Major Riparian Vegetation Types of Eastern Wyoming

A Report Submitted to the

Wyoming Department of Environmental Quality
Water Quality Division

by

George P. Jones & Gillian M. Walford
Wyoming Natural Diversity Database
(The Nature Conservancy)
1604 Grand Avenue
Laramie, Wyoming 82070

Under Grant Number 9-01136

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ACKNOWLEDGEMENTS

We are grateful for advice and assistance from a variety of people. We thank the many landowners, most of whom wish to remain anonymous, who allowed us to collect information on their lands and who discussed this project with us. Without their cooperation, we could not have done this work, and we hope that they will feel that this project was useful and their cooperation was worthwhile.

The members of our advisory committee, listed below, helped us with technical and practical matters and we thank them sincerely for their time and work. In some cases we declined to take their advice, and the shortcomings in this project that might have therefore resulted are our responsibility, not theirs.

Everet Bainter, Soil Conservation Service, Casper.
Bob Budd, Wyoming Stock Growers' Association, Cheyenne. (Now with The Nature Conservancy).
Bill DiRienzo, Wyoming Department of Environmental Quality, Cheyenne.
Jerrold Dodd, University of Wyoming Range Management Division, Laramie. (Now with the North Dakota State University Department of Range and Animal Science)
Michele Girard, USDA Forest Service, Sheridan.
Dick Loper, Lander, representing the Wyoming State Grazing Board.
Reg Rothwell, Wyoming Game and Fish Department, Cheyenne.
Don Viktorin, Soil Conservation Service, Worland.
Judy von Ahlefeldt, USDA Forest Service, Laramie.
Andy Warren, Bureau of Land Management, Rawlins.

We also received useful comments from Bill Laycock of the University of Wyoming's Range Management Division and Carolyn Passeneaux of the Wyoming Wool Growers' Association.

In selecting potential study sites and contacting landowners, we received help from the following people: Cheryl Grapes and Tina Willis of the Converse County Conservation District; Phil Gonzalez, Nikki Lohse, and Diana Mader of the Lake DeSmet Conservation District; Charlie Scott and Pete Scott of the Two Bar Ranch; Willie Fitzgerald and George Soehn of the BLM's Platte River Resource Area; and Larry Apple of the BLM's Casper District.

Larry Munn and George Vance of the University of Wyoming's Plant, Soil, and Insect Sciences Division advised us on soil sampling and analysis, and Dennis Knight of the University's Botany Department provided space in his laboratory to measure soil electrical conductivity. Ron Hartman and Ernie Nelson, curator and manager, respectively, of the Rocky Mountain

Herbarium, provided work space and assistance in identifying plants.

Steve Kettler, formerly the riparian ecologist with the Wyoming Natural Diversity Database, organized and led the fieldwork during both seasons and began the data analysis. Mike Oliver, Michele Barlow, and Kris Peterson were the able field assistants on the project. The Nature Conservancy's Patrick Bourgeron advised us on sampling design and data analysis, and the Conservancy's Brian Richter was our guide to hydrology and geomorphology.

I. INTRODUCTION

This report presents the results of a project to identify and describe the most common riparian vegetation types of eastern Wyoming's plains and basins.

This project has two goals. The first is to collect and disseminate information on the nature, ecology, and distribution of riparian vegetation types in eastern Wyoming. We hope that this information about what the riparian types are, where they are, and how they work will be useful to land owners, land managers, and the general public as they think about management and conservation plans. The second goal is to provide a classification of riparian vegetation types as a way to organize information from other studies and from future research on the management and ecology of riparian areas.

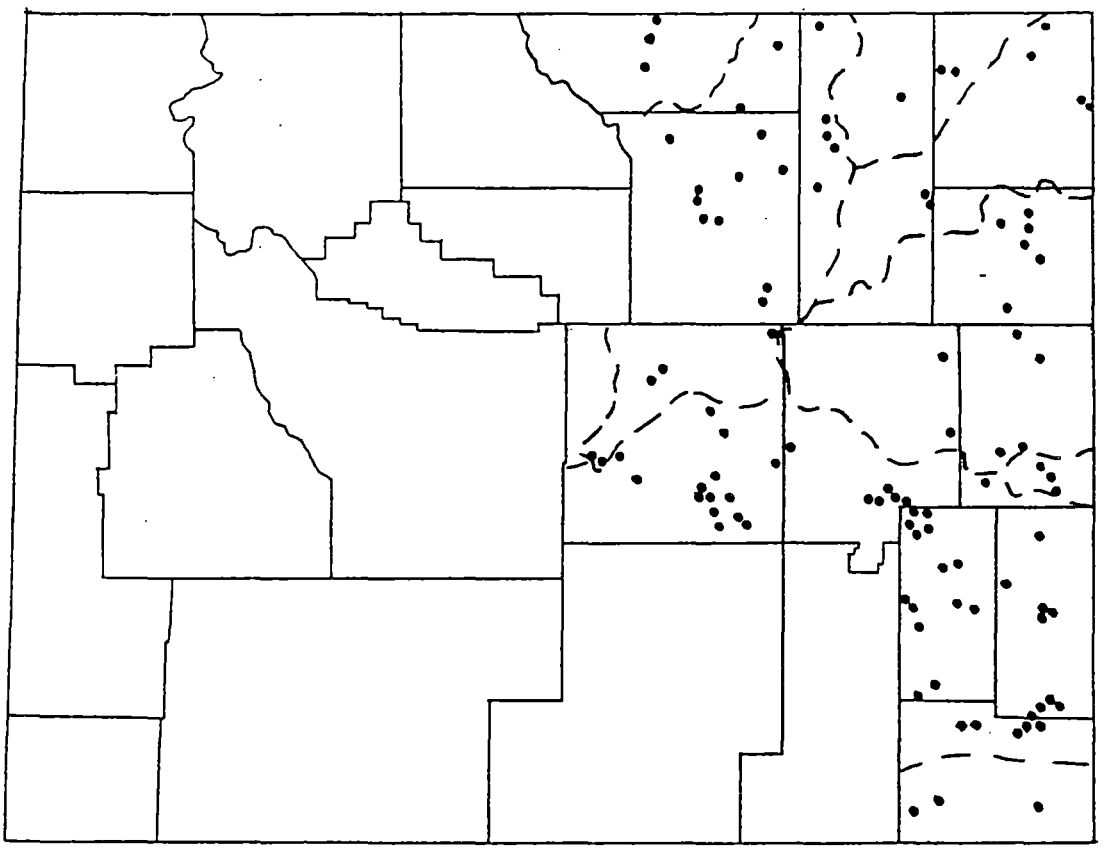
THE APPROACH USED IN THIS PROJECT

During the summers of 1991 and 1992, biologists from The Nature Conservancy's Wyoming Natural Diversity Database (WYNDD) visited sites throughout eastern Wyoming (Figure 1) to collect information on the riparian vegetation, the physical environment, and (when possible) the history and management of each site. A **site** was defined as a length of stream at least one-quarter of a mile long. **Riparian vegetation** in this project means the plants growing along ephemeral, intermittent, or perennial water courses, where surface or subsurface water provides more moisture throughout the growing season than precipitation provides to upland plants. The roots of riparian plants reach the surface or subsurface water at least part of the year. Riparian vegetation typically grows within 100 yards of stream courses, but it may extend farther than 100 yards and some of the vegetation within 100 yards of a stream course may not be riparian. Riparian vegetation may be submerged during periods of high water, and it may emerge from shallow water for much of the year.

Most of the sites contained more than one type of riparian vegetation, and we collected information on the vegetation and the physical environment from one stand of each vegetation type. (A **stand** was defined as an area of vegetation within which the mix of species and the number and heights of vegetation layers was relatively uniform.) We did not include sites along ephemeral streams (those that flow only after storms); sites with planted vegetation; or sites with bridges, gravel pits, or similar features.

To produce a classification of riparian vegetation types, we grouped stands of vegetation similar in composition and structure together into the same vegetation type. Our classification is

Figure 1. Map of the study area, showing county boundaries and sampling sites. Dashed lines are divides between river basins.

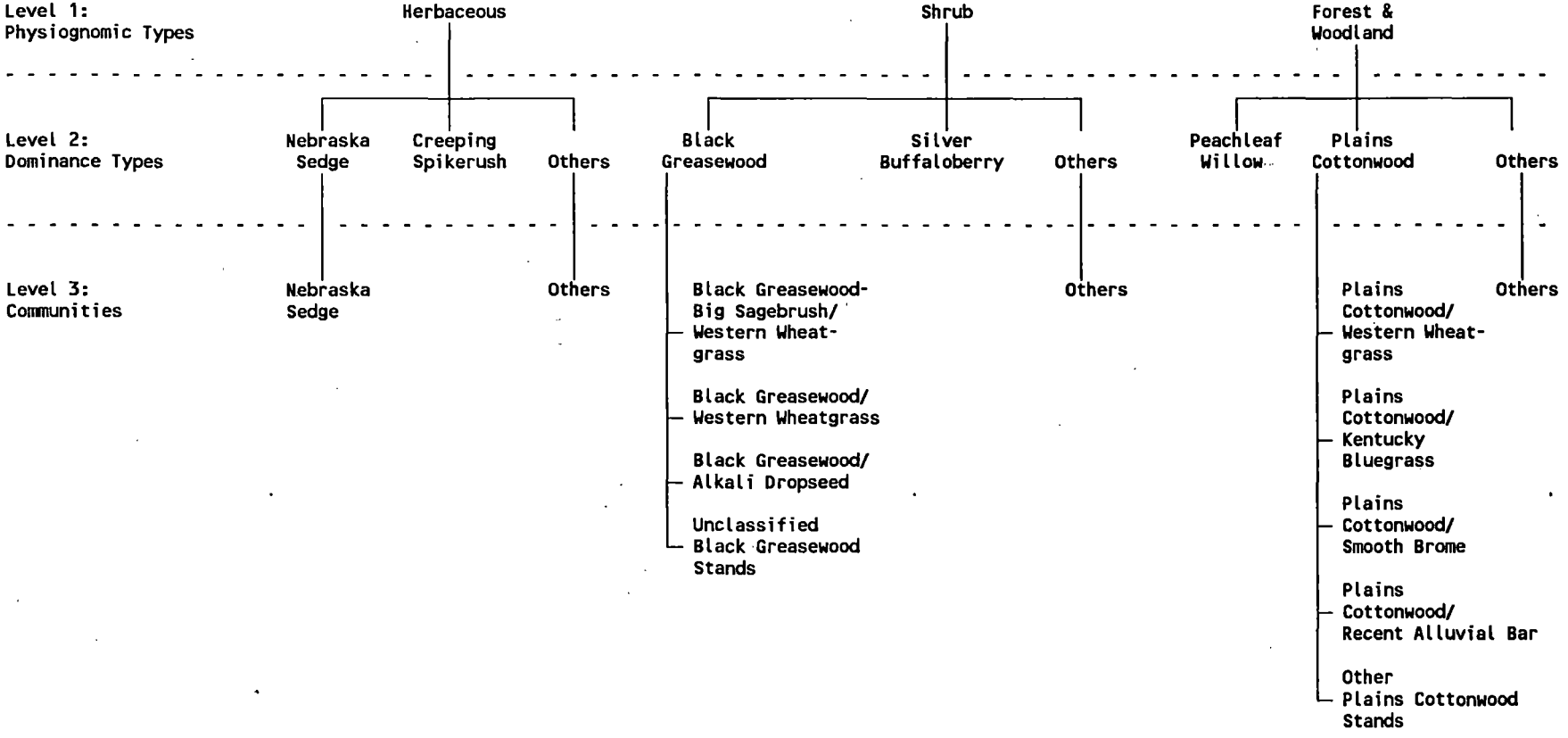


hierarchical and contains three levels (Figure 2). On the most general level, we describe broad **physiognomic types** that contain stands with dominant plants of the same life-form: trees, shrubs, or herbaceous plants. Within each of those physiognomic types we identify **dominance types**, each containing the stands dominated by the same species of plant. And within most dominance types we identify **plant communities** -- groups of stands that share a combination of species that occur together repeatedly and differ substantially from other groups of species. For each vegetation type in the classification, we use the information we collected and, when possible, information from other studies, to describe the physical environment in which it occurs, the role of flooding and other disturbances in shaping the vegetation, and the geographic area in which it is found.

This hierarchical classification provides a framework for organizing the information we collected, and it can serve as a framework for information from future work. For example, a research project may show that a particular grazing practice increases forage yield in a plains cottonwood/snowberry riparian area near Casper, and a range scientist may want to know how widely the results of that research apply. What vegetation types are similar to the plains cottonwood/snowberry vegetation used in the study and, therefore, are likely to respond the same way to the grazing treatment? Or a wildlife biologist may want to know what types of riparian vegetation provide good nesting habitat for certain migratory birds, and by referring to the classification, he or she can see what vegetation types have similar vegetation structure and where in the state they occur. A landowner may want to know what management practices can increase the amount of shrub cover along a stretch of stream, and by referring to the vegetation classification, he or she can find out what vegetation types occur along that stream and what information is available on managing them. A hierarchical classification can also be used to inventory and map riparian vegetation types at several levels of detail. Inventories of general vegetation types over large areas can use the physiognomic types or the dominance types from the classification, while detailed work on small areas can use the plant communities.

Vegetation is only one part of a riparian area, and classification schemes that include hydrology (Gebhardt and others, 1988), landform (Kovalchik and Chitwood, 1990), or other parts of the riparian area may be more useful in managing riparian areas than are classifications using just vegetation because they help to identify the site potential -- that is, they suggest what kinds of vegetation can grow on particular sites. (See Gebhardt and others [1990] for a review of the benefits of different riparian classification schemes.) In this project we concentrate on classifying vegetation types for two reasons. First, vegetation is the most obvious and readily perceived

Figure 2. The three levels in the hierarchical classification of vegetation types. Only a portion of the vegetation types in each level are shown for illustration. For a complete list of types, see the table of contents.



part of the riparian area. Second, the more information to be used in producing the classification, the more information that must be collected in the field. The amount of information we could collect was limited by time and our budget, and we opted to visit as many sites as possible and collect only the essential information at each.

Consequently, we have produced a classification of riparian vegetation types rather than a classification of riparian types defined by vegetation and other factors. To make the vegetation classification more useful we discuss, as far as our data and the relevant information from the literature allow, the relationships between vegetation, soil type, and hydrology. We hope in this way to show the vegetation types that different kinds of riparian areas can support.

There are several things that we **do not** seek to do in this project. First, we do not define condition classes for riparian types or specify what constitutes a "healthy" riparian area. Although people with diverse interests could agree on some of the traits of a healthy riparian area, such as contribution of only a modest amount of sediment to the stream or provision of a reasonable amount of forage for livestock and wildlife, the opinion that each person has of whether a vegetation type indicates good, fair, or poor condition depends on what that person wants out of a riparian area.

Second, we do not prescribe management practices for riparian vegetation types or for particular riparian areas. A management prescription for a vegetation type or for a piece of ground must take into account not only the ecology of the vegetation (which we address here) but also the economic, social, and political settings in which the vegetation type or the area occurs and the goals of the land owner or manager.

Third, we have not conducted an inventory of riparian types in the sense of mapping where each type occurs and estimating the abundance of each type. Beyond identifying and describing the vegetation types, we simply note the geographical area in which each occurs.

HISTORY OF THE PROJECT

This project began as a response to a 1989 request for proposals from the Wyoming Department of Environmental Quality's Water Quality Division for a uniform statewide riparian vegetation classification system (Anonymous, 1989). The DEQ accepted The Nature Conservancy's proposal to do the statewide study, and a contract was signed in the fall of 1990. About that time, the Conservancy and the DEQ learned of concerns that members of the livestock industry had regarding the project. To address those concerns, we asked representatives of several

livestock industry groups to serve on an advisory committee to help us design a project that would be acceptable and useful to agricultural landowners.

At the first meeting of the advisory committee in winter 1991, it became apparent that we would be unable to conduct an adequate statewide study in the two years allotted to the project, and several committee members suggested that we concentrate on part of the state. The DEQ agreed, and the study area was reduced from the entire state to the eastern plains and basins (Figure 1). In the summer of 1994 we did additional work in the Bighorn Basin and we will eventually combine the results of that work with this report on eastern Wyoming. We hope to extend the project to southwestern Wyoming and thereby meet the original intent for a statewide study.

RELATIONSHIP TO OTHER RIPARIAN AND WETLAND PROJECTS

Several other classification and inventory projects have been done or are being done in Wyoming, and we have tried to tie the results of our work into those projects. The U.S. Forest Service has published a classification of riparian communities in western Wyoming (Youngblood and others, 1985) and although that study covered mainly mountainous areas, it contains ecological information useful in our work. In 1982, the Wyoming Game and Fish Department published a description of riparian types in the state (Olson and Gerhart, 1982), and our study describes in more detail some of the types described in the Game and Fish publication.

Other vegetation classification projects are underway on the Bighorn National Forest (Michele Girard, personal communication) and the Medicine Bow National Forest (Judy von Ahlefeldt, personal communication), and they will extend knowledge of riparian types to higher elevations. A statewide classification of riparian vegetation types could be produced by combining the results from all of these studies.

We have also related our riparian vegetation types to the work of the U.S. Fish and Wildlife Service's National Wetlands Inventory, which is mapping riparian types from the classification system of Cowardin and others (1979) at a scale of 1:24,000. Cowardin and others have suggested that their classification of wetland and riparian habitats be extended to more detailed levels by identification of dominance types, which is what our classification does. Comparing the vegetation types that we found at our study sites with the habitat types that the Fish and Wildlife Service has mapped for each of those sites will allow our work to extend the level of detail of their mapping.

II. METHODS

STUDY AREA

The point of this study was to characterize the riparian vegetation types of the plains and basins of eastern Wyoming. To avoid mountainous areas, we eliminated from the study the lands identified by Omernick and Gallant (1987) as lying within the Southern Rockies and Middle Rockies ecoregions. Thus we restricted our work to unforested lands below 7,000 feet elevation in southern Wyoming and below 5,000 feet elevation in northern Wyoming (Figure 1). During the summer of 1991, we sampled sites in five geographic areas (Figure 1): the South Platte River Basin, three parts of the North Platte River Basin, and the Niobrara River Basin. During 1992 we covered five additional areas: the Cheyenne, Belle Fourche, Little Missouri, Powder, and Tongue River Basins.

SAMPLING SITE SELECTION

Sampling sites were the locations at which we collected the information on vegetation, environment, and, when possible, land use that forms the basis for this report. Because we wanted the report to include as many riparian vegetation types as possible, we needed a method of selecting sites that would allow us to visit the range of riparian types in eastern Wyoming. Had we known ahead of time what riparian vegetation types were in the study area and where stands of each type were located, we could simply have selected sampling sites to include the range of vegetation types. But we lacked that information, so we had to resort to a more complicated method of selecting sampling sites.

We started with two assumptions: that the riparian vegetation at a particular place is shaped primarily by the climate, the flora (that is, the collection of nearby plants that can contribute seeds), the soil texture and chemistry, the hydrology, the fire regime, and the intensity and timing of grazing and browsing; and that, if we visited sites representing the variation in those factors, we would be able to sample the variation in riparian vegetation types. To accomplish this, we used a system of selecting study sites known as a stratified-random sample design. This design was stratified because we divided the ranges in three of the controlling factors (climate, regional flora, and hydrology) into strata and chose sites within each stratum. It was random because, once we knew what climatic, floral, and hydrological strata we wanted to sample in, we chose the actual locations for sampling sites within each stratum randomly. Thus we tried to select sites based on what environment we would find at each site, then went to see what vegetation was there.

Temperature and precipitation vary with elevation (Martner, 1986), so we stratified each year's study area into 1000-foot elevation zones by tracing elevation lines onto clear acetate overlays of the 1:500,000-scale (1 inch = about 8 miles) Wyoming map (USDI Bureau of Land Management, 1984). The hydrology information we wanted, such as frequency and size of floods, and amount of water in the channel, is available for only a few places in eastern Wyoming, so we had to use an indirect way to estimate the hydrological characteristics of streams. To do so, we used the length of the stream and its tributaries upstream from a point as a surrogate for drainage basin area (the longer the stream, the larger the basin), and assumed that drainage basin area was in turn correlated with the amount of water in a stream. Thus for two stream segments, we assumed that the segment with more stream miles above it had larger floods and more water in the alluvium and channel. We divided each stream on the 1:500,000-scale Wyoming map into segments up to 20 miles long, and for each segment, added up the length of the stream and all tributaries upstream from the segment -- the segment's upstream length. All of those segments were drawn onto a clear acetate overlay of the Wyoming map. We placed each stream segment into one of seven upstream length classes (1 to 5 miles, 5.1 to 10 miles, 10.1 to 30 miles, 30.1 to 90 miles, 90.1 to 270 miles, 270.1 to 810 miles, and longer than 810 miles) and then calculated the total mileage of all the stream segments in each class.

We then combined the elevation zones and the upstream length strata by superimposing the two clear overlays, one showing elevation zones and the other showing the upstream length class of each stream segment. We recorded the elevation/upstream length combination into which each stream segment fell, and added up the miles of stream segment in each combination. Because we knew the total miles of stream in the area we planned to sample that year, we could apportion the number of sampling sites to each elevation/upstream length combination according to what proportion of the total stream miles fell into that combination. For example, we planned to visit 50 sampling sites during the first year. Stream segments between 4,000 and 5,000 feet elevation with 5.1 to 10 miles of tributaries upstream accounted for 40% of the total stream miles in the first year's sampling area, so we tried to locate 50 sites x 40% = 20 sites on stream segments in that elevation zone with that much stream above them. Within each elevation/stream length combination, we randomly selected the appropriate number of sampling sites.

We tried to impose a third stratifying variable, geographic area, because climate (Martner, 1986) and flora vary across latitude and longitude. We found, though, that dividing the number of potential sampling sites in each elevation/length combination between five geographic areas was impractical, so we simply apportioned the number of potential sampling sites into a

geographic area according to the proportion of stream miles in that area, without trying to place the sites within the proper elevation/length combination in that area.

We assumed that the other factors that shape the vegetation at a site -- soil texture and chemistry, fire regime, and intensity and timing of grazing and browsing -- did not vary with latitude and longitude across the study area, but instead varied between sites within a geographic area. So we did not try to stratify the study area according to those factors, and we just collected information on them when we visited sites to look for a relationship between those factors and the vegetation.

Having randomly selected stream segments as potential sampling sites, we narrowed down each segment by using more detailed maps (1:100,000-scale; 1 inch = ca. 1.6 miles) to randomly select a stretch of stream 0.5 mile long within the segment and by viewing aerial photographs (1:24,000 scale) to see if riparian vegetation actually occurred along that stretch. If it did not, we randomly chose another 0.5-mile-long stretch within the same stream segment. When we found a stretch with riparian vegetation, we got the name of the landowner at the appropriate county assessor's office and contacted the owner to explain the project and obtain permission to visit the site.

DATA COLLECTION

When we visited a site, we first confirmed the presence of riparian vegetation by noting whether the plant species dominant in the adjacent uplands were absent from or were minor parts of the vegetation along the stream. We then collected the information listed in Table 1 for the site and made a sketch of the site.

Most sites contained more than one riparian vegetation type, and we marked a stand of each riparian vegetation type present and collected data from the stand (Table 2). A stand was an area of vegetation within which the mix of species and the structure of the vegetation was relatively uniform, and which differed from other areas of vegetation in species mix and vegetation structure. Stands varied in size from about 1/10 acre to one acre, and in cases of small stands, we combined information from two or three nearby stands. Plant specimens were collected and taken to the University of Wyoming's Rocky Mountain Herbarium for positive identification.

Information on the soil was collected from a pit dug in each stand to a depth of 3.5 feet or to the water table, whichever was shallower. Horizons were distinguished by color, structure, or texture. For an index of salinity, we took a sample of each horizon in a plastic bag to the laboratory and measured

Table 1. Information collected for each sampling site.

-- Elevation[1]
-- Stream type: perennial or intermittent (from maps[1] and field observation)
-- Aspect (downstream direction of stream valley)
-- Valley width, from divide to divide (measured on map)[1]
-- Valley depth, from the higher drainage divide to the valley floor (measured on map)[1]
-- Valley gradient (measured on map)[1]
-- Width of the riparian zone (estimated in field)
-- Channel width and depth (estimated in field, at the lower limit of perennial terrestrial vegetation)
-- Channel entrenchment (depth to which channel has cut into valley floor, estimated in field)
-- Type of material on channel bottom[2]
-- Stream gradient (measured on map)[1]
-- Stream sinuosity (stream length/valley length)[1]
-- Upstream basin area (measured on map)[1]
-- Presence of upstream features like dams or diversions that might affect hydrology at site (from map[1], landowner, and field observation)
-- Bank stability (estimated % of banks protected from erosion by vegetation or rock)
-- Hydrologic features such as beaver dams and gullies
-- History of use (when available from land owner or manager)

(1) Feature was measured on 1:24,000-scale topographic map

(2) Bed material was recorded for each of these classes: bedrock, large boulder (> 24 in.), small boulder (10 in.-24 in.), cobble (3 in.-10 in.), gravel (1/16 in.-3 in.), sand, silt, clay, vegetated.

