> sp.                          | 16   |
| <i>Claytonia</i> sp.                         | 4    |
| <i>Heracleum lanatum</i>                     | 23   |
| <i>Hydrophyllum fendleri</i>                 | 13   |
| <i>Mertensia ciliata</i>                     | 21   |
| <i>Ranunculus</i> sp.                        | 1    |
| <i>Rudbeckia laciniata</i> var. <i>ampla</i> | 16   |
| <i>Urtica dioica</i> ssp. <i>gracilis</i>    | 3    |
| <i>Viola canadensis</i>                      | 13   |
| <b>HORSETAILS</b>                            |      |
| <i>Equisetum</i> sp.                         | 1    |

**Thin-leaf Alder-Red Osier Dogwood (*Alnus incana*-*Cornus sericea*) Plant Association**

**CNHP Rank: G4/S3**

**1 Plot--95GK74**

**Reference Reaches:** No reference reaches were found in the study area, however a small occurrence can be seen on the Air Force Academy Grounds, along West Monument Creek, T12S, R67W, Sec 36.

**General Description and Comments:** The *Alnus incana*-*Cornus sericea* plant association is a narrow thicket of medium to tall shrubs lining the stream bank. It is an uncommon association restricted to narrow tributaries and stream benches. Due to the dense shading there is usually little herbaceous foliage in the undergrowth.

**Regional Distribution:** This type is reported from the La Sal Mountains and high central plateaus of Utah and eastern Nevada (Padgett *et al.* 1989, Manning and Padgett 1995).

**Distribution in Colorado:** This plant association has been reported from the Gunnison, White, Yampa, and San Juan River basins (Johnston 1987, Kittel *et al.* 1994, 1995, Kittel and Lederer 1993, Richard *et al.* 1996), while similar stands are reported from the Colorado Front Range (Kittel 1994, Cooper and Cottrell 1990).

*The following characteristics are based on plots and observations from parts of the upper Arkansas River Basin, Colorado.*

**Vegetation:** This association consists of a thick bands of shrubs with *Alnus incana* (34%), *Cornus sericea* (33%), *Salix bebbiana* (8%), *Betula occidentalis* (8%), and others. The herbaceous undergrowth is fairly rich, with a heavy cover of *Poa pratensis* (45%), along with *Rudbeckia laciniata* (9%) and *Apocynum androsaemifolium* (5%) (Table 30).

**Elevation:** 2,010 m (6,580 ft).

**Site Geomorphology:** This plant association occupies narrow streams with narrow floodplains, and generally well armored stream beds and banks (Padgett *et al.* 1989, Manning and Padgett 1995).

**Rosgen's Channel Type:** This plant association is typically found on narrow, steep reaches (A2, A4).

**Soil:** No soils data is available from the study area.

**Adjacent Riparian Vegetation:** The *Pseudotsuga menziesii*/*Cornus sericea* plant association can occur on adjacent narrow reaches, with *Salix exigua* along wider reaches. Typically the *Alnus incana*-*Cornus sericea* type will be the only riparian community along the reach.

**Adjacent Upland Vegetation:** Adjacent hillsides may have *Pinus ponderosa* woodlands or *Quercus gambelii* shrublands.

**Successional Trends and Ecological Processes:** The *Alnus incana-Cornus sericea* plant association is an early-seral type that occurs adjacent to streams and frequently has seasonal flooding. It appears to be a stable, long-lived type, and invasions and succession to other types may be very slow (Manning and Padgett 1995). Both dominant species are excellent bank stabilizers.

**Management:** This type provides stream bank stability, and excellent wildlife habitat. *Cornus sericea* generally has a low forage value for livestock and a high value for erosion control (Manning and Padgett 1995).

**Related Types:** The *Alnus incana/Cornus sericea* type reported by Padgett *et al.* (1989) and Manning and Padgett (1995) is very similar to the Colorado occurrences. Similar types with slightly more diverse shrub layers that include *Betula occidentalis* have been reported from Colorado by Johnston (1987), Kittel *et al.* (1994), (1995), and Kittel and Lederer (1993). The *Alnus incana/Rudbeckia laciniata* type described by Cooper and Cottrell (1990) has a much more diverse forb undergrowth, as does the *Alnus incana-Betula occidentalis* type described by Kittel (1994).

Table 30. Percent Canopy Cover of Important Plant Species in the *Alnus incana-Cornus sericea* Plant Association. See Table 1 for Plot Location. \* = Non-native Species.

| Plot No. ( )                               | GK74 |
|--|------|
| Occurrence Rank                            | C    |
| <b>TREES</b>                               |      |
| <i>Eleagnus angustifolia</i> *             | 1    |
| <b>SHRUBS</b>                              |      |
| <i>Alnus incana</i> ssp. <i>tenuifolia</i> | 34   |
| <i>Betula occidentalis</i>                 | 8    |
| <i>Cornus sericea</i>                      | 33   |
| <i>Humulus lupulus</i>                     | 1    |
| <i>Physocarpus monogynous</i>              | 1    |
| <i>Ribes inerme</i>                        | 2    |
| <i>Rosa woodsii</i>                        | 2    |
| <i>Rubus deliciosus</i>                    | 1    |
| <i>Rubus idaeus</i>                        | 9    |
| <i>Salix bebbiana</i> *                    | 8    |
| <i>Symphoricarpos occidentalis</i>         | 5    |
| <b>GRAMINOIDES</b>                         |      |
| <i>Agrostis stolonifera</i> *              | 8    |
| <i>Bromus inermis</i> *                    | 10   |
| <i>Poa pratensis</i> *                     | 45   |
| <b>FORBS</b>                               |      |
| <i>Apocynum cannabinum</i>                 | 4    |
| <i>Cirsium</i> sp.                         | 2    |
| <i>Convolvulaceae</i> sp.                  | 3    |
| <i>Geranium richardsonii</i>               | 1    |
| <i>Geum macrophyllum</i>                   | 4    |
| <i>Linaria vulgaris</i> *                  | 1    |
| <i>Maianthemum stellatum</i>               | 1    |
| <i>Prunella vulgaris</i> *                 | 1    |
| <i>Taraxacum officinale</i> *              | 1    |
| <b>HORSETAILS</b>                          |      |
| <i>Equisetum arvense</i>                   | 2    |

## Unclassified *Alnus incana* Dominated Stands

Two stands along West Plum Creek (95LS14, 95GK14) occur on raised banks or ridges adjacent to the channel. The ground is steeply sloping so the vegetation changes rapidly from streamside to higher ground that is dominated by more xeric species. Significant amounts of *Symphoricarpos* may represent transitional stands from immediate mesic river banks to the drier upland habitats (Table 31).

Table 31. Percent Canopy Cover of Important Species in *Alnus incana*-*Salix* spp. Dominated Stands. See Table 1 for Plot Locations. \* = Non-native Species.

| Plot Number (95____)   | GK14 | LS14 |
|--|------|------|
| Occurrence Rank  | B    | C    |
| <b>TREES</b>   |      |      |
| <i>Populus deltoides</i> ssp. <i>monilifera</i> --mature trees |      | 2    |
| <i>Quercus gambelii</i>  | 2    |      |
| <i>Salix amygdaloides</i> --mature trees                       | 1    | 3    |
| <b>SHRUBS</b>  |      |      |
| <i>Alnus incana</i> ssp. <i>tenuifolia</i>                     | 18   | 25   |
| <i>Crataegus succulenta</i>                                    | 16   |      |
| <i>Humulus lupulus</i>   | 4    |      |
| <i>Ribes aureum</i>  | 2    |      |
| <i>Rosa woodsii</i>  | 7    | 2    |
| <i>Salix exigua</i>  | 15   | 14   |
| <i>Salix eriocephala</i> var. <i>ligulifolia</i>               | 1    | 45   |
| <i>Symphoricarpos occidentalis</i>                             | 42   | 20   |
| <i>Toxicodendron rydbergii</i>                                 | 5    |      |
| <b>GRAMINOIDES</b>   |      |      |
| <i>Bromus inermis</i> *  | 20   | 40   |
| <i>Carex lanuginosa</i>  | 40   | 10   |
| <i>Eleocharis palustris</i>                                    | 3    |      |
| <i>Poa pratensis</i> *   | 17   | 12   |
| <b>FORBS</b>   |      |      |
| <i>Ambrosia dumosa</i>   | 5    |      |
| <i>Apocynum androsaemifolium</i>                               |      | 3    |
| <i>Cirsium arvense</i> *                                       | 4    |      |
| <i>Euphorbia esula</i> var. <i>uralensis</i>                   |      | 6    |
| <i>Mentha arvensis</i>   | 3    |      |

*Betula occidentalis* Alliance

**River Birch/Mesic forb (*Betula occidentalis*/Mesic forb) Plant Association**

CNHP Rank: G3/S3

11 plots-- 95AM20, 95AM21, 95AM33, 95RR04, 95RR19, 95RR21, 95RR22, 95GK21, 95GK24, 95LS20, 95LS22.

**Reference Reaches:** One reference reach can be seen within the Dome Rock State Wildlife Park on Fourmile Creek, T14S, R70W, Sec 15. This occurrence is about ½ mile long and is in excellent condition.

**General Description and Comments:** The *Betula occidentalis* Plant association is distinguished by a thick, closed to nearly closed, canopy of *Betula occidentalis* tall shrubs. The undergrowth is primarily a thick carpet of grasses and forbs. Forb species richness can be high, with over 30 species in one stand. In fact, more than 60 forb species were tallied for this type, however only the most common ones are listed in Table 32. At higher elevations, conifer trees on valley sides intermingle with the birch at the stream bank (see plots 95GK21, 95GK24, 95LS20, and 95LS22, Table 32).

**Regional Distribution:** The *Betula occidentalis*/Mesic forb plant association has been reported from Nevada, Utah, Montana, and Colorado (Manning and Padgett 1995, Padgett *et al.* 1989, Hansen *et al.* 1995, Kittel *et al.* 1994, 1995).

**Distribution in Colorado:** This type has been reported from the Gunnison and Colorado River basin on the western slope (Kittel *et al.* 1994, 1995), and from the Colorado Front Range (Cooper and Cottrell 1990, Kittel 1994).

*The following characteristics are based on plots and observations from parts of the upper Arkansas and South Platte River Basins, Colorado.*

**Vegetation:** *Betula occidentalis* makes an almost continuous tall-shrub to small-tree canopy along the stream banks with 14-85% cover. Other shrubs present may include *Alnus incana* (0-20%), *Salix exigua* (0-25%), *S. monticola* (0-20%) and *Jamesia americana* (0-21%). Along narrow valleys at higher elevations, conifers may overhang the birch along the stream edge. These include *Abies lasiocarpa* (0-30%), *Picea pungens* (0-8%), and *Pseudotsuga menziesii* (0-66%). The undergrowth is typically a thick carpet of mesic grasses and forbs. Most species do not comprise more than 5-10% cover, but collectively they comprise significant cover. Total cover by forb species ranges from 5% to 50%. Table 32 shows only those species with 5% or greater cover, or that occurred in at least 3 plots.

**Elevation:** 1,940-2,600 m (6,370-8,520 ft).

**Site Geomorphology:** This plant association occupies moderately wide stream benches and

floodplains in moderately wide to narrow valleys. Well-developed (large) occurrences occupy relatively flat stream benches at lower elevations along sunny valley bottoms. This association also occurs along narrow margins of steep, narrow streams which lack floodplains where the valley slopes meet the stream edge. In these stands the birch and trees are squeezed between large boulders, and any herbaceous growth is limited to small pockets (see plots 95GK21, 95GK24, 95LS20, and 95LS22, Table 32).

**Rosgen's Channel Type:** Stands occur along moderately steep to steep streams with little floodplain development (mostly B2, B3, and B4, with some A2). Some streams are wider and less steep with greater floodplain development (C).

**Soil:** Soils are fairly shallow, ranging from 28 to >60 cm. Most soils have a 5-20 cm thick surface layer of 50-90% organic matter. Subsurface layers are consistently clay loams to sandy loams. Most profiles had signs of saturation (mottles) at about 10-25 cm depth. The water table was located at 50 cm in two profiles. All profiles had skeletal layers at depth, being derived from alluvium. Stands along steep streams (plots 95GK21, 95GK24, 95LS20, and 95LS22) have almost no soil development, occurring between large alluvial and colluvial boulders.

**Adjacent Riparian Vegetation:** Stands of *Populus angustifolia/Alnus incana* occur on adjacent wider floodplains, *Salix exigua* on local sand bars, and open hay meadows on cultivated floodplains. *Betula occidentalis*/mesic forb can also be the only association along narrow reaches.

**Adjacent Upland Vegetation:** Adjacent up slope communities include *Pinus edulis-Juniperus osteosperma* and *Pinus ponderosa* woodlands on south facing slopes, and *Pseudotsuga menziesii* and mixed *Abies* and *Pinus* spp. forests on north facing slopes.

**Successional Trends and Ecological Processes:** *Betula occidentalis*/Mesic forb plant association is considered a mid-seral type. *Betula occidentalis* is highly adapted to disturbance and will increase with continued flooding. With heavy grazing it may succeed to a *Salix geyeriana* dominated association (Hansen *et al.* 1995). In wetter sites the undergrowth potential may be for mesic grasses such as *Calamagrostis canadensis* and *Carex* spp., and may belong to a new *Betula occidentalis* plant association.

**Management:** Without heavy grazing this type has a lush undergrowth dominated by native grasses and forbs. With season-long grazing, however, non-native grasses, such as *Poa pratensis* and *Agrostis stolonifera*, may begin to dominate the undergrowth. Browsing by cattle may reduce the stream bank stability by weakening the root system of *Betula*.

**Related Types:** Identical types (*Betula occidentalis*/mesic forb) have been described by Padgett *et al.* (1989), Manning and Padgett (1995), Kittel *et al.* (1994), and Kittel *et al.* (1995). Stands classified within the *Betula occidentalis-Cornus sericea* described by Padgett *et al.* (1989) may be very similar to this association although it has some *Cornus sericea*. Hansen *et al.* (1995)

describe a *Betula occidentalis* community type that appears to be very similar, but includes degraded stands dominated by non-native grasses in the undergrowth. Kittel (1994) describes a mixed *Alnus incana*-*Betula occidentalis* type from the Cache la Poudre River that includes stands with nearly pure *Betula* cover. Johnston (1987) describes an *Alnus incana*-*Betula fontinalis* type from north central Colorado and southeastern Wyoming that may include stands similar to ours. In the stands described here, *Alnus* is a fringe species.

Table 32. Percent Canopy Cover of Important Plant Species in the *Betula occidentalis*/Mesic Forb Plant Association. See Tables 1 and 2 for Plot Locations. \* = Non-native Species.

| Plot No. (95___)                                | AM20      | AM21      | AM33      | RR04     | RR19      | RR21      | RR22     | GK21      | GK24      | LS20     | LS22      |
|---|-----------|-----------|-----------|----------|-----------|-----------|----------|-----------|-----------|----------|-----------|
| Occurrence Rank                                 | B         | B         | A         | B        | A         | B         | C        | B         | B         | B        | B         |
| <b>TREES</b>                                    |           |           |           |          |           |           |          |           |           |          |           |
| <i>Abies lasiocarpa</i>                         |           |           |           |          |           |           |          |           |           | 30       |           |
| <i>Juniperus scopulorum</i>                     |           | 10        |           |          |           | 17        |          |           | 14        |          | 3         |
| <i>Picea pungens</i>                            |           |           | 8         |          |           |           |          |           |           |          |           |
| <i>Pinus ponderosa</i>                          |           | 17        |           | 11       |           |           |          | 10        |           | 7        |           |
| <i>Populus deltoides</i> spp. <i>monilifera</i> |           |           |           | 15       |           |           |          |           |           |          |           |
| <i>Pseudotsuga menziesii</i>                    |           |           |           |          | 1         |           |          | 22        |           |          | 66        |
| <b>SHRUBS</b>                                   |           |           |           |          |           |           |          |           |           |          |           |
| <i>Alnus incana</i>                             | 3         |           |           | 1        |           | 18        | 1        | 17        | 7         | 9        |           |
| <i>Betula occidentalis</i>                      | 37        | 55        | 78        | 85       | 80        | 36        | 92       | 24        | 37        | 31       | 14        |
| <i>Jamesia americana</i>                        |           |           | 5         |          |           |           |          |           | 8         | 13       | 21        |
| <i>Lonicera involucrata</i>                     |           |           |           |          |           | 8         |          |           |           |          |           |
| <i>Pentaphylloides floribunda</i>               | 5         |           | 1         |          |           | 16        |          |           |           |          |           |
| <i>Physocarpus monogynous</i>                   |           | 1         |           |          |           |           |          | 11        |           | 6        | 1         |
| <i>Prunus virginiana</i>                        |           |           |           |          |           |           |          | 6         |           | 3        |           |
| <i>Ribes cereum</i>                             |           |           |           |          |           |           | 5        |           |           |          | 6         |
| <i>Rosa woodsii</i>                             | 1         | 5         | 3         |          |           |           |          | 2         | 1         | 1        |           |
| <i>Salix exigua</i>                             | 16        | 1         |           | 5        |           |           |          |           | 25        |          |           |
| <b>GRAMINOIDES</b>                              |           |           |           |          |           |           |          |           |           |          |           |
| <i>Agrostis stolonifera</i> *                   |           |           | 13        |          | 7         |           |          |           | 4         |          | 4         |
| <i>Calamagrostis canadensis</i>                 | 14        |           |           |          |           |           |          |           | 16        |          |           |
| <i>Carex aquatilis</i>                          |           | 7         |           | 4        |           | 7         |          |           |           |          |           |
| <i>Carex utriculata</i>                         |           |           |           |          |           | 23        |          |           |           |          |           |
| <i>Juncus balticus</i> var. <i>montanus</i>     | 12        | 6         | 5         | 3        | 1         | 17        |          |           | 1         |          |           |
| <i>Poa pratensis</i> *                          | 34        | 6         | 12        |          | 1         |           | 1        |           |           |          |           |
| <b>TOTAL FORB COVER</b>                         | <b>50</b> | <b>15</b> | <b>50</b> | <b>7</b> | <b>47</b> | <b>18</b> | <b>1</b> | <b>43</b> | <b>40</b> | <b>5</b> | <b>10</b> |
| <i>Aralia nudicaulis</i>                        |           |           |           |          |           |           |          |           | 39        |          |           |
| <i>Cardamine breweri</i>                        |           |           |           |          |           | 10        |          |           |           |          |           |
| <i>Heracleum sphondylium</i>                    | 1         |           | 29        | 1        | 34        | 1         |          |           | 1         |          |           |
| <i>Maianthemum stellatum</i>                    | 40        | 4         |           |          |           | 1         |          |           |           |          |           |
| <i>Rudbeckia laciniata</i>                      |           |           | 2         | 1        |           | 2         |          |           |           |          | 1         |
| <i>Solidago</i> sp.                             | 9         |           |           |          |           |           |          |           | 3         |          |           |
| <b>HORSETAILS</b>                               |           |           |           |          |           |           |          |           |           |          |           |
| <i>Equisetum arvense</i>                        |           | 1         | 8         | 4        | 1         | 1         |          |           | 36        |          | 23        |
| <i>Equisetum hyemale</i>                        |           | 4         |           | 2        |           |           |          |           | 4         |          |           |

*Salix drummondiana* Alliance

Drummond's willow/mesic forb (*Salix drummondiana*/mesic forb) Plant Association

CNHP Rank: G4/S4

2 Plots--95AM42, 95LS18

**Reference Reaches:** No high quality reaches were found, but a fair example can be seen on BLM land on Birdseye Gulch, across from highway 91, T8S, R79W, Sec 34.

**General Description and Comments:** *Salix drummondiana* grows in steeper reaches than all other willows, often along boulder-filled streams. In narrow canyons and gulches, it can form solid bands along the stream edge. It almost never forms broad willow carrs, or shrublands. *Salix drummondiana* can be difficult to distinguish without catkins from its look-alike willow, *Salix geyeriana*. Both are tall (>2 m) montane willows with strongly prunose twigs (a waxy bloom that rubs off, like on a plum). *Salix geyeriana* can be distinguished from *Salix drummondiana* vegetatively by the width of the mature leaves; they are never more than 13 mm wide on non-sucker shoots (Welsh *et al.* 1987). While *Salix drummondiana* does intermix with other willows, it generally becomes the sole dominant in thick bands on steep, narrow stream banks.

**Regional Distribution:** This association has been reported from Nevada, Utah and Colorado (Manning and Padgett 1995, Padgett *et al.* 1989, Kittel *et al.* 1994, 1995, Cooper and Cottrell 1990). Similar *Salix drummondiana* dominated community types have been reported from Montana, Utah and Wyoming (Hansen *et al.* 1995, Padgett *et al.* 1989, Youngblood *et al.* 1985).

**Distribution in Colorado:** The *Salix drummondiana*/mesic forb type is found throughout the western slope of Colorado, and in montane regions along the Colorado Front Range (Kittel and Lederer 1993, Kittel *et al.* 1994, 1995, Cooper and Cottrell 1990).

*The following characteristics are based on plots and observations from parts of the upper Arkansas and upper South Platte River Basins, Colorado.*

**Vegetation:** *Salix drummondiana* forms an open to closed, narrow canopy of shrubs lining the stream bank (40-70%). Other shrubs present are *Salix brachycarpa* (0-3%) at higher elevations, and *Alnus incana* (0-21%), *Salix monticola* (0-5%) and *Salix bebbiana* (1%) at lower elevations (Table 33). The herbaceous undergrowth is sparse due to heavy shade and shallow soils.

**Elevation:** 2,622-3,230 m (8,680-10,600 ft.)

**Site Geomorphology:** This association occurs on narrow stream benches and stream banks of fast moving streams. One stand occurred in a swale between a road embankment and a raised stream bank (plot 95LS18).

**Rosgen's Channel Type:** This association usually occurs on very steep reaches (A2, A3) but can also occur on broader channels (B3).

**Soil:** Soils of this type are shallow (ave. 30 cm), and skeletal (15-60% cobbles and gravels). Many coarse fragments are angular.

**Adjacent Riparian Vegetation:** Little adjacent riparian vegetation exists, as this type is often the only association along the reach.

**Adjacent Upland Vegetation:** North facing slopes are forests with *Abies lasiocarpa* and *Picea engelmannii*, while the south facing slopes can be more open *Pinus ponderosa*, or *Pinus edulis* woodlands.

**Successional Trends and Ecological Processes:** The *Salix drummondiana*/mesic forb plant association can occupy steep side seeps, with deep, organic soils (Manning and Padgett 1995). However, these stands and others occurring adjacent to stream banks have well aerated soils. *S. drummondiana* can sucker after fire or other disturbance and is an excellent bank stabilizer (Padgett *et al.* 1989).

**Management:** Little forage is available for livestock grazing. Season-long grazing can reduce the native forb cover and increase the abundance of non-native grasses, such as *Poa pratensis* and *Agrostis stolonifera*. Continued heavy grazing and browsing may weaken the root systems of *S. drummondiana* (Padgett *et al.* 1989).

**Related Types:** The *Salix boothii*/mesic forb types described by Padgett *et al.* (1989) and Youngblood *et al.* (1985) are similar in that they include pure *Salix drummondiana* dominated stands. *Salix drummondiana* dominated types from Montana described by Hansen *et al.* (1995), (*S. drummondiana*/*Calamagrostis canadensis*, *S. drummondiana*/*Carex utriculata*), and the *S. drummondiana* community type are different in that they are dominated by graminoides in the undergrowth. Baker (1989) describes two mixed types (*Salix drummondiana*-*S. monticola*/*Calamagrostis canadensis*-*Carex rostrata* and *S. drummondiana*-*S. monticola*-*S. planifolia*/*Calamagrostis canadensis*-*Carex rostrata*) that are quite different from our stands which have a much less diverse willow canopy. The *Salix drummondiana*/mesic forb type described by Kittel and Lederer (1993), Kittel *et al.* (1994), and Kittel *et al.* (1995), and the *S. drummondiana*/*Mertensia ciliata* type described by Cooper and Cottrell (1990) are identical to the type described here.

Table 33. Percent Canopy Cover of Important Plant Species in the *Salix drummondiana*/Mesic Forb Plant Association. See Tables 1 and 2 for Plot Locations. \* = Non-native Species.

| Plot No. (95___)                            | AM42 | LS18 |
|---|------|------|
| Occurrence Rank                             | B    | D    |
| <b>TREES</b>                                |      |      |
| <i>Abies lasiocarpa</i>                     | 5    |      |
| <i>Picea engelmannii</i> --seedlings        | 10   |      |
| <i>Populus angustifolia</i>                 |      | 3    |
| <i>Populus tremuloides</i>                  | 11   |      |
| <b>SHRUBS</b>                               |      |      |
| <i>Alnus incana</i> ssp. <i>tenuifolia</i>  |      | 20   |
| <i>Lonicera involucrata</i>                 | 10   | 5    |
| <i>Salix drummondiana</i>                   | 39   | 70   |
| <i>Salix monticola</i>                      |      | 5    |
| <b>GRAMINOIDES</b>                          |      |      |
| <i>Bromus inermis</i> *                     |      | 1    |
| <i>Bromus</i> sp.                           | 3    |      |
| <i>Juncus balticus</i> var. <i>montanus</i> | 3    |      |
| <i>Muhlenbergia montana</i>                 | 1    |      |
| <i>Poa pratensis</i> *                      | 3    | 4    |
| <i>Poa</i> sp.                              | 4    |      |
| <b>FORBS</b>                                |      |      |
| <i>Achillea millefolium</i>                 | 3    | 1    |
| <i>Cardamine cordifolia</i>                 | 3    |      |
| <i>Cirsium</i> sp.                          | 3    |      |
| <i>Conioselinum scopulorum</i>              | 1    |      |
| <i>Epilobium angustifolium</i>              | 3    |      |
| <i>Fragaria virginiana</i>                  | 3    |      |
| <i>Geum macrophyllum</i>                    | 1    |      |
| <i>Mertensia ciliata</i>                    | 10   | 2    |
| <i>Polygonum viviparum</i>                  | 1    |      |
| <i>Senecio integerrimus</i>                 | 10   |      |
| <i>Solidago</i> sp.                         | 3    |      |
| <i>Taraxacum officinale</i> *               | 1    | 1    |
| <b>HORSETAILS</b>                           |      |      |
| <i>Equisetum arvense</i>                    | 10   |      |

## *Salix exigua* Alliance

**Coyote willow/mesic graminoides (*Salix exigua*/mesic graminoides) Plant Association**

**CNHP Rank: G5/S5**

Lower South Platte, 9 Plots-- 95LS15, 95LS17, 95GK06, 95GK13, 95GK18, 95GK23, 95LS26, 95GK28, 95GK29.

Upper Arkansas, 5 plots-- 95AM48, 95RR11, 95GK65, 95GK66, 95GK75.

**Reference Reaches:** No high quality reaches were found in the study area, however a good example can be seen on Lower East Gulch, on BLM lands, T18S, R73W, Sec 28.

**General Description and Comments:** *Salix exigua* is one of the most common willows in Colorado. The two associations, *S. exigua*/mesic graminoid and *S. exigua*/bare ground, are easy to recognize as a monotypic stand of *S. exigua*. An undergrowth of grasses and forbs with a ground cover of at least 25% falls into the mesic graminoid type, while an undergrowth with widely scattered to no forbs and grasses belongs to the bare ground association. Both are early-seral and occur along stream banks, swales and irrigations ditches. Plots 95LS26 and 95GK29 have significant amounts of *Panicum virgatum*, *Sorghastrum nutans*, and *Spartina pectinata* in the undergrowth due to proximity to tall-grass wet meadows along the Arikaree River floodplain. We include these stands here as a variation of the *Salix exigua*/mesic graminoid type.

**Regional Distribution:** This is a common type reported from Oregon, Nevada, Utah, Montana, southeastern Idaho and Wyoming (Bourgeron and Engelking 1994, Manning and Padgett 1995, Padgett *et al.* 1989, Hansen *et al.* 1991, Jones and Walford 1995, Youngblood *et al.* 1985). Several *Salix exigua* plant associations with a variety of graminoid dominated undergrowths are known to occur in New Mexico, within the Rio Grande and Pecos River basins (Durkin *et al.* 1994, 1995).

**Distribution in Colorado:** In Colorado it is reported from throughout the western slope (Kittel and Lederer 1993, Kittel *et al.* 1994, 1995), and appears to be a common plant association along streams of the Colorado Front Range (Friedman 1993, Kittel 1994, Cooper and Cottrell 1990) and along the mainstem of the South Platte River (Christy 1973, and this report).

*The following characteristics are based on plots and observations from parts of the lower South Platte and upper Arkansas River Basins, Colorado.*

**Vegetation:** *Salix exigua* is the predominating willow (26-86%), giving this association its characteristic greyish-green color. Other willows that occur in the canopy are *S. ligulifolia* (0-23%) and *S. monticola* (0-15%). The undergrowth has at least 20-35% cover by various graminoid species such as *Carex lanuginosa* and *Juncus balticus*. Forb cover is usually low, but can have a high percentage of non-natives (e.g. *Medicago lupulina* 30%, *Poa pratensis* 41%, Table 34 and 35).

**Elevation:** 1,750-2,610 m (5,720-8,560 ft.)

**Site Geomorphology:** This plant association occurs on point bars, low floodplains and terraces, along overflow channels, and is usually within 1 meter vertical distance of the channel. It can also occur in mesic swales away from stream channels.

**Rosgen's Channel Type:** This type occurs on broad to narrow meandering streams with sandy or cobble beds (C5) and along the margins of Beaver ponds.

**Soil:** Soils are typically somewhat more developed than the *Salix exigua*/bare ground plant association due to a slightly more stable environment and greater input of organic matter. However, they are generally thin (<1 m) and skeletal with depth (10-50% cobbles). Textures are typically loamy sands interspersed with layers of silty clays and alternating with coarse sands. Upper layers (10-30 cm) often have 25-30% organic matter.

**Adjacent Riparian Vegetation:** Associated riparian communities are stands of *Populus angustifolia* or *P. deltoides*-*Salix amygdaloides*, with *Salix exigua* in the understory. Thickets of *Prunus virginiana* and *Ribes* spp. or irrigated hay meadows generally occur on higher terraces and adjacent elevated floodplains. Stands of *Carex aquatilis* can occur in adjacent wet areas and *Symphoricarpos* spp. shrublands occur in drier areas of the floodplain.

**Adjacent Upland Vegetation:** Streams cutting through steep rock gullies and canyons often have *Pinus ponderosa* or *Pinus edulis* and *Juniperus monosperma* woodlands on the uplands with *Quercus gambelii* thickets on the lower slopes. *Pseudotsuga menziesii* forests can occur on north facing canyon walls. Irrigated hay and other crops are commonly associated on the immediate uplands of more gentle streams.

**Successional Trends and Ecological Processes:** This plant association is typical of recent floodplains and highly disturbed low wet areas and is considered early-seral. The degree of herbaceous growth in the understory is an indication of the amount of time since the last scouring (or depositional) flood event. *Salix exigua* is an excellent soil stabilizer and can reduce the erosive power of flood waters. It can withstand flooding with its flexible stems and reduce erosion potential by increasing the friction of streamflow and trapping sediments. The presence of cottonwood seedlings within this association indicate succession to a cottonwood stand, if seedlings survive subsequent flooding events.

**Management:** *Salix exigua* readily sprouts with removal by grazing if the grazing intensity and persistence does not reduce the root food reserve (Jones and Walford 1995). Prolonged grazing can remove willows from a site and increase the cover of non-native weedy species (Hansen *et al.* 1991).

**Related Types:** The *Salix exigua*/mesic graminoid community type is described by Padgett *et al.* (1989), Kittel *et al.* (1994, and 1995), Kittel and Lederer (1993), and Jones and Walford (1995).

Hansen *et al.* (1991) describe a *Salix exigua* community type which includes stands similar to our *Salix exigua*/mesic graminoid plant association. Johnston (1987) describes two similar types, *S. exigua*-*Salix* spp./*Calamagrostis canadensis*-*Equisetum arvense* and *S. exigua*-*Salix* spp./*Poa* sp., in which he includes sparse and more diverse stands, including the similar type, *S. exigua*/*Poa pratensis*, described by Youngblood *et al.* (1985). Soil descriptions of this plant association from eastern Wyoming (Jones and Walford 1995) are also similar to ours.

Table 34. Percent Canopy Cover for Important Species for the *Salix exigua*/mesic graminoid Plant Association, in the Lower South Platte River Basin. See Table 1 for Plot Locations.

\* = Non-native Species.

| Plot Numbers (95 ___)                      | LS15 | LS17 | GK06 | GK13 | GK18 | GK23 | LS26 | GK28 | GK29 |
|--|------|------|------|------|------|------|------|------|------|
| Occurrence Rank                            | B    | B    | B    | B    | B    | C    | B    | B/A  | A    |
| <b>SHRUBS</b>                              |      |      |      |      |      |      |      |      |      |
| <i>Alnus incana</i> ssp. <i>tenuifolia</i> | 5    | 1    |      |      | 1    |      |      |      |      |
| <i>Salix exigua</i>                        | 63   | 57   | 75   | 53   | 65   | 52   | 66   | 36   | 26   |
| <i>Salix eriocephala</i>                   | 23   | 12   |      |      | 7    |      |      |      |      |
| <i>Salix monticola</i>                     |      | 7    |      |      | 7    | 15   |      |      |      |
| <b>GRAMINOIDES</b>                         |      |      |      |      |      |      |      |      |      |
| <i>Carex lanuginosa</i>                    | 21   | 35   |      | 39   |      | 7    | 13   | 7    |      |
| <i>Carex nebrascensis</i>                  |      | 20   |      | 12   |      |      |      |      |      |
| <i>Eleocharis palustris</i>                |      | 26   | 9    |      | 5    | 1    |      | 3    | 2    |
| <i>Glyceria grandis</i>                    |      | 1    |      |      | 17   |      |      |      |      |
| <i>Panicum virgatum</i>                    |      |      |      |      |      |      | 12   | 29   | 55   |
| <i>Poa pratensis</i> *                     | 3    |      |      | 12   | 6    | 27   | 1    | 1    | 3    |
| <i>Sorghastrum nutans</i>                  |      |      |      |      |      |      |      |      | 41   |
| <i>Scirpus pungens</i>                     |      |      | 24   |      |      |      |      | 20   |      |
| <i>Spartina pectinata</i>                  |      |      |      |      |      |      | 29   | 6    |      |
| <i>Typha latifolia</i>                     |      |      |      |      | 19   |      |      |      |      |
| <b>FORBS</b>                               |      |      |      |      |      |      |      |      |      |
| <i>Epilobium</i> sp.                       |      | 1    |      |      | 8    | 1    |      |      |      |
| <i>Geum macrophyllum</i>                   |      |      |      |      | 6    | 1    |      |      |      |
| <i>Glycyrrhiza lepidota</i>                | 11   |      |      | 1    |      | 1    | 4    |      | 11   |
| <i>Medicago lupulina</i> *                 |      |      |      | 8    |      | 30   |      |      |      |
| <b>HORSETAILS</b>                          |      |      |      |      |      |      |      |      |      |
| <i>Equisetum arvense</i>                   | 6    |      |      |      |      | 8    |      | 1    |      |

Table 35. Percent Canopy Cover for Important Species for the *Salix exigua*/mesic graminoid Plant Association, in the Upper Arkansas River Basin. See Table 2 for Plot Locations. \* = Non-native Species.

| Plot No. (95 ___)                                 | AM48 | RR11 | GK65 | GK66 | GK75 |
|---|------|------|------|------|------|
| Occurrence Rank                                   | B    | B    | B    | B/C  | B    |
| <b>SHRUBS</b>                                     |      |      |      |      |      |
| <i>Salix exigua</i>                               | 70   | 73   | 51   | 83   | 86   |
| <i>Salix monticola</i>                            |      |      | 7    | 13   |      |
| <i>Symphoricarpos occidentalis</i>                |      |      | 16   |      |      |
| <b>GRAMINOIDES</b>                                |      |      |      |      |      |
| <i>Agrostis stolonifera</i> *                     | 20   |      |      |      | 2    |
| <i>Bromus inermis</i> *                           |      |      |      | 30   | 4    |
| <i>Calamagrostis canadensis</i>                   |      |      |      |      | 6    |
| <i>Carex aquatilis</i>                            |      | 4    |      |      |      |
| <i>Carex lanuginosa</i>                           |      |      |      |      | 6    |
| <i>Carex</i> sp.                                  |      |      | 29   |      |      |
| <i>Elymus canadensis</i>                          |      |      |      | 3    | 1    |
| <i>Elymus lanceolatus</i> ssp. <i>lanceolatus</i> |      |      | 3    | 35   |      |
| <i>Juncus balticus</i> var. <i>montanus</i>       | 1    | 2    | 30   |      |      |
| <i>Muhlenbergia montana</i>                       |      |      | 2    |      |      |
| <i>Poa pratensis</i> *                            | 10   | 41   | 20   | 16   | 16   |
| <i>Scirpus microcarpus</i>                        |      |      |      |      | 1    |
| <b>FORBS</b>                                      |      |      |      |      |      |
| <i>Achillea millefolium</i>                       | 1    | 3    |      |      |      |
| <i>Cirsium</i> sp.                                | 3    | 1    |      |      | 3    |
| <i>Clematis ligusticifolia</i>                    | 3    |      |      |      |      |
| <i>Glycyrrhiza lepidota</i>                       |      |      | 2    |      |      |
| <i>Heracleum sphondylium</i>                      |      | 16   |      |      | 1    |
| <i>Linaria vulgaris</i> *                         |      |      | 1    | 15   |      |
| <i>Melilotus officinalis</i> *                    | 10   |      |      |      |      |
| <i>Mentha arvensis</i>                            |      |      |      | 2    | 5    |
| <i>Taraxacum officinale</i> *                     | 1    | 10   |      | 2    |      |
| <i>Trifolium repens</i> *                         |      | 18   |      |      | 1    |
| <i>Verbascum thapsus</i>                          |      |      | 16   |      |      |
| <b>HORSETAILS</b>                                 |      |      |      |      |      |
| <i>Equisetum arvense</i>                          | 3    | 1    |      |      |      |

**Coyote willow/bare ground (*Salix exigua*/bare ground) Plant Association**

**CNHP Rank: G5/S5**

Lower South Platte, 7 Plots--95LS04, 95LS33, 95LS34, 95LS37, 95GK37, 95GK46, 95GK56.  
Upper Arkansas, 6 plots--95AM05, 95AM18, 95AM47, 95RR07, 95RR08, 95RR10.

**References Reaches:** An excellent example of this type can be seen on the Pawnee National Grasslands, along Twomile Creek, 1.4 miles east of Highway 71, Weld Co. T11N, R56W, Sec 32.

**General Description and Comments:** *Salix exigua* is one of the most common willows in Colorado. The two associations, *S. exigua*/mesic graminoid and *S. exigua*/bare ground, are easy to recognize as a monotypic stand of *S. exigua*. An undergrowth of grasses and forbs with a ground cover of at least 25% falls into the mesic graminoid type, while an undergrowth with widely scattered to no forbs and grasses belongs to the bare ground association. Both are early-seral and occur on the wetter side stream banks, swales and irrigations ditches. Plots 95LS26 and 95GK29 have significant amounts of *Panicum virgatum*, *Sorghastrum nutans*, and *Spartina pectinata* in the undergrowth due to proximity to tall-grass wet meadows along the Arikaree River floodplain. We include these stands here as a variation of the *Salix exigua*/mesic graminoid type.

**Regional Distribution:** This plant association is very common and is found throughout the plains and lower mountains of Montana, Wyoming, Nevada, Utah, Colorado, and New Mexico (Hansen *et al.* 1991, Jones and Walford 1995, Manning and Padgett 1995, Padgett *et al.* 1989, and Kittel and Lederer 1993, Kittel *et al.* 1994, 1995, Durkin *et al.* 1995).

**Distribution in Colorado:** The *Salix exigua*/bare ground plant association is known throughout Colorado, on the western slope (Kittel and Lederer 1993, Kittel *et al.* 1994, 1995), on the eastern plains (Christy 1973, Culver *et al.* 1996, and this report), and along the foothills and mountains of the eastern front (Kittel 1994, and this report).

*The following characteristics are based on plots and observations from parts of the lower South Platte and upper Arkansas River Basins, Colorado.*

**Vegetation:** This association is characterized by an almost exclusive cover by *Salix exigua* (63-90%) with very low herbaceous cover. Combined bare soil, gravel, cobble and rock ground cover estimates are typically high (55-99%) (Table 36 and 37).

**Elevation:** 1,060-2,380 m (3,475-7,800 ft).

**Site Geomorphology:** This plant association is usually within the active channel of a stream, and is rarely more than a few decimeters above this level in vertical distance. The site usually experiences annual flooding.

**Rosgen's Channel Type:** In the lower S. Platte watershed this association occurs on meandering, sand-bed streams (C5), and broad sand-bed braided streams (D5). In the upper Arkansas watershed, it occurs on moderate gradient streams (B3, B4), meandering streams (C3, C4), and along eroding gulches (F3).

**Soil:** Soils of this association are typically coarse alluvial sands and gravels. Along the So. Platte River, a recent deposit (1995 flood) of fine clay or silt was found on the surface of the soil. Sampled pits showed highly stratified profiles with alternating clay loams and organic materials with coarser sands, indicating frequent fluvial depositional events. Within the lower Arkansas watershed, soils of this association are typically thin layers of sandy loam over very coarse alluvium. Occasional stands occur on deep pockets of sand.

**Adjacent Riparian Vegetation:** Along the S. Platte River the *Populus deltoides*-(*Salix amygdaloides*)/*Salix exigua* early seral (seedlings and sapling size trees only) community occurs on adjacent sand bars and low terraces, and older stands of *Populus deltoides*-*Salix amygdaloides*/*Spartina pectinata* occur on higher terraces. On smaller tributaries adjacent communities include *Carex nebrascensis* and *Eleocharis palustris*, or *Typha angustifolia* stands. Along streams in the upper Arkansas watershed, *Populus angustifolia* stands are adjacent in the riparian area, as are patches of *Eleocharis palustris* and *Carex* spp. wetlands.

**Adjacent Upland Vegetation:** Non-riparian communities bordering the S. Platte River consist of agricultural fields (sugar beets, winter wheat, and others), with rolling hills of silver *Salix geyeriana* and xeric tall grass prairies south of the floodplain east of Sterling. On the Pawnee National Grassland adjacent uplands have *Bouteloua gracilis* short grass prairies. In the steep canyons of the upper Arkansas River drainage, typical upslope vegetation includes *Pinus edulis* and *Juniperus monosperma* woodlands, *Quercus gambelii* shrublands, and *Pseudotsuga menziesii* forests.

**Successional Trends and Ecological Processes:** This plant association is considered an early seral community, capable of colonizing freshly deposited sand and gravel bars. *Salix exigua* is an excellent soil stabilizer with a deep root system. It can withstand flooding with its flexible stems, and reduces erosion potential by increasing the friction of streamflow and trapping sediments. The presence of cottonwood seedlings within this association indicates succession to a cottonwood stand, if seedlings survive subsequent flooding events.

**Management:** Forage production is low and the dense overstory may limit livestock movement within this type (Manning and Padgett 1995). Soil compaction is generally not a problem because of high coarse fragment content of the soils. Overgrazing by livestock will reduce the vigor of the willows present, and they may eventually be eliminated from the site (Hansen *et al.* 1995). Removal of the association and stream bank exposure can lead to erosion problems.

**Related Types:** The *Salix exigua*/barren, *S. exigua*/sparse, and *S. exigua*/bench community types described by Padgett *et al.* (1989), Durkin *et al.* (1995), and Manning and Padgett (1995),

respectively, are identical to our stands. Other similar types include the *Salix exigua* type listed in Reid and Bourgeron (1991). Jones and Walford (1995) describe unclassified stands of *Salix exigua* with >30% coarse material at the surface and mostly non-native herbaceous cover with occasional young stems of *Populus deltoides* or *Salix amygdaloides*. These stands appear to be similar to the *S. exigua*/bare ground type described here.

Table 36. Percent Canopy Cover for Important Species in the *Salix exigua*/bare ground Plant Association in the Lower South Platte River Basin. See Table 1 for Plot Locations. \* = Non-native Species.

| Plot Number (95___)                      | LS04 | LS33 | LS34 | LS37 | GK37 | GK46 | GK56 |
|--|------|------|------|------|------|------|------|
| Occurrence Rank                          | B    | B    | B    | B    | B    | B    | C    |
| <b>TREES</b>                             |      |      |      |      |      |      |      |
| <i>Populus deltoides</i> --mature trees  |      |      | 9    |      |      |      |      |
| <i>Populus deltoides</i> --saplings      |      | 1    |      | 2    |      |      | 7    |
| <i>Salix amygdaloides</i> --mature trees |      | 1    | 2    |      | 5    |      | 1    |
| <b>SHRUBS and VINES</b>                  |      |      |      |      |      |      |      |
| <i>Humulus lupulus</i>                   |      |      |      |      |      | 18   |      |
| <i>Salix exigua</i>                      | 63   | 63   | 72   | 9    | 82   | 82   | 86   |
| <i>Vitis riparia</i>                     |      | 2    |      |      | 8    |      |      |
| <b>GRAMINOIDES</b>                       |      |      |      |      |      |      |      |
| <i>Carex</i> sp.                         |      | 23   | 1    | 1    | 2    |      |      |
| <i>Cyperus strigosus</i> *               |      |      |      |      |      | 21   |      |
| <i>Echinochloa crus-galli</i> *          |      | 7    | 2    | 2    | 5    |      | 1    |
| <i>Eleocharis palustris</i>              | 3    |      |      |      |      |      |      |
| <i>Scirpus pungens</i>                   |      | 8    |      |      |      |      |      |
| <i>Spartina pectinata</i>                |      |      |      |      |      |      |      |
| <b>FORBS</b>                             |      |      |      |      |      |      |      |
| <i>Asclepias</i> sp.                     |      | 13   |      |      | 2    |      |      |
| <i>Cirsium arvense</i> *                 |      |      |      |      |      | 13   |      |
| <i>Melilotus officinalis</i> *           | 2    |      |      |      |      |      |      |
| <i>Polygonum pennsylvanicum</i>          |      |      | 8    |      |      | 1    | 2    |
| <i>Rumex crispus</i> *                   | 1    | 8    |      |      |      | 1    | 1    |
| Unknown forb                             | 1    | 18   | 1    | 1    |      | 14   | 4    |

Table 37. Percent Canopy Cover for Important Species in the *Salix exigua*/bare ground Plant Association in the Upper Arkansas River Basin. See Table 2 for Plot Locations. \* = Non-native Species.

| Plot No. (95 )                              | AM05 | AM18 | AM47 | RR07 | RR08 | RR10 |
|---|------|------|------|------|------|------|
| Occurrence Rank                             | C    | B/C  | C    | C    | C    | B    |
| <b>TREES</b>                                |      |      |      |      |      |      |
| <i>Populus angustifolia</i> --saplings      |      |      |      | 8    |      |      |
| <i>Populus angustifolia</i> --seedlings     |      |      |      | 3    |      | 1    |
| <i>Populus deltoides</i>                    | 5    | 1    |      | 1    |      |      |
| <b>SHRUBS</b>                               |      |      |      |      |      |      |
| <i>Salix exigua</i>                         | 27   | 52   | 88   | 45   | 90   | 30   |
| <i>Salix irrorata</i>                       | 13   |      |      |      |      |      |
| <b>GRAMINOIDES</b>                          |      |      |      |      |      |      |
| <i>Agrostis stolonifera</i> *               |      |      | 10   |      |      |      |
| <i>Bromus inermis</i> *                     | 4    |      | 1    |      | 1    |      |
| <i>Bromus</i> sp.                           | 3    | 4    |      | 5    |      |      |
| <i>Bromus tectorum</i> *                    | 1    |      |      | 1    |      | 2    |
| <i>Carex utriculata</i>                     |      | 1    |      |      |      |      |
| <i>Eleocharis palustris</i>                 |      | 1    |      | 1    |      | 1    |
| <i>Elytrigia repens</i> *                   |      | 8    |      |      |      |      |
| <i>Juncus balticus</i> var. <i>montanus</i> | 4    |      | 2    |      |      |      |
| <i>Poa pratensis</i> *                      | 7    | 9    | 1    | 4    | 15   | 3    |
| <b>FORBS</b>                                |      |      |      |      |      |      |
| <i>Cirsium</i> sp.                          |      | 8    | 3    |      | 1    | 1    |
| <i>Erigeron</i> sp.                         | 1    |      |      | 1    | 1    | 3    |
| <i>Lepidium virginicum</i>                  | 1    |      |      |      |      | 1    |
| <i>Medicago lupulina</i> *                  |      | 1    |      | 1    | 4    | 5    |
| <i>Melilotus</i> sp.                        |      | 2    |      |      |      |      |
| <i>Solidago canadensis</i>                  |      |      | 8    |      |      |      |
| <i>Taraxacum officinale</i> *               | 1    | 1    |      |      | 1    | 1    |
| <i>Trifolium repens</i> *                   | 6    | 1    |      | 1    | 22   | 8    |
| <b>HORSETAILS</b>                           |      |      |      |      |      |      |
| <i>Equisetum arvense</i>                    | 2    | 3    |      | 1    | 1    |      |
| <i>Equisetum hyemale</i>                    | 1    |      | 1    | 1    | 1    |      |

## *Salix geyeriana* Alliance

**Geyer willow/Aquatic sedge (*Salix geyeriana*/*Carex aquatilis*) Plant Association**

CNHP Rank: G3/S2

2 plots-- 95AM29, 95AM36.

**Reference Reaches:** A small but fairly good occurrence can be seen along Lowpass Gulch on BLM land, T11S, R79W, Sec 30.

**General Description and Comments:** *Salix geyeriana* forms tall willow shrublands, or carrs, where the canopy is closed to nearly closed. A thick carpet of mesic grasses and forbs blanket the ground which is often hummocky. Willows occupy the raised mounds, and grasses dominate the swales. Smaller shrubs may occur under the tall willow canopy. *Salix geyeriana* is difficult to distinguish without catkins from its look-alike willow, *Salix drummondiana*. Both are tall (>2 m) montane willows with strongly prunose twigs (a waxy bloom that rubs off, like on a plum). *Salix geyeriana* can be distinguished from *Salix drummondiana* vegetatively by the mature leaf width; they are never more than 13 mm wide on non-sucker shoots (Welsh *et al.* 1987). *Salix drummondiana* rarely dominates broad shrublands on gentle floodplains (although it has been observed to do so in the San Juan mountains, Richard *et al.* 1996).

**Regional Distribution:** This plant association is reported from Utah and western Colorado (Padgett *et al.* 1989, Kettler and McMullen 1996, Kittel *et al.* 1995). Similar *Salix geyeriana* dominated types are reported from Montana (Hansen *et al.* 1995).

**Distribution in Colorado:** The *Salix geyeriana*/*Carex aquatilis* is known to occur on Routt and San Juan National Forests (Kettler and McMullen 1996, Richard *in press*) and in the Gunnison River Basin (Kittel *et al.* 1995).

*The following characteristics are based on plots and observations from parts of the upper Arkansas River Basin, Colorado.*

**Vegetation:** This association is characterized by a tall willow canopy dominated by *Salix geyeriana* (28-36%). Other shrubs present include *Salix monticola* (0-5%), *Betula glandulosa* (0-24%) and *Pentaphylloides floribunda* (2%). Graminoid cover is greater than forb cover and is dominated by *Carex aquatilis* (17-40%) (Table 38).

**Elevation:** 2,780-2,890 m (9,120-9,480 ft).

**Site Geomorphology:** This association occurs on narrow flat benches and broad floodplains with flat to hummocky micro topography.

**Rosgen's Channel Type:** This type occurs along flat elevated benches of steep reaches (G3), or along the wide floodplain of narrow, subalpine, low gradient, highly sinuous, or braided streams

(E3, D3).

**Soil:** Soils are deep (> 1 m) fine textured clay loams and sandy clay loams. One profile has 40% mottling at 24 cm depth, while another has 40% coarse fragments at 40 cm.

**Adjacent Riparian Vegetation:** *Picea pungens* forests occur on adjacent stream banks in narrow reaches, and open hay meadows occur adjacent on broader floodplain reaches.

**Adjacent Upland Vegetation:** Adjacent hillslopes have *Artemisia tridentata* shrublands or *Pseudotsuga menziesii* forests on steep canyon walls.

**Successional Trends and Ecological Processes:** *Salix geyeriana* appears to gain dominance where a high water table saturates the soil for much of the growing season. It appears to be a long-lived and relatively stable association, although the presence of coniferous trees may indicate succession to a conifer dominated type. Willow dominated areas that occur on undulating floodplains are often a mosaic of intermingling wet-meadows and shrublands. However, in the stands sampled, the *Salix geyeriana* canopy completely overlapped low-lying swales and other topographic associations, such that we consider the stand to be one plant association.

**Management:** Wet and saturated soils characteristic of this association are vulnerable to compaction by livestock and heavy equipment. Browsing by wildlife may hedge the willows, and overgrazing by livestock can dry the site, increase non-native grass cover, and reduce the vigor of willow root structure (Hansen *et al.* 1995).

**Related Types:** Padgett *et al.* (1989) and Youngblood *et al.* (1985) describe a very similar *Salix geyeriana*/*Carex aquatilis* community type. Ours also appears similar to the *Salix geyeriana*-*Salix* spp./*Calamagrostis canadensis* type described by Johnston (1987), although our stands lacked significant *Calamagrostis canadensis* cover.

Table 38. Percent Canopy Cover of Important Plant Species in the *Salix geyeriana*/*Carex aquatilis* Plant Association. See Table 2 for Plot Locations. \* = Non-native Species.

| Plot No. (95___)                                     | AM29 | AM36 |
|--|------|------|
| Occurrence Rank                                      | B    | B    |
| <b>SHRUBS</b>  |      |      |
| <i>Betula glandulosa</i>                             | 24   |      |
| <i>Lonicera involucrata</i>                          | 4    |      |
| <i>Pentaphylloides floribunda</i>                    | 1    | 2    |
| <i>Ribes cereum</i>                                  | 1    |      |
| <i>Rosa woodsii</i>                                  | 1    |      |
| <i>Salix brachycarpa</i>                             |      | 1    |
| <i>Salix geyeriana</i>                               | 36   | 28   |
| <i>Salix eriocephala</i>                             | 6    |      |
| <i>Salix monticola</i>                               |      | 5    |
| <i>Salix planifolia</i> ssp. <i>planifolia</i>       |      | 1    |
| <b>GRAMINOIDES</b>                                   |      |      |
| <i>Agrostis stolonifera</i> *                        | 9    | 1    |
| <i>Alopecurus alpinus</i>                            |      | 4    |
| <i>Bromus tectorum</i> *                             | 1    |      |
| <i>Calamagrostis canadensis</i>                      |      | 20   |
| <i>Carex aquatilis</i>                               | 17   | 42   |
| <i>Carex lanuginosa</i>                              | 1    |      |
| <i>Carex utriculata</i>                              |      | 9    |
| <i>Juncus balticus</i> var. <i>montanus</i>          | 19   |      |
| <i>Poa pratensis</i> *                               | 5    | 1    |
| <b>FORBS</b>   |      |      |
| <i>Achillea millefolium</i> var. <i>occidentalis</i> | 4    |      |
| <i>Apiaceae</i> sp.                                  | 2    |      |
| <i>Epilobium ciliatum</i>                            |      | 2    |
| <i>Fragaria virginiana</i>                           | 11   |      |
| <i>Galium trifidum</i>                               |      | 2    |
| <i>Mertensia ciliata</i>                             |      | 4    |
| <i>Polemonium foliosissimum</i>                      |      | 5    |
| <i>Rorippa nasturtium-aquaticum</i> *                |      | 3    |
| <i>Stellaria longifolia</i>                          |      | 9    |
| <b>HORSETAILS</b>                                    |      |      |
| <i>Equisetum arvense</i>                             | 10   | 7    |

*Salix lucida* var. *caudata* Alliance

No plant associations were determined from the study area. Similar types have been described from the Yampa River (The Nature Conservancy 1994, Baker 1984).

One stand along West Kiowa Creek, near the town of Elbert at 1,650 m (5,400 ft) elevation (95LS08) is dominated by *S. lucida* spp. *caudata*. (Table 40) Nearby stands are dominated by *S. eriocephala* var. *ligulifolia*. This plant association occurs in the wettest part of the riparian area, usually adjacent to flowing water of the channel on low point bars and islands, as well as on low stream banks and overflow channels. It occurs in saturated areas on soils high in organic matter content and with reduced conditions.