Table 2. Information collected for each stand at a site.

VEGETATION

-- Estimated canopy cover of each species[1]
-- Estimated height of a typical individual of each species
-- Measured diameter at breast height (dbh) of trees
-- Estimated amount of bare soil, litter, wood, gravel, rock, plant base, mosses and lichens on the ground surface[1]

PHYSICAL ENVIRONMENT

-- Height above stream channel (estimated in 1991, surveyed in 1992)
-- Distance from the stream channel (estimated)
-- Thickness (measured) of each soil horizon
-- Texture of each soil horizon (by hand) and % coarse fragments (>1/16 in.)
-- Salinity of each soil horizon (from electrical conductivity measured on a sample in the laboratory)
-- Moist color of each horizon (recorded using Munsell color charts in the field)

DISTURBANCE

-- Signs of browsing and grazing (partially-eaten plants)
-- Signs of flooding, fire, windthrow

(1) Cover was recorded according to these classes: <1%, 1-5%, 5.1-15%, 15.1-25%, 25.1-35%, 35.1-45%, 45.1-55%, 55.1-65%, 65.1-75%, 75.1-85%, 85.1-95%, >95%).

(2) Trees were recorded in these categories: seedling (less than 3.3′ tall), sapling (over 3.3′ tall and less than 5" dbh), pole (5.1" - 9" dbh), small tree (9.1" - 14" dbh), medium tree (14.1" - 21" dbh), large tree (21.1" - 36" dbh), very large tree (over 36" dbh).

electrical conductivity. Soil samples were air-dried and stored for several months before conductivity was measured.

DATA ANALYSIS

Classification

The point of a classification is to group stands with similar vegetation together into the same vegetation type, so that the vegetation type includes stands that are subject to similar ecological processes, provide similar amounts of habitat and forage, and respond similarly to management. We constructed a three-level, hierarchical classification of vegetation types, in which the amount of similarity between the stands in a type increases from the highest level to the lowest. Although we used computer programs to help us see similarity between stands and to identify vegetation types, we did not depend on arbitrary measures of similarity to decide which stands belong to which vegetation types. Instead we used our judgement and information from other classifications to try to describe vegetation types that would be readily identifiable and useful to other people.

The first level of the classification contains vegetation types identified by physiognomy, or general appearance of the vegetation. At this level, we placed stands with less than 10% tree canopy cover and less than 10% shrub canopy cover into a herbaceous physiognomic type; stands with at least 10% shrub canopy cover but less than 10% tree canopy cover into a shrub physiognomic type; and stands with at least 10% tree canopy cover into a forest and woodland physiognomic type. Then, within each physiognomic type, we grouped together the stands dominated by the same overstory species into dominance types, the second level of the classification. And within a dominance type, if possible, we grouped the stands with the same understory species together into a plant community, the third and most detailed level of the classification.

At the dominance type and plant community levels, we grouped similar stands together using a technique called cluster analysis. Cluster analysis compares each stand to every other stand, and combines the two most similar stands into a cluster. The remaining stands are compared to each other and to the cluster, and similar stands are combined into another cluster or are added to the existing cluster. This process is repeated until all stands belong to a cluster.

Stands in the herbaceous physiognomic type were clustered using canopy cover as a measure of dominance. Each dominance type contains stands with the same dominant species, and each community contains stands with the same mix of secondary species.

In the shrub physiognomic type, canopy cover also was used as the measure of dominance. Stands were clustered into dominance types according to the dominant species in the shrub layer. Plant communities were identified within dominance types according to the amount of secondary species in the shrub layer and the amount of each understory species.

In the forest and woodland physiognomic type, the stands were clustered into dominance types according to the density and diameter of stems of each tree species. When possible, the stands within a dominance type were placed into a plant community either by cluster analysis on the understory species (using canopy cover as the measure of dominance) or by comparing the composition of a stand to communities described from other studies.

Exotic plant species were not used in the cluster analyses for two reasons. First, the presence of such exotic species as orchardgrass or smooth brome in the understory of a stand often was due to the presence of a hay meadow nearby and didn't necessarily reflect the environment of the stand. Second, many exotic species are able to grow in a wide variety of environments (Thornton and others, 1974) and their presence may obscure relationships between the vegetation and the environment. When we did the cluster analyses on the data without exotics, we found a number of tree stands that fit poorly into recognizable communities. Understories in those stands were dominated by exotic plants, and we subjectively grouped those stands into communities with exotic understories. For all vegetation types, exotics are included in the descriptions.

After the stands had been assigned to vegetation types in the classification, we looked for relationships between each vegetation type and selected environmental factors by examining the range in those factors over which stands of the different types occurred.

III. RESULTS

During two seasons of field work, we visited 100 sites (Figure 1) and collected data from 228 plots. From those data, we identified three riparian physiognomic vegetation types, 26 dominance types, and 22 communities (Figure 2). In identifying and naming these vegetation types, we rely heavily on dominant and subdominant species. The dominant species are those that contribute more canopy cover than other species do; subdominant species contribute much, but not most, of the canopy cover in a stand. A stand of vegetation may have several dominant species.

We described a community within a dominance type only if we found a group of stands that shared approximately the same mix of understory species (in the woodland and shrub physiognomic types)

or sub-dominant species (in the herbaceous physiognomic type). In only half of the dominance types could we identify communities.

We did not use a statistical measure of similarity to decide whether a group of stands constitute a community. Rather we used our judgement of whether most people familiar with the vegetation would recognize a close similarity between stands in the field. In identifying and naming communities, we relied on publications describing riparian types from other areas, particularly the publication of the Montana Riparian Association (Hansen and others, 1991).

The bulk of this report consists of descriptions of the dominance types and plant communities. In each description, we have included information on the major species present, the structure of the vegetation, the geographic area in which we encountered stands of the type, the environment in which the stands occurred, the soil features associated with the vegetation type, the most common adjacent riparian vegetation types, the introduced plant species most often present, the ecology of the vegetation, and relationships to other classifications. The descriptions of the vegetation and the environment come mainly from the information we collected, while the sections on ecology are drawn largely from the literature.

For each vegetation type, we have included a table showing the density or the canopy cover of the plant species present in the stands of the type. Each species is represented in those tables by a six letter acronym derived from the first three letters of the genus name and the first three letters of the species name. Full common and scientific names are given in Appendix 2. Common names were taken primarily from Beetle (1970), and scientific names from Dorn (1992).

KEY TO RIPARIAN VEGETATION TYPES

This key can be used to place a stand of riparian vegetation into one of the types described in this report. Begin with steps 1a and 1b of the key: read those statements, decide which applies to the stand of interest, and go to the next step indicated. For example, if step 1a applies, continue to step 2. If 1b applies, continue to step 18a. When you reach the name of a type printed in capital letters, read the description for that type to see if your stand fits. Do not assume that your stand fits a vegetation type until you've read the description for that type. Some stands will not fit into any of the vegetation types described in this report, and if the key is used properly, you should end at the statement, "Type not described in this report."

In this key and throughout the report, the term "dominant" means a plant that contributes the most canopy cover. Forbs are broad leaved herbaceous plants, and graminoids are narrow leaved herbaceous plants (grasses, sedges, and rushes).

1a. At least 10% of the ground is beneath tree (including seedling and sapling) canopies. (Forest and Woodland Physiognomic Types) 2.

2a. Cottonwoods dominate the tree canopy.

3a. Plains cottonwood (Populus deltoides) dominates the tree canopy. PLAINS COTTONWOOD (POPULUS DELTOIDES) DOMINANCE TYPE. 4.

4a. Plains cottonwood seedlings or saplings dominate the canopy on a bar near the channel; trees are rare or absent. PLAINS COTTONWOOD (POPULUS DELTOIDES)/RECENT ALLUVIAL BAR COMMUNITY.

4b. Plains cottonwood trees form a canopy; seedlings and saplings are rare or absent. 5.

5a. Shrub canopies cover at least 10% of the ground beneath the tree overstory. 6.

6a. Western snowberry dominates the shrub canopy. PLAINS COTTONWOOD/WESTERN SNOWBERRY (POPULUS DELTOIDES/ SYMPHORICARPOS OCCIDENTALIS) COMMUNITY.

6b. Shrub species other than western snowberry dominate the shrub layer. UNCLASSIFIED PLAINS COTTONWOOD (POPULUS DELTOIDES) STAND.

5b. Shrub canopies cover less than 10% of the ground. 7.

7a. Western wheatgrass (Elymus smithii) or thickspike wheatgrass (Elymus dasystachyum) (or both) contribute at least 25% of the understory cover, but other species (especially annuals or Kentucky bluegrass) may be more common. PLAINS COTTONWOOD/WESTERN WHEATGRASS (POPULUS DELTOIDES/ELYMUS SMITHII) COMMUNITY.

7b. Western wheatgrass or thickspike wheatgrass are absent or contribute less than 25% of the understory cover. 8.

8a. Kentucky bluegrass (Poa pratensis) contributes at least a third of the understory cover. PLAINS COTTONWOOD/KENTUCKY BLUEGRASS (POPULUS DELTOIDES/ POA PRATENSIS) COMMUNITY.

8b. Kentucky bluegrass may be present but contributes less than a third of the understory cover. 9.

9a. Smooth brome (Bromus inermis) dominates the understory. PLAINS COTTONWOOD/SMOOTH BROME (POPULUS DELTOIDES/BROMUS INERMIS) COMMUNITY.

9b. Smooth brome is rare or absent. UNCLASSIFIED PLAINS COTTONWOOD STAND.

3b. Cottonwoods other than plains cottonwood dominate the tree canopy. 10.

10a. Narrowleaf cottonwood (Populus angustifolia) dominates the tree canopy. NARROWLEAF COTTONWOOD (POPULUS ANGUSTIFOLIA) Dominance Type. 11.

11a. Narrowleaf cottonwood seedlings or saplings form a stand on a bar near the channel; trees are rare or absent. NARROWLEAF COTTONWOOD (POPULUS ANGUSTIFOLIA)/RECENT ALLUVIAL BAR COMMUNITY.

11b. Narrowleaf cottonwood trees form a canopy; seedlings and saplings are rare or absent. 12.

12a. Western wheatgrass (Elymus smithii) or thickspike wheatgrass (Elymus dasystachyum) (or both) contribute at least 25% of the understory cover, but other species (especially annuals or Kentucky bluegrass) may be more common. NARROWLEAF COTTONWOOD/WESTERN WHEATGRASS (POPULUS ANGUSTIFOLIA/ELYMUS SMITHII) COMMUNITY.

12b. Western wheatgrass or thickspike wheatgrass are absent or contribute less than 25% of the understory cover. 13.

13a. Carpet bentgrass (Agrostis stolonifera) contributes at least 25% of the understory cover. NARROWLEAF COTTONWOOD/CARPET BENTGRASS (POPULUS ANGUSTIFOLIA/AGROSTIS STOLONIFERA) COMMUNITY.

13b. Carpet bentgrass contributes less than 25% of the understory canopy. 14.

14a. Kentucky bluegrass (Poa pratensis) contributes at least 25% of the understory cover. NARROWLEAF COTTONWOOD/KENTUCKY BLUEGRASS (POPULUS ANGUSTIFOLIA/POA PRATENSIS) COMMUNITY.

14b. Kentucky bluegrass may be present but contributes less than 25% of the understory cover. 15.

15a. Smooth brome (Bromus inermis) dominates the understory. NARROWLEAF COTTONWOOD/ SMOOTH BROME (POPULUS ANGUSTIFOLIA/BROMUS INERMIS) COMMUNITY.

15b. Smooth brome is rare or absent. UNCLASSIFIED NARROWLEAF COTTONWOOD STAND.

10b. Lanceleaf cottonwood (Populus acuminata) dominates the tree canopy. LANCELEAF COTTONWOOD (POPULUS ACUMINATA) DOMINANCE TYPE.

2b. Trees other than cottonwood dominate the tree canopy. 16.

16a. Peachleaf willow (Salix amygdaloides) dominates the tree canopy. PEACHLEAF WILLOW (SALIX AMYGDALOIDES) DOMINANCE TYPE.

16b. Peachleaf willow is rare or absent. 17.

17a. Boxelder (Acer negundo) dominates the tree canopy. BOXELDER (ACER NEGUNDO) DOMINANCE TYPE.

17b. Green ash (Fraxinus pennsylvanica) dominates the tree canopy cover. GREEN ASH (FRAXINUS PENNSYLVANICA) DOMINANCE TYPE.

1b. Less than 10% of the ground is beneath tree canopies. 18.

18a. At least 10% of the ground is beneath shrub canopies. 19.

19a. Common chokecherry (Prunus virginiana) dominates the shrub canopy. COMMON CHOKECHERRY (PRUNUS VIRGINIANA) DOMINANCE TYPE.

19b. Species other than common chokecherry dominate the shrub layer. 20.

20a. Silver buffaloberry (Shepherdia argentea) dominates the shrub layer. SILVER BUFFALOBERRY (SHEPHERDIA ARGENTEA) DOMINANCE TYPE.

20b. Silver buffaloberry contributes less canopy cover than do other species. 21.

21a. Western snowberry (Symphoricarpos occidentalis) dominates the shrub layer. WESTERN SNOWBERRY (SYMPHORICARPOS OCCIDENTALIS) DOMINANCE TYPE.

21b. Species other than western snowberry dominates the shrub layer. 22.

22a. Basin silver sagebrush (Artemisia cana ssp. cana) dominates the shrub layer. BASIN SILVER SAGEBRUSH (ARTEMISIA CANA SSP. CANA) DOMINANCE TYPE. 23.

23a. Western wheatgrass (Elymus smithii) or green needlegrass (Stipa viridula) contribute at least 25% of the understory cover. BASIN SILVER SAGEBRUSH/WESTERN WHEATGRASS (ARTEMISIA CANA SSP. CANA/ELYMUS SMITHII) COMMUNITY.

23b. Western wheatgrass and green needlegrass are rare or absent. UNCLASSIFIED BASIN SILVER SAGEBRUSH (ARTEMISIA CANA SSP. CANA) STAND.

22b. Shrubs other than basin silver sagebrush dominate the shrub layer. 24.

24a. Coyote willow (Salix exigua) dominates the shrub layer. COYOTE WILLOW (SALIX EXIGUA) DOMINANCE TYPE. 25.

25a. Grasses & sedges contribute most of the understory cover; forbs contribute little cover or are absent. COYOTE WILLOW (SALIX EXIGUA/MESIC GRAMINOID COMMUNITY.

25b. Grasses & sedges contribute little understory cover. UNCLASSIFIED COYOTE WILLOW (SALIX EXIGUA) STAND.

24b. Shrubs other than coyote willow dominate the shrub layer. 26.

26a. Black greasewood (Sarcobatus vermiculatus) dominates the shrub layer or codominates with other shrubs. BLACK GREASEWOOD (SARCOBATUS VERMICULATUS) DOMINANCE TYPE. 27.

27a. Basin big sagebrush (Artemisia tridentata ssp. tridentata) and black greasewood (Sarcobatus vermiculatus) codominate the shrub layer; western wheatgrass (Elymus smithii) or thickspike wheatgrass (Elymus dasystachyum) (or both) contribute as much cover to the understory as do other herbaceous species. BLACK GREASEWOOD-BASIN BIG SAGEBRUSH/WESTERN WHEATGRASS (SARCOBATUS VERMICULATUS-ARTEMISIA TRIDENTATA SSP. TRIDENTATA/ELYMUS SMITHII) COMMUNITY.

27b. Basin big sagebrush contributes little canopy cover or is absent. 28.

28a. Sand dropseed (Sporobolus cryptandrus) contributes as much cover as does any other understory species. BLACK GREASEWOOD/SAND DROPSEED (SARCOBATUS VERMICULATUS/SPOROBOLUS CRYPTANDRUS) COMMUNITY.

28a. Sand dropseed contributes little cover or is absent. 29.

29a. Western wheatgrass (Elymus smithii) or thickspike wheatgrass (Elymus dasystachyum) (or both) contribute at least 25% of the understory canopy cover. BLACK GREASEWOOD/WESTERN WHEATGRASS (SARCOBATUS VERMICULATUS/ ELYMUS SMITHII) COMMUNITY.

29b. Western wheatgrass and thickspike wheatgrass contribute little cover or are absent. Types not described in this report.

26b. Other shrubs contribute more cover than does black greasewood. Types not described in this report.

18b. Less than 10% of the ground is beneath shrub canopies. Herbaceous Types. 30.

30a. Grasses contribute most of the canopy cover. 31.

31a. Cordgrasses (Spartina spp.) contribute at least 25% of the canopy cover. 32.

32a. Prairie cordgrass (Spartina pectinata) contributes at least 25% of the canopy cover. PRAIRIE CORDGRASS (SPARTINA PECTINATA) DOMINANCE TYPE.

32b. Alkali cordgrass (Spartina gracilis) contributes at least 25% of the canopy cover. ALKALI CORDGRASS (SPARTINA GRACILIS) DOMINANCE TYPE.

31b. Cordgrasses contribute less than 25% of the canopy cover. 33.

33a. Inland saltgrass (Distichlis stricta) or alkali sacaton (Sporobolus airoides) dominate. INLAND SALTGRASS (DISTICHLIS STRICTA) DOMINANCE TYPE.

33b. Grasses other than inland saltgrass or alkali sacaton dominate. 34.

34a. Western wheatgrass (Elymus smithii) dominates or codominates. WESTERN WHEATGRASS (ELYMUS SMITHII) COMMUNITY.

34b. Grasses other than western wheatgrass dominate. Types not described in this report.

30b. Other graminoids (sedges, rushes, spikerushes) or cattails dominate. 35.

35a. Cattails (Typha spp.) dominate. CATTAIL (TYPHA SPP.) DOMINANCE TYPE.

35b. Cattails contribute little cover or are absent. 36.

36a. Sedges (Carex spp.) dominate. 37.

37a. Nebraska sedge (Carex nebrascensis) or field clustered sedge (Carex praegracilis) dominate. 38.

38a. Nebraska sedge dominates. NEBRASKA SEDGE (CAREX NEBRASCENSIS) COMMUNITY.

38b. Field clustered sedge dominates. FIELD CLUSTERED SEDGE (CAREX PRAEGRACILIS) DOMINANCE TYPE.

37b. Sedges other than Nebraska sedge or field clustered sedge dominate. Types not described in this report.

36b. Rushes (Juncus spp.), bulrushes (Scirpus spp.), or spikerushes (Eleocharis spp.) dominate. 39.

39a. Baltic rush (Juncus balticus) dominates. BALTIC RUSH (JUNCUS BALTICUS) COMMUNITY.

39b. Bulrushes or spikerushes contribute at least as much cover as does baltic rush. 40.

40a. Bulrushes contribute most of the canopy cover. 41.

41a. Softstem bulrush (Scirpus validus) dominates. SOFTSTEM BULRUSH (SCIRPUS VALIDUS) DOMINANCE TYPE.

41b. Leafy bulrush (Scirpus pungens) dominates. LEAFY BULRUSH (SCIRPUS PUNGENS) COMMUNITY.

40b. Spikerushes dominate. 42.

42a. Creeping spikerush (Eleocharis palustris) dominates. CREEPING SPIKERUSH (ELEOCHARIS PALUSTRIS) COMMUNITY.

42b. A spikerush other than creeping spikerush dominates. Types not described in this report.

HERBACEOUS PHYSIOGNOMIC TYPE

Stands placed in the herbaceous physiognomic type are those with less than 10% canopy cover by trees and less than 10% canopy cover by shrubs. Their composition ranges from strong dominance by one species to a mix of several species. Herbaceous riparian stands often occur as narrow, continuous or discontinuous strips of grasses and forbs along the stream channel. They may also form crescent-shaped patches on the insides of bends, or they may occupy terraces above the channel.

Stands of our herbaceous physiognomic type fit into the herbaceous vegetation class of the Land Classification Framework of Driscoll and others (1984). That classification differs from ours by including stands with up to 25% canopy cover of trees or shrubs in the herbaceous class. Within the Cowardin wetland classification (Cowardin and others, 1979) stands of our herbaceous physiognomic type belong to the palustrine system.

Figure 3. Elevations of sites with plots in the herbaceous physiognomic type. Labels on the x-axis refer to the following dominance types:

CARNEB = Nebraska sedge
JUNBAL = Baltic rush
SCIVAL = Softstem bulrush
TYPHA = Cattail
SPAGRA = Alkali cordgrass
SCIPUN = Leafy bulrush
ELEPAL = Creeping spikerush
DISSPI = Inland saltgrass
SPAPEC = Prairie cordgrass
ELYMSI = Western wheatgrass

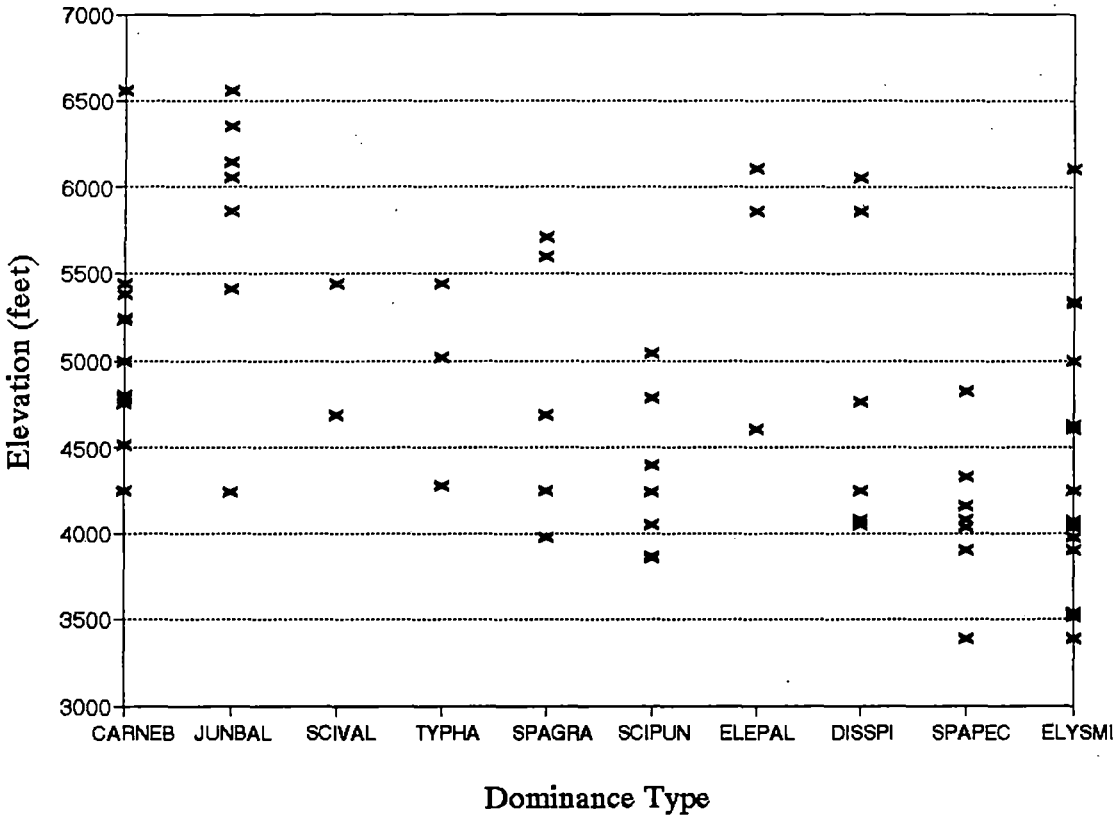


Figure 4. Square miles of drainage basin upstream from sites with plots of the herbaceous physiognomic type. Labels on the x-axis refer to the following dominance types:

CARNEB = Nebraska sedge
JUNBAL = Baltic rush
SCIVAL = Softstem bulrush
TYPHA = Cattail
SPAGRA = Alkali cordgrass
SCIPUN = Leafy bulrush
ELEPAL = Creeping spikerush
DISSPI = Inland saltgrass
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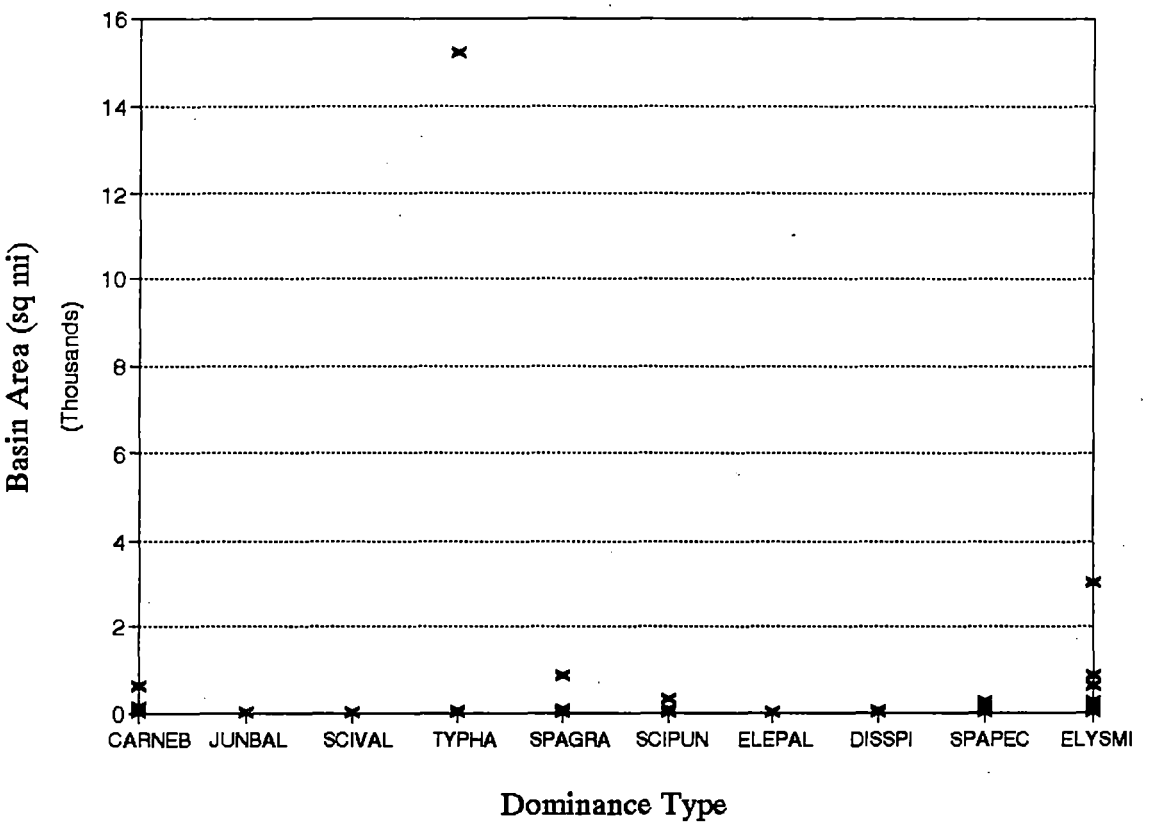


Figure 5. Widths of channels along which we sampled plots of the herbaceous physiognomic type. Labels on the x-axis refer to the following dominance types:

CARNEB = Nebraska sedge
JUNBAL = Baltic rush
SCIVAL = Softstem bulrush
TYPHA = Cattail
SPAGRA = Alkali cordgrass
SCIPUN = Leafy bulrush
ELEPAL = Creeping spikerush
DISSPI = Inland saltgrass
SPAPEC = Prairie cordgrass
ELYMSI = Western wheatgrass

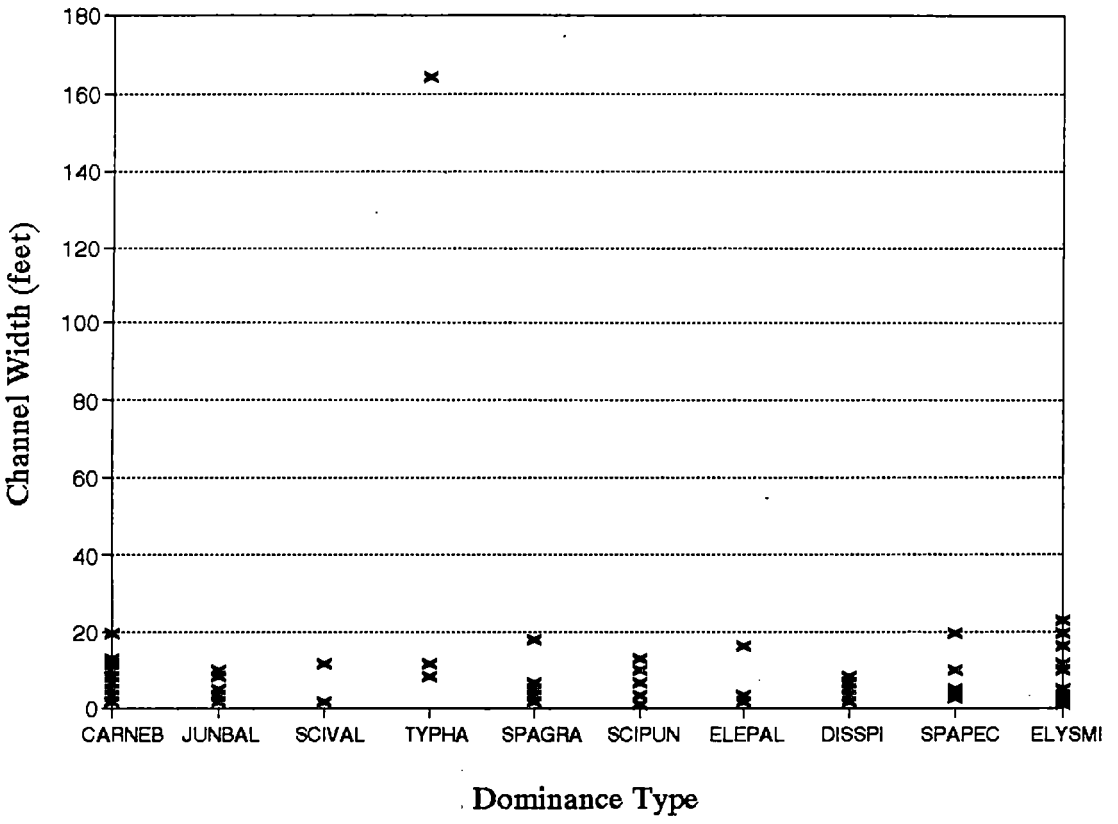


Figure 6. Distances in feet between plots of the herbaceous physiognomic type and the nearest active stream channel. Labels on the x-axis refer to the following dominance types:

CARNEB = Nebraska sedge
JUNBAL = Baltic rush
SCIVAL = Softstem bulrush
TYPHA = Cattail
SPAGRA = Alkali cordgrass
SCIPUN = Leafy bulrush
ELEPAL = Creeping spikerush
DISSPI = Inland saltgrass
SPAPEC = Prairie cordgrass
ELYMSI = Western wheatgrass

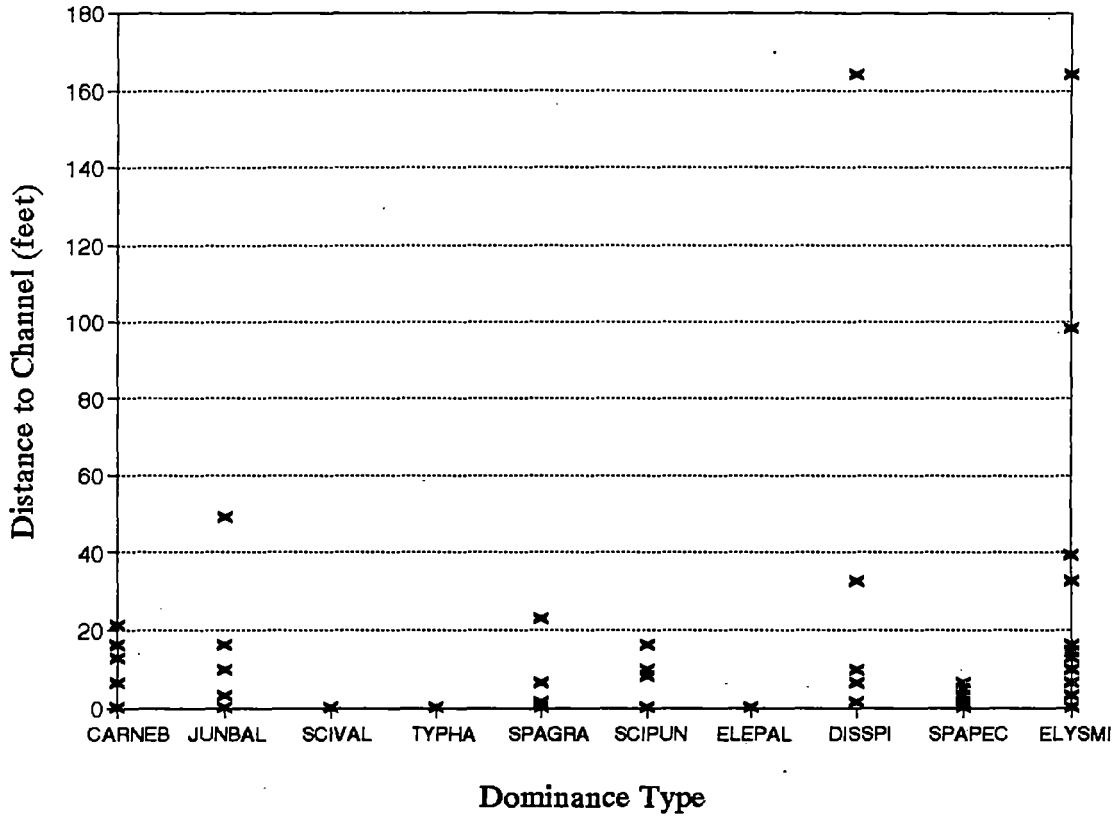


Figure 7. Heights of plots of the herbaceous physiognomic type above the nearest active stream channel. Labels on the x-axis refer to the following dominance types:

CARNEB = Nebraska sedge
JUNBAL = Baltic rush
SCIVAL = Softstem bulrush
TYPHA = Cattail
SPAGRA = Alkali cordgrass
SCIPUN = Leafy bulrush
ELEPAL = Creeping spikerush
DISSPI = Inland saltgrass
SPAPEC = Prairie cordgrass
ELYMSI = Western wheatgrass

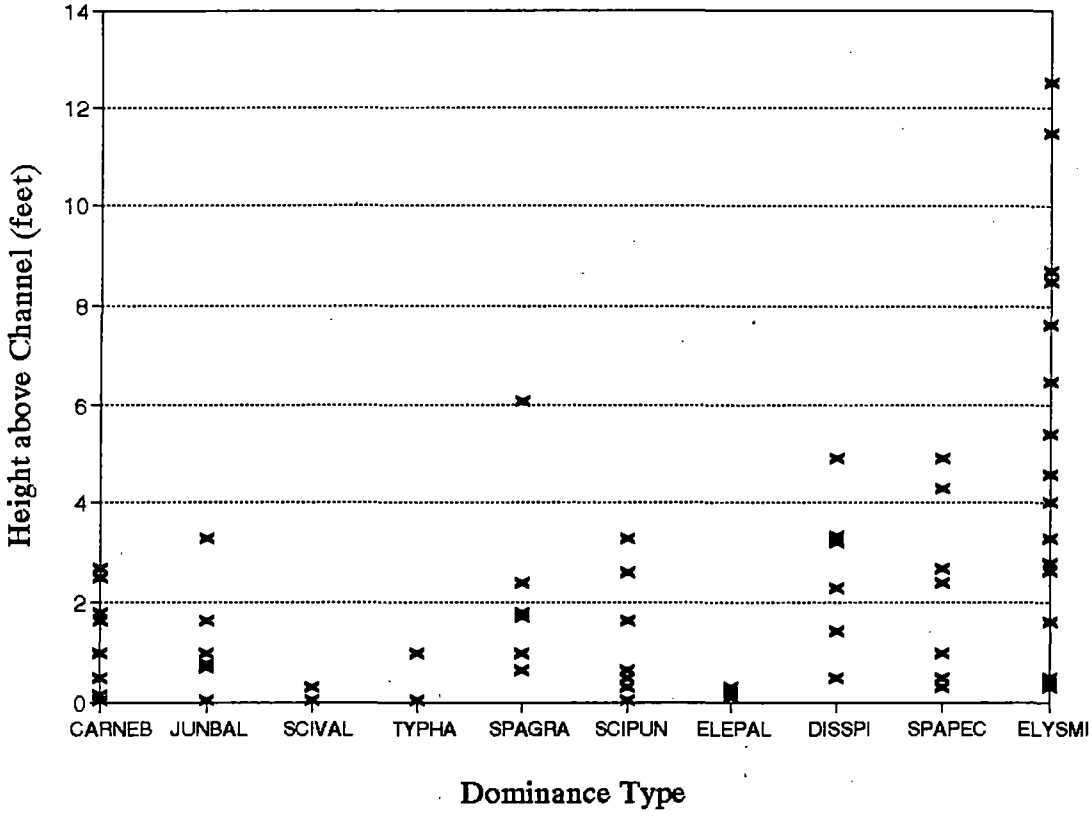


Figure 8. Depth of soil mottling (indicating a fluctuating water table) or gleying (indicating a high water table) beneath plots of the herbaceous physiognomic type. Labels on the x-axis refer to the following dominance types:

CARNEB = Nebraska sedge
JUNBAL = Baltic rush
SCIVAL = Softstem bulrush
TYPHA = Cattail
SPAGRA = Alkali cordgrass
SCIPUN = Leafy bulrush
ELEPAL = Creeping spikerush
DISSPI = Inland saltgrass
SPAPEC = Prairie cordgrass
ELYMSI = Western wheatgrass

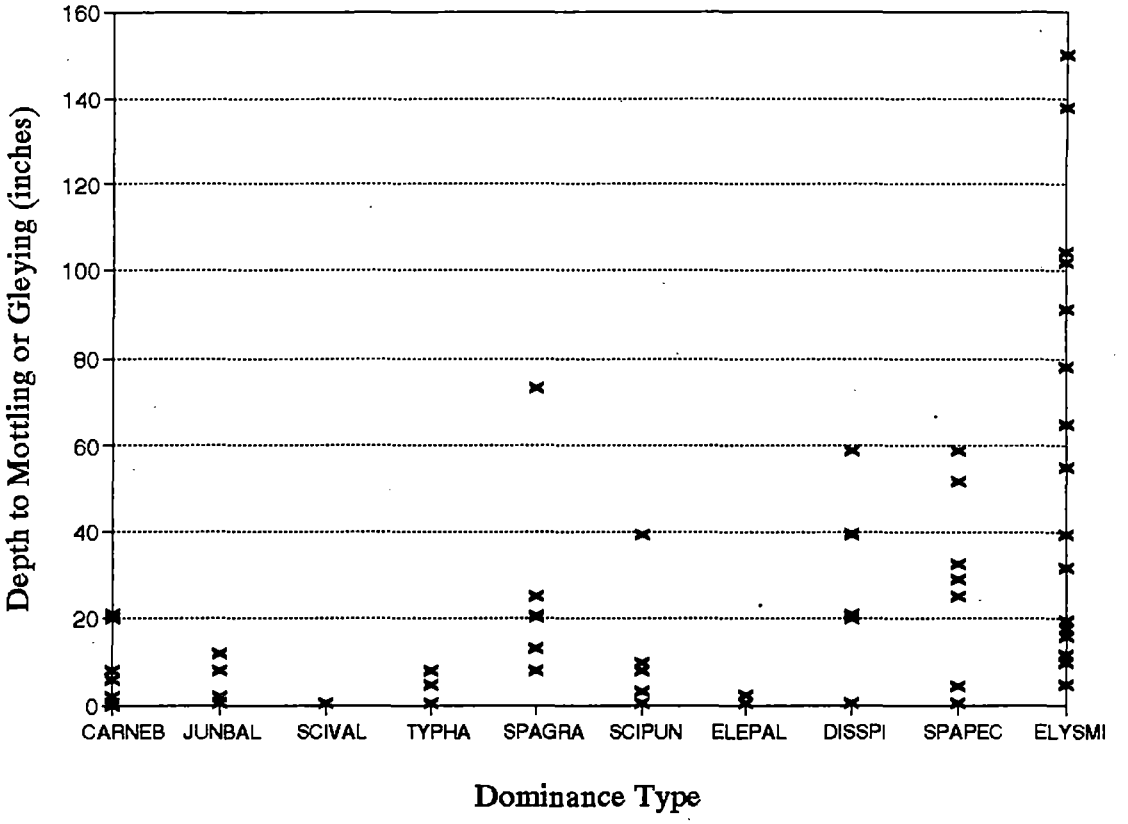


Figure 9. Percent by volume of coarse fragments (larger than 2 mm) in soils beneath plots of the herbaceous physiognomic type. Labels on the x-axis refer to the following dominance types:

CARNEB = Nebraska sedge
JUNBAL = Baltic rush
SCIVAL = Softstem bulrush
TYPHA = Cattail
SPAGRA = Alkali cordgrass
SCIPUN = Leafy bulrush
ELEPAL = Creeping spikerush
DISSPI = Inland saltgrass
SPAPEC = Prairie cordgrass
ELYMSI = Western wheatgrass

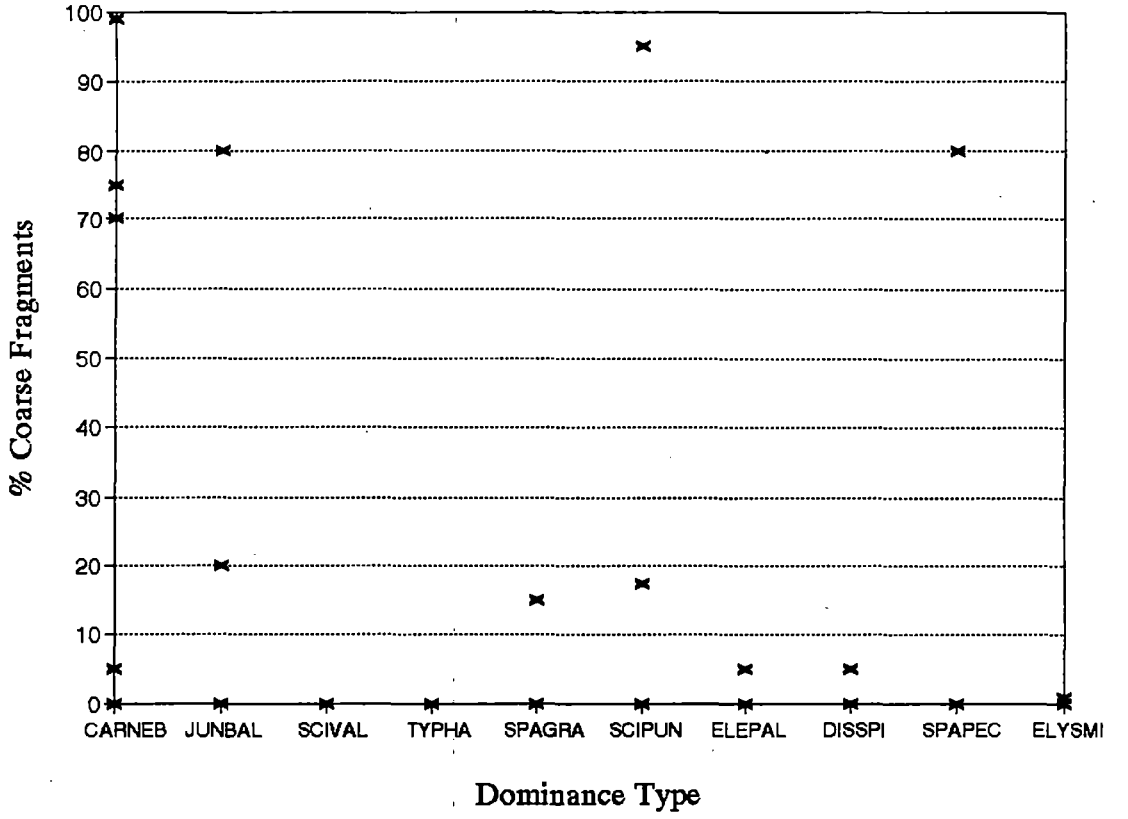
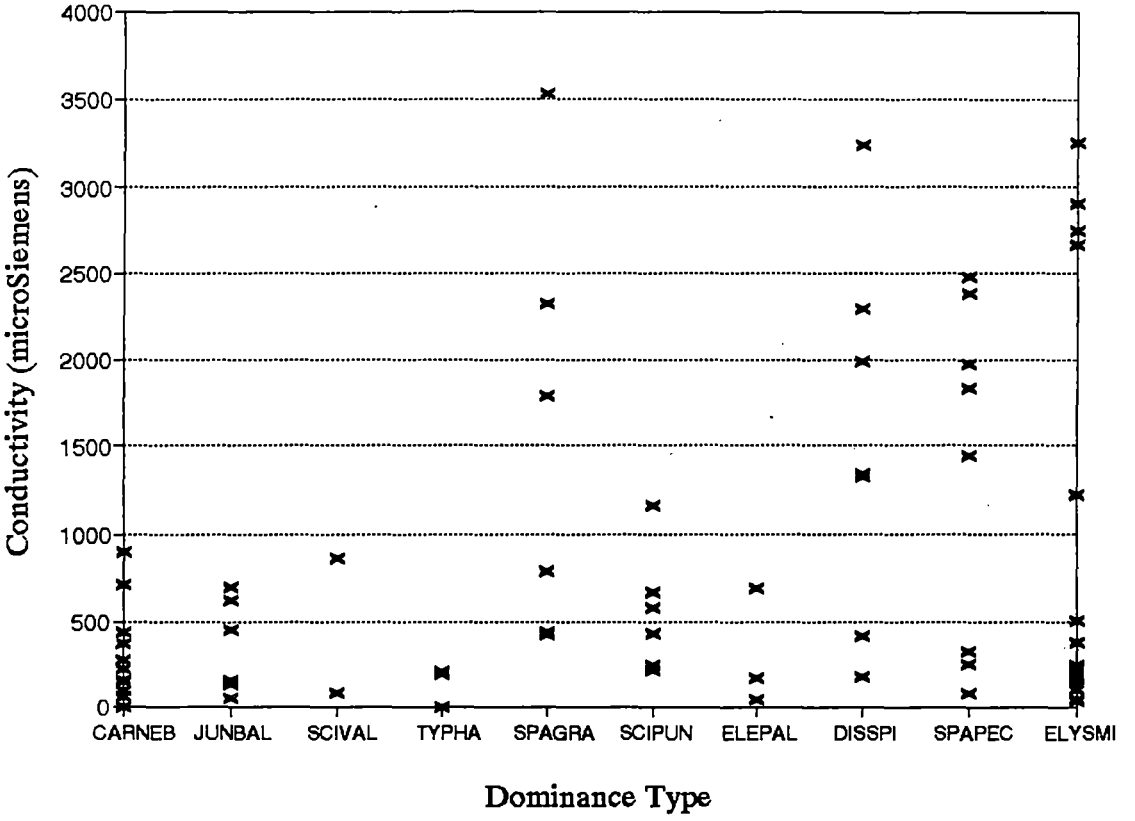


Figure 10. Maximum electrical conductivity (an indicator of salinity) in soils beneath plots of the herbaceous physiognomic type. Labels on the x-axis refer to the following dominance types:

CARNEB = Nebraska sedge
JUNBAL = Baltic rush
SCIVAL = Softstem bulrush
TYPHA = Cattail
SPAGRA = Alkali cordgrass
SCIPUN = Leafy bulrush
ELEPAL = Creeping spikerush
DISSPI = Inland saltgrass
SPAPEC = Prairie cordgrass
ELYMSI = Western wheatgrass



Nebraska Sedge (Carex nebrascensis) Dominance Type

Nebraska sedge is the major species in communities of this dominance type. Stands are found in locations having high water tables. In Wyoming, stands have been found between 4,200 and 7,900 ft elevation. All of our stands are placed into the Nebraska Sedge Community.

Nebraska Sedge (Carex nebrascensis) Community

(12 stands sampled)

VEGETATION STRUCTURE & COMPOSITION: Nebraska sedge is the dominant plant with canopy cover ranging from 20% to 90% and averaging 52% in our 12 stands (Table 4). Carpet bent grass (Agrostis stolonifera) is found in 67% of the stands with 1 to 20% cover. Leafy bulrush (Scirpus pungens) occurs in over half the stands and is dense in three stands. Foxtail barley (Hordeum jubatum) and smooth horsetail (Equisetum laevigatum) are common in small amounts.

This community appears as linear patches along channels. Stands are commonly dense and grow to a height of 1.5 ft (0.5 m).

ENVIRONMENT: Stands of the Nebraska sedge community occur in bands adjacent to the channel and up to 3.3 ft (1 m) above the channel (Figure 7). Most occurrences are wet throughout the growing season.

LOCATION: We sampled stands of the Nebraska sedge community throughout eastern Wyoming (Figure 11) at elevations between 4,250 feet and 5,500 feet (Figure 3). Most stands are located on small streams high in the drainage basin (Figure 4) and on stream gradients between 0.2% - 2.2%.

SOIL: Many of the sites are wet throughout the growing season, so mottling or gleying usually occur at a shallow depth (< 1.5 ft or 50 cm) (Figure 8). Soils have one or two horizons within 1.5 feet (50 cm) of the surface. Textures are sandy or silty loams, silty clay loams or clays.