Table 39. Percent Canopy Cover Values for a *Salix lucida* var. *caudata* Dominated Stand. See Table 1 for Plot Location. \* = Non-native Species.

| Plot Number (95____)                     | LS08 |
|--|------|
| Occurrence Rank                          | B    |
| TREES                                    |      |
| <i>Salix amygdaloides</i> --mature trees | 2    |
| SHRUBS                                   |      |
| <i>Salix lucida</i> ssp. <i>caudata</i>  | 56   |
| GRAMINOIDES                              |      |
| <i>Bromus inermis</i> *                  | 1    |
| <i>Carex nebrascensis</i>                | 36   |
| <i>Eleocharis palustris</i>              | 5    |
| <i>Juncus articus</i>                    | 1    |
| <i>Poa pratensis</i> *                   | 1    |
| <i>Scirpus microcarpus</i>               | 16   |
| <i>Typha latifolia</i>                   | 3    |

**Rocky Mountain willow-Geyer willow/mesic graminoid (*Salix monticola*-*Salix geyeriana* /mesic graminoid) Plant Association**

CNHP Rank: GU/S3

4 plots--95AM19, 95AM44, 95AM45, 95AM58.

**Reference Reaches:** A large occurrence of this grazing induced type can be seen in Dome Rock State Wildlife Area along Fourmile Creek, just west of Dome Rock itself, T14S,R70W, Sec 16. It is a large, healthy stand, with heavy cover of *Agrostis stolonifera*, non-native grass, in the undergrowth.

**General Description and Comments:** This is a grazing induced mixed-willow shrubland with tall willow canopies nearly overlapping each other. The undergrowth is a carpet of grasses and forbs, and the ground has a hummocky micro-topography. Season-long grazing has increased the non-native grass cover, and reduced the native forbs of what once was a mixed-willow/mesic forb plant association.

**Regional Distribution:** This mixed type is known from eastern Idaho, Wyoming, Utah, and Colorado (Johnston 1987, Cooper and Cottrell 1990, Kettler and McMullen 1996, Bourgéron and Engelking 1994).

**Distribution in Colorado:** The *Salix monticola*-*Salix geyeriana*/mesic forb plant association is known to occur on the Routt National Forest (Kettler and McMullen 1996), and in the San Miguel River drainage (Kittel and Lederer 1993). Similar associations are known from the Colorado Front Range and the western slope (Cooper and Cottrell 1990, Baker 1989).

*The following characteristics are based on plots and observations from parts of the upper Arkansas River Basin, Colorado.*

**Vegetation:** This association is characterized by a tall, nearly closed canopy of *Salix monticola* (8-70%) with *Salix geyeriana* (30-70%). Other shrubs present include *Ribes inerme* (0-35%) and *Pentaphylloides floribunda* (0-3%). The undergrowth is a thick carpet of forbs in undisturbed stands, with *Conioselinum scopulorum* (0-10%) and *Cardamine cordifolia* (0-3%). Disturbed stands have high cover of non-native grasses such as *Agrostis stolonifera* (10-52%) and *Poa pratensis* (20%) (Table 39).

**Elevation:** 2,600-2,880 m (8,500-9,440 ft).

**Site Geomorphology:** This type occurs in broad alluvial floodplains of U and V-shaped valleys with steep side slopes.

**Rosgen's Channel Type:** Stream channels tend to be broad and meandering (C4) or less sinuous (B3). Two sites occur along ephemeral streams (G4).

**Soil:** Soils are deep (>50cm) silty loams to sandy clay loams and deep sands. Some profiles had considerable coarse fragments (70% at 25 cm) while others had no fragments at depths of 70 cm or more. Mottles were evident (30%) in one profile at just 10 cm below the surface.

**Adjacent Riparian Vegetation:** This association tends to occur as large carrs that fill up the valley floor, however stringer stands of *Alnus* or *Betula* may occur at the stream edge.

**Adjacent Upland Vegetation:** Valley slopes are forested with stands of *Pseudotsuga menziesii*, *Populus tremuloides*, or *Picea engelmannii*.

**Successional Trends and Ecological Processes:** This plant association appears to be a grazing induced type of the *Salix monticola-Salix geyeriana*/mesic forb type. Moist sites with a water table within 20-50 cm of the soil surface tend to have rich forb diversity and abundance, while wetter sites that are saturated for most of the growing season may be dominated by native graminoides such as *Carex utriculata*, or if annually flooded, *Equisetum arvense* (Padgett *et al.* 1989).

**Management:** The management responses of this type are likely to be similar to other tall willow shrublands such as those dominated by *Salix boothii* and *Salix geyeriana* types (see Hansen *et al.* 1995). Willow carrs provide abundant forage to livestock, and with heavy grazing may shift to dominance in the undergrowth by non-native grasses such as *Agrostis stolonifera* and *Poa pratensis* (Hansen *et al.* 1995). Wet soils are susceptible to compaction early in the growing season.

**Related Types:** Baker (1989) describes a *Salix geyeriana-Salix monticola/Calamagrostis canadensis-Carex aquatilis-Carex rostrata* plant association that is dominated by native graminoides in the undergrowth. Johnston (1987) reports a *Salix geyeriana-Salix spp./Calamagrostis canadensis* plant association that again is dominated by native grasses in the undergrowth. Stands of the *Salix geyeriana-Salix monticola*/mesic forb type from the San Miguel River drainage described by Kittel and Lederer (1993) had occasional high cover of *Carex aquatilis* and *Poa pratensis*. *Salix monticola* dominated or co-dominated stands in Utah are included in *Salix boothii* plant associations described by Padgett *et al.* (1989).

Table 40. Percent Canopy Cover of Important Plant Species in the *Salix monticola*-*Salix geyeriana* /mesic forb Plant Association. See Table 2 for Plot Locations. \* = Non-native Species.

| Plot No. (95 _____)                         | AM19 | AM44 | AM45 | AM58 |
|---|------|------|------|------|
| Occurrence Rank                             | B    | B    | B    | B    |
| <b>TREES</b>                                |      |      |      |      |
| <i>Populus tremuloides</i>                  |      | 13   |      |      |
| <b>SHRUBS</b>                               |      |      |      |      |
| <i>Betula occidentalis</i>                  | 2    |      |      |      |
| <i>Pentaphylloides floribunda</i>           |      | 3    | 2    |      |
| <i>Ribes inerme</i>                         |      | 20   | 35   | 3    |
| <i>Rubus idaeus</i>                         |      | 3    |      |      |
| <i>Salix drummondiana</i>                   |      | 3    |      |      |
| <i>Salix geyeriana</i>                      | 68   | 30   | 37   | 56   |
| <i>Salix monticola</i>                      | 68   | 60   | 17   | 8    |
| <b>GRAMINOIDES</b>                          |      |      |      |      |
| <i>Agrostis stolonifera</i> *               | 52   | 20   | 10   | 30   |
| <i>Juncus balticus</i> var. <i>montanus</i> | 4    | 3    | 1    | 10*  |
| <i>Poa pratensis</i> *                      | 17   | 10   | 14   | 20   |
| <b>FORBS</b>                                |      |      |      |      |
| <i>Achillea millefolium</i>                 | 1    | 10   | 14   | 1    |
| <i>Astragalus</i> sp.                       |      | 10   | 1    |      |
| <i>Cardamine cordifolia</i>                 |      | 3    |      |      |
| <i>Cirsium tioganum</i>                     |      | 10   | 1    |      |
| <i>Conioselinum scopulorum</i>              |      | 3    | 4    |      |
| <i>Epilobium angustifolium</i>              |      |      | 5    |      |
| <i>Epilobium</i> sp.                        |      | 3    |      |      |
| <i>Erigeron</i> sp.                         |      | 3    |      |      |
| <i>Fragaria virginiana</i>                  |      | 3    |      | 30   |
| <i>Maianthemum stellatum</i>                |      |      | 8    |      |
| <i>Mertensia ciliata</i>                    | 2    | 3    | 14   |      |
| <i>Taraxacum officinale</i> *               | 1    | 1    |      |      |
| <i>Trifolium repens</i> *                   |      |      |      | 30   |
| <b>HORSETAILS</b>                           |      |      |      |      |
| <i>Equisetum arvense</i>                    |      | 3    |      |      |

### Unclassified *Salix monticola* Stands:

Lower Iowa Gulch (plot 95RR25) has a broad braided floodplain dominated by a stand of *Salix monticola* (27%) and *Salix boothii* (16%) with an undergrowth of *Carex aquatilis* (22%) and *Carex utriculata* (16%) (Table 41). It is a montane stream at 3,024 m (9,900 ft) elevation and appears to be very similar to the montane *Salix boothii*/*Carex aquatilis* type described by Padgett *et al.* (1989). *Salix monticola* dominated or co-dominated stands in Utah are included in *Salix boothii* plant associations described by Padgett *et al.* (1989).

Garber Creek (plot 95LS21) is a narrow creek running through irrigated hay fields and several irrigation diversions and ponds filled with *Typha latifolia*. It is a foothills stream at 1,860 m (6100 ft) elevation. It has a mix of *Salix monticola*, *S. exigua*, with many stems of *Alnus incana* and *Populus angustifolia* (Table 41). The stream channel itself was nearly choked with herbaceous vegetation, indicating some effluent or other upstream pollution problem. The site has a history of over-grazing, and was once a severely down-cut channel which can be seen in downstream reaches. Today it is under new management and the abundance of woody species appears to indicate transitional recovery. The site appears to have the potential of a mosaic of *Populus angustifolia*/*Alnus incana* and *Salix monticola* plant associations, among others.

Table 41. Percent Canopy Cover of Important Plant Species in Unclassified *Salix monticola* Dominated Stands. See Table 1 for Plot Locations. \* = Non-native Species.

| Plot No. (95___)                            | LS21 | RR25 |
|---|------|------|
| Occurrence Rank                             | B/C  | B    |
| <b>TREES</b>                                |      |      |
| <i>Populus angustifolia</i>                 | 15   |      |
| <i>Salix amygdaloides</i>                   | 5    |      |
| <b>SHRUBS</b>                               |      |      |
| <i>Alnus incana</i>                         | 3    |      |
| <i>Pentaphylloides floribunda</i>           |      | 2    |
| <i>Salix boothii</i>                        |      | 16   |
| <i>Salix drummondiana</i>                   |      | 1    |
| <i>Salix lucida</i> var. <i>caudata</i>     | 13   |      |
| <i>Salix exigua</i>                         | 38   |      |
| <i>Salix geyeriana</i>                      |      | 1    |
| <i>Salix eriocephala</i>                    |      | 1    |
| <i>Salix monticola</i>                      | 35   | 27   |
| <b>GRAMINOIDES</b>                          |      |      |
| <i>Carex aquatilis</i>                      |      | 22   |
| <i>Carex utriculata</i>                     |      | 16   |
| <i>Deschampsia cespitosa</i>                |      | 3    |
| <i>Juncus balticus</i> var. <i>montanus</i> |      | 1    |
| <i>Juncus drummondii</i>                    |      | 2    |
| <i>Poa palustris</i>                        |      | 1    |
| <i>Poa pratensis</i> *                      | 23   |      |
| <b>FORBS</b>                                |      |      |
| <i>Achillea millefolium</i>                 |      | 2    |
| <i>Cardamine cordifolia</i>                 |      | 1    |
| <i>Conioselinum scopulorum</i>              |      | 1    |
| <i>Epilobium angustifolium</i>              |      | 3    |
| <i>Geum macrophyllum</i>                    |      | 1    |
| <i>Maianthemum stellatum</i>                |      | 1    |
| <i>Mertensia ciliata</i>                    |      | 1    |
| <i>Thalictrum alpinum</i>                   |      | 1    |
| <b>HORSETAILS</b>                           |      |      |
| <i>Equisetum arvense</i>                    |      | 1    |

*Salix eriocephala* var. *ligulifolia* Alliance

Yellow willow/mesic graminoid (*Salix eriocephala* var. *ligulifolia*/mesic graminoid) Plant Association

CNHP Rank: G37/S3?

6 plots-- 95GK19, 95AM34, 95LS07, 95GK10, 95GK11, 95GK15.

**Reference Reaches:** A good montane stand can be seen on BLM land, along East Fork Arkansas River, T8S, R79 W, Sec 33. Foothill examples occur along West Plum and Kiowa Creeks (specific locations withheld to respect landowner privacy). An excellent montane example occurs on Elkhorn Creek, Larimer County (specific location withheld to respect landowner privacy).

**General Description and Comments:** The *Salix eriocephala* var. *ligulifolia* plant association is a medium to tall willow shrubland occurring in saturated areas in the foothills, where it is often mixed with *Salix exigua* and *S. lucida*. At higher elevations it forms relatively broad areas mixed with *S. monticola* and *S. drummondiana*. *Salix eriocephala* var. *ligulifolia* is a new name for specimens identified as *Salix lutea* and *Salix eriocephala* in Colorado. Dorn (1995 and his review and annotation of *Salix* specimens at the University of Colorado herbarium) states that the species *S. lutea* (as used in Colorado literature) is *S. eriocephala* var. *watsonii*, which is known only from the extreme northwestern corner of the state, and that *S. eriocephala* var. *ligulifolia* should be applied to most of the specimens identified as *S. lutea* and *S. ligulifolia* in Colorado.

**Regional Distribution:** A *Salix lutea* community type is reported from Eastern Wyoming/western Idaho (Youngblood *et al.* 1985), however these stands would not have any *Salix eriocephala* var. *ligulifolia* (Dorn 1995).

**Distribution in Colorado:** Not reported in the literature, but likely to occur along the Colorado Front Range, and scattered locations on the western slope.

*The following characteristics are based on plots and observations from parts of the upper Arkansas and lower South Platte River Basins, Colorado.*

**Vegetation:** Tall stands of *Salix eriocephala* var. *ligulifolia* (0-68%) mixed with *S. exigua* (0-25%) and *Salix lucida* spp. *caudata* (9-56%) characterize this plant association in the foothills. The undergrowth is lush, dominated by *Carex nebrascensis* with *C. lanuginosa* and *Eleocharis palustris*. In late June and early July streams were running high, and our plots had 25-95% standing water. One higher elevation 2,550 m (8,360 ft) stand (plot 95GK19) has a canopy dominated by *Salix eriocephala* var. *ligulifolia* (35%), *Salix monticola* (0-13%), *S. wolfii* (0-11%), *S. planifolia* (0-8%) with several other willows all under 5% cover, including *S. bebbiana*, *S. drummondiana*, and *S. geyeriana*. The ground surface is hummocky with standing water in the swales. Graminoid cover is generally high, with various species such as *Carex nebrascensis* (0-36%), *C. utriculata* (0-41%), *Calamagrostis canadensis* (0-27%), and others (Table 42). One

high elevation stand has an herbaceous undergrowth rich in forbs (>70%) including *Thalictrum fenderli* (20%) and *Fragaria virginiana* (12%) (Table 42).

Elevation: 1,930-3,110 m (6,350-10,240 ft).

**Site Geomorphology:** Foothill examples of this plant association occur in the wettest part of the riparian area, usually adjacent to flowing water of the channel on low point bars and islands, as well as on low stream banks and overflow channels. At higher elevations it occurs in moderately wide valleys with extensive beaver ponds and dams, or in broad subalpine glaciated valleys where the ground is gently sloping and saturated for much of the growing season.

**Soil:** Soils of lower alluvial occurrences are deep to shallow (>1 m-50 cm) sandy clay loams and sands over unconsolidated alluvial material with thin buried layers of organic material. The water table at the time of sampling was above the surface of the soil by 10-20 cm. Soils of upper elevation stands are saturated sandy loams and clay loams with high organic matter content in the upper layers (30%).

**Rosgen's Channel Type:** Foothill stands occur along broad meandering streams with sandy beds (C5). At higher altitudes stands occur along steep gully type streams (G3) or braided stream channels below active beaver ponds.

**Adjacent Riparian Vegetation:** In the foothills this association occurs as part of a diverse mosaic of young *Populus angustifolia*, *Populus deltoides*, and *Salix amygdaloides* stands. Other *Salix* spp. dominated stands, open meadows of *Bromus inermis*, and older stands of *Populus deltoides* occur on higher terraces. At higher elevations it may intermix with *Carex aquatilis* meadows.

**Adjacent Upland Vegetation:** Foothill reaches are surrounded by irrigated hay meadows of smooth brome (*Bromus inermis*), scattered *Quercus gambelii* and *Pinus ponderosa* on rocky hillsides. Montane areas may have *Ariemisia* spp. shrublands, *Abies lasiocarpa* and *Picea engelmannii* or *Pinus ponderosa* forests on the surrounding slopes.

**Succession and Ecological Processes:** Little is known about this newly described association. Along foothill streams it appears to be early to mid-seral, occupying point bars and low stream banks that are flooded annually in spring, and may represent transitional stands between *Salix exigua* plant associations of lower elevations and *Salix eriocephala* types of higher elevations. Montane stands appear more long-lived, associated with beaver activity and saturated soils throughout the growing season.

**Management:** Foothills occurrences are highly productive and provide forage for livestock. Over-grazing and over-browsing should be avoided to maintain woody species vigor. Roots of the willows provide stream bank stability (Hansen *et al.* 1995, Padgett *et al.* 1989).

Related Types: Dorn's 1995 treatment for this willow is too recent to be reflected in the plant community classification literature. The closely related *Salix lutea* community type has been reported from Eastern Wyoming/western Idaho (Youngblood *et al.* 1985), however, according to Dorn (1995) these stands would not have any *Salix eriocephala* var. *ligulifolia*.

Table 42. Percent Canopy Cover of Important Plant Species in *Salix eriocephala* var. *ligulifolia* /mesic graminoid Plant Association. See Tables 1 and 2 for Plot Locations. \* = non-native species.

| Plot ( )   | GK10 | GK11 | GK15 | LS07 | GK19 | AM34 |
|--|------|------|------|------|------|------|
| Occurrence Rank  | C    | C    | B    | C    | A    | B    |
| <b>TREES</b>   |      |      |      |      |      |      |
| <i>Populus angustifolia</i> --seedlings                    |      |      | 5    |      |      |      |
| <i>Populus deltoides</i> ssp. <i>monilifera</i>            |      |      |      | 26   |      |      |
| <i>Populus deltoides</i> ssp. <i>monilifera</i> --saplings | 5    |      |      |      |      |      |
| <b>SHRUBS</b>  |      |      |      |      |      |      |
| <i>Salix eriocephala</i> var. <i>ligulifolia</i>           | 24   | 20   | 70   | 68   | 35   | 48   |
| <i>Salix exigua</i>  | 1    | 6    | 8    | 23   |      |      |
| <i>Salix lucida</i> ssp. <i>caudata</i>                    | 19   | 35   |      | 9    |      |      |
| <i>Salix monticola</i>                                     |      |      |      |      | 13   |      |
| <i>Salix planifolia</i> ssp. <i>planifolia</i>             |      |      |      |      | 6    | 8    |
| <i>Salix wolfii</i>  |      |      |      |      |      | 11   |
| <b>GRAMINOIDES</b>   |      |      |      |      |      |      |
| <i>Alopecurus aequalis</i>                                 | 1    |      |      | 3    |      |      |
| <i>Calamagrostis canadensis</i>                            |      |      |      |      | 27   |      |
| <i>Carex lanuginosa</i>                                    | 4    | 7    | 46   | 5    |      |      |
| <i>Carex nebrascensis</i>                                  | 15   | 36   |      | 10   |      |      |
| <i>Carex utriculata</i>                                    |      |      |      |      | 41   |      |
| <i>Poa pratensis</i> *                                     | 1    | 2    | 10   | 1    | 5    | 24   |
| <i>Scirpus pungens</i>                                     | 14   |      | 1    | 4    |      |      |
| <i>Scirpus microcarpus</i>                                 |      | 16   | 1    |      |      |      |
| <i>Typha latifolia</i>                                     | 13   | 3    |      |      |      |      |
| <b>FORBS</b>   |      |      |      |      |      |      |
| <i>Mentha arvensis</i>                                     | 5    | 2    |      | 3    |      |      |
| <i>Solidago multiradiata</i>                               |      |      |      |      |      | 9    |
| <i>Solidago</i> sp.  |      | 1    | 5    |      |      |      |
| <i>Taraxacum officinale</i> *                              |      |      |      |      | 1    | 9    |
| <i>Thalictrum fendleri</i>                                 |      |      |      |      | 1    | 19   |
| <b>HORSETAILS</b>  |      |      |      |      |      |      |
| <i>Equisetum arvense</i>                                   | 3    | 3    | 3    | 1    |      | 2    |

## *Symphoricarpos occidentalis* Alliance

### Snowberry (*Symphoricarpos occidentalis*) Plant Association

CNHP Rank: G4/S3?

5 plots--95GK05, 95GK45, 95GK48, 95GK67, 95GK73.

**Reference Reaches:** No reference reaches were located in the study area, however a good example of this type can be seen along Kettle Creek, just north of the sports club firing range, U.S. Air Force Academy grounds, T12S R66W, Sec 21.

**General Description and Comments:** The *Symphoricarpos occidentalis* plant association is a minor type occurring in small draws and on toe slopes within foothill canyons of the Colorado Front Range. Along the S. Platte River floodplain it forms large, patchy stands on higher terraces and islands. It is easily recognized as a low to medium high (0.5-1 m) shrub community forming large patches with few other shrubs present.

**Regional Distribution:** This type is known from Montana, Wyoming, and eastern Colorado. (Hansen *et al.* 1988, Jones and Walford 1995, Akashi 1988, and this report).

**Distribution in Colorado:** This association is only known from east of the Continental Divide. It occurs in rocky draws of the Pawnee National Grassland, on terraces and floodplains of the Cache la Poudre and S. Platte Rivers, and on toe slopes and stream benches of eastern foothills streams (Christy 1973, Kittel 1994, and this report). On the western slope, *S. rotundifolius* is a very common non-riparian association (Johnson 1987).

*The following characteristics are based on plots and observations from parts of the lower So. Platte and upper Arkansas River Basins, Colorado.*

**Vegetation:** *Symphoricarpos occidentalis* forms a moderately dense shrub layer about 1.5 feet tall, *Ribes aureum* (0-3%) and *Salix exigua* (0-3%) are present in small amounts. *Toxicodendron rhydbergii* (0-96%) was thick in one plot growing as a very dense vine underneath and around the *Symphoricarpos* stems (Table 43).

**Elevation:** 1,200-2,000 m (3,940-6,590 ft.)

**Site Characteristics:** This association occurs on higher terraces and open rises of the broad floodplain of the S. Platte River. Along smaller tributaries, it occurs on draws and along rocky ledges. It can occur in narrow bands or as widely spaced individuals, but most often it is found in large, thick patches.

**Rosgen's Channel Type:** This association occurs along large braided channels (D5), and small narrow steep tributaries (B3, G5).

**Soil:** Soil textures are silty clay loams and silty loams with moderately deep top layers (3-5 feet).

**Adjacent Riparian Vegetation:** This plant association grades into stands of *Populus deltoides*/*Symphoricarpos occidentalis* on the broad, open floodplains of the S. Platte River. *Salix exigua*/mesic graminoid occurs in adjacent swales. It can be the only community in narrow gulches and small draws, or can occur with *Alnus incana* and *Populus angustifolia* stands on perennial streams.

**Adjacent Upland Vegetation:** Agricultural fields, rangeland, and *Bouteloua gracilis* grasslands occur on the upland where this plant association is found. On foothill streams, *Pinus ponderosa* and *Quercus gambelii* occur on surrounding hill slopes.

**Succession and Ecological Processes:** It is apparent that this plant association is one of the last successional stages of the pioneering floodplain forest of the S. Platte River. Older trees die and fall over, leaving an open shrubland of *Symphoricarpos* (personal observation, see also Christy 1973). This association occupies the driest sites within the riparian area and may be transitional between riverine and upland habitats.

**Management:** Along smaller tributaries, this type was seen growing along fences with a dramatic fence-line contrast, where *Symphoricarpos* is widely spaced and nearly hidden by the *Agropyron intermedia* on the grazed side, and thick stands of *Symphoricarpos* mixed with *Prunus virginiana* grow on the ungrazed side of the fence. In Wyoming *Symphoricarpos* is considered an indication of a lack of grazing (Jones and Walford 1995), while in Montana it is thought to be a grazing induced type (Hansen *et al.* 1988).

**Related Types:** A similar *Symphoricarpos occidentalis* dominance has been described by Jones and Walford (1995), however their stands contain significant amounts of *Fraxinus pennsylvanica* and *Acer negundo* saplings and seedlings while the Colorado stands do not. In Wyoming, Akashi (1988) describes a *Rhus trilobata*-*Symphoricarpos occidentalis* shrubland, however most of the associated shrub species do not occur within the Colorado stands. Kittel (1994) reports a *Symphoricarpos alba*/mesic graminoid community type from the Cache la Poudre River.

Table 43. Percent Canopy Cover of Important Species of the *Symphoricarpos occidentalis* Plant Association. See Tables 1 and 2 for Plot Locations. \* = Non-native Species.

| Plot Number (95 ____)                                       | GK05 | GK45 | GK48 | GK76 | GK73 |
|---|------|------|------|------|------|
| Occurrence Rank   | C    | C    | C    | C    | C    |
| <b>TREES</b>  |      |      |      |      |      |
| <i>Populus deltoides</i> ssp. <i>monilifera</i> --seedlings |      | 8    |      |      |      |
| <b>SHRUBS</b>   |      |      |      |      |      |
| <i>Ribes aureum</i>   |      |      | 3    | 3    | 1    |
| <i>Salix exigua</i>   |      | 3    | 1    | 7    |      |
| <i>Symphoricarpos occidentalis</i>                          | 30   | 42   | 85   | 49   | 90   |
| <i>Toxicodendron rydbergii</i>                              |      |      | 96   |      |      |
| <b>GRAMINOIDES</b>  |      |      |      |      |      |
| <i>Agropyron cristatum</i>                                  | 16   |      |      |      |      |
| <i>Bromus tectorum</i> *                                    | 9    |      |      |      |      |
| <i>Carex</i> sp.  | 5    |      |      |      |      |
| <i>Pascopyrum smithii</i>                                   | 27   |      |      | 3    |      |
| <i>Poa pratensis</i> *                                      | 29   | 6    | 19   | 29   | 8    |
| <b>FORBS</b>  |      |      |      |      |      |
| <i>Brassicaceae</i> spp.                                    | 1    |      | 32   |      |      |
| <i>Cirsium arvense</i> *                                    |      |      | 3    |      |      |
| <i>Cirsium</i> sp.  |      |      | 4    |      | 1    |
| <i>Descurainia sophia</i> *                                 | 13   |      |      |      |      |
| <i>Glycyrrhiza lepidota</i>                                 |      |      | 3    |      | 1    |

**Chokecherry-snowberry (*Prunus virginiana*-*Symphoricarpos occidentalis*) Plant Association**

CNHP Rank: GU/SU

2 Plots--95LS03, 95GK04

**Reference Reaches:** No references were located in the study area, but a good example can be seen in Dave's Draw on the Pawnee National Grassland, T10N, R60W, Sec 24.

**General Description and Comments:** This is a low to medium shrubland that is narrow and confined to gullies and arroyos and narrow stream benches. The vegetation is very thick and almost impossible to walk through.

**Regional Distribution:** This association is reported to occur throughout Montana and Wyoming (Hansen *et al.* 1995, Jones and Walford 1995). Similar types have also been reported from Nevada (Manning and Padgett 1995)

**Distribution in Colorado:** The *Prunus virginiana*-*Symphoricarpos occidentalis* association is a minor type found only in dry gullies and draws on the eastern plains, although similar types have been reported from the western slope (Kittel *et al.* 1994, see also Related Types below).

*The following characteristics are based on plots and observations from parts of the South Platte River Basin, Colorado.*

**Vegetation:** This association is characterized by a thick layer of shrubs about 1.5-4 feet tall, consisting of *Prunus virginiana* (20-41%) and *Symphoricarpos occidentalis* (20-40%). Other shrub species present include *Ribes aureum* (1-20%) and *Toxicodendron rhydbergii* (10%). A few scattered *Juniperus scopulorum* also occur within the draw. The undergrowth is dominated by *Poa pratensis* (20-40%) and *Bromus tectorum* (3-40%). Forbs are scattered and weedy (Table 44).

**Elevation:** 1,630-1,650 m (5,370-5,400 ft).

**Site Geomorphology:** This plant association occurs in entrenched washes with rock outcrops providing a strong north-south aspect.

**Rosgen's Channel Type:** Along the Front Range, this association appears to occur only in steep gullies and arroyos (G5).

**Soil:** Soils are shallow to deep alluvial deposits directly on bedrock. Textures are mostly silty loams, becoming skeletal at depth.

**Adjacent Riparian Vegetation:** Scattered patches of *Juniperus scopulorum* and *Rhus trilobata* occur in protected pockets along the draw.