EXOTICS: Few exotics occur in these dense stands. Smooth brome (Bromus inermis), common timothy (Phleum pratense) and white clover (Trifolium repens) each have cover values greater than 10% in one stand.

ADJACENT RIPARIAN VEGETATION: Vegetation types in the channel adjacent to Nebraska sedge stands are wooly sedge/rush (Carex lanuginosa/Scirpus sp.) stands, narrowleaf cattail (Typha angustifolia) stands, or softstem bulrush (Scirpus validus) stands. At the same level as the Nebraska sedge stand or at slightly higher levels may be found leafy bulrush (Scirpus

pungens) stands, baltic rush (Juncus balticus) stands, or smooth horsetail (Equisetum laevigatum) stands. On higher terraces, woodlands with plains cottonwood (Populus deltoides), peachleaf willow (Salix amygdaloides) or boxelder (Acer negundo) may occur. Terraces may also be dominated by western wheatgrass (Elymus smithii) or smooth brome (Bromus inermis).

ECOLOGY: Nebraska sedge is common in swamps, wet meadows and ditches where soils are saturated to the surface. It has a wide elevation range (3,000 feet to 10,000 feet) and a wide geographic range, from South Dakota and Kansas, west to New Mexico, California and British Columbia (Hermann 1970).

The strongly rhizomatous root system of Nebraska sedge makes it excellent in stabilizing stream banks. Nebraska sedge provides valuable forage in late season for livestock (Hermann 1970). It may also provide cover and food for small game and waterfowl (Youngblood and others, 1985).

OTHER CLASSIFICATIONS: Studies in Wyoming, Idaho, Utah and Montana have identified a community, community type or plant association named for Nebraska sedge. The species composition, though, differs between these. In the U.S. Forest Service studies of Idaho, Utah, and western Wyoming (Youngblood and others, 1985; Padgett and others, 1989), major species in addition to Nebraska sedge are tufted hairgrass (Deschampsia cespitosa) and baltic rush (Juncus balticus). In the Yampa Basin, Colorado study (Kittel and Lederer, 1993), carpet bent grass (Agrostis gigantea, synonymous with A. stolonifera) occurs most often with Nebraska sedge. Compositions of the 12 Nebraska sedge stands of this eastern Wyoming study are more similar to those of the Yampa Basin. Differences in associated species may be due to the elevation range of this dominance type.

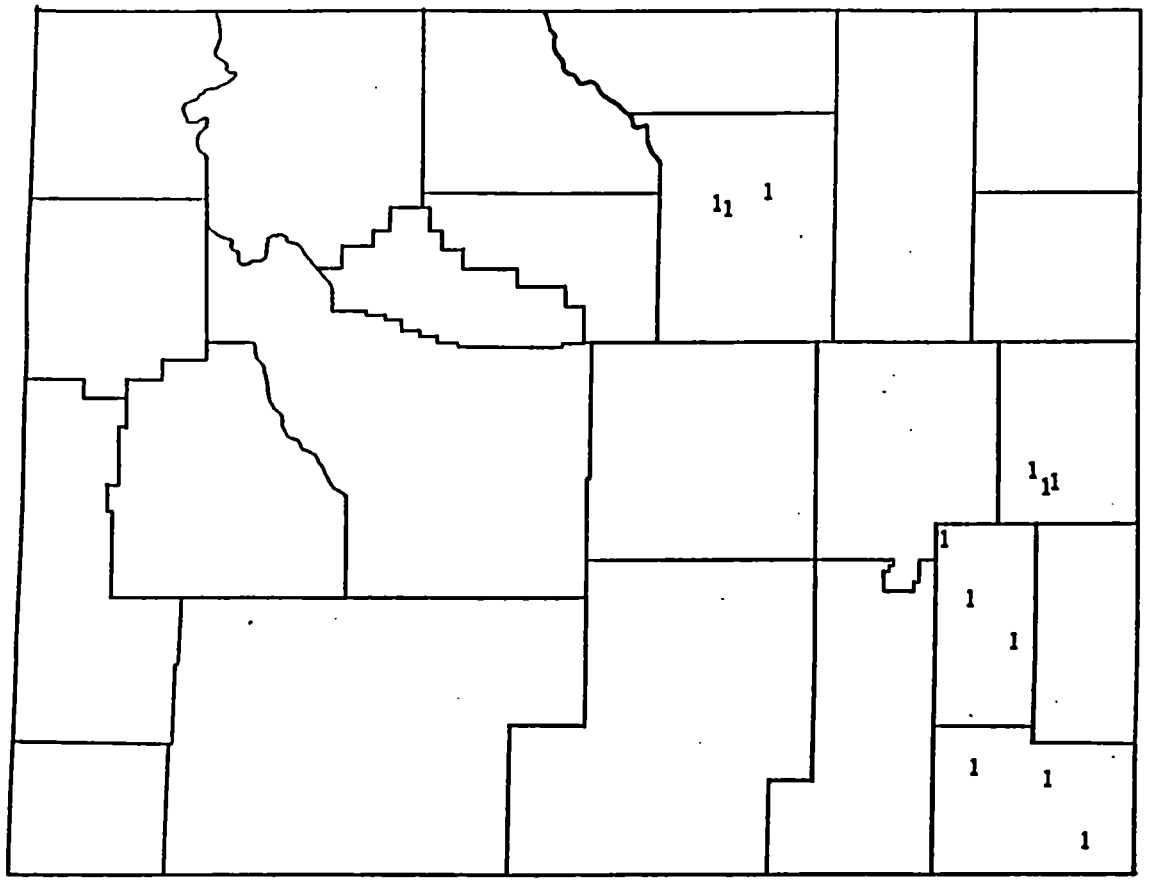
In the classification of wetland habitats (Cowardin and others, 1979), the Nebraska sedge community belongs to the Palustrine System, Emergent Wetland Class, Persistent Subclass. In the ecological land classification framework (Driscoll and others, 1984), stands of this community belong to the Herbaceous Vegetation Class, Medium Tall Grassland Subclass, Medium Tall Grassland Without a Woody Layer Group, Sod Grass Formation.

Stands of the Nebraska sedge community occur on the following range sites (USDA Soil Conservation Service, 1988):

10-14" Northern Plains: Wetland, Subirrigated
12-14" Southern Plains: Wetland
15-17" Southern Plains: Wetland
15-19" Mountains Southeast: Wetland

Figure 11. Map of Wyoming counties showing the approximate locations of sites with stands of the Nebraska sedge community.

Map Symbol	Vegetation Type
1	Nebraska sedge community (12 stands)



Field Clustered Sedge (Carex praegracilis) Dominance Type

(2 stands sampled)

VEGETATION STRUCTURE & COMPOSITION: Field clustered sedge (Carex praegracilis) is the dominant species (Table 5). Other species with 10-20% cover include leafy bulrush (Scirpus pungens), foxtail barley (Hordeum jubatum), and baltic rush (Juncus balticus). These vegetation can be 1.5 feet (0.5 m) tall.

ENVIRONMENT: We found field clustered sedge stands parallel to the channel, in strips up to 33 feet (10 m) wide. Our stands occurred less than 1 foot above the channel.

SOIL: Stands occur on soils with one or two horizons within 1.5 feet of the surface. Soil textures are sandy clay loams and sandy loams.

LOCATION: The field clustered sedge dominance type was sampled in Natrona and Weston counties in eastern Wyoming (Figure 12). It occurred on sinuous, low gradient channels.

EXOTICS: There were few exotics in either of these two stands.

ADJACENT RIPARIAN VEGETATION: Leafy bulrush (Scirpus pungens) or creeping spikerush (Eleocharis palustris) stands may grow in the channel. At higher levels, stands of inland saltgrass (Distichlis stricta) occur.

ECOLOGY: Field clustered sedge is often abundant in moist, open habitats, especially on the plains (Hermann 1970).

OTHER CLASSIFICATIONS: A community of the field clustered sedge dominance type is described for Idaho and Utah (Brotherson and Brown 1984). The Idaho/Utah community is co-dominated by water sedge (Carex aquatilis) which did not occur in any of our sites as it is usually found at higher elevations.

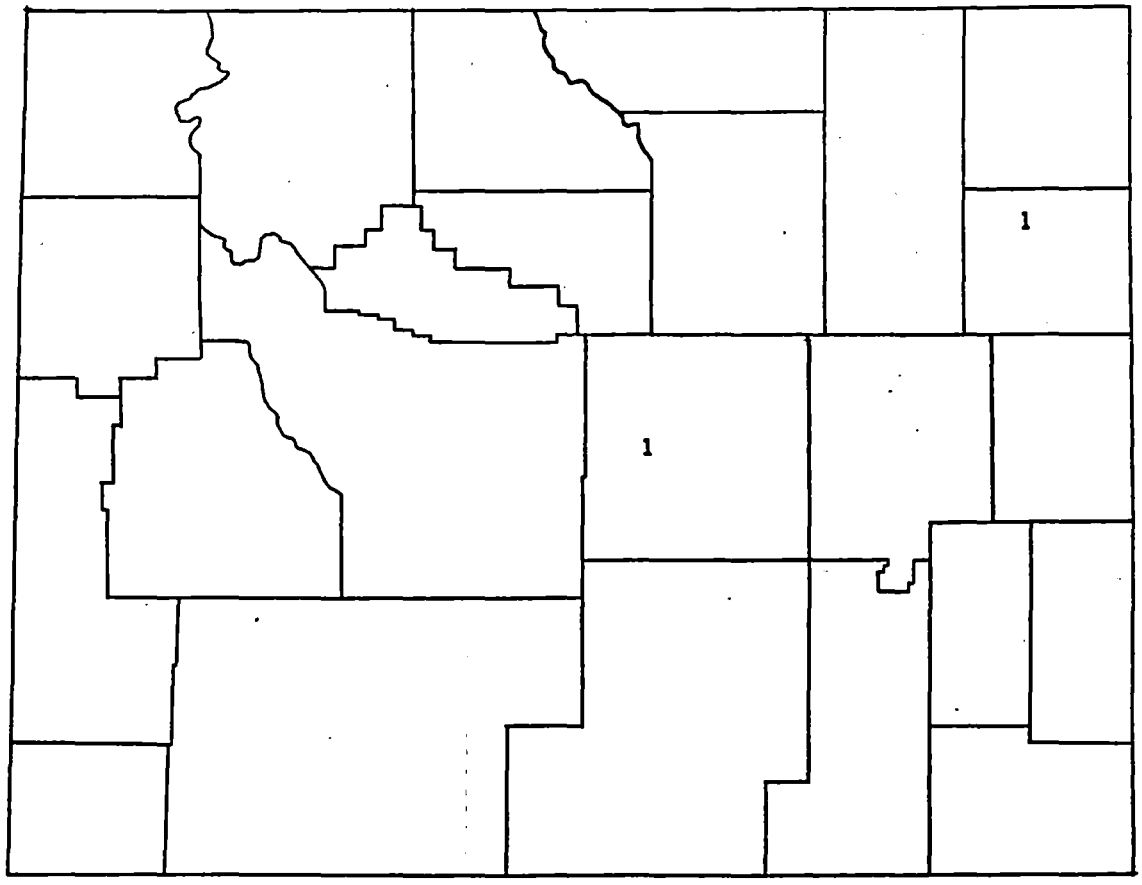
In the wetland habitat classification of Cowardin and others (1979), field clustered sedge stands belong to the Palustrine System, Emergent Wetland Class, Persistent Subclass. In the ecological land classification framework (Driscoll and others, 1984), they belong to the Herbaceous Vegetation Class, Short Grassland Subclass, Short Grassland Without a Woody Layer Group, Sod Grass Formation.

Our stands of field clustered sedge apparently occurred on the following range sites (USDA Soil Conservation Service, 1988):

10-14" High Plains Southeast: Wetland
19-14" Northern Plains: Wetland

Figure 12. Map of Wyoming counties showing the approximate locations of sites with stands of the field clustered sedge dominance type.

Map Symbol	Vegetation Type
1	Field clustered sedge community (2 stands)



Inland Saltgrass (Distichlis stricta) Dominance Type

(7 stands sampled)

VEGETATION: The inland saltgrass dominance type includes stands in which inland saltgrass (Distichlis stricta) dominates or co-dominates the vegetation (Table 6). Species that share dominance with inland saltgrass in different stands include western wheatgrass (Elymus smithii), Nuttall's alkali grass (Puccinellia nutalliana), alkali sacaton (or alkali dropseed; Sporobolus airoides), and seepweed (Suaeda calceoliformis). The vegetation is usually less than a foot tall, and total cover can range from sparse to dense.

We have placed all of the stands that we sampled into the dominance type because we could see no consistent differences between stands in species composition or environment that would allow us to describe communities.

LOCATION: Nearly all of the sites at which we found inland saltgrass stands were on small, low-gradient, meandering, intermittent channels (Figure 5) near the heads of drainage basins (Figure 4). Those sites were located throughout eastern Wyoming (Figure 13) at elevations between 4,050 and 6,050 feet (Figure 3).

ENVIRONMENT: Inland saltgrass grows on moist, alkaline or saline soils. Stands can be found in saline meadows (Brotherson and Barnes 1984) or in alkaline swales and stream valleys (Costello 1944). It can also be found on drier sites.

The stands that we sampled occurred on the floodplain or on terraces, from 1 to 5 feet (0.15-1.5 m) above the channel (Figure 7). Most stands were within 10 feet (3 m) of the channel (Figure 6).

SOIL: Soil horizons were usually sandy loams, sandy clays, or silty clays. Soil salinity, as indicated by electrical conductivity measurements, was highest in horizons near the soil surface, and in the stands with the most inland saltgrass (Figure 10).

EXOTICS: Exotic plants (especially summer cypress and cheatgrass) usually are present, but only one of our stands had a substantial amount of exotic species (cheatgrass).

ADJACENT RIPARIAN VEGETATION: Intermittent channels may be occupied by leafy bulrush, foxtail barley, or creeping spikerush vegetation. Lower terraces may support field clustered sedge stands. Baltic rush, western wheatgrass, or silver sagebrush/western wheatgrass stands may occur on terraces above inland saltgrass stands.

ECOLOGY: Inland saltgrass grows from early summer until fall. Reproduction occurs primarily from rhizomes. The species resists trampling and may increase when competition from other plants is reduced (Stubbendieck and others, 1992). Cover of saltgrass increases, and cover of other species decreases, with prolonged heavy grazing, and foxtail barley may replace the saltgrass if heavy grazing persists long enough (Hansen and others, 1991).

OTHER CLASSIFICATIONS: Hansen and others (1991) describe an inland saltgrass habitat type from Montana that supports vegetation of the inland saltgrass dominance type. Johnston (1987) reports three plant associations within the inland saltgrass dominance type (the Distichlis spicata/Puccinellia airoides association, the Distichlis spicata/Elytrigia smithii association, and the Distichlis spicata/Sporobolus airoides-Elytrigia smithii association) from Colorado, Utah, and Wyoming, but the stands that we sampled do not seem to fit into his associations.

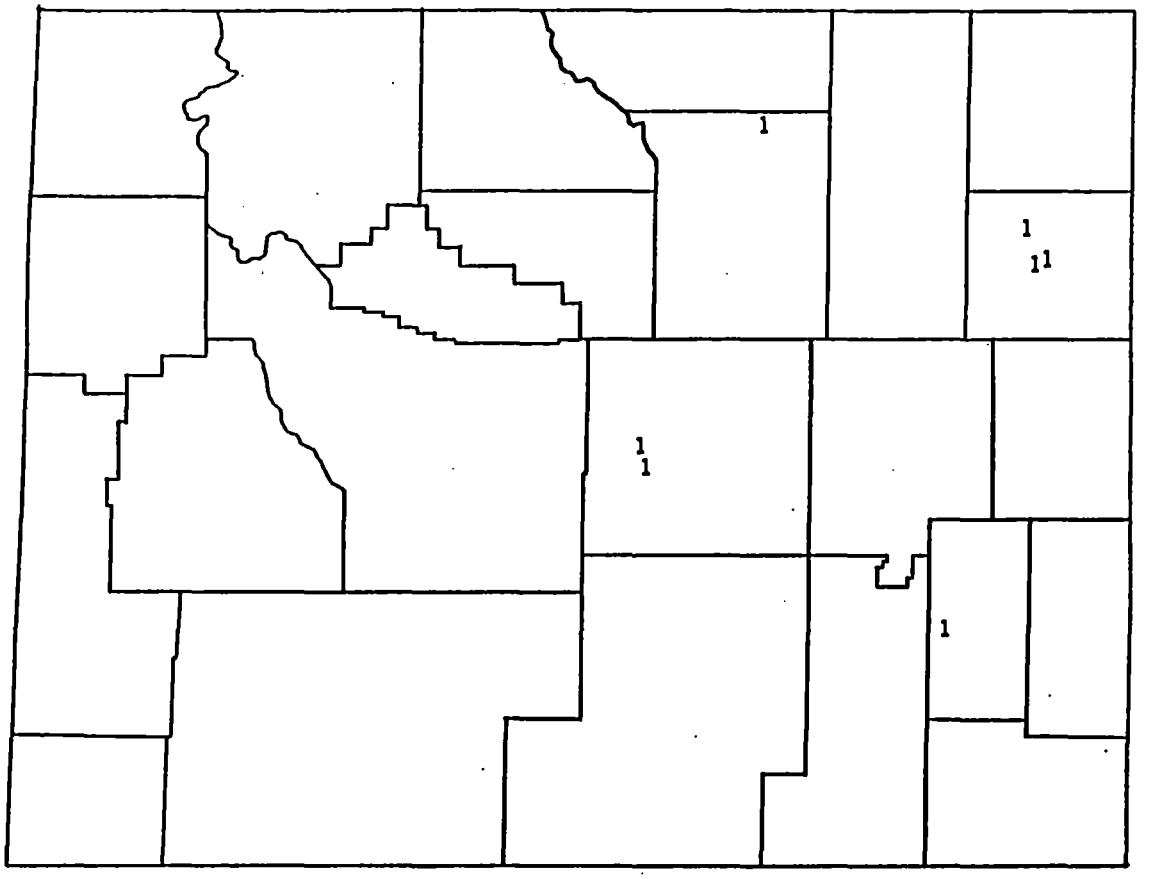
In the classification of wetland habitats (Cowardin and others, 1979), stands of the inland saltgrass dominance type probably belong to the Palustrine System, Emergent Wetland Class, Persistent Subclass. In the ecological land classification framework of Driscoll and others (1984), inland saltgrass stands belong to the Herbaceous Vegetation Class, Short Grassland Subclass, Short Grassland Without a Woody Layer Group, Sod Grass Formation.

We sampled inland saltgrass stands on these range sites (USDA Soil Conservation Service, 1988):

10-14" Northern Plains: Saline Subirrigated, Saline Lowland
12-14" Southern Plains: Saline Subirrigated, Saline Lowland

Figure 13. Map of Wyoming counties showing the approximate locations of sites with stands of the inland saltgrass dominance type.

Map Symbol	Vegetation Type
1	Inland saltgrass dominance type (7 stands)



Creeping Spikerush (Eleocharis palustris) Dominance Type

Creeping spikerush often forms pure stands, and it also occurs with other species such as leafy bulrush (Scirpus pungens) in our stands. In Utah it is reported with baltic rush (Juncus balticus) and with inland saltgrass (Distichlis stricta) (Bourgeron and Engelking 1994). Creeping spikerush stands occur in seasonally-flooded riparian areas and in marsh wetlands.

We consider all three stands as part of a creeping spikerush community.

Creeping Spikerush (Eleocharis palustris) Community

(3 stands sampled)

VEGETATION STRUCTURE & COMPOSITION: Creeping spikerush dominates the vegetation of this community (Table 7). Leafy bulrush (Scirpus pungens) may contribute substantial cover. Few other species are present. The vegetation typically is 1 to 2 feet (0.3 to 0.6 m) tall.

LOCATION: Stands of the creeping spikerush community occur on small, intermittent streams with low-gradient, moderately sinuous channels. We found the community in central and north-central Wyoming (Figure 14) from 4,600 to 6,100 feet elevation (Figure 3).

ENVIRONMENT: Dense patches of creeping spikerush occur around pools and in wet sections of the channel bed. All three of our stands were on intermittent streams where water in the channel ponds part of the year.

SOIL: The surface horizons in our stands were predominantly clays. Other horizons included sandy clays and silty clays. Electrical conductivities were low in all horizons (Figure 10), indicating relatively low salinity.

EXOTICS: Few exotic plants were present in the three stands of this community that we sampled.

ADJACENT RIPARIAN VEGETATION: Communities adjacent to creeping spikerush may include field clustered sedge (Carex praegracilis) or western wheatgrass (Elymus smithii) on the first surface above the channel. Higher terraces may have inland saltgrass (Distichlis stricta) or silver sagebrush/western wheatgrass (Artemisia cana/Elymus smithii) stands.

ECOLOGY: Creeping spikerush is a rhizomatous plant that survives both flooding and dry periods and tolerates alkaline environments. It grows from sea level to the mountains in marshes, wet meadows, ditches, shores and stream banks, and often in shallow water (Hitchcock and Cronquist 1981, Hansen and others 1991).

OTHER CLASSIFICATIONS: An Eleocharis palustris habitat type is found throughout Montana (Hansen and others, 1991), and a community with this name has been described from central Oregon (Kovalchik 1987), Utah and southern Idaho (Padgett and others, 1989), and western Colorado (Baker and Kennedy 1985; Kittel and Lederer 1993).

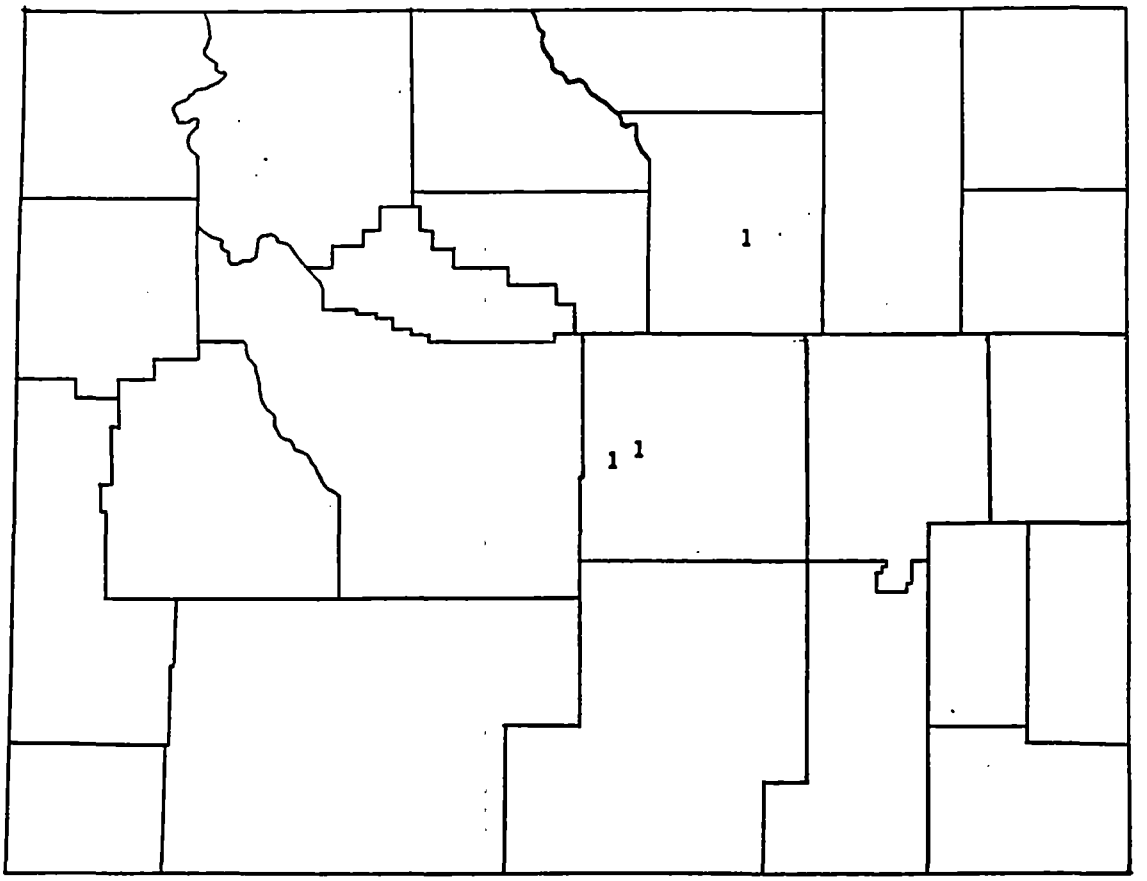
In the classification of wetland habitats (Cowardin and others, 1979), the creeping spikerush community belongs to the Palustrine System, Emergent Wetland Class, Persistent Subclass. In the ecological land classification framework of Driscoll and others (1984), this community belongs to the Herbaceous Vegetation Class, Short Grassland Subclass, Short Grassland Without a Woody Layer Group, Sod Grass Formation.

Our stands of creeping spikerush apparently occurred on the following range sites (USDA Soil Conservation Service, 1988):

12-14" High Plains Southeast: Wetland
10-14" Northern Plains: Wetland, Subirrigated

Figure 14. Map of Wyoming counties showing the approximate locations of sites with stands of the creeping spikerush community.

Map Symbol	Vegetation Type
1	Creeping spikerush community (3 stands)



Western Wheatgrass (Elymus smithii) Dominance Type

Western wheatgrass is common in riparian and in upland sites. In Wyoming it is an important low elevation riparian species in moist, fine textured soils. We place all of the stands sampled into a western wheatgrass community.

Western Wheatgrass (Elymus smithii) Community

(16 stands sampled)

VEGETATION STRUCTURE & COMPOSITION: Western wheatgrass is usually the dominant species, but it may share dominance, especially with American licorice (Glycyrrhiza lepidota) or Kentucky bluegrass (Poa pratensis) (Table 8). Stands range in shape from narrow bands to patches of several acres. The vegetation is generally about a foot tall.

ENVIRONMENT: Western wheatgrass stands have the widest range in height above the channel of the herbaceous types we studied (Figure 7). Most of our stands were located on terraces at least 1.5 feet above the channel. Some stands were adjacent to the channel or occurred on the banks sloping up to the first terrace. Half of our sites with western wheatgrass stands lay along confined channels, and half on wide floodplains.

LOCATION: Stands of the western wheatgrass community were found in most of the northeastern Wyoming counties (Figure 15) from 3,385 to 6,105 feet elevation. Stands were located near the heads of some drainage basins and lower in others (Figure 4). The stream gradient was usually low and the channels sinuous.

SOIL: Soil texture is highly variable, with most horizons beneath our stands being clays, silty clays, and sandy loams. A quarter of the stands had soils with high electrical conductivity in the lower horizons, indicating high salinity (Figure 10).

EXOTICS: Exotic species, especially Kentucky bluegrass (Poa pratensis), sweetclover (Melilotus sp.), Canada thistle (Cirsium arvense), smooth brome (Bromus inermis) and cheatgrass brome (Bromus tectorum), often occur in stands of this community and may be abundant. Common dandelion (Taraxacum officinale) occurs frequently in low amounts.

ADJACENT RIPARIAN VEGETATION: Prairie cordgrass (Spartina pectinata) stands frequently grow on lower surfaces than western wheatgrass stands. Other communities commonly found on the floodplain or in the channel are creeping spikerush (Eleocharis palustris), coyote willow (Salix exigua), Nebraska sedge (Carex nebrascensis), bulrush (Scirpus validus or S. pungens) or alkali cordgrass (Spartina gracilis). Common adjacent tree stands are plains cottonwood (Populus deltoides), boxelder (Acer negundo), or

peachleaf willow (Salix amygdaloides) dominance types. Western wheatgrass stands often merge into silver sagebrush/western wheatgrass (Artemisia cana/Elymus smithii) or black greasewood/western wheatgrass (Sarcobatus vermiculatus/Elymus smithii) stands.

ECOLOGY: Stands dominated by western wheatgrass occupy draws, swales, and other sites that receive surface or subsurface water. The species tolerates drought and alkali. It reproduces vigorously by creeping rootstocks in addition to seed produced late in the growing season. Western wheatgrass withstands grazing well, although heavy grazing, especially late in the spring, can decrease its cover. The species recovers quickly from drought to re-occupy open areas (Hansen and others, 1991).

OTHER CLASSIFICATIONS: Stands of our community grow on sites like those described by Hansen and others (1991) as the western wheatgrass riparian habitat type in Montana. Our community is the same as the western wheatgrass community described by Thilenius and Brown (1990) as being common in seasonally flooded playas in the Cheyenne River Basin. Our western wheatgrass community apparently includes plant communities described by Bourgeron and Engelking (1994) in which western wheatgrass shares dominance with inland saltgrass (Distichlis stricta) or foxtail barley (Hordeum jubatum). We combined all of our stands into one community because we could find no consistent vegetation differences that matched differences in the environment.

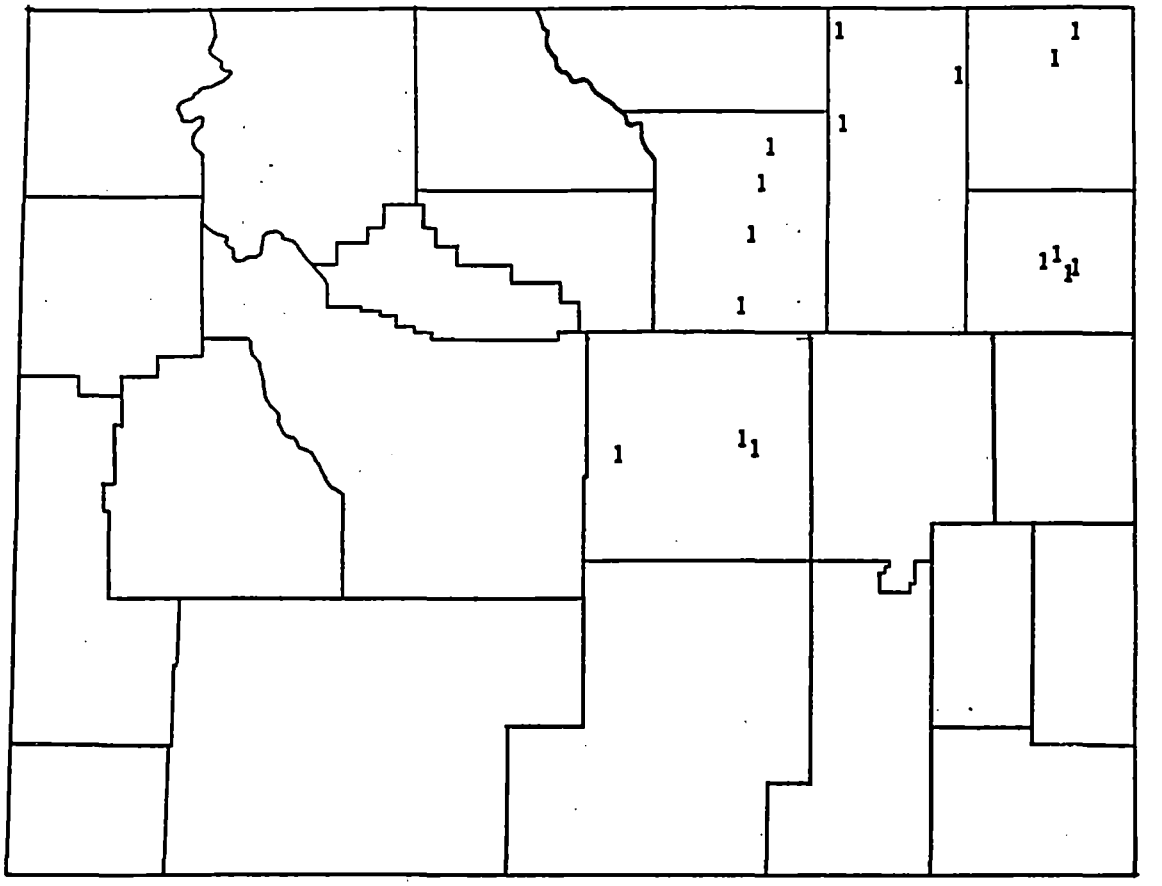
In the ecological land classification framework (Driscoll and others, 1984), western wheatgrass stands belong to the Herbaceous Vegetation Class, Medium Tall Grassland Subclass, Medium Tall Grassland Without a Woody Layer Group, Sod Grass Formation. In the wetland habitat classification (Cowardin and others, 1979), stands of this community belong to the Palustrine System, Emergent Wetland Class, Persistent Subclass.

Stands of the western wheatgrass community occur on the following range sites (USDA Soil Conservation Service, 1988):

10-14" High Plains Southeast: Subirrigated, Loamy Overflow, Clayey Overflow
10-14" Northern Plains: Subirrigated, Overflow
15-17" Northern Plains: Lowland, Overflow, Clayey Overflow, Saline Lowland
15-19" Black Hills: Overflow, Clayey Overflow, Saline Lowland

Figure 15. Map of Wyoming counties showing the approximate locations of sites with stands of the western wheatgrass community.

Map Symbol	Vegetation Type
1	Western Wheatgrass Community (16 stands)



Baltic Rush (Juncus balticus) Dominance Type

Stands of baltic rush are either almost pure rush or they have one or two other species present in substantial amounts. In either case we consider stands to be part of the Baltic Rush Community.

The baltic rush dominance type commonly occurs below 8,000 feet on fine textured soils. It is found on alluvial terraces, in stream valleys, and around seeps.

Baltic Rush (Juncus balticus) Community

(5 stands sampled)

VEGETATION STRUCTURE & COMPOSITION: The baltic rush community commonly occurs as narrow bands adjacent to and slightly higher than the channel. Stands grow to approximately 1.5 feet (0.5 m) tall. Shrubs or trees are rarely present.

Baltic rush is always present and is almost always the dominant plant (Table 9). Field clustered sedge (Carex praegracilis) is usually present, sometimes in large amounts. Nebraska sedge (Carex nebrascensis) is often present in small amounts. Large amounts of bobtail barley or foxtail barley (Hordeum cespitosum or H. jubatum) may be present.

LOCATION: Stands occur on meandering streams between 4,235 feet and 6,560 feet elevation (Figure 3) in the southeastern quarter of the state (Figure 16). The drainage basins above these sites are less than 20 square miles in area (Figure 4).

ENVIRONMENT: Most stands are 1.5 feet (0.5 m) or less above the channel (Figure 7) and lie a within horizontal distance of 16 feet (5 m) from the channel (Figure 6). The Baltic rush community occurs on flat surfaces or gentle slopes.

SOIL: Soils typically have one or two horizons within 2 feet (60 cm) of the surface, usually of the sandy clay loam, sandy loam, or loam textural class. Soils are wet and usually mottled or gleyed. Conductivity tests of soils beneath our stands indicated low salinity (Figure 10).

EXOTICS: Few exotics occur in stands of baltic rush community. Common dandelion (Taraxacum officinale) was most frequent with no more than 5% cover.

ADJACENT RIPARIAN VEGETATION: Leafy bulrush (Scirpus pungens) and creeping spikerush (Eleocharis palustris) stands often occur in the channel. Adjacent wetter areas may be vegetated with Nebraska sedge communities (Carex nebrascensis). Areas that are higher and

drier have western wheatgrass (Elymus smithii) or inland saltgrass (Distichlis stricta) stands.

ECOLOGY: Baltic rush commonly occurs in low elevation valleys and plains, up to 8,000 feet elevation in the mountains. It is found in wet areas, rarely with standing water (Cooper 1989). Stands of baltic rush can be nearly pure in the wetter areas. It is also common for other species to be associated with this community, particularly when baltic rush has been grazed (Youngblood and others 1985).

Baltic rush is more attractive forage when it is young and tender; it is avoided when mature. Baltic rush may be a grazing induced type and is therefore often considered an increaser species. It is also noted to increase with disturbance and replace other riparian grasses. The thick, fibrous roots and sod forming rhizomes of baltic rush are important in stabilizing stream banks (Padgett and others, 1989).

OTHER CLASSIFICATIONS: In the Rocky Mountain region, the baltic rush community has been reported in western Wyoming and eastern Idaho (Youngblood and others, 1985), in Utah and southeastern Idaho (Padgett and others, 1989), in Colorado (Baker 1984), and in Montana (Hansen and others, 1991). It is also found in New Mexico, Nevada, Oregon, and Washington (Bourgeron and Engelking, 1994).

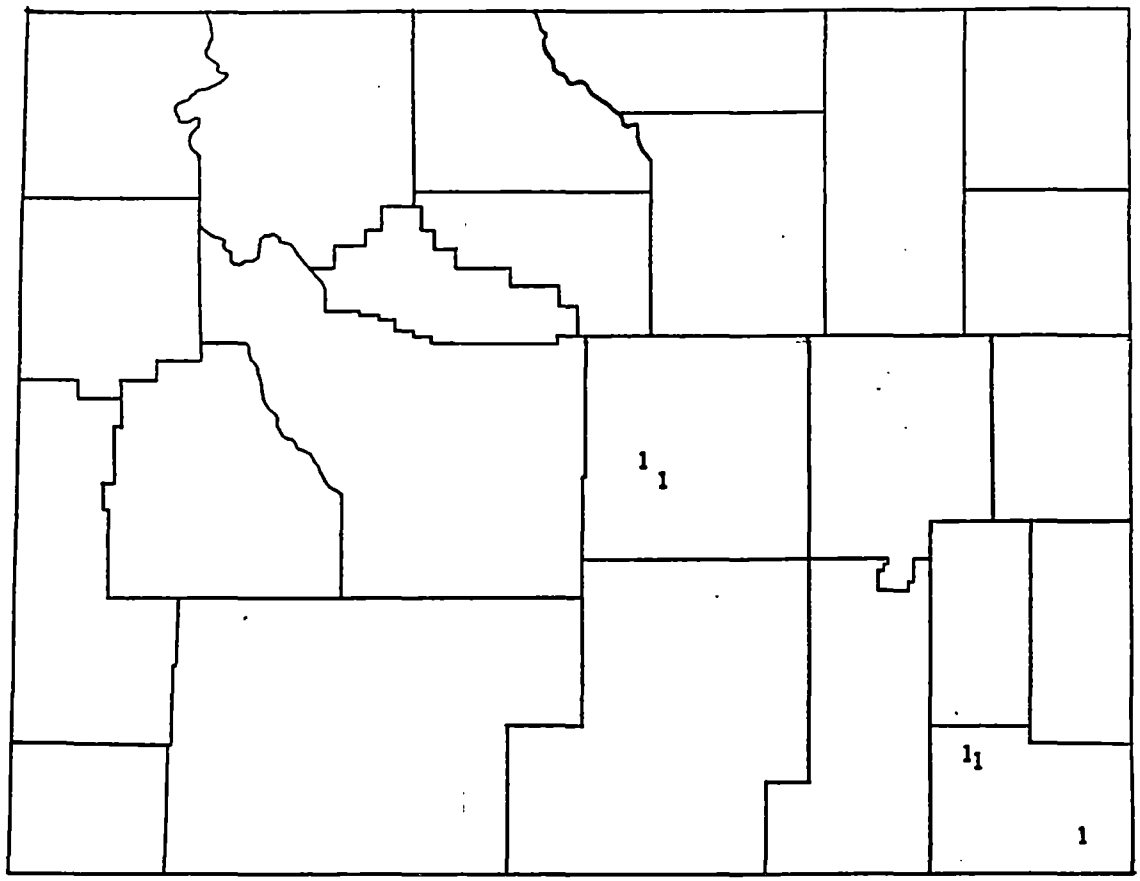
In the classification of wetland habitats (Cowardin and others, 1979), the baltic rush community belongs to the Palustrine System, Emergent Wetland Class, Persistent Subclass. In the ecological land classification framework (Driscoll and others, 1984), stands of this community belong to the Herbaceous Vegetation Class, Short Grassland Subclass, Short Grassland Without a Woody Layer Group, Sod Grass Formation.

We found stands of the baltic rush community on the following range sites (USDA Soil Conservation Service, 1988):

10-14" High Plains Southeast: Wetland
15-17" Southern Plains: Wetland

Figure 16. Map of Wyoming counties showing the approximate locations of sites with stands of the baltic rush community.

Map Symbol	Vegetation Type
1	Baltic rush community (5 stands)



Leafy Bulrush (Scirpus pungens) Dominance Type

Leafy bulrush can produce nearly pure stands, or it can grow with moderate amounts of other grass or sedge species. In both cases, we place stands in the leafy bulrush community.

Leafy Bulrush (Scirpus pungens) Community

(6 stands sampled)

VEGETATION STRUCTURE & COMPOSITION: Leafy bulrush is the only species that occurred in all six stands, with amounts varying from 10 to 70% canopy cover (Table 10). Small amounts of foxtail barley (Hordeum jubatum) were present in all but one stand. Nebraska sedge (Carex nebrascensis) and creeping spikerush (Eleocharis palustris) contributed substantial cover in one stand each.

The vegetation in this community grows to 1.5 feet (0.5 m) tall.

LOCATION: We found the leafy bulrush community in four eastern counties (Figure 17) from 3,850 to 5,050 feet elevation (Figure 3).

ENVIRONMENT: The leafy bulrush community is found on low gradient, shallow, meandering channels. The stands are less than 3.5 feet (1 m) above the channel (Figure 7) and are adjacent to the channel (Figure 6), and often occur as narrow strips along the edge of the channel.

SOIL: Single soil horizons are common to 2 feet (60 cm) depth and usually are sandy loam texture. The soil occasionally has a thin layer of sand on top. A high water table was indicated in our stands by gleying or mottling in the top 10 inches (25 cm) (Figure 8).

EXOTICS: Common quackgrass (Elymus repens) was abundant in one of our stands. Trace amounts of sweetclover (Melilotus sp.) and common dandelion (Taraxacum officinale) were present in several stands.

ADJACENT RIPARIAN VEGETATION: We found a wide variety of communities adjacent to the leafy bulrush stands. Cattail (Typha spp.) occurred in one channel. Field clustered sedge (Carex praegracilis), inland saltgrass (Distichlis stricta), or alkali cordgrass (Spartina gracilis) communities occurred on the adjacent, higher terraces. The highest surface was occupied by western wheatgrass (Elymus smithii) or by silver sagebrush (Artemisia cana) and western wheatgrass (Elymus smithii).

ECOLOGY: Leafy bulrush is common in the northern Great Plains, in wet areas on shores, stream banks, wet meadows, ditches, and in seepage areas (Larson 1993). Typically the water table is high in the spring but drops during the growing season.

OTHER CLASSIFICATIONS: A Scirpus pungens Habitat Type is described for central and eastern Montana (Hansen and others, 1991). In the classification of wetland habitats (Cowardin and others, 1979), leafy bulrush stands belong to the Palustrine System, Emergent Wetland Class, Persistent Subclass. In the ecological land classification framework of Driscoll and others (1984), this community belongs to the Herbaceous Vegetation Class, Medium Grassland Subclass, Medium Grassland Without a Woody Layer Group, Sod Grass Formation.

Leafy bulrush stands grow on the following range sites (USDA Soil Conservation Service, 1988):

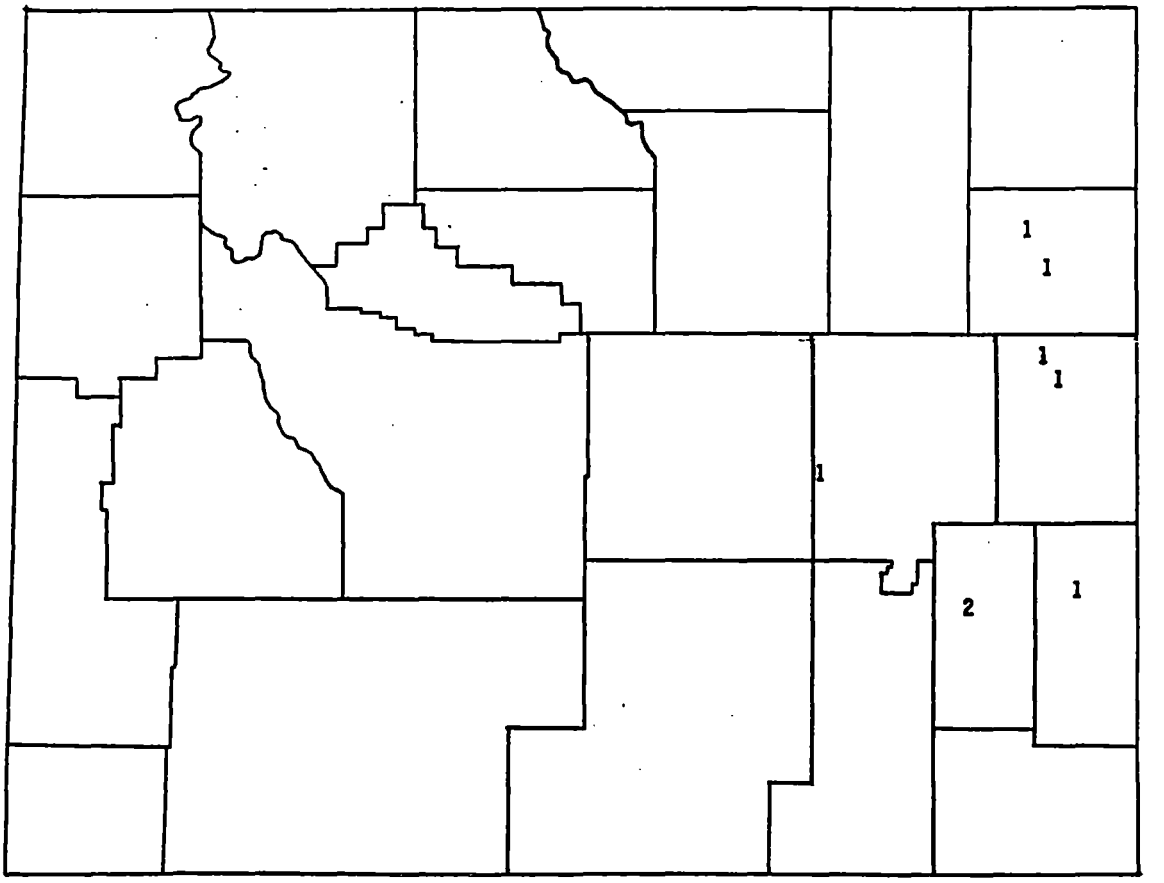
12-14" Southern Plains: Wetland
10-14" Northern Plains: Wetland

Unclassified Leafy Bulrush (Scirpus pungens) Stand

We sampled one stand dominated by leafy bulrush and valley sedge (Carex vallicola). We're placing this stand in the leafy bulrush dominance type, but are not describing it as a community.

Figure 17. Map of Wyoming counties showing the approximate locations of sites with stands of the leafy bulrush community.

Map Symbol	Vegetation Type
1	Leafy bulrush community (6 stands)
2	Unclassified leafy bulrush stand (1 stand)



Softstem Bulrush (Scirpus validus) Dominance Type

(2 stands sampled)

VEGETATION: We sampled two stands that had softstem bulrush as a major component. One stand is nearly pure softstem bulrush, and alkali cordgrass (Spartina gracilis) is a major species in the second stand (Table 11).

Softstem bulrush stands grow to a height of 4 feet and occurs as narrow strips in or adjacent to channels.

ENVIRONMENT: Softstem bulrush occurs in or slightly above narrow, shallow channels (Figures 5, 6, and 7). The channel may be indistinct and streamflow intermittent.

LOCATION: Stands of softstem bulrush were found in southeastern and northeastern counties of Wyoming (Figure 18) between 4,500 and 5,500 feet elevation (Figure 3). The streams where these stands are located are small and typically drain a basin of less than 10 square miles (Figure 4).

SOIL: Soils are saturated and the thick upper horizons are loams or sandy loams.

EXOTICS: Very few exotics occurred in the stands of softstem bulrush that were sampled.

ADJACENT RIPARIAN VEGETATION: Narrowleaf cattail (Typha angustifolia) occurs directly in the channel. Adjacent to the softstem bulrush on slightly higher surfaces may grow stands of Nebraska sedge (Carex nebrascensis), alkali cordgrass (Spartina gracilis), or Chinese tamarisk (Tamarix chinensis). At drier adjacent sites western wheatgrass (Elymus smithii) stands may occur.

ECOLOGY: Softstem bulrush grows in the very wet soils of riparian habitats and also in freshwater marshes. This dominance type may be considered a wetland type since it is permanently inundated with standing water during most years, but it also occurs in what is clearly a riparian area.

COMMUNITIES: More softstem bulrush stands need to be sampled and described before communities are identified.