**Adjacent Upland Vegetation:** Adjacent uplands have *Stipa comata*-*Bouteloua gracilis* grasslands.

**Successional and Ecological Processes:** This association appears to be limited to small protected pockets within incised gullies and washes on the plains. These shrub species require more moisture than the surrounding uplands and occur in areas where runoff can quickly reach their roots, mainly at the bottom of rock outcrops and similar sites within the riparian zone. Manning and Padgett (1995) state that this type represents succession away from riparian conditions, and Hansen *et al.* (1995) suggest it may be a grazing induced disclimax from the *Fraxinus/Prunus virginiana* community. Colorado stands appear to be facultatively riparian, and probably represent site potential in ungrazed conditions.

**Management:** Thick stands provide little forage production for livestock (Hansen *et al.* 1995). With heavy browsing *Rosa woodsii* will increase in abundance (Manning and Padgett 1995).

**Related Types:** Hansen *et al.* (1995) describe a *Prunus virginiana* community type that is identical in species composition, environmental setting, occurrence location, and size to Colorado stands. Manning and Padgett (1995) describe a similar *Prunus virginiana/Rosa woodsii* community type, however no *Symphoricarpos* appears in their stands. Jones and Walford (1995) report a *Prunus virginiana* dominance type that is wide spread throughout Wyoming and closely resembles the type described from Montana by Hansen *et al.* (1991, 1995). A similar type is reported from the Colorado River basin, the *Prunus virginiana* plant association (Kittel *et al.* 1994), but it has wetter species such as *Cornus sericea* and *Pseudotsuga menziesii*, making it quite different from the *Prunus virginiana* stands described here from the eastern plains.

Table 44. Percent Canopy Cover of Important Species of the *Prunus virginiana*-*Symphoricarpos occidentalis* Plant Association. See Tables 1 and 2 for Plot Locations. \* = Non-native Species.

| Plot No. ( )                                     | GK03 | LS03 |
|--|------|------|
| Occurrence Rank                                  | B    | B    |
| <i>Juniperus scopulorum</i> --mature trees       | 12   | 1    |
| SHRUBS   |      |      |
| <i>Prunus virginiana</i> var. <i>melanocarpa</i> | 20   | 42   |
| <i>Rhus trilobata</i> var. <i>trilobata</i>      | 34   |      |
| <i>Ribes aureum</i>                              | 1    | 20   |
| <i>Ribes cereum</i>                              | 2    | 1    |
| <i>Rosa woodsii</i>                              | 1    |      |
| <i>Symphoricarpos occidentalis</i>               | 20   | 40   |
| <i>Toxicodendron rydbergii</i>                   | 3    | 10   |
| GRAMINOIDES                                      |      |      |
| <i>Bromus tectorum</i> *                         | 3    | 40   |
| <i>Eleocharis palustris</i>                      | 1    |      |
| <i>Poa pratensis</i> *                           | 20   | 1    |
| <i>Stipa comata</i>                              | 3    |      |
| FORBS  |      |      |
| <i>Artemisia ludoviciana</i>                     |      | 3    |
| <i>Convolvulus arvensis</i>                      | 1    |      |
| <i>Descurainia sophia</i> *                      | 1    | 1    |
| <i>Glycyrrhiza lepidota</i>                      | 3    | 3    |
| <i>Maianthemum stellatum</i>                     | 30   | 20   |
| <i>Melilotus officinalis</i> *                   | 1    |      |
| <i>Thlaspi arvense</i>                           |      | 3    |
| <i>Vicia americana</i>                           | 1    |      |

UNESCO: III.B.3.d. DECIDUOUS PEAT SHRUBLANDS

COWARDIN: PALUSTRINE DECIDUOUS SCRUB-SHRUB SHRUBLAND

*Salix brachycarpa* Alliance

No plant associations were determined from the study area because not enough samples were taken at high elevations.

East Fork Arkansas River (plot 95RR23) is a broad glaciated valley with a mosaic of willows and wet sedge meadows. This stand is dominated by *Salix brachycarpa* (68%) with a bit of *Salix wolfii* (1%), and *Carex aquatilis* (22%) and *Carex utriculata* (6%) in the undergrowth. Forb cover was <5% total (Table 45). This type of moist *Salix brachycarpa* has not been well documented in the literature, but other stands are known from the Colorado River drainage (Kittel *et al.* 1994). This type may be included in reports of the *Salix planifolia*-*Salix wolfii*/*Caltha leptosepala*-*Carex aquatilis* type described by Baker (1989) or the *Salix wolfii*/*Deschampsia cespitosa* type described by Johnson (1987). Other similar types include the *Salix planifolia*-*Salix brachycarpa* types reported from the San Juan Mountains, the Front Range, and from Gunnison National Forest (Baker 1989, Hess and Wasser 1982, Komarkova 1986, Kittel and Lederer 1993).

Table 45. Percent Canopy Cover for Important Species in *Salix brachycarpa* Dominated Stands. See Table 2 for Plot Location.

| Plot No. (95 <u>    </u> )      | RR23 |
|---------------------------------|------|
| Occurrence Rank                 | B    |
| SHRUBS                          |      |
| <i>Salix brachycarpa</i>        | 68   |
| <i>Salix wolfii</i>             | 2    |
| GRAMINOIDES                     |      |
| <i>Carex aquatilis</i>          | 22   |
| <i>Carex utriculata</i>         | 6    |
| FORBS                           |      |
| <i>Cardamine cordifolia</i>     | 2    |
| <i>Geum macrophyllum</i>        | 1    |
| <i>Mertensia ciliata</i>        | 1    |
| <i>Polemonium foliosissimum</i> | 1    |
| <i>Thalictrum alpinum</i>       | 1    |
| Unknown forb                    | 2    |

## *Salix planifolia* Alliance

Planeleaf willow/Aquatic sedge (*Salix planifolia*/*Carex aquatilis*) Plant Association  
CNHP Rank: G4/S4  
2 plots-- 95RR24, 95GK20.

**Reference Reaches:** No reference reaches were located, however a large occurrence in fair to good condition can be seen on BLM lands along Tennessee Creek adjacent to Highway 24, across from Missouri Hill, T8S, R80W, Sec28.

**General Description and Comments:** This a common plant association of subalpine glaciated valleys. It is a low-stature willow shrubland of almost pure *Salix planifolia* to mixed with *S. brachycarpa* or *S. wolfii* at high elevations, grading into taller willow carrs and intermixing with *S. monticola* at lower elevations (see plot 95RR24).

**Regional Distribution:** This type is known from northwestern and north central Wyoming (Johnston 1987), the Uinta mountains and central Utah (Padgett *et al.* 1989), and Montana (Bourgeron and Engelking 1994).

**Distribution in Colorado:** This plant association is a common type and occurs throughout the high country of Colorado. It has been reported from Roosevelt, Arapaho, Gunnison, Pike, and Routt National Forests (Johnston 1987), and in the higher elevations of the Front Range (Cooper and Cottrell 1990). In the Yampa River Basin this type is abundant throughout the Park Range, the Elkhead Mountains, and the Flat Top Mountains (Kittel and Lederer 1993). In the Gunnison River Basin it occurs in the upper reaches of the Big Blue and West Elk Wilderness Areas (Kittel *et al.* 1995).

*The following characteristics are based on plots and observations from parts of the upper Arkansas and South Platte River Basins, Colorado.*

**Vegetation:** This association is characterized by *Salix planifolia* (50-60%) occasionally with other willows such as *S. monticola* (3-38%), *S. geyeriana* (1-10%), and *S. drummondiana* (0-12%). The undergrowth is dominated by graminoides such as *Carex aquatilis* (30%) and other *Carex* species and many forb species that do not contribute much more than 20% of the herbaceous cover (Table 46).

**Elevation:** 2,450-3,050 m (9,100-10,000 ft).

**Site Geomorphology:** This plant association occurs in wide, wet valleys on gently sloping snowmelt fed swales. It also occurs in narrow valleys with sinuous streams and wet floodplains.

**Rosgen's Channel Type:** This type occurs on narrow, sinuous stream reaches (E4) and wider streams (B3). It is often associated with beaver ponds.

**Soil:** Soils are mineral silty clay and sandy loams with up to 30% organic matter in the top 20 cm.

**Adjacent Riparian Vegetation:** This association often forms a mosaic with *Carex aquatilis* meadows and *Salix brachycarpa* shrublands.

**Adjacent Upland Vegetation:** Adjacent hillslopes are often covered in *Picea engelmannii*/*Abies lasiocarpa* forests or subalpine grasslands (e.g. *Danthonia*).

**Successional Trends and Ecological Processes:** This plant association occurs in wet swales that are saturated throughout the growing season. Both *Caltha leptosepala* and *Carex aquatilis* can tolerate saturated soils, and occasionally they co-dominate (Padgett *et al.* 1989). Johnston (1987) notes that patches of *Carex utriculata* can occur within this plant association.

**Management:** Soils are susceptible to compaction by livestock. Heavy grazing will open the canopy and lower the water table through increased evapotranspiration, allowing non-native grasses and forbs to become dominant in the undergrowth (Padgett *et al.* 1989, Hansen *et al.* 1995).

**Related Types:** This common association has been well documented in the literature under several names: *Salix planifolia*/*Carex aquatilis* (Padgett *et al.* 1989, Johnston 1987, Komarkova 1986, Hess 1981); *Salix planifolia*/*Caltha leptosepala*-*Carex aquatilis* phase (Hess and Wasser 1982), and *Salix planifolia*/*Carex aquatilis* (Cooper and Cottrell 1990).

Table 46. Percent Canopy Cover of Important Plant Species in the *Salix planifolia*/*Carex aquatilis* Plant Association. See Table 2 for Plot Locations. \* = Non-native Species.

| Plot No. (95___)                               | RR24 | GK20 |
|--|------|------|
| Occurrence Rank                                | B    | C    |
| <b>SHRUBS</b>                                  |      |      |
| <i>Betula glandulosa</i>                       | 4    |      |
| <i>Salix drummondiana</i>                      |      | 12   |
| <i>Salix geyeriana</i>                         | 1    | 9    |
| <i>Salix monticola</i>                         | 38   | 3    |
| <i>Salix planifolia</i> ssp. <i>planifolia</i> | 51   | 60   |
| <i>Salix wolfii</i>                            | 3    |      |
| <b>GRAMINOIDES</b>                             |      |      |
| <i>Calamagrostis canadensis</i>                | 2    | 11   |
| <i>Carex aquatilis</i>                         | 30   | 32   |
| <i>Carex microptera</i>                        | 1    |      |
| <i>Carex utriculata</i>                        | 1    | 8    |
| <b>FORBS</b>                                   |      |      |
| <i>Achillea millefolium</i>                    |      | 3    |
| <i>Cardamine cordifolia</i>                    | 1    | 1    |
| <i>Conioselinum scopulorum</i>                 | 3    |      |
| <i>Epilobium angustifolium</i>                 | 2    | 7    |
| <i>Fragaria virginiana</i>                     |      | 7    |
| <i>Heracleum sphondylium</i>                   |      | 2    |
| <i>Montia chamissoi</i>                        | 1    |      |
| <i>Pedicularis groenlandica</i>                | 1    |      |
| <i>Pyrola</i> sp.                              |      | 1    |
| <i>Sedum integrifolium</i>                     |      | 1    |
| <i>Swertia perennis</i>                        | 1    |      |
| <i>Thalictrum fendleri</i>                     |      | 1    |
| <i>Viola</i> sp.                               | 1    | 1    |
| <b>HORSETAILS</b>                              |      |      |
| <i>Equisetum arvense</i>                       |      | 3    |

**Planeleaf willow/Marsh marigold (*Salix planifolia*/*Caltha leptosepala*) Plant Association**

**CNHP Rank:** G4/S4

2 plots-- 95RR26, 95LS19.

**Reference Reaches:** A very good example of this plant association can be seen in the Dyer Amphitheater on BLM lands, T9S, R79W, Sec 26.

**General Description and Comments:** This association is a common subalpine wetland characterized by low-stature shrubs (0.5 m tall) with very wet to saturated soils and a thick carpet of forbs in the undergrowth.

**Regional Distribution:** This type is known from northwestern and north central Wyoming (Johnston 1987).

**Distribution in Colorado:** It is a major subalpine wetland type that occurs throughout the high country of Colorado. It has been documented from Roosevelt, Arapaho, Gunnison, Pike, and Routt National Forests (Johnston 1987).

*The following characteristics are based on plots and observations from parts of the upper Arkansas and South Platte River Basins, Colorado.*

**Vegetation:** *Salix planifolia* grows in nearly pure stands (37-94%) with few other shrubs present such as *Betula glandulosa* (0-16%) or *Salix brachycarpa* (0-1%). The herbaceous undergrowth can be sparse due to saturated soils and heavy shade but is characterized by an abundance of forbs with few graminoides. Typically *Caltha leptosepala* (7-30%) and *Cardamine cordifolia* (0-22%) are present in high altitude stands (plot 95RR26), while stands at lower elevations have species such as *Fragaria virginiana* and *Hydrophyllum* spp. (Table 47).

**Elevation:** 2,800-3,600 m (9,180-11,800 ft).

**Site Geomorphology:** This plant association typically occurs in wide, glaciated valleys adjacent to streams and in swales and depressions, and on slopes where snow melt runoff continues to saturate soils at or near the surface for much of the growing season. The ground may be flat or uneven with raised hummocks.

**Rosgen's Channel Type:** This association occurs along low to moderate gradient (1.8-2.3%) streams that are wide to braided and often below beaver dams (B3-D6).

**Soil:** Soils of subalpine occurrences are typically deep, dark clay loams with high organic content. Soils of more montane stands are often mollic, but with a greater mineral component and higher coarse fragments.

**Adjacent Riparian Vegetation:** *Carex aquatilis* and *Carex utriculata* meadows occur on

adjacent saturated areas. *Salix brachycarpa* shrublands or *Deschampsia cespitosa* grasslands occur on adjacent drier slopes.

**Adjacent Upland Vegetation:** Adjacent hillslopes are often covered in *Salix brachycarpa* stands, upland meadows (e.g. *Danthonia* sp.), or *Abies lasiocarpa*-*Picea engelmannii* forests at subalpine altitude. At higher sites, alpine tundra may occur on the surrounding slopes.

**Successional Trends and Ecological Processes:** This plant association occurs in wet swales that are saturated throughout the growing season. It is a long-lived stable plant association that will change with fluctuations in the water table and degree of soil saturation.

**Management:** 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.

**Related Types:** This plant association is very similar to the *Salix planifolia*-*Salix wolfii*/*Caltha leptosepala*-*Carex aquatilis* described by Baker (1989), and the *Salix planifolia*/*Caltha leptosepala* types described by Cooper and Cottrell (1990) and Hess and Wasser (1982).

Table 47. Percent Canopy Cover of Important Plant Species in the *Salix planifolia*/*Caltha leptosepala* Plant Association. See Tables 1 and 2 for Plot Locations. \* = Non-native Species.

| Plot No. (95___)                                | RR26 | LS19 |
|---|------|------|
| Occurrence Rank                                 | A    | C    |
| <b>TREES</b>                                    |      |      |
| <i>Picea engelmannii</i> --young & mature trees |      | 5    |
| <i>Pinus contorta</i> --young & mature trees    |      | 11   |
| <i>Populus tremuloides</i>                      |      | 1    |
| <b>SHRUBS</b>                                   |      |      |
| <i>Alnus incana</i> ssp. <i>tenuifolia</i>      |      | 2    |
| <i>Betula glandulosa</i>                        |      | 16   |
| <i>Lonicera involucrata</i>                     |      | 4    |
| <i>Pentaphylloides floribunda</i>               |      | 1    |
| <i>Salix brachycarpa</i>                        | 1    |      |
| <i>Salix planifolia</i> ssp. <i>planifolia</i>  | 94   | 37   |
| <b>GRAMINOIDES</b>                              |      |      |
| <i>Calamagrostis canadensis</i>                 |      | 14   |
| <i>Carex scopulorum</i>                         | 1    |      |
| <b>FORBS</b>                                    |      |      |
| <i>Caltha leptosepala</i>                       | 32   | 7    |
| <i>Cardamine cordifolia</i>                     | 22   |      |
| <i>Conyza canadensis</i> *                      |      | 12   |
| <i>Dodecatheon pulchellum</i>                   |      | 1    |
| <i>Fragaria virginiana</i>                      |      | 10   |
| <i>Geranium richardsonii</i>                    |      | 18   |
| <i>Hydrophyllum capitatum</i>                   |      | 7    |
| <i>Medicago lupulina</i> *                      |      | 3    |
| <i>Mertensia ciliata</i>                        | 1    |      |
| <i>Sedum rhodanthum</i>                         | 1    | 2    |
| <i>Taraxacum officinale</i> *                   |      | 2    |
| <i>Veronica wormskjoldii</i>                    | 1    |      |
| <i>Viola</i> sp.                                |      | 5    |

## ***Salix wolfii* Alliance**

**Wolf's willow/aquatic sedge (*Salix wolfii*/*Carex aquatilis*) Plant Association**

**CNHP Rank: G4/S4.**

1 plot-- 95AM39

**Reference Reaches:** A good example can be seen along Iowa Gulch on BLM land, T9S, R79W, Sec 35.

**General Description and Comments:** This is a common plant association of very wet sites in the subalpine areas of western Colorado. It occurs in wetter sites than those dominated by *Salix planifolia* and often forms a mosaic with stands of *S. planifolia* and *S. brachycarpa*, and open sedge meadows.

**Regional Distribution:** This association has been reported from Utah and southeastern Idaho (Padgett et al. 1989); from Idaho and Wyoming (Youngblood et al. 1985), Montana (Hansen et al. 1995), and from the Western Slope of Colorado (Kittel et al. 1994).

**Distribution in Colorado:** The *Salix wolfii*/*Carex aquatilis* plant association is weakly documented from Colorado's Western Slope (Kittel et al. 1994, Johnston 1987).

*The following characteristics are based on plots and observations from parts of the upper Arkansas River Basin, Colorado.*

**Vegetation:** The one stand sampled has a variety of willows, including *S. wolfii* (21%), *S. boothii* (11%) and *S. planifolia* (15%). Also present is *Betula glandulosa* (12%). The undergrowth has a rich assortment of forb species, total cover about 50%, including *Ligusticum tenuifolium* and *Thalictrum alpinum* (Table 48). *Carex aquatilis* is the most abundant single species accounting for 21% cover in the stand.

**Elevation:** 3,480 m (11,400 ft).

**Site Geomorphology:** This plant association occurs in moderately narrow valleys, along flat to undulating floodplains above 2670 m (8760 ft) in elevation.

**Rosgen's Channel Type:** This association occurs along broad, gently meandering streams (B2).

**Soil:** Soils are mostly organic.

**Adjacent Riparian Vegetation:** *Salix brachycarpa* and tallus slopes occur adjacent to *Salix wolfii* stands in the mosaic.

**Adjacent Upland Vegetation:** Alpine tundra occurs on surrounding hillslopes.

**Successional Trends and Ecological Processes:** *Carex aquatilis* is well suited to wet, organic soils at these elevations. Succession will occur slowly under these conditions (Padgett *et al.* 1989).

**Management:** The saturated soils are susceptible to compaction. Heavy grazing can lead to soil compaction and a reduction in the *Carex aquatilis*, allowing other grasses and forbs to become established.

**Related Types:** *Salix wolfii/Carex aquatilis* (Youngblood *et al.* 1985, Padgett *et al.* 1989, Johnston 1987) and *Salix planifolia-Salix wolfii/Calamagrostis canadensis-Carex aquatilis* (Baker 1989) are both similar although ours lacks the other willow components.

Table 48. Percent Canopy Cover of Important Plant Species in the *Salix wolfii/Carex aquatilis* Plant Association. See Table 2 for Plot location. \* = Non-native Species.

| Plot No. (95___)                               | AM39 |
|--|------|
| Occurrence Rank                                | B    |
| <b>SHRUBS</b>                                  |      |
| <i>Betula glandulosa</i>                       | 12   |
| <i>Salix boothii</i>                           | 11   |
| <i>Salix brachycarpa</i>                       | 2    |
| <i>Salix planifolia</i> ssp. <i>planifolia</i> | 15   |
| <i>Salix wolfii</i>                            | 21   |
| <b>GRAMINOIDES</b>                             |      |
| <i>Carex aquatilis</i>                         | 21   |
| <i>Carex nova</i>                              | 4    |
| <b>FORBS</b>                                   |      |
| <i>Aconitum columbianum</i>                    | 2    |
| <i>Caltha leptosepala</i>                      | 4    |
| <i>Cardamine cordifolia</i>                    | 6    |
| <i>Ligusticum tenuifolium</i>                  | 17   |
| <i>Mertensia ciliata</i>                       | 2    |
| <i>Oxypolis fendleri</i>                       | 3    |
| <i>Pedicularis groenlandica</i>                | 7    |
| <i>Saxifraga odontoloma</i>                    | 2    |
| <i>Swertia perennis</i>                        | 7    |
| <i>Thalictrum alpinum</i>                      | 13   |

UNESCO: V.C.6.a. MESOPHYTIC SOD-FORMING SUBALPINE-ALPINE GRASSLANDS  
COWARDIN: PALUSTRINE PERSISTENT EMERGENT WETLANDS

*Carex aquatilis* Alliance

**Water sedge (*Carex aquatilis*) Plant Association**

CNHP Rank: G5/S4

2 Plots— 95AM12, 95AM35.

**References reaches:** No reference reaches were located in the study areas, however, a large occurrence in good condition can be seen on BLM lands along East Fork Arkansas River, T8S, R79W, Sec 16.

**Regional Distribution:** This common type is widespread throughout the Rocky Mountain region. It is reported from mid to high-elevations in Montana (Hansen *et al.* 1988, as cited in Padgett *et al.* 1989), eastern Idaho, western Wyoming, and Utah (Johnston 1987).

**Distribution in Colorado:** In Colorado, the *Carex aquatilis* plant association is a major type known throughout the state in subalpine environments. It has been reported from Roosevelt, Arapaho, White River, Routt, and Gunnison National Forests, and Rocky Mountain National Park (Johnston 1987, Kettler and McMullen 1996), as well as from the Yampa, San Miguel, Dolores, Colorado, White, and Gunnison River basins (Kittel and Lederer 1993, Kittel *et al.* 1994, 1995).

*The following characteristics are based on plots and observations from parts of the upper Arkansas River Basin, Colorado.*

**Elevation:** 2,650-3,475 m (8660-11,400 ft) .

**Site Geomorphology:** This plant association occurs in a variety of valley types, but large expanses of it occur in broad, low-gradient valleys where large snow-melt fed swales and slopes dominate the landscape. It can also grow in fine sediments at the margins of lakes and beaver ponds.

**Rosgen's Channel Type:** The largest occurrences are found near narrow, deep, sinuous streams (E4, E5, E6). Some stands occur along steep streams (A3), others along wide, shallow streams (B3), and also where beaver dams and ponds have altered the channel morphology.

**Vegetation:** This plant association is characterized by a dense rhizomatous sward of *Carex aquatilis* (55-71%), usually accompanied by a few other graminoids species such as *Juncus*

*balticus* (0-5%) and others. *Carex utriculata* can often be present but is usually not more than 10-30% cover. A few forbs are commonly present such as *Cardamine cordifolia* (0-11%), *Galium trifidum* (1%), and *Geum macrophyllum* (1%) (Table 49).

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

**Adjacent riparian vegetation:** This meadow association almost always occurs in a mosaic of many riparian plant associations, including *Salix planifolia*, *Salix wolfii*, and *Salix monticola-Salix geyeriana* shrublands, and *Carex utriculata* wetlands in standing water.

**Adjacent upland vegetation:** *Abies lasiocarpa-Picea engelmannii* forests, or alpine fell-fields occur on adjacent hillslopes.

**Successional and Ecological Processes:** The presence of *Carex utriculata* in a *Carex aquatilis* stand may indicate that the site is transitional between the wetter, *C. utriculata* dominated sites, and the drier, *C. aquatilis* dominated sites. Either the stand is progressing through time or the site is a physical transition from one habitat to the next. With time, willows (e.g., *Salix planifolia* or *Salix wolfii*) may become established at the site and may eventually dominate.

**Management:** The *Carex aquatilis* type occurs on soils that are typically wet throughout the growing season, and livestock grazing can often cause hummocking and pitting of the soil, with overuse, or use during the early season when soils are subject to compaction (Padgett *et al.* 1989). *Carex aquatilis* is more palatable to livestock than *C. utriculata*, and grazing this community may favor *C. utriculata* (Padgett *et al.* 1989).

**Related types :** This common type has been well documented in the literature: *Carex aquatilis* (Cooper and Cottrell 1990, Padgett *et al.* 1989, Youngblood *et al.* 1985); it is probably included with the broader type *Carex aquatilis-Carex rostrata* (Hess and Wasser 1982), and *Carex aquatilis-Carex rostrata-Deschampsia cespitosa* (Baker 1989).

Table 49. Percent Canopy Cover for Important Species of the *Carex aquatilis* Plant Association. See Table 2 for Plot Locations. \* = Non-native Species.

| Plot No. (95___)                            | AM12 | AM35 |
|---|------|------|
| Occurrence Rank                             | B    | B    |
| <b>GRAMINOIDES</b>                          |      |      |
| <i>Carex aquatilis</i>                      | 71   | 55   |
| <i>Carex praegracilis</i>                   | 1    |      |
| <i>Carex utriculata</i>                     |      | 20   |
| <i>Juncus balticus</i> var. <i>montanus</i> | 7    |      |
| <i>Poa pratensis</i>                        | 7    |      |
| <b>FORBS</b>                                |      |      |
| <i>Cardamine cordifolia</i>                 |      | 11   |
| <i>Galium trifidum</i>                      |      | 1    |
| <i>Geum macrophyllum</i>                    |      | 1    |
| <i>Rorippa nasturtium-aquaticum</i> *       |      | 1    |
| <i>Stellaria</i> sp.                        | 1    |      |
| <i>Taraxacum officinale</i> *               | 1    |      |
| <i>Trifolium pratense</i> *                 | 1    |      |
| <i>Trifolium repens</i> *                   | 4    |      |
| <b>HORSETAILS</b>                           |      |      |
| <i>Equisetum arvense</i>                    | 1    |      |

## ***Carex praegracilis* Alliance**

### **Clustered Sedge (*Carex praegracilis*) Plant Association**

**CNHP Rank:** G3/S2

**2 Plots--**95GK01, 95LS02

**Reference Reaches:** No reference reaches of this type were located in the study area.

**General Description and Comments:** This is an open meadow in swales following stream courses on the short-grass prairie.

**Regional Distribution:** Plant associations dominated or co-dominated by this species have been reported from Montana, Idaho, Utah, Wyoming, and New Mexico (Bourgeron and Engelking 1994, Hansen *et al.* 1988, Jones and Walford 1995, and Durkin *et al.* 1994).

**Distribution in Colorado:** This association has not been reported from Colorado, however it was found along small creeks of the Pawnee National Grassland, and is likely to occur throughout the northern plains.

*The following characteristics are based on plots and observations from the lower S. Platte River Basin, Colorado.*

**Elevation:** 1,515-1,550 m (4,980-5,110 ft).

**Site Geomorphology:** This association occurs along small, shallow drainages, usually no more than 2-5 meters wide, with a stream width of .5-1.0 m. The stream banks are gentle and flat.

**Rosgen's Channel Type:** Stream channels are wide and flat, with little sinuosity, low gradients (.5-1%), and little to no floodplain development (F6).

**Vegetation:** This plant association is a narrow, moist band of *Carex praegracilis* (24-34%) with *Carex nebrascensis* (3-12%), *Eleocharis palustris* (0-11%), and *Equisetum laevigata* (1-3%). No shrubs or trees are present, and the ground is completely covered with standing live biomass (Table 50).

**Soil:** Soils are fairly deep (60 cm +) and ranged from heavy clays to sandy clay loams. The water table is near the surface in early June (12-44 cm depth). Sampled profiles had distinct, high contrast mottles at about 25 cm in depth.

**Adjacent Riparian Vegetation:** This plant association can occur with patches of *Carex nebrascensis* and *Agropyron smithii*. *Scirpus pungens* and *S. lacustris* stands can also occur in adjacent pools within the channel. However, the *Carex praegracilis* plant association often occurs as the only vegetation type along small streams.

**Adjacent Upland Vegetation:** Upland slopes have short grass *Bouteloua gracilis* prairies and, in the spring of 1996, large patches of *Descurainia sophia*, a non-native mustard.

**Successional and Ecological Processes:** Little is known about the successional status of *C. praegracilis* dominated areas.