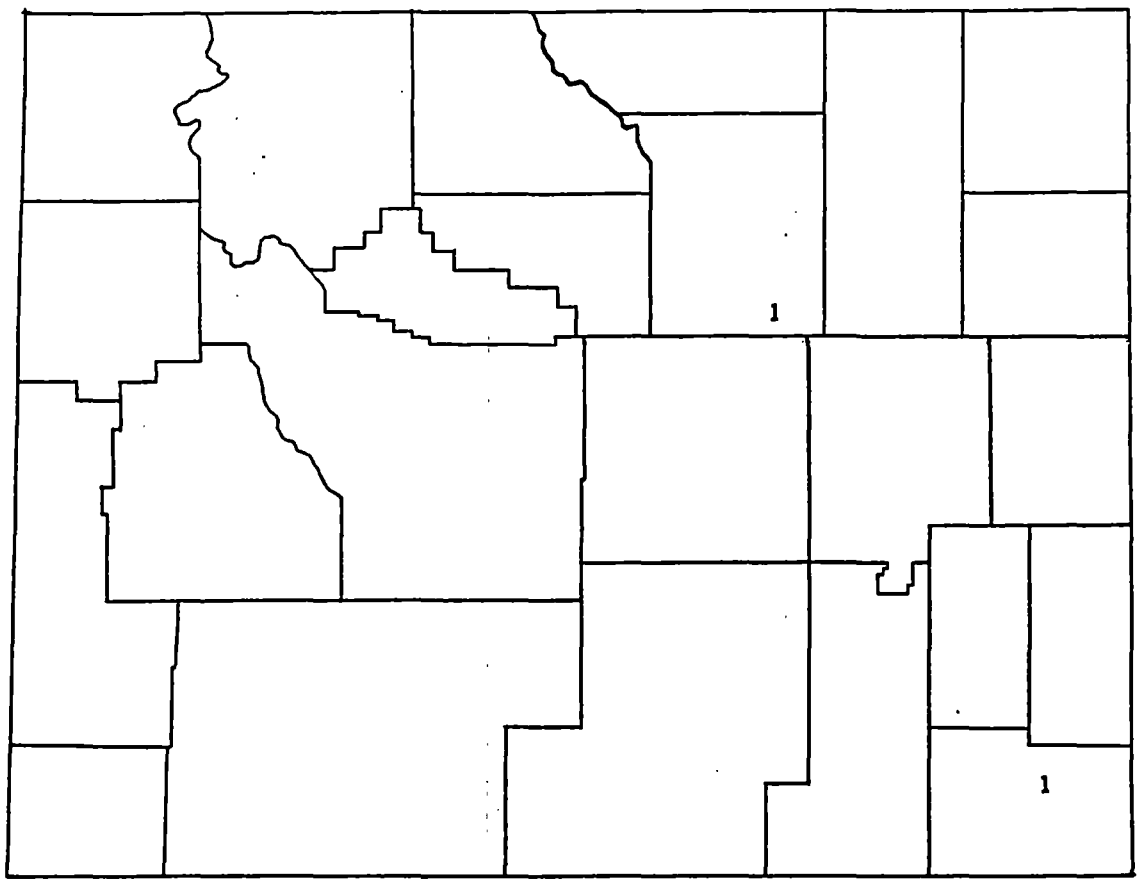
OTHER CLASSIFICATIONS: We found no descriptions of softstem bulrush vegetation in other classifications. In the wetland habitat classification of Cowardin and others (1979), softstem bulrush stands belong to the Palustrine System, Emergent Wetland Class, Persistent Subclass. In the ecological land classification framework (Driscoll and others, 1984), they belong to the Herbaceous Vegetation Class, Medium Grassland Subclass, Medium

Grassland Without a Woody Layer Group, Sod Grass Formation. The softstem bulrush stands we sampled apparently occurred on these range sites (USDA Soil Conservation Service, 1988):

10-14" Northern Plains: Wetland
15-17" Southern Plains: Wetland

Figure 18. Map of Wyoming counties showing the approximate locations of sites with stands of the softstem bulrush dominance type.

Map Symbol	Vegetation Type
1	Softstem bulrush dominance type (2 stands)



Alkali Cordgrass (Spartina gracilis) Dominance Type

Alkali cordgrass is the dominant or co-dominant plant in stands of this dominance type. Stands of alkali cordgrass are found beside small, low gradient, meandering creeks. They are most prevalent on the inside of meanders. There are few communities described for the alkali cordgrass dominance type in the western United States (Bourgeron & Engelking, 1994). The six stands found in this study are treated as a single alkali cordgrass community.

Alkali cordgrass (Spartina gracilis) Community

(6 stands sampled)

VEGETATION STRUCTURE & COMPOSITION: Alkali cordgrass dominates these herbaceous stands (Table 12). In two of our stands, baltic rush (Juncus balticus) also had high cover values. One stand had slightly more leafy bulrush (Scirpus pungens) than alkali cordgrass. Western wheatgrass was present in all stands with amounts varying from 1 to 30% cover. The forbs cocklebur (Xanthium strumarium) and curlycup gumweed (Grindelia squarrosa) were usually present in small amounts.

The alkali cordgrass community grows in narrow bands to 16 feet (5 m) wide or in patches up to 0.1 acre (500 m^2). The dominant plant, alkali cordgrass, grows up to 1.5 feet (0.5 m) tall.

ENVIRONMENT: The alkali cordgrass community was found on low gradient, meandering streams, most of which drain small basins (Figure 4). Alkali cordgrass occurs on the first surface above the channel, usually less than 3 feet above the channel (Figure 7) and less than 10 feet horizontal distance from the channel (Figure 6). The stands commonly occur on the insides of meanders.

SOIL: Soil horizons are commonly sandy loams or sandy clay loams. Electrical conductivity in the soil shows a wide range of values in these stands (Figure 10), indicating a range in salinity. The highest conductivities are found in the deeper horizons.

LOCATION: In this study, the alkali cordgrass community was found in the central and northern counties of eastern Wyoming (Figure 19) between 3,975 and 5,710 feet elevation (Figure 3). Stands were located on small perennial or intermittent creeks (Figure 5).

EXOTICS: Sweetclover (Melilotus sp.) was found in low amounts in all the stands. Smooth brome (Bromus inermis) contributed substantial cover in one stand (Table 12).

ADJACENT RIPARIAN VEGETATION: At lower levels and in the channel, leafy bulrush (Scirpus pungens) or softstem bulrush (Scirpus validus) stands may occur. The inland saltgrass (Distichlis stricta) community may occur on the same surface as the alkali cordgrass stands. On higher terraces, communities adjacent to alkali cordgrass stands may be western wheatgrass (Elymus smithii), silver sagebrush/western wheatgrass (Artemisia cana/Elymus smithii), or flaxleaf rabbitbrush (Chrysothamnus linifolius)..

ECOLOGY: Alkali cordgrass is found in moist, often alkaline areas along streams and in meadows. The water table is high, but the sites are not permanently flooded. Livestock use is limited because alkali cordgrass is most palatable early in the spring when the sites are wet and therefore difficult for livestock to reach (Hansen and others 1991).

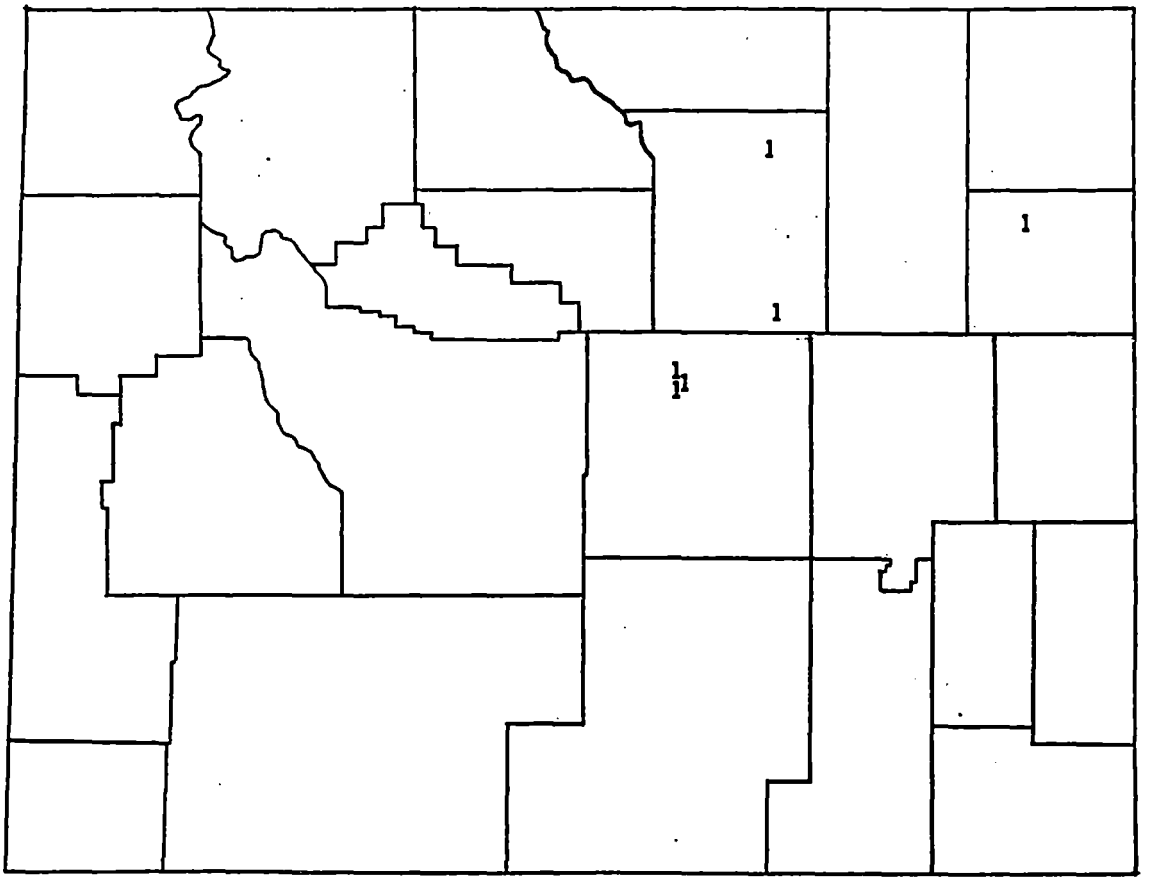
OTHER CLASSIFICATIONS: Hanson (1929) describes a Spartina gracilis community in the San Luis Valley of Colorado. In Montana, alkali cordgrass stands are described from the Prairie Cordgrass Habitat Type (Hansen and others, 1991). In the classification of wetland habitats (Cowardin and others, 1979), alkali cordgrass stands belong to the Palustrine System, Emergent Wetland Class, Persistent Subclass. In the ecological land classification framework of Driscoll and others (1984), they belong to the Herbaceous Vegetation Class, Medium Grassland Subclass, Medium Grassland Without a Woody Layer Group, Sod Grass Formation.

Alkali cordgrass stands apparently occur on the following range sites (USDA Soil Conservation Service, 1988):

10-14" High Plains Southeast: Subirrigated, Saline subirrigated
10-14" Northern Plains: Subirrigated, Saline subirrigated

Figure 19. Map of Wyoming counties showing the approximate locations of sites with stands of the alkali cordgrass community.

Map Symbol	Vegetation Type
1	Alkali cordgrass community (6 stands)



Prairie Cordgrass (Spartina pectinata) Dominance Type

Stands of prairie cordgrass tend to be dense and include few other species. In the Rocky Mountain region, prairie cordgrass communities are identified in Montana, Colorado, and Wyoming (Bourgeron and Engelking, 1994). We consider all of the prairie cordgrass stands that we studied to belong to the community described by Hansen and others (1991) from Montana.

Prairie Cordgrass (Spartina pectinata) Community

(8 stands sampled)

VEGETATION STRUCTURE & COMPOSITION: The vegetation is dense and dominated by prairie cordgrass, which contributes 40 to 90% canopy cover (Table 13). Other species usually contribute less than 15% canopy cover. Species often present are coyote willow (Salix exigua), indigobush (Amorpha fruticosa), Nebraska sedge (Carex nebrascensis), or American licorice (Glycyrrhiza lepidota). Leafy bulrush (Scirpus pungens) is present 50% of the time but usually with less than 5% canopy cover, although one stand had 30% canopy cover.

The prairie cordgrass community usually occurs in long, narrow patches. The vegetation may be 1.5 feet to 5 feet tall.

ENVIRONMENT: The narrow bands of prairie cordgrass occur immediately adjacent to and sometimes within the channel (Figures 5 and 6). The stands sometimes extend across the floodplain and up the slope to the first terrace. Cordgrass stands may be discontinuous along the stream, forming dense patches on the insides of meanders.

LOCATION: We found the prairie cordgrass community in three northeastern counties and one southeastern county of Wyoming (Figure 20) between 3,385 and 4,820 feet elevation (Figure 3). In most cases the channels were low gradient and highly meandering. The floodplains at all sites were narrow (<40 feet wide) and often the channel was deeply entrenched. Stands of the community occurred on both perennial and intermittent channels in small drainage basins (Figure 4).

SOIL: Soil horizons in our stands were mostly clays, silty clay loams, or sandy clay loams. Electrical conductivity of the horizons ranged from low to high (Figure 10), indicating a wide variation in salinity. The upper horizon was typically 20 inches deep.

EXOTICS: Canada thistle (Cirsium arvense) was the most common exotic plant found in our stands. Sweetclover (Melilotus sp.) and common dandelion (Taraxacum officinale) contribute 10% canopy cover to some stands.

ADJACENT RIPARIAN VEGETATION: If the floodplain is large enough, coyote willow (Salix exigua) may be present on the same surface as prairie cordgrass. The adjacent communities on higher surfaces farther from the channel may be the western wheatgrass community or the basin silver sagebrush community, or a combination of the two. Plains cottonwood stands are sometimes present.

ECOLOGY: Prairie cordgrass occurs in muddy spots along rivers and on ditch banks. It may grow on the edges of wet marshes, but is seldom found growing in deep water (Cooper, 1989). The species can grow where water is fresh to brackish and it is found in all but the southeastern and southwestern states. Vigorous rhizomes enable prairie cordgrass to form nearly pure stands (Hansen and others, 1991).

OTHER CLASSIFICATIONS: Our community matches the description of the vegetation from the prairie cordgrass habitat type described in the Montana riparian classification (Hansen and others, 1991). Our community is apparently the same as the prairie cordgrass/leafy bulrush (Spartina pectinata/Scirpus pungens) community reported in Montana (Bourgeron and Engelking 1994).

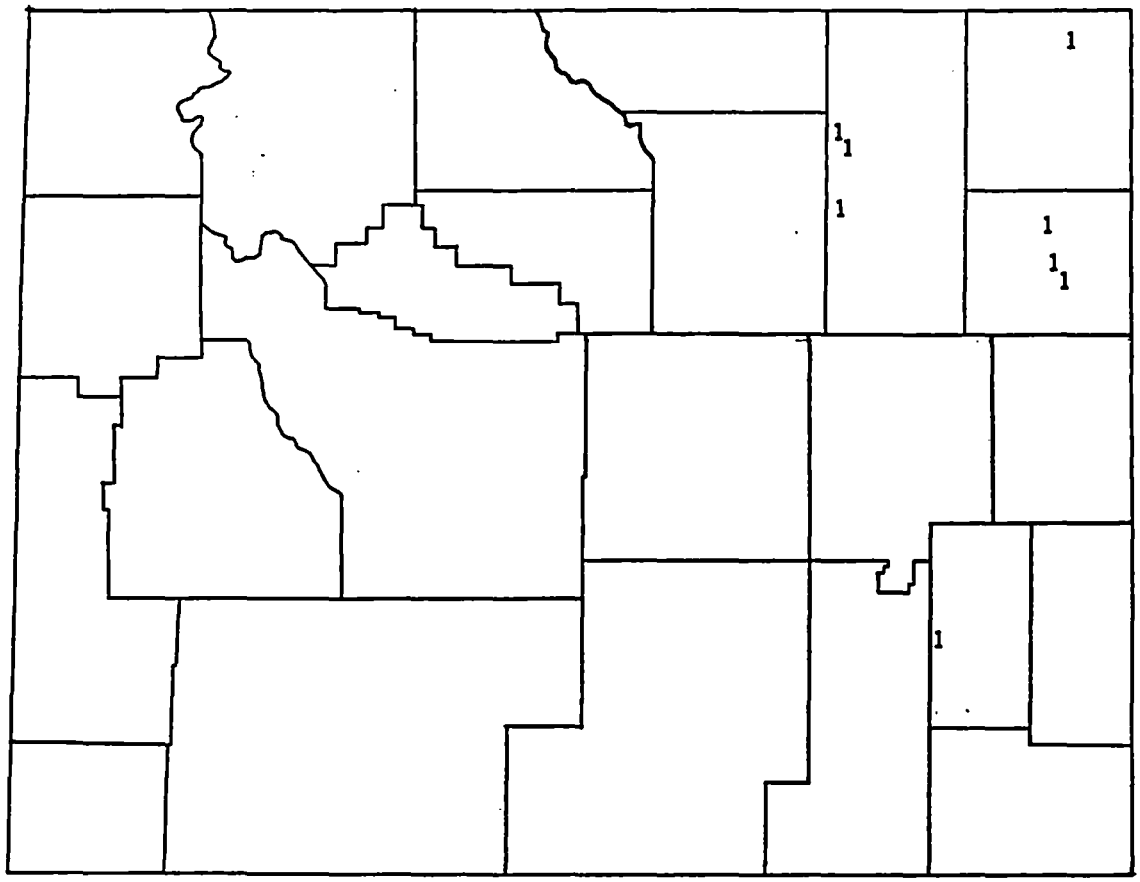
In the wetland habitat classification (Cowardin and others, 1979), stands of the prairie cordgrass community belong to the Palustrine System, Emergent Wetland Class, Persistent Subclass. In the ecological land classification framework (Driscoll and others, 1984), prairie cordgrass stands belong to the Herbaceous Vegetation Class, Tall Grassland Subclass, Tall Grassland Without a Woody Layer Group, Sod Grass Formation.

Our stands of prairie cordgrass grew on the following range sites (USDA Soil Conservation Service, 1988):

10-14" Northern Plains: Subirrigated
15-17" Northern Plains: Subirrigated

Figure 20. Map of Wyoming counties showing the approximate locations of sites with stands of the prairie cordgrass community.

Map Symbol	Vegetation Type
1	Prairie cordgrass community (8 stands)



Cattail (*Typha* sp.) Dominance Type

(3 stands sampled)

VEGETATION: Narrowleaf cattail (*Typha angustifolia*) or common cattail (*Typha latifolia*) dominated three stands in this study (Table 14). One stand had an equal amount of carpet bent grass (*Agrostis stolonifera*), and another stand had a fair amount of softstem bulrush (*Scirpus validus*) and wooly sedge (*Carex lanuginosa*).

ENVIRONMENT: Stands of the cattail dominance type occur on low-gradient streams, directly in small channels or adjacent to larger channels in wet mud. Soils are saturated loams or sandy loams.

LOCATION: Examples of cattail dominance type were found in southeastern Wyoming (Figure 21) at elevations ranging from 4,280 to 5,440 feet (Figure 3). The stands occurred directly in spring fed streams and also adjacent to the meandering North Platte River.

EXOTICS: Only a small amount of common watercress (*Rorippa nasturtium-aquaticum*) was present in one stand.

ADJACENT RIPARIAN COMMUNITIES: Softstem bulrush (*Scirpus validus*) and Nebraska sedge communities occupy slightly drier sites adjacent to cattail stands. Coyote willow (*Salix exigua*) may occur up or downstream from the cattail and adjacent to the channel. On higher terraces, peachleaf willow (*Salix amygdaloides*) or plains cottonwood (*Populus deltoides*) communities may be one of the adjacent riparian communities.

ECOLOGY: Cattails produce abundant, wind dispersed seed. This makes them quick colonizers of bare, wet mineral soils (Hansen and others, 1991). Cattails usually form single-species stands, but also occur with a few other species.

COMMUNITIES: More stands of cattail need to be located and sampled in order to identify the difference between communities of common cattail and narrowleaf cattail. Both community types are represented in the three stands of this cattail dominance type.

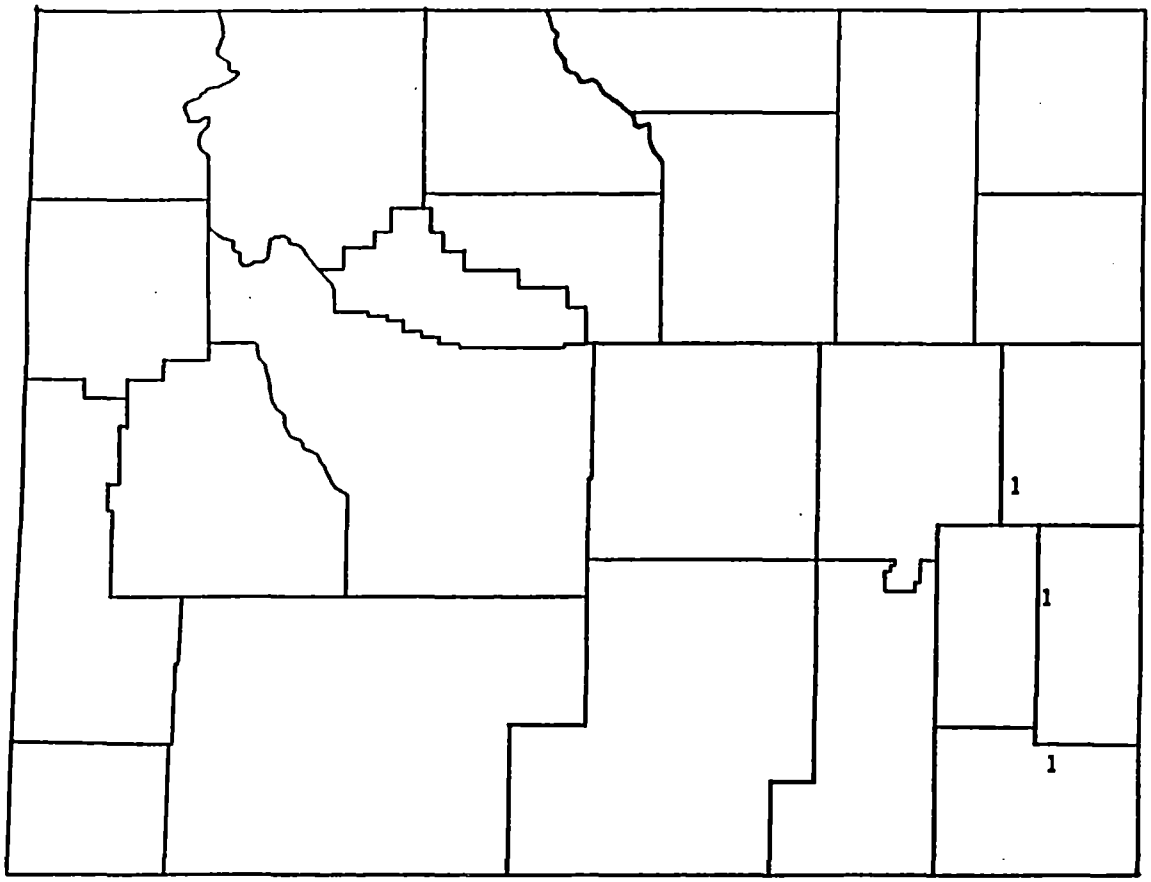
OTHER CLASSIFICATIONS: The common cattail habitat type is described for Montana below 6,500 feet (Hansen and others, 1991), and for Utah's Wasatch Mountains below 5,600 feet (Padgett and others, 1989). In the classification of wetland habitats by Cowardin and others (1979), cattail stands belong to the Palustrine System, Emergent Wetland Class, Persistent Subclass. In the ecological land classification framework (Driscoll and others, 1984), they belong to the Herbaceous Vegetation Class, Tall Grassland Subclass, Tall Grassland Without a Woody Layer Group, Sod Grass Formation. The sites where we found cattail

stands probably belong to the following range sites (USDA Soil Conservation Service, 1988):

10-14" Northern Plains: Wetland
12-14" Southern Plains: Wetland
15-17" Southern Plains: Wetland

Figure 21. Map of Wyoming counties showing the approximate locations of sites with stands of the cattail dominance type.

Map Symbol	Vegetation Type
1	Cattail dominance type (3 stands)



SHRUB PHYSIOGNOMIC TYPE

Stands placed in the shrub physiognomic type are those having less than 10% canopy cover of trees pole size or larger, and having more than 10% canopy cover of shrubs (taller than 1.6 feet) or dwarf shrubs (shorter than 1.6 feet). Stands of tree seedlings could be placed in the shrub physiognomic type, but in this classification we have placed them with the tree-dominated communities because they will grow into woodlands.

Shrub stands often occur as patches interspersed with herbaceous vegetation or with stands of trees. They commonly form ribbons near the stream channel, but they may grow on terraces above the channel.

Stands of our shrubland physiognomic type fit into several groups of the land classification framework of Driscoll and others (1984), as described below for each dominance type or community. Within the Classification of Wetlands and Deepwater Habitats of the United States (Cowardin and others, 1979) our stands belong to the Palustrine System. Stands with 30% or more canopy cover of shrubs and with less than 30% canopy cover of trees are classified in the Scrub-Shrub Wetland class. Stands with less than 30% canopy cover of shrubs and with herbaceous hydrophytes (plants growing in water) present are placed in the Emergent Wetland Class or the Vegetated Unconsolidated Shore Class.