**Management:** *Carex praegracilis* is an important forage for horses and cattle and forms large meadows in southwestern Montana, where it is preferred over any grass species for its forage value (Herman 1970). In Colorado it never forms large extensive meadows and may be limited to more mesic habitats found within riparian areas. Soils of this association are susceptible to compaction if grazed when saturated in early spring and summer.

**Related Types:** A *Carex praegracilis*-*C. aquatilis* type has been described from Utah, and may also occur in Idaho (Bourgeron and Engelking 1994). Hansen *et al.* (1988) describes a *Carex praegracilis* dominance type that occurs throughout much of Montana. Jones and Walford (1995) describe a *Carex praegracilis* dominance type that appears very similar in species composition and environmental setting to the stands sampled in Colorado. A *Juncus balticus*-*Carex praegracilis* community type has been described by Durkin *et al.* (1994). Stands dominated by *C. praegracilis* have been reported from Idaho and Utah (Brotherson and Brown 1984, as cited in Jones and Walford 1995), and can be abundant in moist swales of the plains (Herman 1970).

Table 50. Percent Canopy Cover for Important Species of the *Carex praegracilis* Plant Association. See Table 1 for Plot Locations. \* = Non-native Species.

| Plot Number (95___)             | GK01 | LS02 |
|---------------------------------|------|------|
| Occurrence Rank                 | C    | C    |
| <b>GRAMINOIDES</b>              |      |      |
| <i>Bouteloua curtipendula</i>   | 1    |      |
| <i>Bouteloua gracilis</i>       | 6    |      |
| <i>Carex nebrascensis</i>       | 3    | 12   |
| <i>Carex praegracilis</i>       | 34   | 24   |
| <i>Eleocharis palustris</i>     |      | 11   |
| <i>Hordeum jubatum</i> *        | 1    |      |
| <i>Pascopyrum smithii</i>       | 7    |      |
| <i>Poa pratensis</i> *          | 25   |      |
| <i>Scirpus pungens</i>          |      | 1    |
| <b>FORBS</b>                    |      |      |
| <i>Achillea millefolium</i>     |      | 4    |
| <i>Ambrosia</i> sp.             |      | 3    |
| <i>Cirsium arvense</i> *        |      | 12   |
| <i>Cryptantha</i> sp.           | 1    |      |
| <i>Descurainia sophia</i> *     | 1    | 1    |
| <i>Glycyrrhiza lepidota</i>     | 3    | 1    |
| <i>Heterotheca villosa</i>      | 1    |      |
| <i>Lepidium</i> sp.             | 1    |      |
| <i>Lithospermum incisum</i>     | 1    |      |
| <i>Melilotus officinalis</i> *  | 11   |      |
| <i>Ranunculus trichophyllus</i> |      | 1    |
| <i>Sagittaria</i> sp.           |      | 1    |
| <i>Senecio</i> sp.              | 3    |      |
| <i>Taraxacum officinale</i> *   | 1    |      |
| <b>HORSETAILS</b>               |      |      |
| <i>Equisetum laevigatum</i>     | 1    | 3    |

## ***Carex nebrascensis* Alliance**

### **Nebraska sedge (*Carex nebrascensis*) Plant Association**

**CNHP Rank: G4/S4**

**4 Plots--95LS01, 95LS05, 95GK02, 95GK03**

**Reference Reaches:** No reference reaches were found in the study area, however an occurrence in good condition can be seen on Twomile Creek on the Pawnee National Grasslands, Weld County, T11N, R56W, Sec 32.

**General Description and Comments:** This is an open wetland meadow, often on saturated soils for much of the growing season. It generally occurs along the margins of stream banks and lakes.

**Regional Distribution:** The *Carex nebrascensis* is a widespread species, and generally forms small to medium-sized meadows where it occurs. It has been reported as a plant association from New Mexico, Utah, Wyoming, Montana, Idaho, Arizona, and Washington (Durkin *et al.* 1994, 1995, Padgett *et al.* 1989, Jones and Walford 1995, Hansen *et al.* 1989, Johnston 1987).

**Distribution in Colorado:** In Colorado, it occurs in the lower montane (Kittel *et al.* 1994, Cooper and Cottrell 1990) and on the plains in the northeastern part of the state (Baker 1982, as cited in Johnston 1987).

*The following characteristics are based on plots and observations from the lower South Platte River Basin, Colorado.*

**Elevation:** 1,250- 1,580 m (4,100-5,230 ft).

**Site Geomorphology:** This plant association appears to be restricted to very wet soils bordering standing ponds and pools of low gradient stream channels. The stream bed is undulating, creating a pool-meadow sequence that, with higher stream flows, becomes a pool-riffle sequence. The *Carex nebrascensis* plant association occurs on wet-meadow areas between channel pools and as a narrow band around pool edges.

**Rosgen's Channel Type:** This plant association occurs on small meandering streams of low gradient (0.5-0.75%) with little floodplain development (C6 to F6).

**Vegetation:** This plant association is comprised of *Carex nebrascensis* (30-66%) with *Carex praegracilis* (0-6%), *Eleocharis palustris* (10-40%), and *Scirpus pungens* (1-10%). Forb cover is low with *Ranunculus cymbalaria* (0-11%) and *Melilotus officinalis* (1-16%). *Potamogeton* sp. was abundant in one occurrence (34%) (Table 51).

**Soil:** Soils of this plant association are heavy clays and silty clay loams with high organic matter content. All soils sampled had signs of periodic anoxic conditions, either in the form of a gleyed layer or abundant mottling within 20 cm of the surface.

**Adjacent Riparian Vegetation:** Adjacent riparian plant associations are *Carex praegracilis*, *Scirpus lacustris*, and *Salix exigua* types.

**Adjacent Upland Vegetation:** Upland slopes are mostly *Bouteloua gracilis* short grass prairies.

**Successional and Ecological Processes:** *Carex nebrascensis* occupies some of the wettest habitats, and the soils are easily compacted by grazing when saturated in early spring and summer.

**Management:** *Carex nebrascensis* dominated meadows can be important forage for grazing and as cut hay (Herman 1970). It is not considered as palatable as other *Carex* spp. yet is often heavily grazed in the late-season (Herman 1970). Moist soils are subject to compaction.

**Related Types:** The *Carex nebrascensis* type has been well documented in the literature, as well as a co-dominant in other plant associations including, but not limited to, *Carex aquatilis*, *Carex utriculata*, and *Juncus balticus* (Padgett *et al.* 1989, Durkin *et al.* 1994, 1995, Johnston 1987, Kittel and Lederer 1993, Kittel *et al.* 1994, Jones and Walford 1995, Hansen *et al.* 1988, 1989, Cooper and Cottrell 1990, Bourgeron and Engelking 1994).

Table 51. Percent Canopy Cover for Important Species of the *Carex nebrascensis* Plant Association. See Table 1 for Plot Locations. \* = Non-native Species.

| Plot Number (95___)                          | LS01 | LS05 | GK02 | GK03 |
|--|------|------|------|------|
| Occurrence Rank                              | C    | B    | C    | D    |
| <b>GRAMINOIDES</b>                           |      |      |      |      |
| <i>Carex nebrascensis</i>                    | 67   | 30   | 63   | 33   |
| <i>Carex praegracilis</i>                    |      | 1    | 6    |      |
| <i>Eleocharis palustris</i>                  | 43   | 10   | 10   | 26   |
| <i>Juncus balticus</i> var. <i>montanus</i>  | 1    |      |      |      |
| <i>Poa pratensis</i> *                       | 1    | 3    | 1    | 2    |
| <i>Scirpus pungens</i>                       | 13   | 10   | 1    | 1    |
| <i>Spartina gracilis</i>                     |      | 1    |      |      |
| <b>FORBS</b>                                 |      |      |      |      |
| <i>Melilotus officinalis</i> *               |      | 1    | 1    | 16   |
| <i>Plantago patagonica</i>                   |      |      |      | 1    |
| <i>Potamogeton</i> sp.                       | 34   |      | 1    |      |
| <i>Potentilla</i> sp.                        |      |      |      | 5    |
| <i>Ranunculus cymbalaria</i>                 | 11   |      | 1    | 1    |
| <i>Rorippa palustris</i> ssp. <i>hispida</i> |      |      |      | 1    |
| <i>Rumex crispus</i> *                       |      |      |      | 1    |
| <i>Taraxacum officinale</i> *                |      |      |      | 1    |
| <b>HORSETAILS</b>                            |      |      |      |      |
| <i>Equisetum laevigatum</i>                  |      |      |      | 1    |

## ***Carex lanuginosa* Alliance**

### **Woolly sedge (*Carex lanuginosa*) Plant Association (Tentative)**

**CNHP Rank:** G4/S3?

**1 plot--95LS13**

**Reference Reaches:** Only one stand was located in the study area along the S. Platte River on DOW land, T8S, R68W, Sec 14.

**General Description and Comments:** This is a distinctive wetland-indicator sedge that forms small to medium pure stands in very wet conditions. Many small stands were observed on the S. Platte River floodplain in depressions and swales, often under the canopy of cottonwood trees, and occasionally in full sun.

**Regional Distribution:** This plant association has been reported from Oregon, Utah, Idaho, Montana, North and South Dakota, Nebraska, Kansas, and Colorado (Bourgeron and Engelking 1994, Hansen *et al.* 1988, 1991, Midwest Heritage Task Force 1994, Kittel *et al.* 1995).

**Distribution in Colorado:** In Colorado, it has been observed along the Gunnison River (Kittel *et al.* 1995), the floodplain of the South Platte River in northeastern Colorado, and tributaries of the South Platte River draining the Black Forest (Palmer Divide) (this report).

*The following characteristics are based on plots and observations from the lower South Platte River Basin, Colorado.*

**Elevation:** 1,817 m (5960 ft).

**Site Geomorphology:** This association occurs in very wet conditions, generally at the saturated edge of the stream channel, and often in standing water.

**Rosgen's Channel Type:** This type had been observed on many types of channels, but in general, it occurs along meandering, moderate gradient (1%) streams (C4).

**Vegetation:** This association is characterized by a near monotypic stand of *Carex lanuginosa* (80%) with a few other graminoids such as *Carex nebrascensis* (2%), *Scirpus pungens* (<1%), and *Poa pratensis* (8%). Scattered forbs include *Cirsium arvense* (4%) and *Mentha arvensis* (8%) (Table 52).

**Soil:** Soils are deep silt loam to clays with mottling occurring throughout the profile.

**Adjacent Riparian Vegetation:** Stands of *Salix amygdaloides* and *Populus angustifolia* woodlands occur along foothill streams, while *Populus deltoides* woodlands occur along stream reaches on the plains.

**Adjacent Upland Vegetation:** Upland communities are *Pinus ponderosa* forests along foothill tributaries, and *Bouteloua gracilis* short grass prairies along reaches on the eastern plains.

**Successional and Ecological Processes:** *Carex lanuginosa* is tolerant of flooding and very palatable to most livestock, though apparently not utilized by deer (Hermann 1970). It has long creeping rhizomes that form dense mats that can effectively stabilize stream banks (Hansen *et al.* 1988).

**Management:** Soils of this plant association are saturated to very moist throughout most of the growing season, and are susceptible to compaction by grazing animals.

**Related Types:** A *Carex lanuginosa* dominance type is reported from Montana, and is considered a minor, mid-elevation type (Hansen *et al.* 1988, 1991). The *Carex lanuginosa* plant association has been reported to occur in Idaho, Oregon, and Utah (Bourgeron and Engelking 1994). Bands of *Carex lanuginosa* along stream banks have been reported from the Gunnison River, Colorado (Kittel *et al.* 1995). Two rare plant associations, ranked S1 and S1?, consisting of *Carex lanuginosa* and *Scirpus* spp., have been reported from Nebraska and Kansas (Midwest Heritage Task Force 1994). Additionally, *Carex lanuginosa* stands have been reported to occur with *Spartina pectinata* in the Dakotas, Nebraska, and Kansas (Midwest Heritage Task Force 1994).

Table 52. Percent Canopy Cover for Important Species of the *Carex lanuginosa* Plant Association. See Table 1 for Plot Location. \* = Non-native Species.

| Plot Number (95 )           | LS13 |
|-----------------------------|------|
| Occurrence Rank             | B    |
| <b>GRAMINOIDES</b>          |      |
| <i>Carex lanuginosa</i>     | 80   |
| <i>Carex nebrascensis</i>   | 2    |
| <i>Hordeum jubatum</i>      | 1    |
| <i>Poa pratensis</i> *      | 8    |
| <i>Scirpus pungens</i>      | 1    |
| <b>FORBS</b>                |      |
| <i>Achillea millefolium</i> | 1    |
| <i>Ambrosia</i> sp.         | 1    |
| <i>Cirsium arvense</i> *    | 4    |
| <i>Lactuca</i> sp.          | 1    |
| <i>Mentha arvensis</i>      | 8    |
| <i>Mentha</i> sp.           | 1    |
| <i>Unknown forb</i>         | 5    |

## *Carex utriculata* Alliance

Beaked sedge (*Carex utriculata*) Plant Association

CNHP Rank: G3G4/S3

1 plot-- 95AM37

**Reference Reaches:** One large occurrence can be seen along Iowa Gulch on BLM land, T10S, R80W, Sec 2.

**General Description and Comments:** *Carex utriculata* stands occupy the wettest meadow sites on mineral soils, while *Carex aquatilis* occurs in slightly better drained areas, often on heavy, more organic soils. These two species intermix at intermediate habitats, and thus create the confusion in the literature as to whether there are one or two plant associations. We chose to follow Padgett *et al.*'s (1989) and Youngblood *et al.*'s (1985) lead in distinguishing between plant associations which often have different environmental characteristics as well as different species composition, and because in Colorado, pure stands of both species occur, as well as large stands of completely intermixed stands. Note that this species has been erroneously called *Carex rostrata* in Colorado literature (Weber and Whitman 1992).

**Regional Distribution:** This type has been described by many authors from central and eastern Oregon, central and eastern Utah, southeastern Idaho, western Wyoming, and western and central Montana (Kovalchik 1987, Padgett *et al.* 1989, Youngblood *et al.* 1985, Jones and Walford 1995, Hansen *et al.* 1995).

**Distribution in Colorado:** In Colorado the *Carex utriculata* plant association is a major type known throughout the state in subalpine environments. It has been reported from Roosevelt, Arapaho, White River, Routt, and Gunnison National Forests, Rocky Mountain National Park (Johnston 1987, Kettler and McMullen 1996), as well as from the Yampa, San Miguel, Dolores, Colorado, White, and Gunnison River basins (Kittel and Lederer 1993, Kittel *et al.* 1994, 1995).

**Elevation:** 3,020 m (9,900 ft).

**Site Geomorphology:** *Carex utriculata* grows in standing water and saturated soils around lakes and beaver ponds. It also grows in wet swales and overflow channels where standing water occurs.

**Soil:** Soils are thick and saturated organic, often intergrading with mineral soils.

**Vegetation:** This plant association is characterized by nearly pure stands of *Carex utriculata*. *Carex aquatilis* may also be present in minor amounts (<10%) (Table 53). Willow carrs are

often adjacent, and a few scattered individual willows occur, particularly *Salix planifolia* at higher elevations and *Salix monticola* at lower elevations.

**Adjacent riparian vegetation:** This association is often part of a wetland mosaic, with *Salix planifolia*, *Salix monticola*, and *Salix geyeriana* shrublands. It also occurs adjacent to and intergrades with *Carex aquatilis* meadows.

**Adjacent upland vegetation:** *Abies lasiocarpa*-*Picea engelmannii* forests, *Populus tremuloides* woodlands, and *Quercus gambelii* shrublands occur on adjacent hillslopes.

**Successional and Ecological Processes:** *Carex utriculata* appears to be an early seral, colonizing species becoming abundant at the margins of newly formed beaver ponds (Padgett *et al.* 1989). With a drop in the water table, other *Careces* and willows will move in and the site will change to a *Carex aquatilis* type and, later, to a *Salix* dominated type.

**Related types:** This common association has been well documented in the literature: *Carex utriculata* (Cooper and Cottrell 1990); *Carex rostrata* (Youngblood *et al.* 1985, Padgett *et al.* 1989). It is probably included within the broader types *Carex rostrata*-*Carex aquatilis* (Hess and Wasser 1982), *Carex aquatilis*-*Carex utriculata*-*Carex utriculata* Phase (Johnston 1987), and *Carex aquatilis*-*Carex rostrata*-*Deschampsia cespitosa* (Baker 1989).

Table 53. Percent Canopy Cover for Important Species of the *Carex utriculata* Plant Association. See Table 2 for Plot Locations. \* Non-native Species.

| Plot No. (95 )                              | AM37 |
|---|------|
| Occurrence Rank                             | B    |
| <b>SHRUBS</b>                               |      |
| <i>Pentaphylloides floribunda</i>           | 5    |
| <i>Salix geyeriana</i>                      | 1    |
| <i>Salix monticola</i>                      | 1    |
| <b>GRAMINOIDES</b>                          |      |
| <i>Calamagrostis canadensis</i>             | 1    |
| <i>Carex aquatilis</i>                      | 8    |
| <i>Carex utriculata</i>                     | 61   |
| <i>Juncus balticus</i> var. <i>montanus</i> | 2    |
| <i>Poa pratensis</i> *                      | 1    |

## *Eleocharis palustris* Alliance

### Spike rush (*Eleocharis palustris*) Plant Association

CNHP Rank: G5/S3S4

2 Plots--95LS23, 95LS24

**Reference Reaches:** No reference reaches were found in the study area.

**General Descriptions and Comments:** Stands of the *Eleocharis palustris* association sampled along the Arikaree River have high species richness and more biomass than *Eleocharis palustris* stands at higher elevations in cool, montane settings. The associated species within this plant association are more closely aligned with stands sampled on the Comanche National Grasslands and along the Rio Grande River Valley, New Mexico (see Culver *et al.* 1996, and Durkin *et al.* 1995). The presence of *Panicum virgatum* appears to be unique to the Arikaree River environment and is not mentioned as a co-associate for this plant association elsewhere in the literature.

**Regional Distribution:** The *Eleocharis palustris* plant association has been reported throughout the southern Rocky Mountains from Colorado, Wyoming, Utah, and southwestern Idaho (Sanderson and Kettler 1996, Jones and Walford 1995, Kittel and Lederer 1993, Johnston 1987, Padgett *et al.* 1989, and Youngblood *et al.* 1985). It is also reported from Oregon (Kovalchik 1987) and New Mexico (Durkin *et al.* 1995).

**Distribution in Colorado:** Cooper (1993) reported an *Eleocharis palustris* plant association from the Crested Butte region. Cooper and Severn (1992) report an *Eleocharis palustris* plant association from the San Luis Valley. Culver *et al.* (1996) describe a mixed *Eleocharis-Scirpus* plant association from the Comanche National Grasslands.

*The following characteristics are based on plots and observations from the lower S. Platte River Basin, Colorado.*

**Elevation:** 1,100-1,200 m (3,860-3,930 ft).

**Site Geomorphology:** The *Eleocharis palustris* plant association grows on the edges of small to large ponds, lakes, reservoirs, and in back water reaches of large rivers. It is a common emergent association that occurs in shallow, mostly still water. This association occurs right in the stream channel of the Arikaree River.

**Rosgen's Channel Type:** This association occurs along strongly meandering stream channels with moderate gradients (C4-6).

**Vegetation:** This association is characterized by thick herbaceous growth of *Eleocharis palustris* (12-66%), *Leeseria oryzoides* (16-40%), and *Scirpus pungens* (17-29%). Other graminoides

present are *Panicum virgatum* (7-15%), *Carex lanuginosa* (7%), and *Spartina pectinata* (0-12%) (Table 54).

**Soils:** Soils of this association are fine-textured loamy sands, clays, and sandy clays. Both sample profiles had considerable organic content in the upper 10-20 cm. Although the profiles indicated heavy, moist soil, no hydric indicators were observed.

**Adjacent Riparian Vegetation:** Adjacent stands of *Scirpus pungens* and *Scirpus lacustris* occur within the stream channel. Wet meadow prairies of *Panicum virgatum* and *Sorghastrum nutans* occupy the immediate stream banks and low floodplains. Large stands of *Populus deltoides* and *Salix amygdaloides* also occur scattered across the floodplain.

**Adjacent upland Vegetation:** Upland rolling hills are occupied by short grass *Bouteloua gracilis* grasslands, or sandsage shrublands.

**Successional and Ecological Processes:** *Eleocharis palustris* is a rhizomatous plant that survives both flooding and dry periods. It can also tolerate fluctuating water levels. With more stable water levels, this association may be replaced by a *Scirpus* dominated plant association.

**Management:** The low palatability of *Eleocharis palustris* and seasonally wet soils limit the grazing value of type for livestock (Hansen *et al.* 1995).

**Related Types:** Sanderson and Kettler (1996), Jones and Walford (1995), Kittel and Lederer (1993), Johnston (1987), Padgett *et al.* (1989), and Youngblood *et al.* (1985) describe an *Eleocharis palustris* plant association. Kovalichik (1987) described a similar *Eleocharis palustris* association from Oregon. Durkin *et al.* (1995) report several similar *Eleocharis palustris* plant associations from the Rio Grande River valley, New Mexico. Cooper (1993) reported an *Eleocharis palustris* plant association from the Crested Butte region. Cooper and Severn (1992) report an *Eleocharis palustris* plant association from the San Luis Valley. Culver *et al.* (1996) describe a mixed *Eleocharis-Scirpus* plant association from the Comanche National Grasslands.

Table 54. Percent Canopy Cover for Important Species of the *Eleocharis palustris* Plant Association. See Table 1 for Plot Locations. \* = Non-native Species.

| Plot Number (95___)         | LS23 | LS24 |
|-----------------------------|------|------|
| Occurrence Rank             | B    | A    |
| <b>SHRUBS</b>               |      |      |
| <i>Salix exigua</i>         |      | 3    |
| <b>GRAMINOIDES</b>          |      |      |
| <i>Andropogon gerardii</i>  |      | 1    |
| <i>Carex lanuginosa</i>     | 7    | 6    |
| <i>Eleocharis palustris</i> | 66   | 12   |
| <i>Leersia oryzoides*</i>   | 40   | 16   |
| <i>Panicum virgatum</i>     | 15   | 7    |
| <i>Scirpus acutus</i>       | 1    | 23   |
| <i>Scirpus pungens</i>      | 17   | 29   |
| <i>Spartina pectinata</i>   | 12   |      |
| <b>FORBS</b>                |      |      |
| <i>Glycyrrhiza lepidota</i> |      | 4    |
| <i>Sagittaria</i> sp.       | 1    | 2    |
| <i>Solidago</i> sp.         | 5    |      |

### *Scirpus acutus* Alliance

#### Softstem and Hardstem Bulrush (*Scirpus acutus-Scirpus tabernaemontani*) Plant Association--Tentative

CNHP Rank: G5/S3?

1 plot--95GK60

Reference Reaches: Only one stand was located in the study area.

**General Description and Comments:** In Colorado *Scirpus acutus* and *Scirpus tabernaemontani* are considered to be two subspecies of *Schoenoplectus lacustris* ssp. *acutus* and ssp. *creber*, respectively (Weber and Whitman 1992). The field determination between them is difficult and they are often confused. Because we have observed these two species (or subspecies) in nearly identical habitats, and other states report they can co-occur (Midwest Heritage Task Force 1994), we propose a single plant association under the name *Scirpus acutus-Scirpus tabernaemontani*, where either species can occur as the dominant, in a monoculture, or in any mixture of the two. This association often occupies sites similar to those of the *Typha* spp. plant associations, and some authors have lumped *Scirpus* and *Typha* associations together (e.g., Cooper 1988). Observations from Colorado suggest that these associations rarely intergrade, and when adjacent stands occur, the transition from one association to another is usually abrupt (Hansen *et al.* 1988, Sanderson and Kettler 1995). Thus we propose separate *Typha* spp. and *Scirpus* spp. plant associations.

**Regional Distribution:** This plant association is known in small pockets and large wetland stands on the Great Plains (Hansen *et al.* 1988, 1989, Johnston 1987, Midwest Heritage Task Force 1994).

**Distribution in Colorado:** This association has been reported from the western slope (Kittel *et al.* 1994), Sanderson and Kettler (1995), and occurs in small pockets throughout the eastern edge of the Rocky Mountains front (Johnston 1987).

*The following characteristics are based on plots and observations from the lower S. Platte River Basin, Colorado.*

**Elevation:** 1,300 m (4,290 ft).

**Site Geomorphology:** The *Scirpus acutus-Scirpus tabernaemontani* plant association occurs in wet swales, overflow channels with standing water, ditches, and at the edges of beaver ponds. One stand occurred on a saturated floodplain where a perched water table emerged from the surrounding bedrock.

**Rosgen's Channel Type:** This association occurs on small slow-moving tributaries and large, meandering rivers with backwater habitats such as overflow channels, swales and other low areas of ponding water. This type also occurs in ditches and behind railroad embankments.

**Vegetation:** This association is characterized by a near mono-typic stand of *Scirpus acutus* (80%), with a few aquatic species including *Eleocharis rostellata* (10%) and *Mimulus guttatus* (1%) (Table 55).

**Soil:** Soils of this association are deep heavy clays and silty loams with a high organic matter content. Profiles are made of thick black organic matter or fine clays. Soils remain saturated for most of the growing season and often have an anoxic gleyed layer within 50 cm of the soil surface.

**Adjacent Riparian Vegetation:** Other emergent wetland vegetation is commonly found with this plant association, such as stands of *Typha* spp. and other *Scirpus* spp. Within the riparian zone *Populus deltoides* and *Salix amygdaloides* may be present on the floodplain. On the open prairies along small streams, adjacent riparian vegetation types include stands of *Carex nebrascensis* and others.

**Adjacent Upland Vegetation:** Along the lower South Platte River adjacent upland vegetation is rangeland of sand dominated hills or agricultural fields.

**Successional and Ecological Processes:** Stands of *Scirpus* are important to wildlife species, especially birds, by providing cover and nesting habitat to a number of waterfowl species.

**Management:** *Scirpus* is not palatable to livestock, and the wet nature of the soils precludes any grazing activities.

**Related Types:** A *Scirpus tabernaemontani* plant association has been described by Sanderson and Kettler (1995). A *Scirpus acutus* dominance type and riparian site type has been described from Montana (Hansen *et al.* 1988, 1989), and has similar if not identical associated species and environmental settings. A *Scirpus americanus*/*Carex* spp. plant association has been described by Johnston (1987) and includes stands of *Scirpus acutus* reported from North Dakota (Sloan 1970, as cited in Johnston 1987). A *Scirpus acutus*-*Eleocharis macrostachya* community type has been described from New Mexico (Durkin *et al.* 1994), but it has higher species richness and different associated species than the *Scirpus acutus* stands sampled in Colorado. *Scirpus acutus* dominated alkaline and non-alkaline communities have been reported from Nebraska, and several *Scirpus* spp.-*Typha* spp. communities have been reported from Nebraska, the Dakotas, and Kansas (Midwest Heritage Task Force 1994).

**Table 55. Percent Canopy Cover for Important Species of the *Scirpus acutus-Scirpus tabernaemontani* Plant Association. See Table 1 for Plot Location.**

|                              |      |
|------------------------------|------|
| Plot Number (95 _____)       | GK60 |
| Occurrence Rank              | C    |
| <b>GRAMINOIDES</b>           |      |
| <i>Eleocharis rostellata</i> | 20   |
| <i>Scirpus acutus</i>        | 80   |
| <b>FORBS</b>                 |      |
| <i>Mimulus guttatus</i>      | 1    |

***Typha angustifolia* Alliance**

**Narrow-leaf cattail (*Typha angustifolia*) Plant Association**

**CNHP Rank: GU/S3?**

**2 Plots--95GK47, 95GK59**

**Reference Reaches:** A large stand occurs where Bijou Creek comes into the S. Platte River at the narrows on Bureau of Reclamation Land, T4N, R58W, Sec 28. Probably the largest stand in the state occurs in an oxbow of the Arikaree River just west of the Nebraska state line (specific location withheld to protect landowner privacy).

**General description and Comments:** *Typha angustifolia* is the most eastern of Colorado's three *Typha* species, and it can be distinguished by its narrow leaves. It forms a tall (2-3 m), monotypic stands commonly in 2-4 feet of standing water.

**Regional Distribution:** This association is reported from throughout the northern and central Great Plain states, the Dakotas, Montana, Wyoming, Nebraska, Kansas, northern Texas, and northwestern Oklahoma (Johnston 1987, the Midwest Heritage Task Force 1994).

**Distribution in Colorado:** This association has not been documented in the literature, but the species is known to occur throughout the plains of eastern Colorado (Weber 1990). During this study it was commonly observed along overflow channels and oxbow lakes of the mainstem of the S. Platte, and it can occur in small ponded areas around stock ponds and railroad embankments.

*The following characteristics are based on plots and observations from the lower S. Platte River Basin, Colorado.*

**Elevation:** 1,225-1,300 m (4,005-4,290 ft).

**Site Geomorphology:** This plant association occurs in standing water at least 1 foot in depth. It is found along the margins of beaver ponds, overflow channels, back water sloughs, floodplain swales, drainage ditches, behind railroad embankments, and anyplace where water collects to at least 2-3 feet in depth and remains for two-thirds of the growing season.

**Rosgen's Channel Type:** This association can be found on nearly every type of channel, but typically along meandering, low gradient streams (C5, F5, and D5).

**Vegetation:** *Typha angustifolia* forms near-monotypic (70-85%) stands between 3 and 6 feet tall. Other species include *Potamogeton* spp. (0-25%), *Spartina pectinata* (0-1%), and *Veronica* spp. (0-3%) (Table 56).

**Soil:** Soils are deep, heavy silty clay loam and organic mucks. Some profiles have 10-30% coarse material and are fairly well drained, others are anoxic throughout most of the year.

**Adjacent Riparian Vegetation:** *Scirpus* marshes and *Carex* meadows can be found adjacent to the *Typha* plant association. Stands of *Populus deltoides* and *Salix amygdaloides* occur on higher terraces.

**Adjacent Upland Vegetation:** On the plains *Bouteloua gracilis* dominated short grass prairie or agricultural fields occur on the uplands.

**Successional and Ecological Processes:** *Typha angustifolia* occupies inundated and disturbed grounds and can tolerate deeper water and higher alkalinity levels than *T. latifolia* (Great Plains Flora Association 1986). *Typha* species are early colonizers of wet mineral soil and will persist under wet conditions (Hansen *et al.* 1995). *Typha* is a prolific seed producer, and can spread rapidly to available habitats. Its roots and lower stems are well adapted to prolonged submergence, but it requires periods of draw-down for seed germination to occur (Hansen *et al.* 1995).

**Management:** This association does not provide much forage for livestock. It is an important wetland type for many species of birds and waterfowl. It is reported, however, that with heavy livestock use stands can be converted to the *Carex nebrascensis* community type in Montana (Hansen *et al.* 1995).

**Related Types:** *Typha* spp. dominated wetlands have been described by Hansen *et al.* (1991), Jones and Walford (1995), Padgett *et al.* (1989) and the Midwest Heritage Task Force (1994). A *Typha latifolia/Sagittaria latifolia* plant association is reported to occur in Nebraska, north eastern Colorado, western Wyoming, eastern Idaho, and North Dakota by Johnston (1987).

Table 56. Percent Canopy Cover for Important Species of the *Typha angustifolia* Plant Association. See Table 1 for Plot Locations. \* = Non-native Species.

| Plot Number (95 )               | GK47 | GK59 |
|---------------------------------|------|------|
| Occurrence Rank                 | C    | C    |
| <b>TREES</b>                    |      |      |
| <i>Elaeagnus angustifolia</i> * |      | 10   |
| <b>SHRUBS</b>                   |      |      |
| <i>Salix exigua</i>             | 7    |      |
| <b>GRAMINOIDES</b>              |      |      |
| <i>Typha angustifolia</i>       | 86   | 70   |
| <i>Cyperus oederatus</i> *      | 2    |      |
| <i>Eleocharis</i> sp.           | 1    |      |
| <i>Eragrostis pilosa</i> *      | 1    |      |
| <i>Leersia oryzoides</i> *      | 5    |      |
| <i>Spartina pectinata</i>       | 1    |      |
| <b>FORBS</b>                    |      |      |
| <i>Ambrosia</i> sp.             | 1    |      |
| <i>Arctium minus</i> *          | 5    |      |
| <i>Biden cernua</i>             | 1    |      |
| <i>Chenopodium album</i>        | 2    |      |
| <i>Polygonum pensylvanicum</i>  | 6    |      |
| <i>Potamogeton</i> sp.          |      | 25   |
| <i>Veronica</i> sp.             | 1    |      |

UNESCO: V.A.4.a. TALL GRASSLAND--MAINLY SOD-FORMING GRASS  
COWARDIN: PALUSTRINE PERSISTENT EMERGENT WETLAND

*Andropogon gerardii-Sorghastrum nutans* Alliance

Big bluestem-Indiangrass (*Andropogon gerardii-Sorghastrum nutans*) Plant Association  
(ANGE-SONU)

CNHP Rank: G1G2?/S1S2?

2 Plots-- 95LS27, 95GK27.

Reference Reaches: Excellent condition occurrences occur along the Arikaree River on private land (specific location withheld to protect landowner privacy).

**General Description and Comments:** The *Andropogon gerardii-Sorghastrum nutans* plant association is not an obligate riparian plant association. On the eastern plains of Colorado, areas with enough moisture year-round to support tall and mixed grass communities only occur along mesic floodplains and intermittent drainages. This association is considered a mesic lowland type in Nebraska where stands receive additional run-off moisture (Weaver 1965). Colorado stands clearly represent the western-most extension of this mesic grassland. One stand sampled (plot 95GK27) may represent a degraded example of the *Andropogon gerardii-Sorghastrum nutans* plant association. It has a high amount of *Poa pratensis*, a non-native increaser species. In addition, this stand occurs in a deep swale of the floodplain and has more *Scirpus pungens* than other documented occurrences. Taxonomically our stands seem to lie between two types described in the literature, the *Andropogon gerardii-Panicum virgatum* types and the *Andropogon gerardii-Sorghastrum nutans* types (Midwest Heritage Task Force 1994). A regional approach to classification would help clarify this taxonomic issue.

**Regional Distribution:** The *Andropogon gerardii-Sorghastrum nutans* plant association is documented from North and South Dakota, Nebraska, Kansas, eastern Colorado, and possibly Oklahoma (Johnston 1987, Midwest Heritage Task Force 1995, Weaver 1965).

**Distribution in Colorado:** This association is known from the northeastern corner of the state on the plains and within Boulder County (Colorado Natural Heritage Database 1994).

*The following characteristics are based on plots and observations from the lower S. Platte River Basin, Colorado.*

**Elevation:** 1,125-1200 m (3,692-3,940 ft).

**Site Geomorphology:** This plant association occupies low, flat floodplains and terraces. The sites are usually within 0.2-1.5 meters of the water table and occur at some distance from the active stream channel (100-365 m).

**Rosgen's Channel Type:** The channel is of moderate sinuosity and low gradient (.001-1.06%), with a well developed floodplain and strong meander pattern (C6).

**Vegetation:** This plant association is characterized by an thick sward of grasses dominated by *Andropogon gerardii* (0-12%), *Sorghastrum nutans* (9-21%), *Panicum virgatum* (23-68%), *Spartina pectinata* (0-1%), and *Carex praegracilis* (11-35%). Other graminoides include *Scirpus pungens* (2-12%) and *Poa pratensis* (0-43%). Forb species are scattered and include *Glycyrrhiza lepidota* (7-9%), *Cichorium intybus* (3-8%), and *Solidago* spp. (0-5%). A few shrub stems may grade in from neighboring plant associations like *Salix exigua* (1%) (Table 57).

**Soil:** Soils are well drained and range from fine sands to loamy sand. Some profiles had signs of flooding (mottling), while others did not. In general the soils are coarse textured and relatively better drained than soils of the nearby floodplain environment.

**Adjacent Riparian Vegetation:** Adjacent stands of *Salix exigua*, *Populus deltoides* and *Salix amygdaloides* are common. In low-lying areas stands of *Scirpus pungens* or *Typha angustifolia* can also occur.

**Adjacent Upland Vegetation:** Uplands had short grass (*Bouteloua* spp.) prairies, with occasional sand-sage hills.

**Successional and Ecological Processes:** This plant association is intermediate between palustrine and terrestrial. The water table is often near the surface and standing water may be present in winter, spring, or after heavy rains. Along the Arikaree River spring flows raise the water table, and summer precipitation with run-off flows from neighboring sand hills keep the water table within 40 cm of the surface, conducive to *Andropogon gerardii* growth (Weaver 1965).

**Management:** Winter-only grazing by livestock appears to keep stands in good condition. Fire is likely to be an important management tool for maintaining native species vigor and reducing invasive species.

**Related Types:** Several stands of an *Andropogon gerardii*-*Sorghastrum nutans* plant association are reported by Johnston (1987). Several *Andropogon gerardii*-*Sorghastrum nutans* plant associations are listed in the Midwest Regional Classification (Midwest Heritage Task Force 1994). Stands in Colorado appear to be most closely related to the wet-prairie type described by the Nebraska Heritage Program (personnel communication), which is dominated by *Andropogon gerardii*, *Spartina pectinata*, *Panicum virgatum*, and *Sorghastrum nutans*.

Table 57. Percent Canopy Cover for Important Species of the *Andropogon gerardii*-*Sorghastrum nutans* Plant Association. See Table 1 for Plot Locations. \* = Non-native Species.

| Plot Number (95 )                           | LS27 | GK27 |
|---|------|------|
| Occurrence Rank                             | B    | B    |
| <b>SHRUBS</b>                               |      |      |
| <i>Salix exigua</i>                         | 1    | 1    |
| <b>GRAMINOIDES</b>                          |      |      |
| <i>Andropogon gerardii</i>                  | 12   |      |
| <i>Carex praegracilis</i>                   | 11   | 35   |
| <i>Eleocharis palustris</i>                 | 1    |      |
| <i>Juncus balticus</i> var. <i>montanus</i> | 2    | 4    |
| <i>Panicum virgatum</i>                     | 23   | 68   |
| <i>Poa pratensis</i> *                      |      | 43   |
| <i>Schizachyrium scoparium</i>              |      | 2    |
| <i>Scirpus pungens</i>                      | 2    | 12   |
| <i>Sorghastrum nutans</i>                   | 21   | 9    |
| <i>Spartina pectinata</i>                   | 1    |      |
| <i>Stipa</i> sp.                            | 15   |      |
| <b>FORBS</b>                                |      |      |
| <i>Ambrosia dumosa</i>                      |      | 6    |
| <i>Ambrosia</i> sp.                         | 5    |      |
| <i>Cichorium intybus</i>                    | 3    | 8    |
| <i>Geranium richardsonii</i>                | 2    |      |
| <i>Glycyrrhiza lepidota</i>                 | 9    | 7    |
| <i>Lactuca</i> sp.                          | 2    |      |
| <i>Mentha</i> sp.                           | 1    |      |
| <i>Rumex crispus</i> *                      |      | 1    |
| <i>Solidago</i> sp.                         | 1    | 2    |
| <b>HORSETAILS</b>                           |      |      |
| <i>Equisetum laevigatum</i>                 | 5    | 1    |

## *Spartina pectinata* Alliance

Prairie Slough grass, Prairie Cordgrass (*Spartina pectinata*) Plant Association

CNHP RANK: G2/S2?

1 Plot--95LS28

**Reference Reaches:** Several large stands of this type can be seen on the S. Platte River Floodplain on DOW land, between Sterling and Julesburg.

**General Description and Comments:** This is a tall-grass meadow comprised entirely of *Spartina pectinata*. It occurs in small swales and on the floodplains of larger rivers on the plains. Stands of this grass have been included in other tall-grass prairie plant associations. On large river floodplains, however, this type occurs as large patches, and is distinguished from adjacent riparian types by micro-topography and degree of soil saturation. Weaver (1965) reports that, historically, large stands of *Spartina pectinata* occurred on mud flats of the Missouri River.

**Regional Distribution:** The *Spartina pectinata* plant association has been reported from throughout the northern Great Plains and eastern Rocky Mountain Front (Hansen *et al.* 1988, 1991, Weaver 1965, Jones and Walford 1995, Johnston 1987, and the Midwest Heritage Task Force 1994).

**Distribution in Colorado:** In Colorado the *Spartina pectinata* plant association is found only along the South Platte and Arikaree Rivers and their tributaries in the northeastern corner of the state (this report).

*The following characteristics are based on plots and observations from the lower S. Platte River Basin, Colorado.*

**Elevation:** 1,030 m (3,370 ft).

**Site Geomorphology:** *Spartina pectinata* stands occur in low swales and overflow areas of large river floodplains. The stand we sampled occurs in a shallow overflow area between two slightly raised ridges with linear bands of *Populus deltoides*.

**Rosgen's Channel Type:** The stand is on a large meandering river with a mostly sand bed (C6).

**Vegetation:** Graminoids and little else characterizes this plant association. *Spartina pectinata* (69%) co-dominates with *Panicum virgatum* (30%). Other tall graminoides present include *Andropogon gerardii* (6%), *Carex praegracilis* (1%) and *Scirpus acutus* (5%). A non-native weed, *Cirsium arvense* (20%), is abundant at the site indicating chronic disturbance (Table 58).

**Soil:** The soil is a fine loam to silty clay with mottles abundant from 12 to 69 cm depth.

**Adjacent Riparian Vegetation:** Stands of *Populus deltoides* occur on the adjacent, slightly raised floodplain ridges. *Typha angustifolia* stands occur in adjacent, wetter areas.

**Adjacent Upland Vegetation:** Upland slopes have mostly *Bouteloua curtipendula* short grass prairie, pasture lands, and cultivated fields.

**Successional and Ecological Processes:** This grass is tolerant of sediment deposition and has sharp-pointed shoots that may push their way upward through a foot of new soil (Weaver 1965). On the S. Platte River floodplain it appears to be an early colonizer of the fresh sediments laid down by the 1995 flood.

**Management:** Stands of *Spartina pectinata* have high production rates, however the rough-edged leaves make for poor forage quality, and it is not readily eaten by livestock or wildlife. Its tall height and thick growth provide shade and cover for wildlife and certain bird species (Hansen *et al.* 1988). It can make excellent hay if cut two or three times each growing season, thereby reducing forage coarseness (Weaver 1965, Hansen *et al.* 1988).

**Related Types:** Hansen *et al.* (1988, 1991) report a *Spartina pectinata* dominance type from central and eastern Montana, where it can form nearly pure stands in swales, meadows, and at the edges of marshes and ponds. Jones and Walford (1995) describe a community from northeastern and south eastern Wyoming. Weaver (1965) reports hundred of square miles of bottom land floodplains along the Missouri River and its tributaries covered in *Spartina pectinata*. A *Spartina pectinata/Calamagrostis canadensis* plant association has been reported from north-central Nebraska (Johnston 1987). Several *Spartina pectinata* co-dominated grassland plant associations have been reported from Nebraska, North and South Dakota, and Kansas (Midwest Heritage Task Force 1994). Bourgeron and Engelking (1994) list a *Spartina pectinata* and *S. pectinata-Scirpus pungens* from Colorado and Montana that may be similar.

Table 58. Percent Canopy Cover for Important Species in the *Spartina pectinata* Plant Association. See Table 1 for Plot Location. \*= Non-native Species.

| Plot Number (95 )          | LS28 |
|----------------------------|------|
| Occurrence Rank            | C/B  |
| <b>GRAMINOIDES</b>         |      |
| <i>Andropogon gerardii</i> | 6    |
| <i>Carex praegracilis</i>  | 1    |
| <i>Panicum virgatum</i>    | 30   |
| <i>Scirpus pungens</i>     | 5    |
| <i>Spartina pectinata</i>  | 69   |
| <b>FORBS</b>               |      |
| <i>Ambrosia dumosa</i>     | 10   |
| <i>Cirsium arvense*</i>    | 20   |
| <i>Lactuca sp.</i>         | 3    |
| <i>Mentha sp.</i>          | 2    |
| <i>Rumex crispus*</i>      | 1    |
| <i>Solidago sp.</i>        | 2    |

UNESCO: MAINLY PERENNIAL FLOWERING FORBS  
 COWARDIN: PALUSTRINE PERSISTENT EMERGENT WETLAND

Forb Dominated Stands

One stand (plot 95AM38) is dominated by *Caltha leptosepala* and *Cardamine cordifolia* with *Carex aquatilis* (Table 59). It is typical of broad subalpine basins that have saturated soils throughout the growing season. Soils are dark-colored silt clays with high amounts of organic matter. It often occurs within a wetland mosaic of shrublands dominated by *Salix planifolia* or *S. wolfii*, and wet meadows of *Carex aquatilis* or *C. scopulorum*. This stand should probably be placed in the *Caltha leptosepala* plant association (G4/S3?).

Similar *Caltha leptosepala* dominated associations have been described from Utah by Padgett *et al.* (1989) and Johnston (1987), and from Idaho by Johnston (1987). From Colorado, Kittel (1994) describes a *Caltha leptosepala* community type from Rocky Mountain National Park, and Cooper and Cottrell (1990) describe a *Psychrophila* (syn. = *Caltha*) *leptosepala*-*Trollius laxus* type from the Colorado Front Range.

Table 59. Percent Canopy Cover of Plant Species in a *Caltha leptosepala* Dominated Stand. See Table 2 for Plot Location.

| Plot No. (95 )                  | AM38 |
|---------------------------------|------|
| Occurrence Rank                 | A    |
| <b>GRAMINOIDES</b>              |      |
| <i>Carex aquatilis</i>          | 18   |
| <i>Poa sp.</i>                  | 1    |
| <b>FORBS</b>                    |      |
| <i>Caltha leptosepala</i>       | 83   |
| <i>Cardamine cordifolia</i>     | 14   |
| <i>Mertensia ciliata</i>        | 3    |
| <i>Pedicularis groenlandica</i> | 1    |
| <i>Sedum rhodanthum</i>         | 3    |
| <i>Stellaria sp.</i>            | 1    |

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Appendix A. Ecologically Significant Riparian Areas of the Lower South Platte River Basin.

COLORADO NATURAL HERITAGE PROGRAM  
CONSERVATION SITE PROFILE

SOUTH PLATTE RIVER

at

JULESBURG

**COLORADO NATURAL HERITAGE PROGRAM  
CONSERVATION SITE PROFILE**

**JULESBURG SITE**

**BIODIVERSITY SIGNIFICANCE: 2: VERY HIGH SIGNIFICANCE**

**PROTECTION URGENCY RATING: 5: NO ACTION TO BE TAKEN ON THIS SITE**

**MANAGEMENT URGENCY RATING: 5: NOT NEEDED; NO THREATS ANTICIPATED**

**LOCATION:**

From Julesburg drive south and east on Hwy 385 (cross S. Platte River ) and turn west onto County Road 28. In about 1.25 miles you'll see Pony Express S.W.A. parking area North of road. Park here and walk onto floodplain. Occurrence starts at the Julesburg bridge.

**USGS Quadrangle name(s): Julesburg, Ovid, Sedgwick**

**Township, Range and Section:**

012N044W 33  
011N044W 4,5,6,7  
011N045W 12,11,10,9,8,7,6  
011N046W 11,10,15,16,17,20.

**Elevation: 3450 ft. to 3580 ft.**

**GENERAL DESCRIPTION:**

The South Platte River is a major tributary to the Platte River. The headwaters are above Denver, near Fairplay. The floodplain of the lower South Platte River (from Greeley downstream) is broad, and today there exists a continuous canopy of cottonwood riparian woodland to the state line. The best examples of this natural riparian mosaic occur at the Tamarack Ranch State Wildlife Area (Tamarack Site) and from the town of Sedgwick to the Nebraska state line (Julesburg Site).

At the turn of the century, the S. Platte was a wide, sandy river described as "a mile wide and an inch deep", with very few trees or riparian vegetation to report (journals of Fremont, and others). Today the river is still a braided channel, but much of the old river bed has become a forested floodplain. Since the 1920's, stream-flows of the S. Platte have been changed through control of peak run-off and augmentation of late summer flows with water imported from the western slope. Altogether these changes have brought about an environment more favorable to the establishment of cottonwoods.

While we know there was little riparian vegetation at the time of the western expansion, that was only one snap-shot in time. Plains riparian ecosystems are very dynamic, and it is not

systems (San Pedro, Arikaree, and others) that large scale geomorphic changes (San Pedro River, NM) and dramatic shifts in the amount of riparian vegetation (Arikaree River, CO) occur naturally, and that flooding and drought cycles may be the driving force behind the natural increases and decreases in broad floodplain ecosystems, masking the impacts of human-induced hydrological changes.

The current floodplain supports a diverse mixture of riparian woodlands, shrublands, and wetlands. Most of these communities have not been previously described in the literature or CNHP data. The mosaic of cottonwood dominated communities represents a series of successional stages and micro-habitats. The *Populus deltoides*-(*Salix amygdaloides*)/*Spartina pectinata* community is documented for the first time in Colorado. The undergrowth of these medium-aged stands is nearly pure *Spartina pectinata* (prairie slough grass), a native to the floodplains of the Platte and its tributaries (Native Vegetation of Nebraska, J.E. Weaver, 1965). Other woodland types new to Colorado are *Populus deltoides*/*Carex lanuginosa*, where woolly sedge dominates the undergrowth in linear bands along moist swale bottoms, and *Populus deltoides*/*Symphoricarpos occidentalis*, a patch type that appears to be a later seral stage, and generally grows along drier ridges and the outer margins of the floodplain. Here the trees are large and widely spaced, giving the floodplain a savanna-like appearance. *Populus deltoides*-*Salix amygdaloides*-*Salix exigua* represents the young saplings and seeding stage of these woodland communities. Stands of this type are typically found on elevated islands, point bars and overflow channels near the current channel. In addition to the cottonwood woodlands, shrublands such as *Salix exigua*/barren soil occurs in large patches on islands and overflow channels. Wetlands dominated by *Phragmites australis*, *Typha latifolia*, and *Scirpus* spp. marshes occur on backwater sloughs and abandoned channels with standing water (personal observation).

Discussions with Kansas and Nebraska State Heritage ecologists indicate that all of these communities likely occur along river floodplains in those states. Detailed inventories of the South and North Platte Rivers in Nebraska and other riparian habitats in Kansas have yet to be conducted. Due to the uncertain origin (natural or anthropogenic) of this floodplain ecosystem, and the need for more inventories in neighboring states, these community names and ranks are considered preliminary.

#### NATURAL HERITAGE RESOURCE SIGNIFICANCE:

This site contains the best examples of native floodplain mosaic on the S. Platte River within the state and likely the best occurrence on the Plains (personal communication with Kansas and Nebraska Heritage Ecologists). The South Platte River is by no means pristine (there are no "A" ranked occurrences due to the major hydrological changes in S. Platte flow-regime) and the riparian communities may be a product of altered hydrology, however current growth is reproducing and dominated by native species, is providing wildlife and other endangered species habitat. Long term viability is dependant on hydro management. Flooding is required to maintain this ecosystem.

## NATURAL HERITAGE RESOURCE SIGNIFICANCE:

| SCIENTIFIC NAME:   | COMMON NAME:       | GLOBAL*<br>RANK | STATE*<br>RANK | USFWS<br>STATUS | STATE*<br>STATUS | Other**<br>ZENS |
|--|--------------------|-----------------|----------------|-----------------|------------------|-----------------|
| HYBOGNATHUS HANKINSONI   | BRASSY MINNOW      | G5              | S3             |                 |                  |                 |
| HYBOGNATHUS HANKINSONI   | BRASSY MINNOW      | G5              | S3             |                 |                  |                 |
| HYBOGNATHUS HANKINSONI   | BRASSY MINNOW      | G5              | S3             |                 |                  |                 |
| HYBOGNATHUS HANKINSONI   | BRASSY MINNOW      | G5              | S3             |                 |                  |                 |
| PHENACOSIUS MIRABILIS  | SUCKERMOUTH MINNOW | G5              | S3             |                 | SC               |                 |
| PHENACOSIUS MIRABILIS  | SUCKERMOUTH MINNOW | G5              | S3             |                 | SC               |                 |
| PHENACOSIUS MIRABILIS  | SUCKERMOUTH MINNOW | G5              | S3             |                 | SC               |                 |
| PHENACOSIUS MIRABILIS  | SUCKERMOUTH MINNOW | G5              | S3             |                 | SC               |                 |
| PHENACOSIUS MIRABILIS  | SUCKERMOUTH MINNOW | G5              | S3             |                 | SC               |                 |
| PHENACOSIUS MIRABILIS  | SUCKERMOUTH MINNOW | G5              | S3             |                 | SC               |                 |
| FUNDULUS SCIADICUS   | FLAINS TOPMINNOW   | G4              | S2             | C2              | SC               | FS              |
| FUNDULUS SCIADICUS   | FLAINS TOPMINNOW   | G4              | S2             | C2              | SC               | FS              |
| POPULUS DELTOIDES-SALIX AMYGDALOIDES/SALIX EXIGUA<br>PLAINS COTTONWOOD RIPARIAN WOODLAND         |                    | G2G3            | S2S3           |                 |                  |                 |
| POPULUS DELTOIDES-(SALIX AMYGDALOIDES)/SPARTINA PECTINATA<br>PLAINS COTTONWOOD RIPARIAN WOODLAND |                    | G1G2            | S1             |                 |                  |                 |
| POPULUS DELTOIDES/SYMPHORICARPOS OCCIDENTALIS<br>PLAINS COTTONWOOD RIPARIAN WOODLAND             |                    | G2G3            | S1             |                 |                  |                 |
| SALIX EXIGUA/MESIC GRAMINOID<br>COYOTE WILLOW/MESIC GRAMINOID                                    |                    | G5              | S5             |                 |                  |                 |

\* CNRP Ranking system, \* C2= proposed listing as endangered or threatened. \*\* FS=Forest Service Sensitive Species list

CURRENT STATUS: Owned by state

The site is owned by the State. The land is managed as a state wildlife area by the Division of Wildlife. The riparian area is not grazed by livestock. It is managed primarily for wildlife and hunting access. The area is not current grazed by livestock.

Some Russian olives and tamarisk occur, but not in abundance. Green Ash is present, and is native to Nebraska. Weber describes it as adventive in Colorado, escaping from towns and gardens. Along the S. Platte River, green ash is in its native habitat, and may be considered a natural component of the vegetation.

BOUNDARY JUSTIFICATION:

Boundaries that protect the elements from direct impacts such as weed invasions or channel dredging should be used as primary boundaries. Secondary boundaries should include

major ecological processes that allow the elements to survive. These may include but are not limited to fire, herbivory, 25-100+ return flow flooding events, and others.

#### PROTECTION AND MANAGEMENT CONSIDERATIONS:

Because of the major changes in the natural hydrology of the South Platte River, future research needs to focus on the historic flows that allowed the current floodplain forest to establish, and determine if it is the sole product of human alterations, or otherwise. In addition, if the alterations indeed provided for this natural succession of cottonwood communities, the question needs to be raised: Is it worth protecting? Usually we are facing the problem of habitat destruction, here it looks like we've created some.

Other questions to consider: Will the current hydrologic management maintain the current ecosystem? Is the width of the floodplain mosaic in decline and if so is this part of the natural cycle, or a sign of a one time event?

#### OFF-SITE CONSIDERATIONS:

Adjacent sandhills to south contain native sand-sage and other grassland communities.

#### RECOMMENDED FURTHER RESEARCH:

Monitor cottonwood regeneration. Determine stand ages and correlate to past hydrologic events. Determine flooding regime, water management, past climates, and other factors that have allowed the current floodplain forest to develop. Project this information into the future by modeling riparian ecosystem response to different hydrological management regimes.



Globally Rare Plains Cottonwood-Peached Leaved Willow Riparian Forest, South Platte River near Julesburg, Colorado



Mosaic of Natural Riparian Communities, South Platte River, Tamarack Ranch State Wildlife Area, Colorado.



Globally Rare Plains Cottonwood/Prairie Slough Grass Riparian Forests, South Platte River, Tamarack Ranch State Wildlife Area, Colorado.



Overflow Channel on the South Platte River Floodplain, Tamarack Ranch State Wildlife Area, Colorado.



Globally rare Plains Cottonwood/Snowberry Riparian Forests, South Platte River, Messix State Wildlife Area, Colorado.



Close-up of Plains Cottonwood-Peached leaved Willow Riparian Forest, South Platte River, Tamarack Ranch State Wildlife Area, Colorado.

Appendix B. Ecologically Significant Riparian Areas of the Upper Arkansas River Basin.