Figure 22. Elevations of sites with plots in the shrub physiognomic type. Labels on the x-axis refer to the following dominance types:

SALEXI = Coyote willow
SYMOCC = Western snowberry
SHEARG = Silver buffaloberry
SARVER = Black greasewood
ARTCAN = Silver sagebrush
PRUVIR = Chokecherry

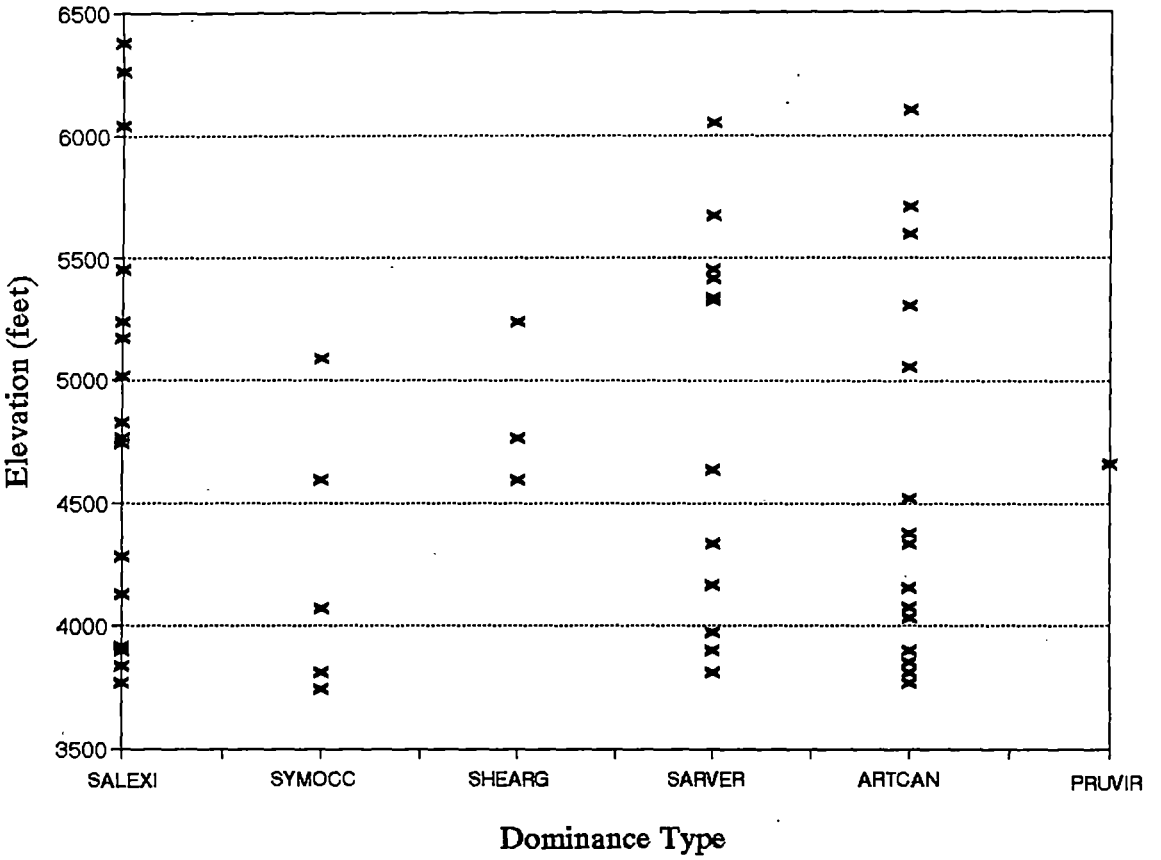


Figure 23. Square miles of drainage basin upstream from sites with plots of the shrub physiognomic type. Labels on the x-axis refer to the following dominance types:

SALEXI = Coyote willow
SYMOCC = Western snowberry
SHEARG = Silver buffaloberry
SARVER = Black greasewood
ARTCAN = Silver sagebrush
PRUVIR = Chokecherry

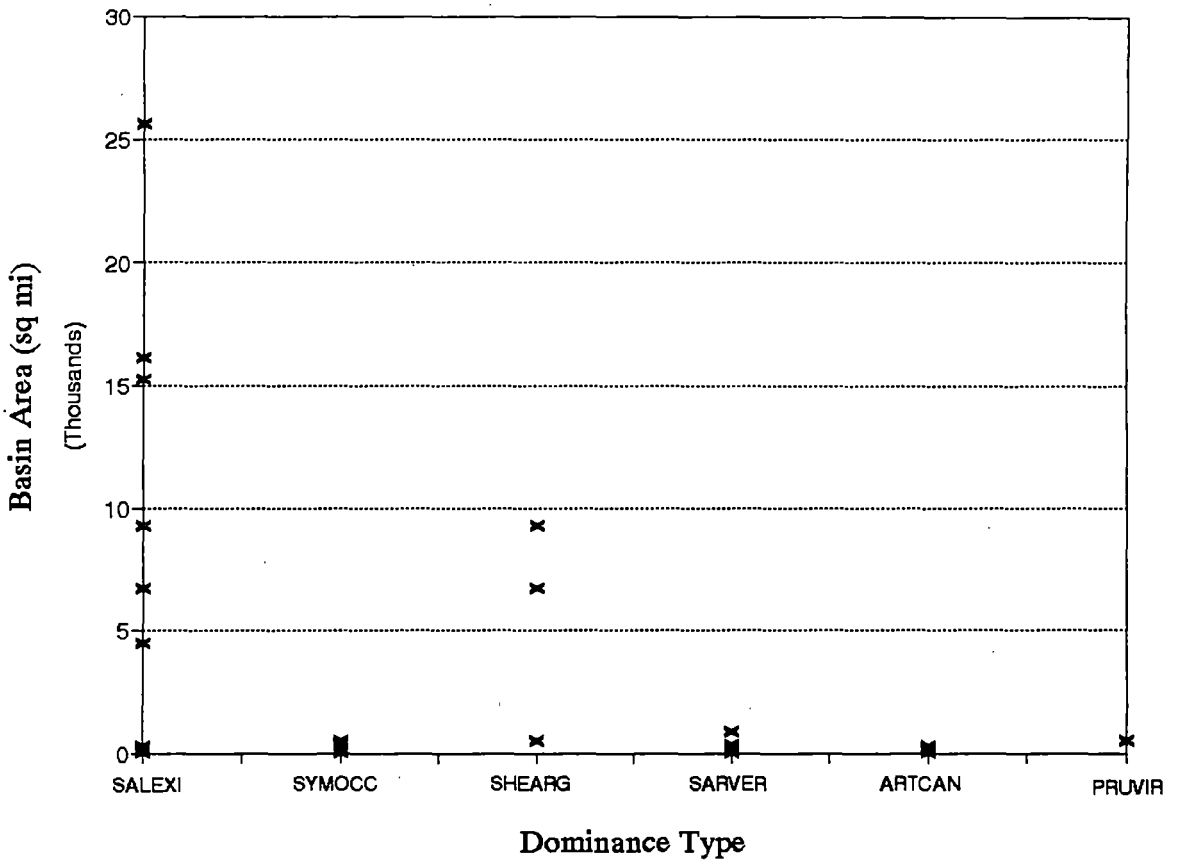


Figure 24. Widths of channels along which we sampled plots of the shrub physiognomic type. Labels on the x-axis refer to the following dominance types:

SALEXI = Coyote willow
SYMOCC = Western snowberry
SHEARG = Silver buffaloberry
SARVER = Black greasewood
ARTCAN = Silver sagebrush
PRUVIR = Chokecherry

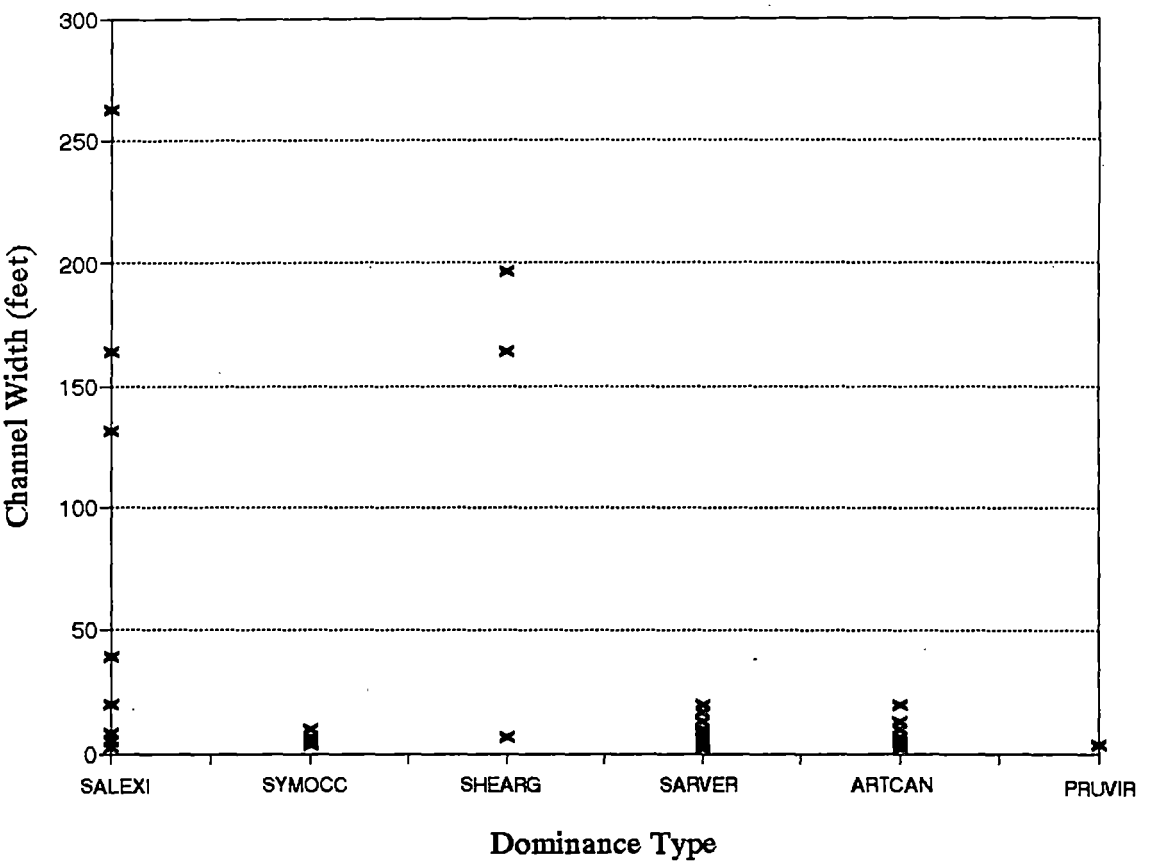


Figure 25. Distances in feet between plots of the shrub physiognomic type and the nearest active stream channel. Labels on the x-axis refer to the following dominance types:

SALEXI = Coyote willow
SYMOCC = Western snowberry
SHEARG = Silver buffaloberry
SARVER = Black greasewood
ARTCAN = Silver sagebrush
PRUVIR = Chokecherry

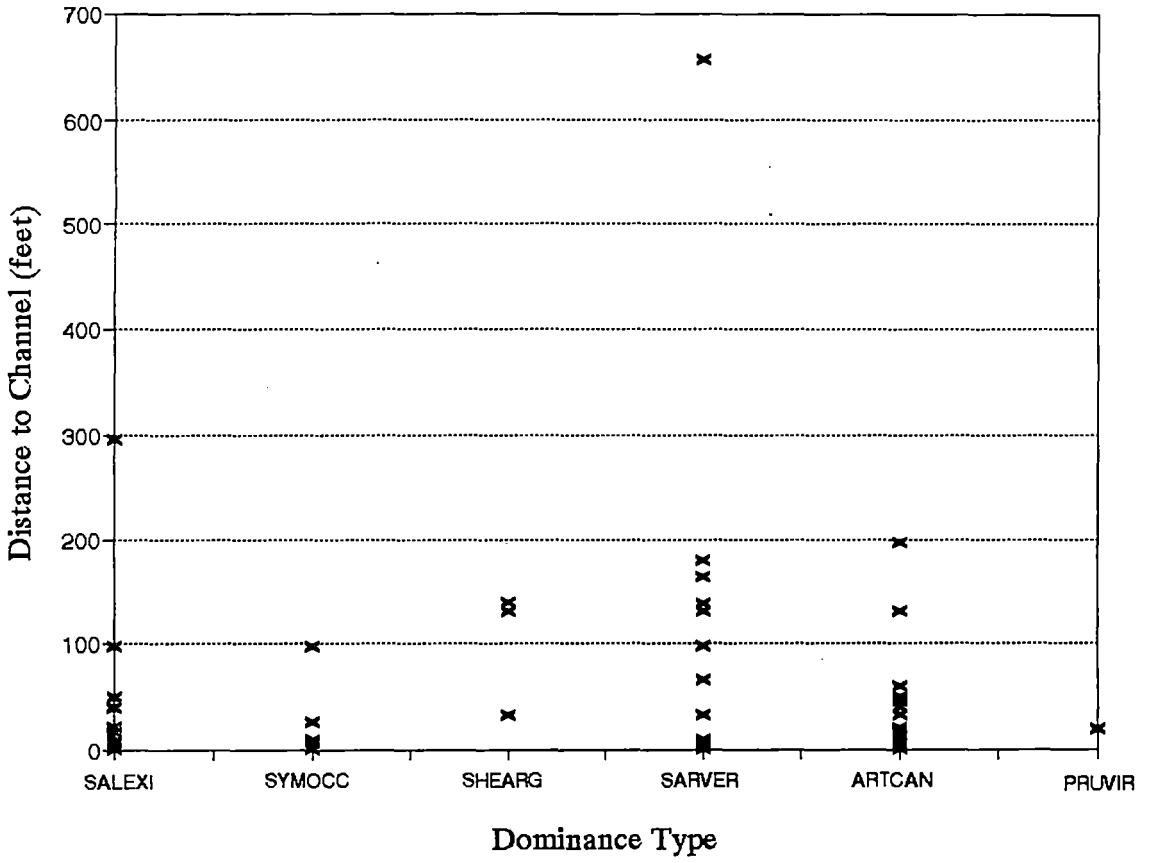


Figure 26. Heights of plots of the shrub physiognomic type above the nearest active stream channel. Labels on the x-axis refer to the following dominance types:

SALEXI = Coyote willow
SYMOCC = Western snowberry
SHEARG = Silver buffaloberry
SARVER = Black greasewood
ARTCAN = Silver sagebrush
PRUVIR = Chokecherry

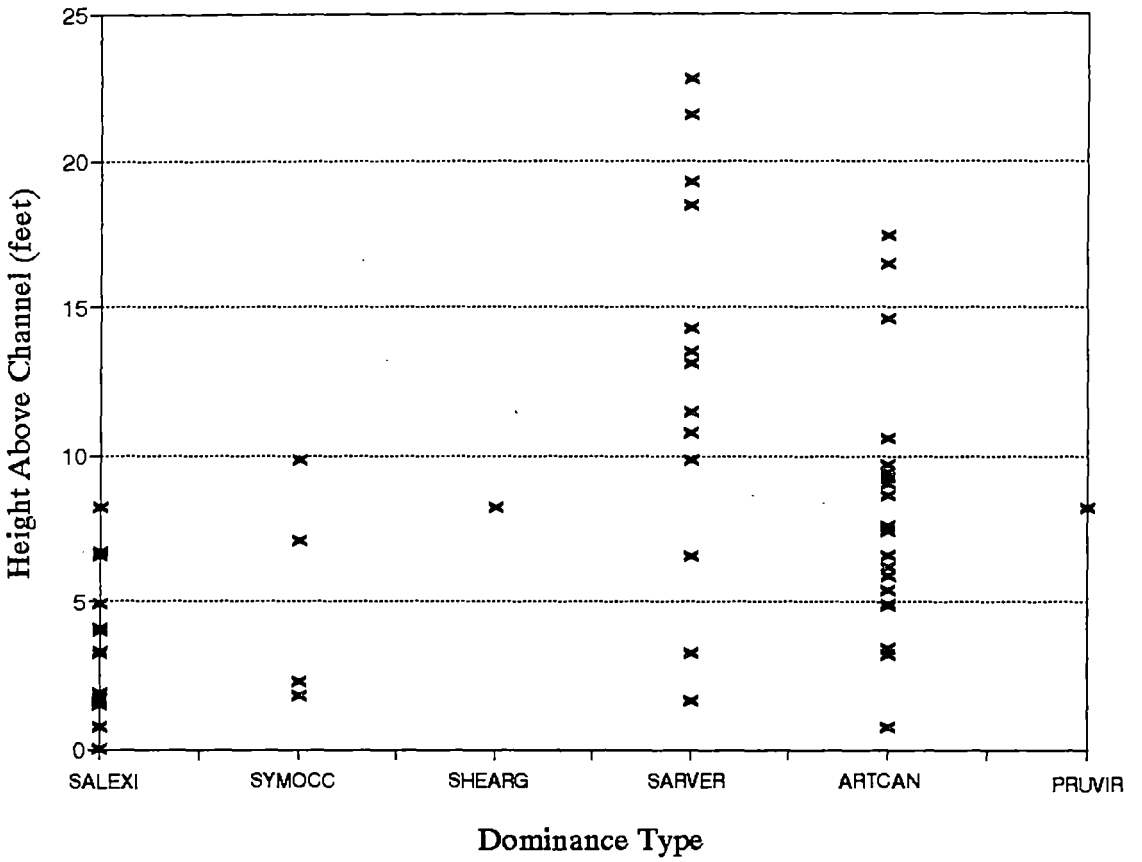


Figure 27. Depth of soil mottling (indicating a fluctuating water table) or gleying (indicating a high water table) beneath plots of the shrub physiognomic type. Labels on the x-axis refer to the following dominance types:

SALEXI = Coyote willow
SYMOCC = Western snowberry
SHEARG = Silver buffaloberry
SARVER = Black greasewood
ARTCAN = Silver sagebrush
PRUVIR = Chokecherry

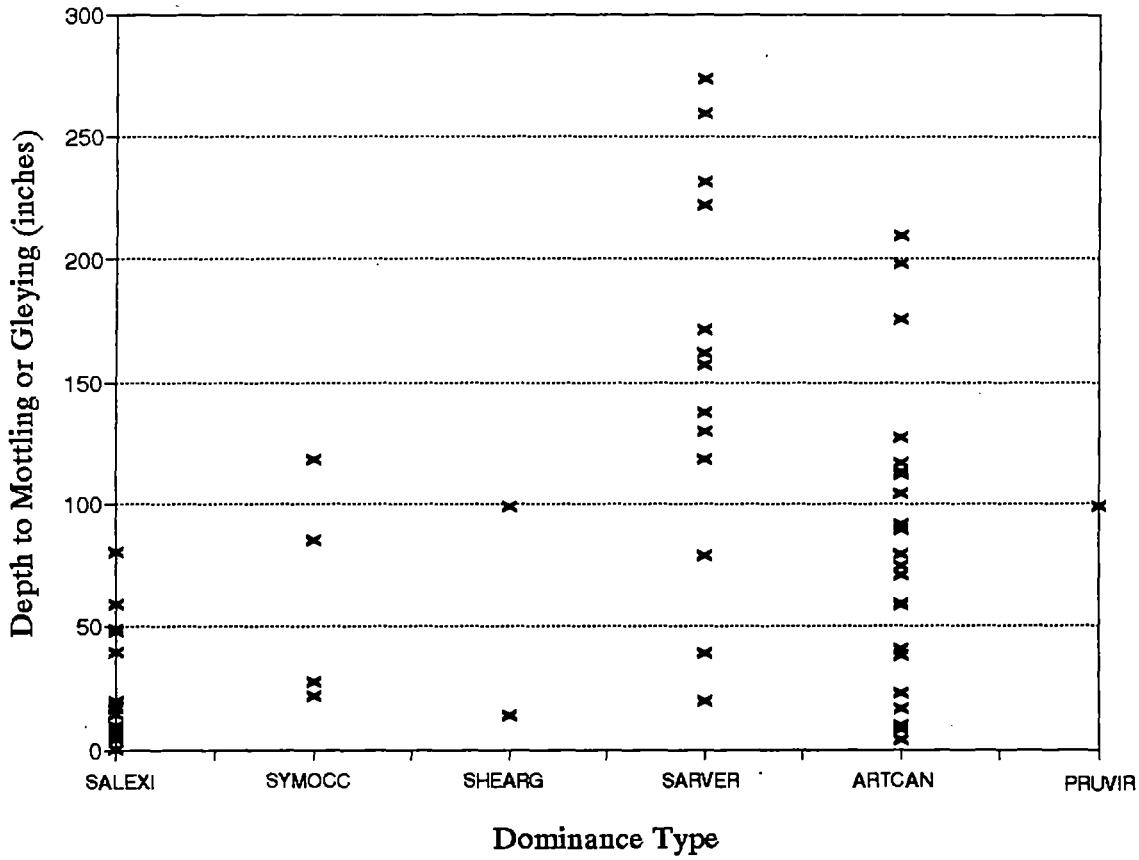


Figure 28. Maximum electrical conductivity (an indicator of salinity) in soils beneath plots of the shrub physiognomic type. Labels on the x-axis refer to the following dominance types:

SALEXI = Coyote willow
SYMOCC = Western snowberry
SHEARG = Silver buffaloberry
SARVER = Black greasewood
ARTCAN = Silver sagebrush
PRUVIR = Chokecherry

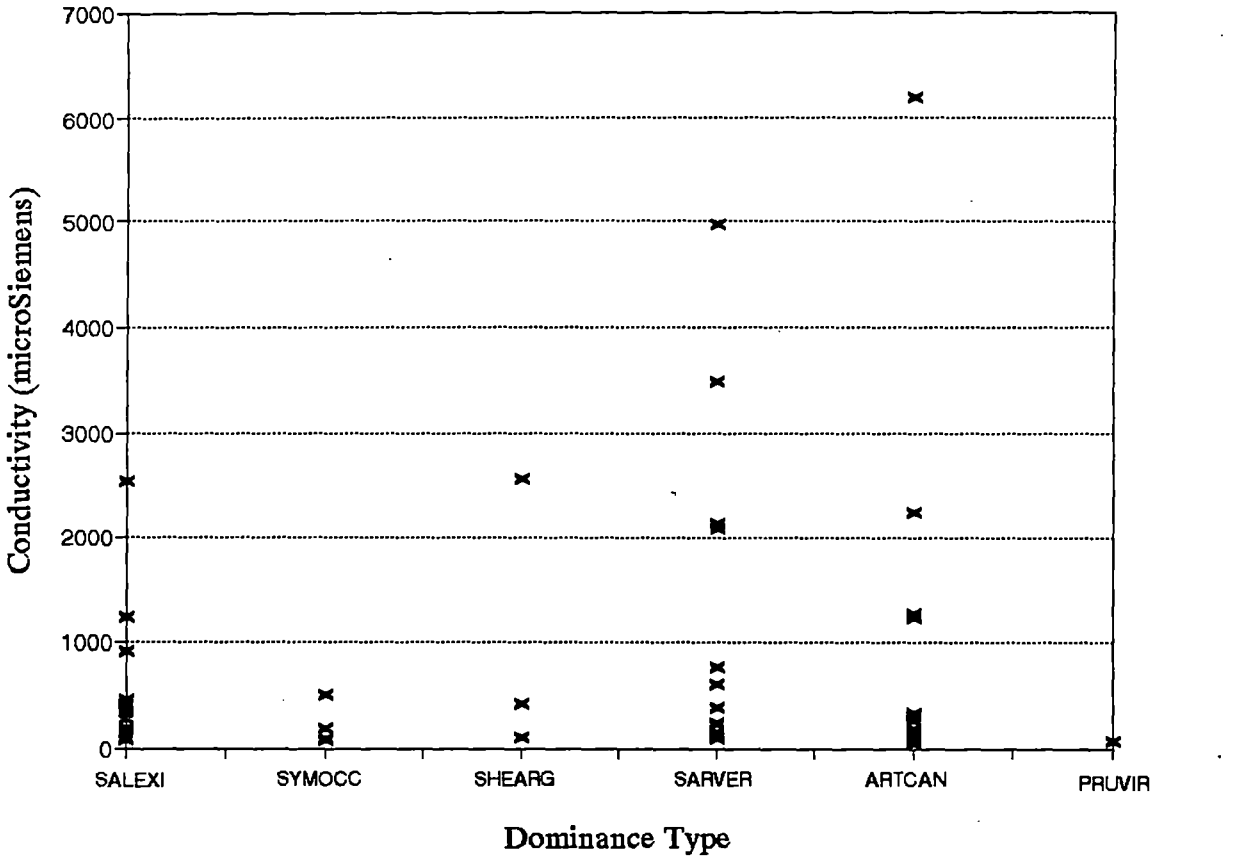
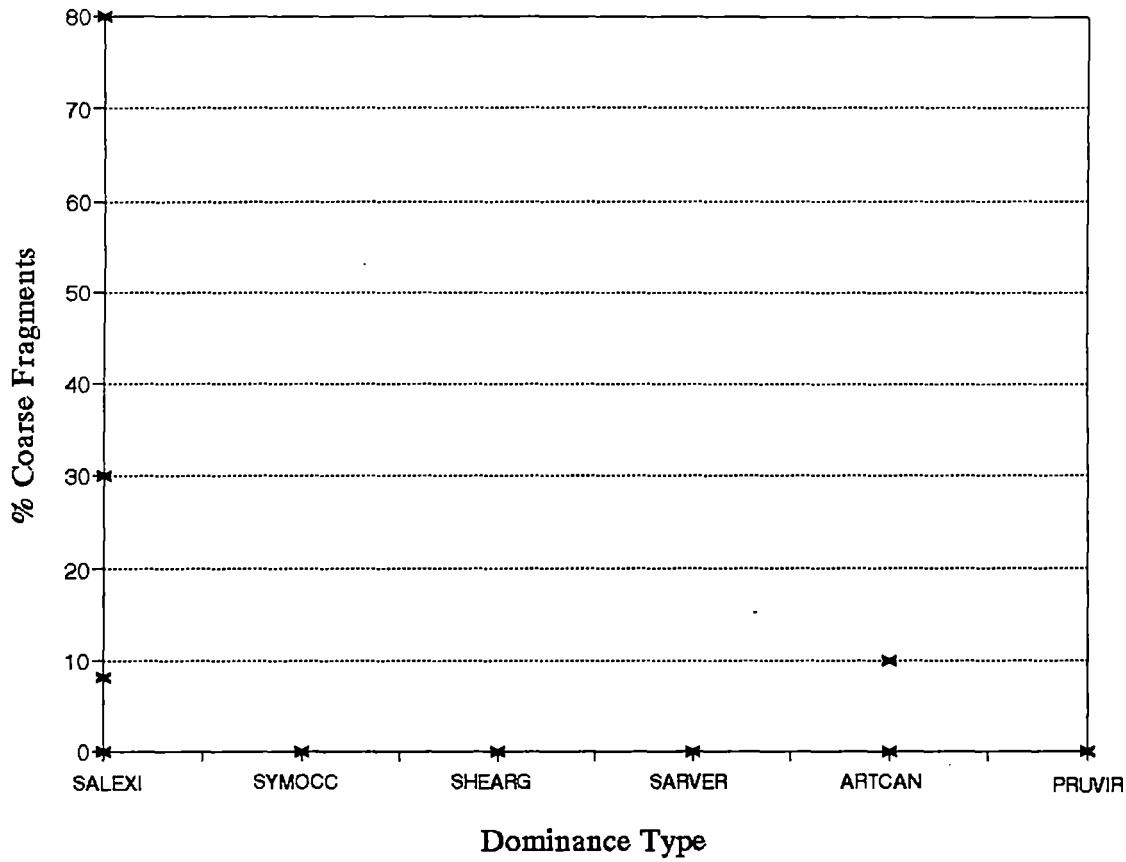