COLORADO NATURAL HERITAGE PROGRAM  
CONSERVATION SITE PROFILE

GARDEN PARK FOSSIL SITE

SIZE: 4500.00

BIODIVERSITY SIGNIFICANCE: 1: OUTSTANDING SIGNIFICANCE

PROTECTION URGENCY RATING: 2: THREAT/OPPORTUNITY WITHIN 5 YEARS

MANAGEMENT URGENCY RATING: 2: ESSENTIAL WITHIN FIVE YEARS TO  
PREVENT LOSS

LOCATION: South end of Garden Park in Fourmile Creek Drainage, Fremont County, CO.  
USGS Quadrangle name(s): Cooper Mountain  
Townrange and section: T017S, R070W, Sections:20,21,23,24,25,26,27,28,33,34,35,36  
T017S, R069W, Section: 19

GENERAL DESCRIPTION:

The Garden Park Fossil Site is located along Fourmile and Felch creeks. Felch Creek flows west into Fourmile Creek which then flows south into the Arkansas River. The site is characterized by a mosaic of high quality pinon/juniper woodlands, grasslands, and clay barrens. *Eriogonum brandegei* (G1G2\S1S2) and *Mentzelia chrysantha* (G1G2\S1S2) occur in pockets along steep slopes cut by the creeks and within basins of eroded bentonite clay soil. *Asclepias uncialis* (G1G2\S1S2) is found in grasslands dominated by *Bouteloua gracilis*, *Aristida purpurea*, and *Erioneuron pilosum*. This riparian community is classified as *Populus angustifolia*\*Prunus virginiana*, a proposed G2?\S1? community. The canyon section of Felch Creek is full of large granite boulders that produce a pool-drop creek. There are many small wading pools, waterfalls, and dense cottonwood trees that make this section very scenic. This site also affords excellent views of the Sangre de Cristo Mountain Range.

NATURAL HERITAGE RESOURCE SIGNIFICANCE:

Four significant elements of natural diversity are found within the Garden Park Fossil site: *Eriogonum brandegei* (G1G2\S1S2), *Mentzelia chrysantha* (G1G2\S1S2), *Asclepias uncialis* (G1G2\S1S2), and a *Populus angustifolia*\*Prunus virginiana* (G2?\S1?) community (Table 1). The Garden Park Fossil Site contains several occurrences of each of these globally rare plant species, in addition to a high quality riparian area. *Eriogonum brandegei* has an extremely limited global range of 50 square miles, with only nine known occurrences. The two occurrences at Garden Fossil Park contain thousands of individuals of varying size-classes over approximately 280 acres of habitat in excellent condition.

*Mentzelia chrysantha* is another limited endemic with a global range of about 30 square

miles. The two occurrences at Garden Fossil are in good to high quality condition, with hundreds of individual plants in approximately 160 acres of habitat.

Another regional endemic, *Asclepias uncialis*, is known from only 6 locations in the world, 2 of which occur at Garden Fossil Park. Only 200 individuals have been estimated for this species globally. One occurrence has 24 individuals located within a relatively undisturbed site. The other occurrence was recorded in 1990 and, unfortunately, has no information on the population size.

In addition, one of the highest quality occurrences of any riparian plant community recorded in the lower elevation of the middle Arkansas Valley is within this site. An A-ranked occurrence of *Populus angustifolia/Prunus virginiana* plant association occurs here, and lies within a pristine riparian mosaic with an un-altered hydrologic regime.

TABLE 1. Elements of Biodiversity at the Garden Park Fossil Site.

| SCIENTIFIC NAME:   | COMMON NAME:             | GLOBAL RANK | STATE RANK | FEDERAL STATUS | STATE STATUS | USFS SENS |
|--|--------------------------|-------------|------------|----------------|--------------|-----------|
| CONEPATUS MESOLEUCUS   | HOG-NOSED SKUNK          | G5          | S1         |                |              |           |
| POPULUS ANGUSTIFOLIA/PRUNUS VIRGINIANA<br>NARROWLEAF COTTONWOOD/COMMON CHOKECHERRY |                          | G2?         | S1         |                |              |           |
| ASCLEPIAS UNCLIALIS  | DWARF MILKWEED           | G1G2        | S1S2       | C2             |              | FS        |
| ASCLEPIAS UNCLIALIS  | DWARF MILKWEED           | G1G2        | S1S2       | C2             |              | FS        |
| ASCLEPIAS UNCLIALIS  | DWARF MILKWEED           | G1G2        | S1S2       | C2             |              | FS        |
| MENTZELIA CHRYSANTHA   | GOLDEN BLAZING STAR      | G1G2        | S1S2       |                |              |           |
| MENTZELIA CHRYSANTHA   | GOLDEN BLAZING STAR      | G1G2        | S1S2       |                |              |           |
| ERIOGONUM BRANDEGEI  | BRANDEGEE WILD BUCKWHEAT | G1G2        | S1S2       | C1             |              | FS        |
| ERIOGONUM BRANDEGEI  | BRANDEGEE WILD BUCKWHEAT | G1G2        | S1S2       | C1             |              | FS        |
| ERIOGONUM BRANDEGEI  | BRANDEGEE WILD BUCKWHEAT | G1G2        | S1S2       | C1             |              | FS        |

#### CURRENT STATUS:

Excavation for dinosaur bones and bentonite mining are potential threats, and recreational use is likely on the rise. BLM is working on an ACEC designation for portions of this site. Road access needs to be restricted away from the rare plant populations to minimize impacts. Similar sites in the area are experiencing heavy ORV use. Drainages and roadsides are weedy in places, with aggressive invaders such as cheat grass (*Bromus tectorum*), yellow sweet clover (*Melilotus officinale*), and Timothy (*Phleum pratense*). The south side of the site has been burned and is very weedy. This site is also a significant paleontological area; five type specimens of dinosaur

species have been collected here. Several historical excavation quarries for dinosaur bones are located at the site. There has been some grazing and homesteading within site.

**BOUNDARY JUSTIFICATION:**

Primary boundaries need to be placed to protect habitat and ecological processes necessary to support each occurrence. Secondary boundaries are required to provide a buffer and to connect several element occurrences that fall within the 3-by-2 mile area.

**PROTECTION AND MANAGEMENT CONSIDERATIONS:**

Restrict road access to occurrences.

**OFF-SITE CONSIDERATIONS:**

Mines in Cripple Creek area may pollute Fourmile Creek.

**RECOMMENDED FURTHER RESEARCH:**

We need to assess the possibility of land-use risks, especially recreational use and archaeological excavations. We need to determine the specific plans of the ACEC designation, and begin negotiations if alterations are necessary for element protection. In addition, we need to determine if any land acquisition is part of the BLM management plan.

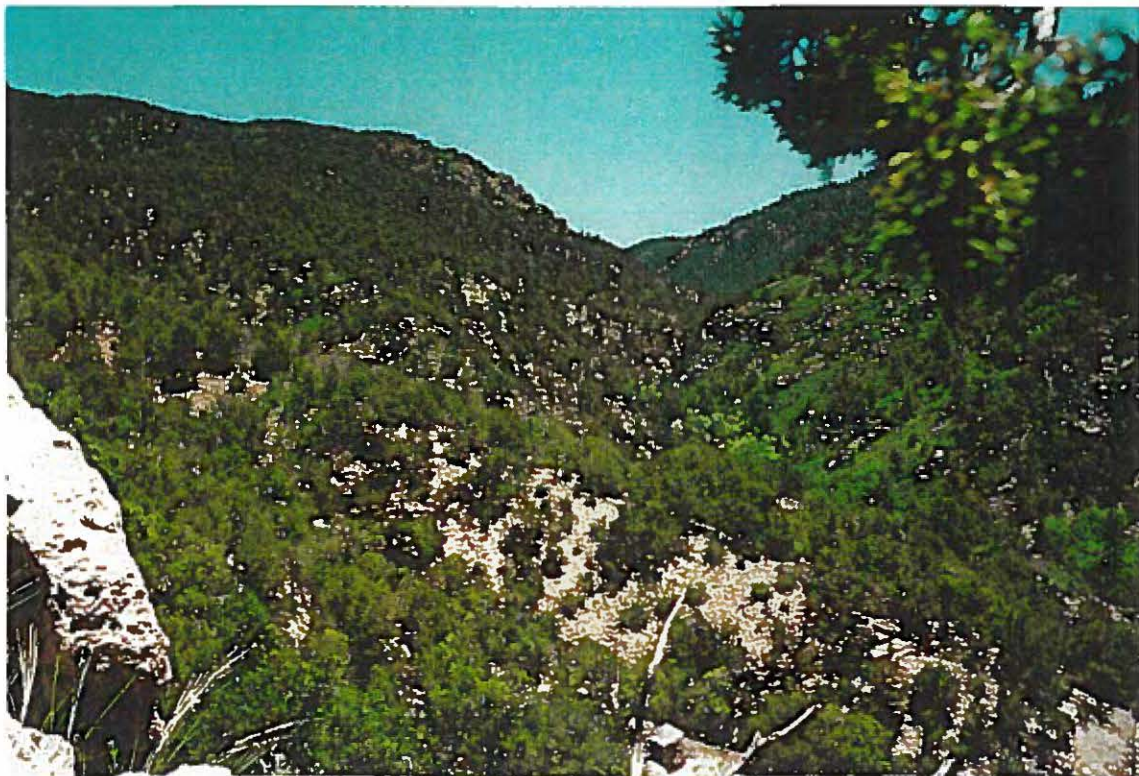


Figure 1. View of the Felch Creek drainage.

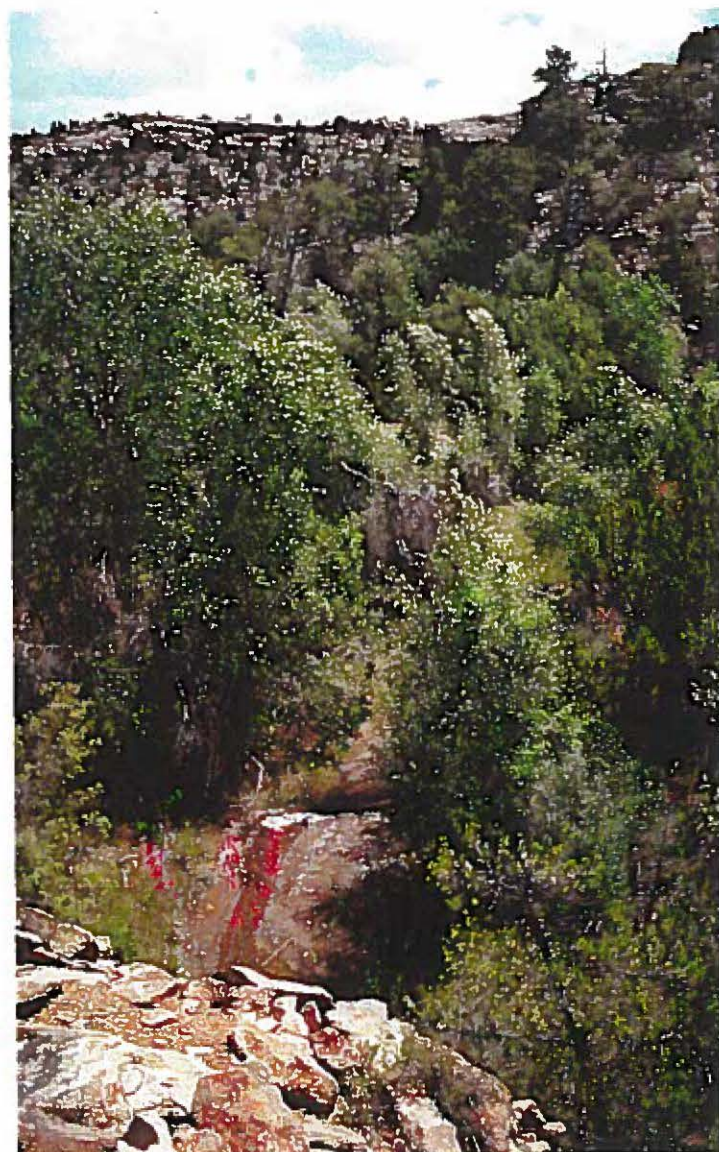


Figure 2. *Populus angustifolia* /*Prunus virginiana* community, along an unnamed tributary to Badger Creek. The same type of community occurs on Felch Creek.

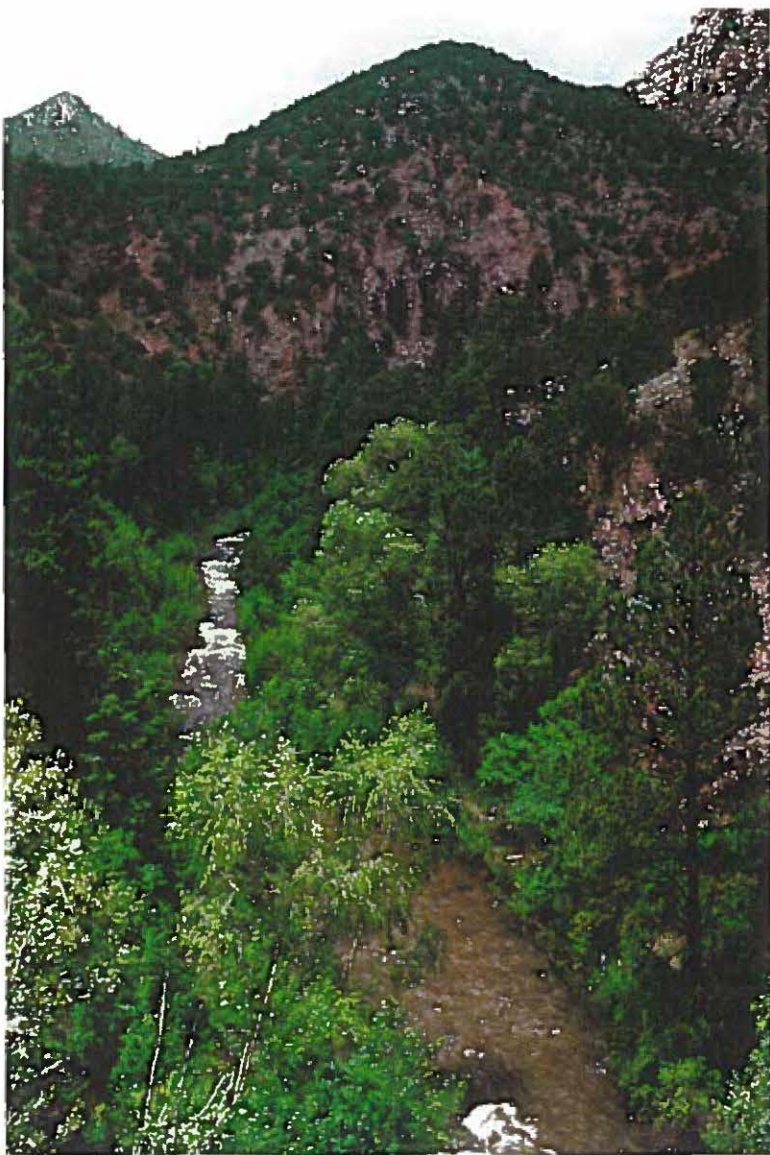
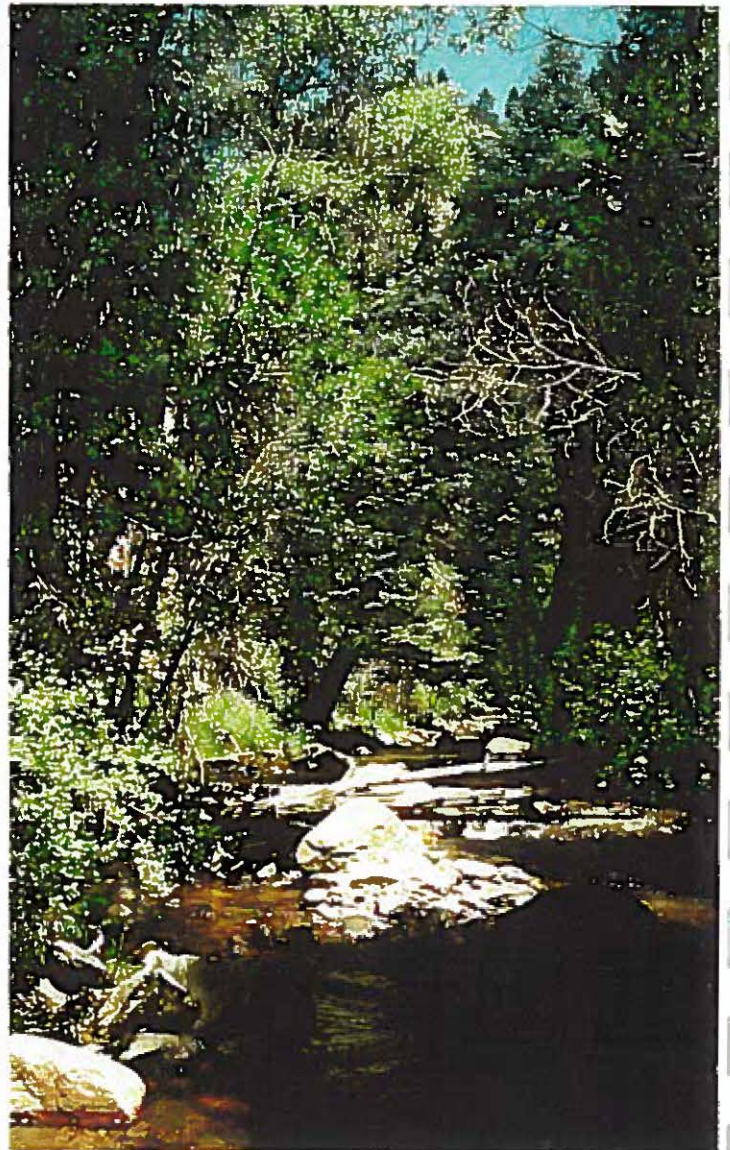


Figure 3. An example of a high quality riparian area along a foothill stream (Beaver Creek) of the Arkansas River Basin.

Figure 4. Another example of high quality riparian area within the Arkansas River Basin. This A-ranked occurrence is along East Beaver Creek.



**Appendix C. Plant Species List from the Lower South Platte River Basin, (including South Boulder Creek above Eldora Park). Nomenclature follows Kartez 1994, except for the genus *Salix*, where we follow Dorn 1977 and Dorn 1995.**

*[The following text is extremely faint and illegible, appearing to be a list of plant species.]*

1995 South Platte Riparian Plant Species List, nomenclature follows Kartez 1994, except for the genus *Salix*, where we follow Dorn 1977 and Dorn 1995.

#### TREES

1. *Abies lasiocarpa* (Hook.) Nutt.--young & mature
2. *Acer negundo* L.--young & mature trees
3. *Celtis laevigata* var. *reticulata* (Torr.) L. Benson
4. *Elaeagnus angustifolia* L.
5. *Fraxinus pennsylvanica* Marsh.--mature trees
6. *Fraxinus pennsylvanica* Marsh.--saplings
7. *Fraxinus pennsylvanica* Marsh.--seedlings
8. *Juniperus scopulorum* Sarg.--seedlings
9. *Juniperus scopulorum* Sarg.--young & mature trees
10. *Picea engelmannii* Parry ex Engelm.--young & mature trees
11. *Pinus contorta* Dougl. ex Loud.--young & mature
12. *Pinus ponderosa* P. & C. Lawson--young & mature trees
13. *Populus angustifolia* James--saplings
14. *Populus angustifolia* James--seedlings
15. *Populus angustifolia* James--young & mature trees
16. *Populus deltoides* ssp. *monilifera* (Ait.) Eckenwalder--mature trees
17. *Populus deltoides* ssp. *monilifera* (Ait.) Eckenwalder--saplings
18. *Populus deltoides* ssp. *monilifera* (Ait.) Eckenwalder--seedlings
19. *Populus tremuloides* (Michx.)
20. *Populus x acuminata* Rydb.--young & mature trees
21. *Pseudotsuga menziesii* (Mirbel) Franco--young & mature trees
22. *Quercus gambelii* Nutt
23. *Salix amygdaloides* Anderss.--mature trees
24. *Salix amygdaloides* Anderss.--saplings
25. *Salix amygdaloides* Anderss.--seedlings
26. *Salix fragilis* L.
27. *Ulmus pumila* L.

#### SHRUBS

28. *Acer glabrum* Torr.
29. *Alnus incana* ssp. *tenuifolia* (Nutt.) Breitung
30. *Betula glandulosa* Michaux
31. *Betula occidentalis* Hook.
32. *Chrysothamnus nauseosus*
33. *Chrysothamnus* sp.
34. *Cornus sericea* L.
35. *Crataegus succulenta* Schrad. ex Link
36. *Echinocystis lobata* (Michx.) Torr. & Gray
37. *Humulus lupulus* L.

38. *Jamesia americana* Torr. & Gray
39. *Lonicera involucrata* Banks ex Spreng.
40. *Parthenocissus quinquefolia* var. *quinquefolia*
41. *Pentaphylloides floribunda* (Pursh) A. Love
42. *Physocarpus monogynus* (Torr.) Coult.
43. *Prunus americana* Marsh.
44. *Prunus virginiana* var. *melanocarpa* (A. Nels.) Sarg.
45. *Rhus trilobata* var. *trilobata*
46. *Ribes aureum* Pursh
47. *Ribes cereum* Dougl.
48. *Ribes coloradense* Coville
49. *Ribes inerme* Rydb.
50. *Rosa woodsii* Lindl.
51. *Rubus idaeus* L.
52. *Salix bebbiana* Sarg.
53. *Salix drummondiana* Barratt ex Hook
54. *Salix exigua* Nutt.
55. *Salix geyeriana* Anderss.
56. *Salix eriocephala* ssp. *mackenzieana* var. *ligulifolia* (Ball) Don
57. *Salix lucida* ssp. *caudata* (Nutt.) E. Murr.
58. *Salix lutea* Nutt.
59. *Salix monticola* Bebb
60. *Salix planifolia* ssp. *planifolia* Pursh
61. *Symphoricarpos occidentalis* Hook.
62. *Toxicodendron rydbergii* (Small ex Rydb.) Greene
63. *Typha angustifolia* L.
64. Unknown shrub
65. *Vitis riparia* Michx.

#### GRAMINOIDES

66. *Agropyron cristatum* (L.) Gaerth.
67. *Agropyron* sp.
68. *Agrostis scabra* Willd.
69. *Agrostis* sp.
70. *Agrostis stolonifera* L.
71. *Alopecurus aequalis* Sobol.
72. *Alopecurus* sp.
73. *Andropogon* sp.
74. *Bouteloua curtipendula* (Michx.) Torr.
75. *Bouteloua gracilis* (Willd. ex Kunth) Lag. ex Griffiths
76. *Bouteloua hirsuta* Lag.
77. *Bromus hordeaceus* ssp. *hordeaceus*
78. *Bromus inermis* Leys.

79. *Bromus japonicus* Thunb. ex Murr.
80. *Bromus tectorum* L.
81. *Calamagrostis canadensis* (Michx.) Beauv.
82. *Carex aquatilis* Wahlenb.
83. *Carex canescens* L.
84. *Carex duriuscula* C.A. Mey.
85. *Carex hystercina* Muhl. ex Willd.
86. *Carex lanuginosa* Michx.
87. *Carex microptera* MacKenzie
88. *Carex nebrascensis* Dewey
89. *Carex* sp.
90. *Carex utriculata* F. Boot
91. *Cyperus* sp.
92. *Dactylis glomerata* L.
93. *Digitaria* sp.
94. *Distichlis spicata* (L.) Greene
95. *Echinochloa crus-galli* (L.) P. Beauvois
96. *Eleocharis palustris* (L.) Roemer & J.A. Schultes
97. *Eleocharis rostellata* (Torr.) Torr.
98. *Eleocharis* sp.
99. *Elymus canadensis* L.
100. *Elymus lanceolatus* ssp. *lanceolatus* (Scribn. & J.G. Sm.) Gould
101. *Elytrigia intermedia* (Host) Nevski
102. *Eragrostis pilosa* (L.) Beauv.
103. *Eragrostis* sp.
104. *Glyceria grandis* S.Wats.
105. *Glyceria* sp.
106. *Hordeum jubatum* L.
107. *Juncus balticus* var. *Montaus* Englm.
108. *Juncus* sp.
109. *Juncus* sp. (round)
110. *Juncus tracyi* Rydb.
111. *Leersia oryzoides* (L.) Swartz.
112. *Luzula parviflora* (Ehrh.) Desv.
113. *Mimosa* sp.
114. *Panicum capillare* L.
115. *Panicum* sp.
116. *Panicum virgatum* L.
117. *Pascopyrum smithii* (Rydb.) A. Love
118. *Phalaris arundinacea* L.
119. *Phleum alpinum* L.
120. *Phleum pratense* L.
121. *Phragmites australis*

122. *Poa compressa* L.
123. *Poa palustris* L.
124. *Poa pratensis* L.
125. *Poa* sp.
126. *Polypogon monspeliensis* (L.) Desf.
127. *Schizachyrium scoparium* (Michx.) Nash
128. *Scirpus acutus* Muhl. ex Bigelow
129. *Scirpus americanus* Pers.
130. *Scirpus microcarpus* J. & K. Presl.
131. *Scirpus pungens* Vahl.
132. *Scirpus* sp.
136. *Setaris vulpiseta* (Lam.) Roemer & J.A. Schultes
137. *Sorghastrum nutans* (L.) Nash
138. *Spartina gracilis* Trin.
139. *Spartina pectinata* Link
140. *Sporobolus* sp.
141. *Stipa comata* Trin. & Rupr.
142. *Stipa* sp.
143. *Typha latifolia* L.
144. *Typha* sp.
145. Unknown graminoid

#### FORBS

146. *Vulpia octoflora* (Walt.) Rydb.
147. *Achillea millefolium* L.
148. *Ambrosia dumosa* (Gray) Payne
149. *Ambrosia* sp.
150. *Anaphalis margaritacea* (L.) Benth. & Hook. f.
151. *Angelica* sp.
152. *Antennaria parvifolia* Nutt.
153. *Apocynum androsaemifolium* L.
154. *Aralia nudicaulis* L.
155. *Arctium minus* Bernh
156. *Arctostaphylos uva-ursi* (L.) Spreng.
157. *Arnica cordifolia* Hook.
158. *Artemisia dracunculus* L.
159. *Artemisia ludoviciana* Nutt.
160. *Asclepias* sp.
161. *Asclepias speciosa* Torr.
162. *Asparagus officinalis* L.
163. *Aster laevis* L.
164. *Aster* sp.
165. *Biden cernua* L.

166. *Bidens frondosa* L.
167. *Bidens* sp.
168. *Bidens tripartita* L.
169. Brassicaceae spp.
170. *Caltha leptosepala* DC.
171. *Cardamine cordifolia* Gray
172. *Cardaria* sp.
173. *Castilleja* sp.
174. *Centaurea diffusa* Lam.
175. *Chamaesyce serpyllifolia* (Pers.) Small
176. *Chamaesyce* sp.
177. *Chenopodium album* L.
178. *Chenopodium glaucum* L.
179. *Cichorium intybus* L.
180. *Cicuta douglasii* (D.C.) Coult. & Rose.
181. *Cicuta* sp.
182. *Cirsium arvense* (L.) Scop.
183. *Cirsium* sp.
184. *Claytonia* sp.
185. *Clematis ligusticifolia* Nutt.
186. *Conium maculatum* L.
187. *Convolvulus arvensis* L.
188. *Corallorhiza maculata* (Raf.) Raf.
189. *Cornus canadense* (L.) Ascherson & Grabner
190. *Cryptantha* sp.
191. *Cynoglossum officinale* L.
192. *Descurainia sophia* (L.) Webb ex Prant
193. *Descurainia* sp.
194. *Dodecatheon pulchellum* (Raf.) Merr.
195. *Echinocereus viridiflorus* Engelm.
196. *Epilobium angustifolium* L.
197. *Epilobium* sp.
198. *Erigeron* sp.
199. *Euphorbia dentata* Michx.
200. *Euphorbia esula* var. *uralensis* (Fish ex Link) Dom
201. *Euphorbia marginata* Pursh
202. *Fragaria virginiana* Duchesne
203. *Galium boreale* L.
204. *Galium* sp.
205. *Galium triflorum* Michx.
206. *Geranium richardsonii* Fisch. & Trautv.
207. *Geum macrophyllum* Willd.
208. *Geum* sp.

209. *Glycyrrhiza lepidota* Pursh
210. *Hackelia floribunda* (Lehm) I.M. Johnston
211. *Harbouria trachypleura* (Gray) Coult. & Rose
212. *Helianthus* sp.
213. *Heracleum lanatum* Michx.
214. *Heterotheca villosa* (Pursh) Shinnars
215. *Hydrophyllum fendleri* (Gray) Heller
216. *Ipomopsis* sp.
217. *Lactuca* sp.
218. *Lappula occidentalis* var. *occidentalis* (S. Wats) Greene
219. *Lepidium* sp.
220. *Lithospermum incisum* Lehm.
221. *Lupinus* sp.
222. *Mahonia repens* (Lindl.) G. Don
223. *Maianthemum racemosum* (L.) Link.
224. *Maianthemum stellatum* (L.) Link
225. *Medicago lupulina* L.
226. *Medicago sativa* L.
227. *Melilotus officinalis* (L.) Lam.
228. *Mentha arvensis* L.
229. *Mentha* sp.
230. *Mertensia ciliata* (James & Torr.) G. Don
231. *Mimulus guttatus* D.C.
232. *Mirabilis nyctaginea* (Michx.) MacM.
233. *Opuntia polyacantha* Haw.
234. *Oxybaphus* sp.
235. *Plantago major* L.
236. *Plantago patagonica* Jacq.
237. *Platanthera stricta* Lindl.
238. *Polanisia dodecandra* (L.) DC.
239. *Polygonum bistortoides* Pursh
240. *Polygonum pensylvanicum* L.
241. *Potamogeton* sp.
242. *Potentilla* sp.
243. *Prunella vulgaris* L.
244. *Psoralea* sp.
245. *Pyrola picata*
246. *Ranunculus cymbalaria* (Pursh) Greene
247. *Ranunculus gmelinii* D.C.
248. *Ranunculus* sp.
249. *Ranunculus trichophyllus* Chaix
250. *Rorippa nasturnium* (L.) Hayek.
251. *Rorippa palustris* spp. *hispida* (Desv.) Jonsell

252. *Rudbeckia lacinata* var. *ampla* (A.Nels) Conq.
253. *Rumex crispus* L.
254. *Sagittaria* sp.
255. *Salsola collina* Pallas
256. *Salvia* sp.
257. *Scrophularia lanceolata* Pursh
258. *Scutellaria brittonii* Porter
259. *Scutellaria* sp.
260. *Sedum integrifolium* (Raf.) A. Nels.
261. *Sedum rhodanthum* Gray.
262. *Senecio* sp.
263. *Senecio triangularis* Hook.
264. *Solanaceae* spp.
265. *Solanum rostratum* Dunal
266. *Solidago* sp.
267. *Stellaria* sp.
268. *Taraxacum officinale* G.H. Weber ex Wiggers
269. *Teucrium canadense* L.
270. *Thalictrum fendleri* Engelm ex. Gray
271. *Thalictrum* sp.
272. *Thermopsis rhombifolia* (Nutt. ex Pursh) Nutt ex Richards
273. *Thlaspi arvense* L.
274. *Thlaspi montanum* L.
275. *Tragopogon dubius* Scop.
276. *Tragopogon* sp.
277. *Trifolium repens* L.
278. Unknown forb
279. *Urtica dioica* ssp. *gracilis* (Ait.) Seland.
280. *Vaccinium* sp.
281. *Verbascum thapsus* L.
282. *Veronica* sp.
283. *Vicia americana* Muhl. ex Willd.
284. *Vicia* sp.
285. *Viola canadensis* L.
286. *Viola* sp.
287. *Xanthium strumarium* L.

#### HORSETAILS

288. *Equisetum arvense* L.
289. *Equisetum laevigatum* A. Braun
290. *Equisetum* sp.

Appendix D. Plant Species List from parts of the Upper Arkansas River Basin. Nomenclature follows Kartez 1994, except for the genus *Salix*, where we follow Dorn 1977 and Dorn 1995.

1995 Upper Arkansas Riparian Plant Species List, nomenclature follows Kartez 1994, except for the genus *Salix*, where we follow Dorn 1977 and Dorn 1995.

#### TREES

1. *Abies concolor*--young and mature
2. *Abies lasiocarpa* (Hook.) Nutt.--young & mature trees
3. *Eleagnus angustifolia*
4. *Fraxinus pennsylvanica* H. Marshall
5. *Juniperus monosperma* (Torr.) Little--young & mature trees
6. *Juniperus scopulorum* Sarg.--saplings
7. *Juniperus scopulorum* Sarg.--seedlings
8. *Juniperus scopulorum* Sarg.--young & mature trees
9. *Picea engelmannii* Parry ex Engelm.--seedlings
10. *Picea engelmannii* Parry ex Engelm.--young & mature trees
11. *Picea pungens* Engelm.--young & mature trees
12. *Pinus contorta* Dougl. ex Loud--young & mature trees
13. *Pinus edulis* Engelm.--young & mature trees
14. *Pinus flexilis* James--young & mature trees
15. *Pinus ponderosa* P. & C. Lawson--young & mature trees
16. *Populus acuminata*--saplings
17. *Populus acuminata*--seedlings
18. *Populus acuminata*--young & mature trees
19. *Populus angustifolia* James--saplings
20. *Populus angustifolia* James--seedlings
21. *Populus angustifolia* James--young & mature trees
22. *Populus deltoides*--young and mature trees
23. *Populus tremuloides* Michx.
24. *Pseudotsuga menziesii* (Mirbel) Franco--saplings
25. *Pseudotsuga menziesii* (Mirbel) Franco--seedlings
26. *Pseudotsuga menziesii* (Mirbel) Franco--young & mature trees
27. *Quercus gambelii* Nutt
28. *Robinia pseudoacacia*
29. *Salix amygdaloides*
30. *Salix fragilis*
31. *Ulmus pumila*

#### SHRUBS

32. *Acer glabrum* Torr.
33. *Alnus incana* ssp. *tenuifolia* (Nutt.) Breitung
34. *Amorpha fruticosa*
35. *Arctostaphalus uva-ursi* (L.) Spreng.
36. *Artemisia bigelovii*
37. *Artemisia tridentata* Nutt.

38. *Betula glandulosa* Michx.
39. *Betula occidentalis* Hook.
40. *Cercocarpus montanus*
41. *Chrysothamnus* sp.
42. *Cornus sericea*
43. *Corylus cornuta*
44. *Frankenia jamesii*
45. *Holodiscus dumosus*
46. *Humulus lupulus*
47. *Jamesia americana*
48. *Juniperus communis*
49. *Lonicera involucrata* Banks ex Spreng
50. *Parthenocissus* sp.
51. *Pentaphylloides floribunda* (Pursh) A. Love
52. *Philadelphus microphyllus* Gray
53. *Physocarpus monogynous*
54. *Prunus americana*
55. *Prunus virginiana* var. *melanocarpa* (A. Nels.) Sarg.
56. *Ptelea trifoliata*
57. *Rhus trilobata* var. *trilobata*
58. *Ribes aureum*
59. *Ribes cereum* Dougl.
60. *Ribes inerme* Rydb.
61. *Ribes leptanthum*
62. *Robinia neomexicana*
63. *Rosa woodsii* Lindl.
64. *Rubus deliciosus*
65. *Rubus idaeus* L.
66. *Salix bebbiana* Sarg.
67. *Salix boothii* Dorn
68. *Salix brachycarpa* Nutt.
69. *Salix drummondiana* Barratt ex Hook
70. *Salix exigua* Nutt.
71. *Salix geyeriana* Anderss
72. *Salix irrorata*
73. *Salix eriocephala* ssp. *mackenzieana* var. *ligulifolia* (Ball) Dorn
74. *Salix lucida* ssp. *caudata* (Nutt.) E. Murr.
75. *Salix monticola* Bebb
76. *Salix planifolia* ssp. *planifolia* Pursh
77. *Salix scouleriana*
78. *Salix wolfii* Bebb
79. *Sambucus racemosa*
80. *Symphoricarpos occidentalis*

- 81. *Symphoricarpos rotundifolius* Gray
- 82. *Toxicodendron rydbergii* (Small ex Rydb.) Greene
- 83. *Vitis riparia*
- 84. *Yucca glauca*

GRAMINOIDES

- 85. *Agropyron* sp.
- 86. *Agrostis* sp.
- 87. *Agrostis stolonifera* L.
- 88. *Alopecurus alpinus*
- 89. *Aristida purpurea*
- 90. *Bouteloua gracilis*
- 91. *Bromus frondosus*
- 92. *Bromus inermis* Leyss.
- 93. *Bromus japonicus* Thunb. ex Murr.
- 94. *Bromus* sp.
- 95. *Bromus tectorum* L.
- 96. *Calamagrostis canadensis* (Michx.) Beauv.
- 97. *Carex aquatilis* Wahlenb.
- 98. *Carex filifolia*
- 99. *Carex lanuginosa* Michx.
- 100. *Carex microptera* MacKenzie
- 101. *Carex praegracilis*
- 102. *Carex norvegica*
- 103. *Carex nova*
- 104. *Carex scopulorum*
- 105. *Carex* sp.
- 106. *Carex utriculata*
- 107. *Deschampsia cespitosa* (L.) Beauv.
- 108. *Eleocharis palustris* (L.) Roemer & J.A. Schultes
- 109. *Elymus canadensis* L.
- 110. *Elymus elymoides*
- 111. *Elymus lanceolatus* ssp. *lanceolatus*
- 112. *Elymus* sp.
- 113. *Elymus trachycaulus* ssp. *trachycaulus*
- 114. *Elytrigia repens* (L.) Desv. ex B.D. Jackson
- 115. *Eragrostis* sp.
- 116. *Festuca kingii*
- 117. *Festuca rubra*
- 118. *Festuca* sp.
- 119. *Glyceria elata* (Nash ex Rydb.) M.E. Jones
- 120. *Glyceria striata* (Lam.) A.S. Hitchc.
- 121. *Hilaria jamesii*

122. *Hordeum jubatum*
123. *Hordeum pusillum*
124. *Juncus balticus* var. *montanus* Englm.
125. *Juncus drummondii*
126. *Juncus longistylis*
127. *Juncus saximontanus*
128. *Juncus* sp.
129. *Koeleria macrantha*
130. *Muhlenbergia montana* Buckl.
131. *Muhlenbergia richardsonii*
132. *Muhlenbergia racemosa*
133. *Nassella viridula*
134. *Oryzopsis hymenoides* (Roemer & J.A. Achultes) Ricker ex Pipe
135. *Oryzopsis micrantha*
136. *Oryzopsis* sp.
137. *Panicum virgatum*
138. *Pascopyrum smithii* (Rydb.) A. Love
139. *Phleum pratense* L.
140. *Phleum* sp.
141. *Poa compressa*
142. *Poa fendleriana*
143. *Poa palustris* L.
144. *Poa pratensis* L.
145. *Poa* sp.
146. *Polypogon monspeliensis*
147. *Scirpus microcarpus* J. & K. Presl.
148. *Sporobolus airoides*
149. *Sporobolus* sp.
150. *Stipa comata*
151. *Stipa neomexicana*
152. Unknown graminoid

#### FORBS

153. *Achillea millefolium* L.
154. *Aconitum columbianum* Nutt.
155. *Allium cernuum*
156. *Allium* sp.
157. *Ambrosia dumosa*
158. *Ambrosia psilostachya*
159. *Amphiachyris dracunculoides*
160. *Androsace occidentalis*
161. *Androsace septentrionalis*
162. *Anemone canadensis*

163. *Anemone* sp.
164. *Angelica* *ampla*
165. *Antennaria* *parvifolia* Nutt.
166. *Antennaria* *rosulata*
167. *Antennaria* sp.
168. *Apiaceae* sp.
169. *Apocynum* *androsaemifolium*
170. *Apocynum* *cannabinum*
171. *Aquilegia* *coerulea* James
172. *Aquilegia* sp.
173. *Arnica* sp.
174. *Artemisia* *filifolia*
175. *Artemisia* *frigida*
176. *Artemisia* *ludoviciana* Nutt.
177. *Asteraceae* sp.
178. *Aster* sp.
179. *Astragalus* sp.
180. *Boraginaceae* sp.
181. *Bidens* *frondosa*
182. *Brickellia* *californica*
183. *Brickellia* sp.
184. *Cactaceae* sp.
185. *Caltha* *leptosepala* D.C.
186. *Campanula* *rotundifolia*
187. *Cardamine* *cordifolia* Gray
188. *Cardamine* *breweri*
189. *Castilleja* *occidentalis*
190. *Centaurea* *diffusa*
191. *Cerastrium* sp.
192. *Cicuta* *douglasii*
193. *Cirsium* *arvense* (L.) Scop.
194. *Cirsium* sp.
195. *Cirsium* *tiogianum* var. *coloradense*
196. *Clematis* *ligusticifolia* Nutt.
197. *Conioselinum* *scopulorum* (Gray) Coulter. & Rose.
198. *Convolvulaceae* sp.
199. *Conyza* *canadensis*
200. *Coreopsis* sp.
201. *Delphinium* *carolinianum* ssp. *virescens*
202. *Descurainia* sp.
203. *Dodecatheon* *pulchellum* (Raf.) Merr.
204. *Epilobium* *angustifolium* L.
205. *Epilobium* *ciliatum*

206. *Epilobium saximontanum*
207. *Epilobium* sp.
208. *Erigeron* sp.
209. *Eriogonum elatum*
210. *Eriogonum* sp.
211. *Erodium cicutarium*
212. *Euphorbia* sp.
213. Fabaceae sp.
214. *Fragaria virginiana* Duchesne
215. *Galium aparine*
216. *Galium boreale*
217. *Galium* sp.
218. *Galium trifidum*
219. *Geranium* L.
220. *Geranium richardsonii* Fisch. & Trautv.
221. *Geum macrophyllum* Willd.
222. *Glycyrrhiza lepidota*
223. *Grindelia squarrosa*
224. *Gutierrezia* sp.
225. *Helianthus* sp.
226. *Heracleum sphondylium*
227. *Heterotheca villosa* (Pursh) Shinnery
228. *Hydrophyllum capitatum*
229. *Ipomopsis aggregata* ssp. *candida*
230. *Ipomopsis* sp.
231. Lamiaceae sp.
232. *Lappula occidentalis* var. *occidentalis*
233. *Lepidium virginicum*
234. *Lesquerella fendleri*
235. *Lesquerella* sp.
236. *Ligusticum porteri* Coult. & Rose
237. *Ligusticum tenuifolium*
238. *Limnorchis* sp.
239. *Linaria vulgaris*
240. *Lithospermum* sp.
241. *Maianthemum racemosum* ssp. *racemosum* (L.) Link
242. *Maianthemum stellatum* (L.) Link
243. *Medicago lupulina* L.
244. *Medicago polymorpha*
245. *Medicago sativa* L.
246. *Medicago* sp.
247. *Melilotus alba* Medikus
248. *Melilotus officinalis* (L.) Lam.

249. *Melilotus* sp.
250. *Mentha arvensis* L.
251. *Mertensia ciliata* (James & Torr.) G. Don
252. *Mertensia* sp.
253. *Mimulus guttatus*
254. *Mirabilis rotundifolius*
255. *Montia chamissoi*
256. *Nepeta cataria*.
257. *Oenothera elata*
258. *Oenothera pallida*
259. *Onagraceae* sp.
260. *Oonopsis foliosa*
261. *Opuntia polyacantha*
262. *Osmorhiza depauperata*
263. *Oxalis dillenii*
264. *Oxypolis fendleri* (Gray) Heller
265. *Oxytropis sericea*
266. *Pedicularis groenlandica* Retz.
267. *Pedicularis* sp.
268. *Penstemon auriberbis*
269. *Penstemon barbatus*
270. *Penstemon glaber*
271. *Penstemon varicolor*
272. *Physalis hederifolia* var. *comata*
273. *Plantago major*
274. *Plantago* sp.
275. *Polemonium foliosissimum* Gray
276. *Polemoniaceae* sp.
277. *Polygonaceae* sp.
278. *Polygonum bistortoides* Pursh
279. *Polygonum viviparum*
280. *Portulaca* sp.
281. *Potamogeton* sp.
282. *Potentilla pulcherrima*
283. *Potentilla* sp.
284. *Prunella vulgaris*
285. *Pseudocymopterus montanus* (Gray) Coult. & Rose
286. *Psoralegium tenuiflorum*
287. *Pyrola minor* L.
288. *Pyrola* sp.
289. *Ranunculus* sp.
290. *Rorippa nasturtium-aquaticum*
291. *Rudbeckia laciniata* var. *ampla*

292. *Rudbeckia* sp.  
 293. *Rumex acetosella*  
 294. *Rumex crispus* L.  
 295. *Rumex* sp.  
 296. *Saxifraga odontoloma* Piper  
 297. *Scrophulariaceae* sp.  
 298. *Sedum integrifolium*  
 299. *Sedum lanceolatum*  
 300. *Sedum rhodanthum* Gray  
 301. *Senecio integerrimus*  
 302. *Senecio* sp.  
 303. *Solidago canadensis* L.  
 304. *Solidago multiradiata*  
 305. *Solidago gigantea*  
 306. *Solidago* sp.  
 307. *Sonchus arvensis*  
 308. *Sphaeralcea* sp.  
 309. *Stellaria longifolia*  
 310. *Stellaria* sp.  
 311. *Swertia perennis* L.  
 312. *Taraxacum officinale* G.H. Weber ex Wiggers  
 313. *Thalictrum alpinum* L.  
 314. *Thalictrum fendleri* Engelm ex. Gray  
 315. *Thalictrum* sp.  
 316. *Thermopsis rhombifolia* var. *divaricarpa*  
 317. *Thermopsis rhombifolia* var. *montana*  
 318. *Thermopsis* sp.  
 319. *Thlaspi montanum* L.  
 320. *Tragopogon dubius*  
 321. *Trifolium pratense* L.  
 322. *Trifolium repens* L.  
 323. *Trifolium* sp.  
 324. *Triglochin* sp.  
 325. Unknown forb  
 326. *Urtica dioica* ssp. *gracilis* (Ait.) Seland.  
 327. *Valeriana edulis* Nutt. ex Torr. & Gray  
 328. *Verbascum thapsus*  
 329. *Verbena* sp.  
 330. *Veronica* sp.  
 331. *Veronica wormskjoldii*  
 332. *Vicia americana* Muhl. ex Willd.  
 333. *Vicia* sp.  
 334. *Viola adunca*

335. *Viola* sp.

**HORSETAILS**

336. *Equisetum arvense* L.

337. *Equisetum hyemale* L.

*[Faint, illegible text, likely bleed-through from the reverse side of the page]*

**Appendix E. Riparian Task Force Memorandum of Understanding.**

MEMORANDUM OF UNDERSTANDING  
BETWEEN THE STATE OF CALIFORNIA  
AND THE FEDERAL GOVERNMENT  
REGARDING THE RIPARIAN TASK FORCE  
ON THE CALIFORNIA RIVERS  
AND STREAMS  
AND THE CALIFORNIA RIVERS  
AND STREAMS  
AND THE CALIFORNIA RIVERS  
AND STREAMS

THIS MEMORANDUM OF UNDERSTANDING  
IS MADE THIS 15TH DAY OF OCTOBER  
1988

The State of California and the Federal Government have agreed to establish a Riparian Task Force to study and report on the riparian resources of California. The Task Force will be composed of representatives from the State and the Federal Government. The Task Force will hold public hearings and submit a report to the State and the Federal Government by the end of 1989.

The Task Force will be authorized to hold public hearings and to conduct such other activities as may be necessary to carry out its duties. The Task Force will be authorized to receive and accept gifts of money and property for its use. The Task Force will be authorized to employ such personnel as may be necessary to carry out its duties.

MEMORANDUM OF UNDERSTANDING  
among  
COLORADO DEPARTMENT OF HEALTH  
COLORADO DIVISION OF PARKS AND OUTDOOR RECREATION  
COLORADO DIVISION OF WILDLIFE  
COLORADO NATURAL HERITAGE PROGRAM  
DENVER BOARD OF WATER COMMISSIONERS  
THE NATURE CONSERVANCY  
U.S. BUREAU OF LAND MANAGEMENT  
U.S. BUREAU OF RECLAMATION  
U.S. ENVIRONMENTAL PROTECTION AGENCY  
U.S. FISH AND WILDLIFE SERVICE  
U.S. FOREST SERVICE  
U.S. GEOLOGICAL SURVEY  
U.S. NATIONAL PARK SERVICE  
U.S. SOIL CONSERVATION SERVICE  
for  
COORDINATION AND SUPPORT OF  
A COLORADO RIPARIAN COMMUNITY CLASSIFICATION

I. GENERAL

This Memorandum of Understanding (MOU) is entered into by the Colorado Department of Health, Colorado Division of Parks and Outdoor Recreation, Colorado Division of Wildlife, Colorado Natural Heritage Program, Denver Board of Water Commissioners, The Nature Conservancy, United States Bureau of Land Management, United States Bureau of Reclamation, United States Environmental Protection Agency, United States Fish and Wildlife Service, United States Forest Service, United States Geological Survey, United States National Park Service, United States Soil Conservation Service, each herein referred to as "party" or collectively as "parties".

II. BACKGROUND

Preventing the loss of valuable riparian areas and associated wetlands is critical, particularly in the arid western United States. Our knowledge of the ecology and distribution of riparian community types in Colorado is both limited and fragmented. There is a strong need for a statewide inventory and classification of riparian vegetation that crosses ownership and political boundaries in Colorado. A coordinated effort would help prevent the proliferation of fragmented studies by different agencies, organizations, and individuals. The statewide riparian community classification project (hereinafter referred to as "the project") will succeed only with the cooperation of state, federal and private land managers. The inter-agency

Colorado Riparian Task Force, composed of representatives from state and federal agencies and private organizations, was established in 1989 to promote and support a statewide classification of riparian vegetation. The Nature Conservancy hired a Riparian Ecologist to begin this statewide effort, coordinate the field collection of data, and complete final reports.

### III. PURPOSE AND OBJECTIVES

The Colorado Riparian Task Force, composed of representatives from state and federal agencies and private organizations which sign as a party to this MOU, consists of a Steering Committee and an appointed Technical Committee. The purpose of this MOU is to formalize the membership of the Colorado Riparian Task Force in order to facilitate cooperative efforts to produce a statewide riparian community classification system for Colorado. The objectives of the Colorado Riparian Task Force are to:

- A. Promote inter-agency communication, coordination and data-sharing for managing riparian areas; data and information generated by the project will be incorporated into the Colorado Natural Heritage Program's Biological and Conservation Databases (BCD).
- B. Develop a hierarchical classification of the riparian vegetation for Colorado.
- C. Produce annual technical reports with information on general physiographic, hydrologic, edaphic, and floristic features, as well as successional trends, of riparian plant communities in Colorado.
- D. Identify riparian sites with high natural values or exceptional ecological importance.
- E. Ensure products are useful for planning and management tools for resource managers to effectively protect and manage Colorado's riparian resources.
- F. Provide financial or other resource assistance for continuation of the riparian community classification project.

### IV. PROCEDURES

The Steering Committee is composed of representative decision makers and budget managers of each party of this MOU. The Technical Committee is composed of scientific experts representative of the parties to this MOU and are appointed by the Steering Committee.

1992 MOU FOR COORDINATION AND SUPPORT OF A COLORADO RIPARIAN COMMUNITY CLASSIFICATION

A. The Steering Committee is responsible for guiding the development of and supporting the Statewide Riparian Classification Project. A chairperson shall be elected by the committee members to serve a term of 2 years. The responsibility of the chairperson shall be to facilitate the Committee meetings. The roles of the Steering Committee are to:

1. Facilitate inter-agency cooperation in meeting the objectives of this MOU, and to oversee the Technical Committee (see below).
2. Seek continued support for the project.
3. Appoint scientific experts to serve on the Technical Committee.
4. Meet at least twice annually.
5. Set long-term goals, objectives and direction of the project.

B. The Technical Committee, composed of scientific experts appointed by the Steering Committee, advises the Steering Committee on actions to carry out the goals of this MOU. Recognized experts not represented by signatories of this MOU may serve on the Technical Committee subject to mutual agreement of the Technical and Steering Committees. A chairperson shall be elected by the committee members to serve a term of 2 years. The responsibility of the chairperson shall be to facilitate the Committee meetings. The roles of the Technical Committee are to:

1. Revise and update, where necessary, the project methodology.
2. Ensure that the data collected are compatible with the needs of participating agencies and organizations.
3. Meet at least twice annually.

C. Participating agencies and organizations may provide staff to carry out activities recommended by the Colorado Riparian Task Force, subject to funding availability. A Riparian Ecologist, currently housed at The Nature Conservancy, is responsible for working with the Steering and Technical Committees in accomplishing the objectives (stated in Section III, A-F) subject to the availability of funding. The roles of the Riparian Ecologist are:

1. To provide overall coordination of field teams, data collection, data analysis and report writing, and to administer the budget.
2. To collect vegetation, soil, hydrologic, and other data from sample sites on a drainage-by-drainage basis, in a form that is compatible with the needs of the parties.
3. To produce annual reports to include: hierarchical classification, dichotomous keys, and ecological descriptions of community types for each major river basin.
4. To ensure data are entered into the statewide databases (BCD) and the classification incorporated into the statewide community classification at the Colorado Natural Heritage Program.

#### V. AUTHORITIES

Nothing in this MOU alters the statutory authorities of the parties. Rather, this MOU is intended to facilitate the accomplishments of those statutory requirements, to cooperative efforts including mandates for consultation on policy matters, and mutual provision of research and technical assistance of all parties in the conduct of programs affecting the quality of human environment and the production of goods and services from forest, range, and other lands.

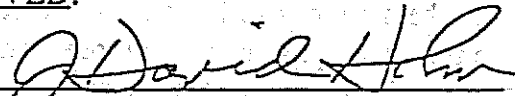
The program or activities conducted under this memorandum of understanding will be in compliance with the nondiscrimination provisions contained in the Titles VI and VII of the Civil Rights Act of 1964, as amended; the Civil Rights Restoration Act of 1987 (Public Law 100-259); and other nondiscrimination statutes: namely, Section 504 of the Rehabilitation Act of 1973, Title IX of the Education Amendments of 1972, and the Age Discrimination Act of 1975. They will also be in accordance with regulations which provide that no person in the United States shall on the grounds of race, color, national origin, age, sex, religion, marital status, or handicap be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under any program or activity receiving federal financial assistance.

#### VI. GENERAL PROVISIONS


- A. Term of Agreement and Periodic Review. This MOU will remain in effect for 5 years from signature date. The participants will review this MOU at least every 5 years to assess its adequacy, effectiveness, and continuing need.

- B. Amendments. Amendments to this agreement may be proposed at any time by any party and shall become effective upon approval by all parties then signatory to this MOU.
- C. Cancellation. This MOU may be cancelled at any time during its term by mutual agreement among the participants. Any individual participant may withdraw by giving the other participants at least 30 days notice.
- D. Adding Participants. New participants may be added to this agreement upon approval by the Steering Committee.
- E. Financial Obligations. Nothing in this agreement shall be construed as obligating any agency or organization to the expenditure of funds. Separate instruments will be developed to provide for the transfer or reimbursement of funds for specific activities related to this agreement.


APPROVED:

  
 Colorado Department of Health  
 J. David Holm, Director of Water  
 Quality Control Division

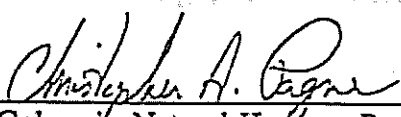
12/13/92  
 Date

  
 Colorado Division of Parks  
 and Outdoor Recreation  
 Laurie A. Matthews, Director

12/1/92  
 Date

  
 Colorado Division of Wildlife  
 Perry D. Olson, Director

Dec 1, 1992  
 Date

  
 Colorado Natural Heritage Program  
 Christopher A. Pague, Coordinator

Dec. 10, 1992  
 Date

Hamlet J. Barry  
Denver Board of Water Commissioners  
Hamlet J. Barry, Manager

12/1/92  
Date

Sydney S. Macy  
The Nature Conservancy  
Sydney S. Macy, State Director

11-22-92  
Date

Robert Moore  
U.S. Bureau of Land Management  
Robert Moore, State Director

12/10/92  
Date

Roland Robison  
U.S. Bureau of Reclamation  
Roland Robison, Upper Colorado  
Regional Director

1/28/93  
Date

D.S. LAUER  
D.S. Lauer  
FOR U.S. Bureau of Reclamation  
J. Neil Stessman, Great Plains  
Regional Director

1-15-93  
Date

Jack W. McGraw  
U.S. Environmental Protection Agency  
Jack W. McGraw  
Acting Regional Administrator

12/23/92  
Date

Ralph O. Morgenweck  
U.S. Fish and Wildlife Service  
Ralph Morgenweck Regional Director

12/22/92  
Date

Elizabeth Estill  
U.S. Forest Service  
Elizabeth Estill, Regional Forester

12/16/92  
Date

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