Figure 29. Percent by volume of coarse fragments (larger than 2 mm) in surface horizons of soils beneath plots of the shrub physiognomic type. Labels on the x-axis refer to the following dominance types:

SALEXI = Coyote willow
SYMOCC = Western snowberry
SHEARG = Silver buffaloberry
SARVER = Black greasewood
ARTCAN = Silver sagebrush
PRUVIR = Chokecherry



Basin Silver Sagebrush (Artemisia cana subsp. cana) Dominance Type

Basin silver sagebrush (Artemisia cana ssp. cana) dominates the shrub layer of this type and grasses dominate the herbaceous layer. Other shrubs which may occur in substantial amounts are black greasewood (Sarcobatus vermiculatus), western snowberry (Symphoricarpos occidentalis), and rubber rabbitbrush (Chrysothamnus nauseosus). Stands occur on terraces up to 16 feet (5 m) above the channel and usually within 60 feet (20 m) horizontal distance of the channel. Soils are usually clay or clay loam textures without coarse particles.

Besides dominating riparian shrub stands, basin silver sagebrush also forms upland shrub stands, especially on sandy soils. Because those stands are not associated with streams and do not occur on alluvial soils, we did not consider them to be riparian vegetation and did not sample them.

We describe one common community in the basin silver sagebrush dominance type.

Basin Silver Sagebrush/Western Wheatgrass (Artemisia cana/Elymus smithii) Community

(20 stands sampled)

VEGETATION STRUCTURE & COMPOSITION: Basin silver sagebrush dominates the shrub layer, which can be sparse (about 10% canopy cover) or dense (Table 15), and may grow as tall as 5 feet. Black greasewood (Sarcobatus vermiculatus) or rubber rabbitbrush (Chrysothamnus nauseosus) may be present in substantial amounts.

Western wheatgrass is always present and often dominates the herbaceous layer. In some stands, though, exotic species (especially Kentucky bluegrass or one of the annual brome grasses) dominate and western wheatgrass may contribute relatively little cover. Green needlegrass (Stipa viridula) is important in many stands. Two of our stands growing on soil with relatively high electrical conductivity (indicating relatively high salt content) had large amounts of inland saltgrass (Distichlis stricta), which is commonly found in saline soils.

LOCATION: This is a common community in eastern Wyoming (Figure 30) over a wide elevation range (Figure 22). The drainage basin area above stands of this type is small (Figure 23) and of low relief (usually less than 1000 feet).

ENVIRONMENT: The basin silver sagebrush/western wheatgrass community is found on terraces usually less than 16 feet above and 65 feet (20 m) from the channel (Figures 25 and 26). This community is often on the outer edge of the riparian zone unless a

black greasewood (Sarcobatus vermiculatus) stand occurs even farther from the channel.

SOIL: Most soils are homogeneous to 1.6 feet (50 cm) depth with a sandy clay, silty clay, clay loam, silty clay loam or sandy clay loam texture. Coarse particles are absent from the surface. Soil salinity may be relatively high, in which case the vegetation contains substantial amounts of inland saltgrass (Distichlis stricta) and black greasewood (Sarcobatus vermiculatus). The majority of our stands had relatively low salinity (Figure 28).

EXOTICS: The most abundant exotic plants are the grasses cheatgrass brome (Bromus tectorum), Kentucky bluegrass (Poa pratensis), and corn brome (Bromus squarrosus). Common exotic forbs found in small amounts are common dandelion (Taraxacum officinale), field pennycress (Thlaspi arvense), and flixweed tansymustard (Descurainia sophia).

ADJACENT RIPARIAN VEGETATION: The silver sagebrush/western wheatgrass community occurs with a variety of other communities. Types that commonly occur in or along the channel are prairie cordgrass (Spartina pectinata), alkali cordgrass (Spartina gracilis), western wheatgrass (Elymus smithii), creeping spikerush (Eleocharis palustris), leafy bulrush (Scirpus pungens), and coyote willow (Salix exigua). Plains cottonwood (Populus deltoides) and boxelder (Acer negundo) woodlands may grow closer to the channel than the silver sagebrush stands, or they may share the same terrace. Black greasewood (Sarcobatus vermiculatus) communities are the only communities which lie above and farther from the channel than the basin silver sagebrush/western wheatgrass community.

ECOLOGY: Western wheatgrass is a common grass on a variety of soils throughout the West (USDA Forest Service, 1937). It often forms a dense sod, and may be the only grass present on clay-rich soils. The species tolerates grazing well, but prolonged heavy grazing can reduce the cover of western wheatgrass and green needlegrass and allow less-palatable species -- Kentucky bluegrass, annual brome grasses, blue grama, common dandelion, western yarrow, sweetclover -- to increase (Hansen and Hoffman, 1988; Hansen and others, 1991).

Basin silver sagebrush/western wheatgrass stands often share riparian sites with plains cottonwood stands, and the silver sagebrush vegetation apparently replaces plains cottonwood stands as the cottonwoods die. One of our silver sagebrush/western wheatgrass stands contained a sparse stand of decadent cottonwoods, and a number of our plains cottonwood stands contained basin silver sagebrush and western wheatgrass. Our data suggest the following successional sequence: plains cottonwood seedlings become established on alluvial bars and grow into saplings, both of which form stands of the plains cottonwood -

recent alluvial bar community; floodwaters deposit sediment, raising the soil surface farther above the channel, allowing silver sagebrush and western wheatgrass to increase as the trees grow larger and the tree canopy opens up, and the vegetation changes to the plains cottonwood/western wheatgrass community; and finally the vegetation changes to the silver sagebrush/western wheatgrass community as the trees die and the shrub and grass cover increase. Consequently the basin silver sagebrush/western wheatgrass community is the climax community on sites that escape drastic disturbance like lateral cutting by streams. Hansen and others (1991) describe a similar sequence of replacement of cottonwood stands by silver sagebrush stands in Montana.

OTHER CLASSIFICATIONS: A silver sagebrush/western wheatgrass habitat type that supports a community of the same name has been described from northwestern North Dakota and southeastern Montana by Hansen and Hoffman (1988) and from central and eastern Montana by Hansen and others (1991).

In the classification of wetland and aquatic habitats (Cowardin and others, 1979), stands of the basin silver sagebrush/western wheatgrass community growing on hydric soils belong to the Palustrine System, Scrub-Shrub Wetland Class, Broad-Leaved Deciduous Subclass. In the interagency ecological land classification framework (Driscoll and others, 1984), they belong to the Shrubland Class, Deciduous Shrubland Subclass, Cold-Deciduous Shrubland Group, Deciduous Alluvial Shrubland Formation. This type occurs on the following range sites (USDA Soil Conservation Service, 1988):

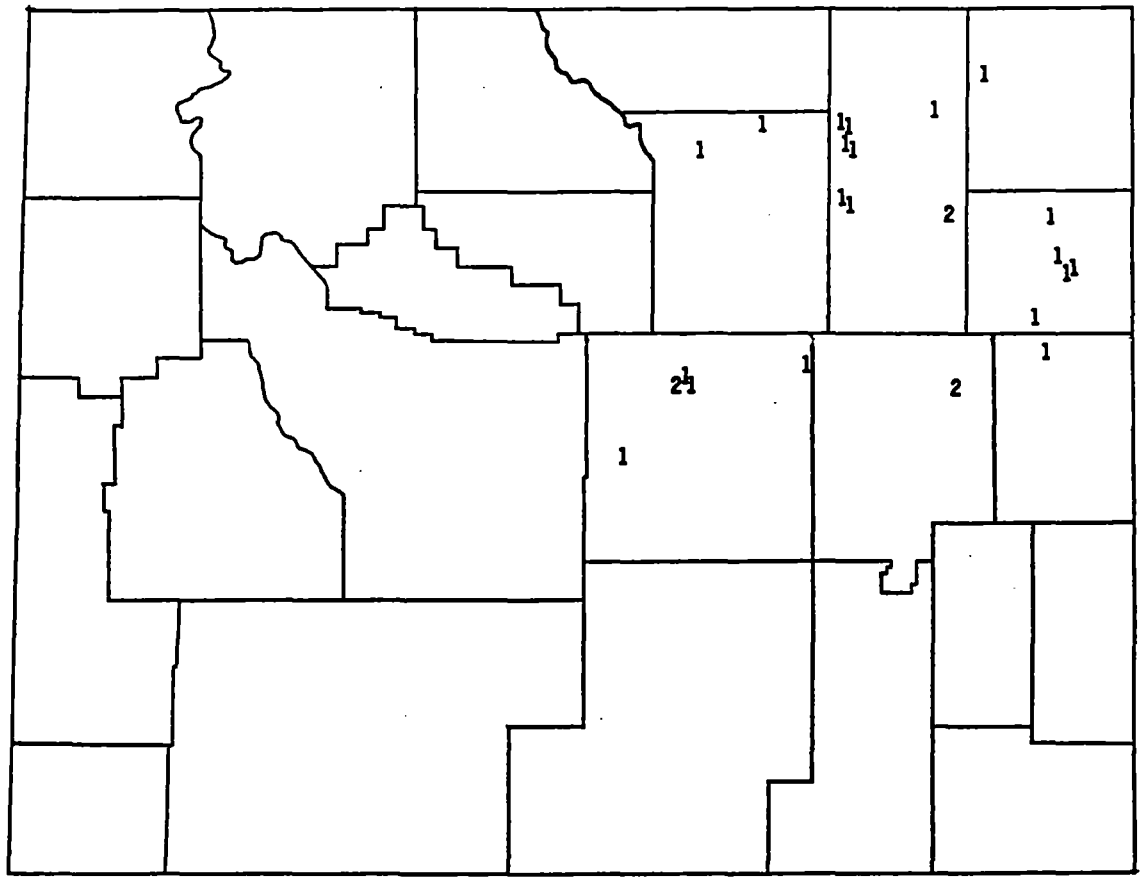
10-14" High Plains Southeast: Lowland, Loamy Overflow, Clayey Overflow
10-14" Northern Plains: Lowland, Overflow
15-17" Northern Plains: Lowland, Overflow, Clayey Overflow

Unclassified Basin Silver Sagebrush Stands

We sampled three stands in the basin silver sagebrush dominance type that we do not consider part of our basin silver sagebrush/western wheatgrass community or part of any other communities described in the literature (Figure 30). Two of the stands have basin silver sagebrush as the dominant shrub in low amounts (6-15% cover) with lower coverage of few other species (Table 15). One of these stands is the only silver sagebrush stand we sampled with a gravel and cobble soil surface. Both have sandy loam soils. The third stand has 50% coverage of basin silver sagebrush with some western snowberry occurring close to the channel. Slender wheatgrass (Elymus trachycaulus) is the dominant grass in the understory. All three stands are on low gradient, highly meandering channels. They are scattered widely in the northeastern part of the state (Figure 34).

Figure 30. Map of Wyoming counties showing the approximate locations of sites with stands of the basin silver sagebrush/western wheatgrass community and unclassified basin silver sagebrush stands.

Map	Vegetation Type
1	Basin silver sagebrush/western wheatgrass community (20 stands)
2	Unclassified basin silver sagebrush stands (3 stands)



Common Chokecherry (Prunus virginiana) Dominance Type

(1 stand sampled)

Although we only sampled one stand dominated by chokecherry, we are describing a common chokecherry dominance type because our stand resembles a chokecherry vegetation type described from Montana (Hansen and others, 1991), and because data from Wyoming stands described elsewhere suggest that a chokecherry type is widespread in Wyoming.

VEGETATION STRUCTURE & COMPOSITION: In our one stand, common chokecherry (Prunus virginiana) dominates a shrub layer five feet tall that contains a small amount of western snowberry (Symphoricarpos occidentalis) (Table 16). The sparse understory consists of poison ivy (Toxicodendron radicans) and smooth brome (Bromus inermis). The chokecherry vegetation at the site grows in patches along old channels.

LOCATION: We sampled the chokecherry stand at a site in Goshen County (Figure 31) along old channels near a meandering stream at 4660 feet elevation.

ENVIRONMENT: The chokecherry stand grew on a terrace 8 feet above and 30 feet from the active channel.

SOIL: The soil beneath the stand was a sandy loam to 1.5 feet below the surface. A recent flood had deposited alluvium on the soil surface.

EXOTICS: Smooth brome was common in the understory of the stand we sampled, and Canada thistle (Cirsium arvense) grew in the edges of the stand.

ADJACENT RIPARIAN VEGETATION: At the site where we found chokecherry vegetation, patches of shrubby boxelder (Acer negundo) and stands of scattered boxelder trees grew closer to the active channel, on the insides of meanders. The adjacent surfaces farther from the channel had been converted to hay meadows.

ECOLOGY: Common chokecherry grows on a variety of soils (USDA Forest Service, 1937). In undisturbed stands, chokecherry forms a thicket with few other species, but grazing and browsing open the stands up and allow other shrubs (hawthorns, snowberry, plums) and understory plants (especially Kentucky bluegrass and bedstraw, Galium spp.) to increase (Hansen and others, 1991). In eastern and central Montana, stands of common chokecherry may indicate disturbance on sites that support green ash/chokecherry or boxelder/chokecherry vegetation.

OTHER CLASSIFICATIONS: Hansen and others (1991) describe a common chokecherry community type from riparian sites throughout Montana.

In Wyoming, stands of the chokecherry dominance type have been sampled along streams at the northern base of Casper Mountain in Natrona County, growing in the riparian zone with stands of narrowleaf cottonwood (Wyoming Natural Diversity Database, unpublished data). Shrub layers in these stands contain hawthorn and snowberry. Chokecherry stands have also been described from streams in canyons on the west slope of the Bighorn Mountains, growing in riparian zones with narrowleaf cottonwood woodlands and boxelder woodlands (Wyoming Natural Diversity Database, unpublished data). Those stands often contain red-osier dogwood (Cornus sericea), water birch (Betula occidentalis), skunkbush sumac (Rhus trilobata), and swamp currant (Ribes lacustre) in the shrub layer, and bedstraw (Galium trifolium), and starry false Solomon's-seal (Maianthemum stellatum) in the understory.

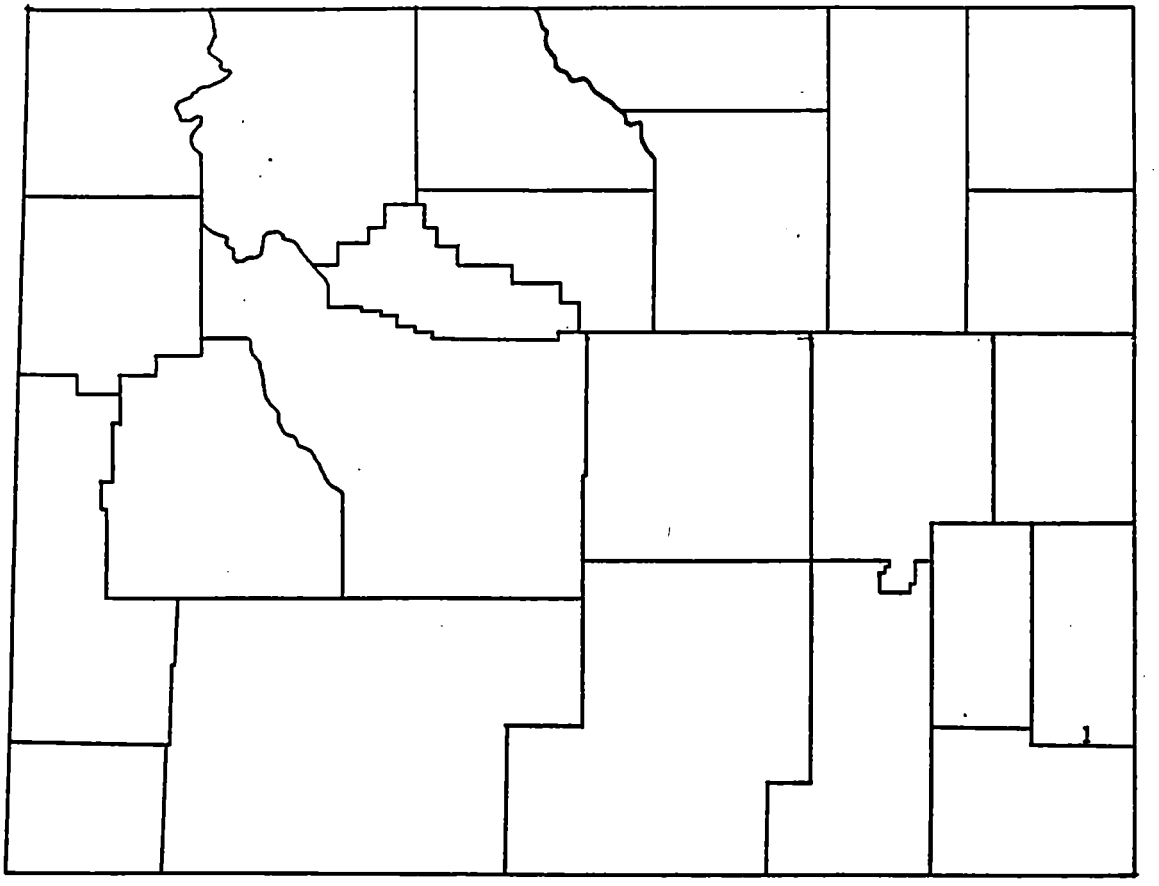
In the wetland habitat classification of Cowardin and others (1979), stands of the chokecherry dominance type growing in hydric soils belong to the Palustrine System, Scrub-Shrub Wetland Class, Broad-Leaved Deciduous Subclass. In the interagency ecological land classification framework (Driscoll and others, 1984), the chokecherry stands belong to the Shrubland Class, Deciduous Shrubland Subclass, Cold-Deciduous Shrubland Group, Deciduous Alluvial Shrubland Formation.

The chokecherry stand that we sampled in this study apparently grew on one of the following range sites (USDA Soil Conservation Service, 1988):

15-17" Southern Plains: Subirrigated or Loamy Overflow

Figure 31. Map of Wyoming counties showing the approximate locations of sites with stands of the common chokecherry dominance type.

Map Symbol	Vegetation Type
1	Common chokecherry dominance type (1 stand)



Coyote Willow (Salix exigua) Dominance Type

VEGETATION: Coyote willow is the dominant shrub of this type. Other shrubs occurring in significant amounts include western snowberry (Symphoricarpos occidentalis), and golden currant (Ribes aureum). Plains cottonwood (Populus deltoides) or peachleaf willow (Salix amygdaloides) seedlings or saplings may be present in small amounts. The understory of these stands can be sparse to moderately dense, and is usually composed of grasses of moist environments. In many stands, the herbaceous undergrowth species are primarily exotics.

Coyote willow stands are usually found next to the channel or separated from the channel by a narrow sedge or rush community. Most stands are less than 6 feet (2 m) above the channel.

We consider all of our stands to belong the coyote willow community/mesic grass community.

Coyote Willow/Mesic Grass (Salix exigua/Mesic Grass) Community

(9 stands sampled)

VEGETATION STRUCTURE & COMPOSITION: Coyote willow (or sandbar willow, Salix exigua), the dominant and often the only shrub in this community (Table 17), ranges in height from 6.5 to 16 feet (2-5 m). Occasional taller peachleaf willow trees (Salix amygdaloides) or three-foot-tall western snowberry (Symphoricarpos occidentalis) may occur with the coyote willow. The undergrowth consists of moderately-dense to dense grasses and sedges. Common tall species include Nebraska sedge (Carex nebrascensis), woolly sedge (Carex lanuginosa), prairie cordgrass (Spartina pectinata), and reed canarygrass (Phalaris arundinacea). Short species include carpet bent grass (Agrostis stolonifera), short awn foxtail (Alopecurus aequalis), Canada wild rye (Elymus canadensis), creeping spikerush (Eleocharis palustris), and various rushes (Juncus sp.). Forb cover is typically sparse.

The coyote willow/mesic grass community often occurs as narrow patches adjacent to the channel, but stands may also cover several hundred square yards.

LOCATION: We found stands of this community in the southeastern quarter of the state (Figure 32) at elevations from below 6400 feet to over 7000 feet (Figure 22).

ENVIRONMENT: Coyote willow/mesic grass stands are usually found next to the channel and on mid-channel bars (Figure 25). In one location a stand of tall shrubs also occurred 100 feet (30 m) from the channel. Stands lie at or slightly above the channel level, and on the first terrace up to 8 feet (2.5 m) above the channel (Figure 26).

SOIL: Coyote willow stands typically occur on sites with several soil horizons with a variety of textures, including sandy loam, sandy clay loam, silty clay loam, clay loam, and silty clay. Gravel and cobbles may lie on the soil surface. Electrical conductivity (an indicator of salinity) was low in most of our stands (Figure 28).

EXOTICS: Canada thistle (Cirsium arvense) was the most common exotic in our stands. Smooth brome (Bromus inermis) and Kentucky bluegrass (Poa pratensis) were occasionally present, and Kentucky bluegrass was the dominant understory species in one plot.

ADJACENT RIPARIAN VEGETATION: Coyote willow/mesic grass stands often are adjacent to sedge marsh, narrowleaf cattail, or softstem bulrush stands on saturated sites. Plains cottonwood woodlands, basin big sagebrush and greasewood, or silver buffaloberry occur on adjacent higher terraces.

ECOLOGY: Coyote willow becomes established on sparsely-vegetated bars and, unless maintained by repeated floods, eventually is replaced by other vegetation. The stands we studied probably will become grass stands as the willows die. The species readily sprouts if the stems are removed by grazing animals, as long as the grazing has not persisted so long that the root system is depleted of food reserves. Prolonged grazing or browsing can hasten the disappearance of the willows from a site, and by opening up the willow canopy, increase the cover of exotic weeds (Hansen and others, 1991).

OTHER CLASSIFICATIONS: The coyote willow/mesic grass community was described by Padgett and others (1989) from Utah and southeastern Idaho. It has also been found in western Colorado (Kittel 1993; Kittel and Lederer 1993). Hansen and others (1991) describe a sandbar willow (Salix exigua) community type from Montana which includes our coyote willow/mesic grass community.

In the wetland habitat classification of Cowardin and others (1979), our coyote willow/mesic grass community belongs to the Palustrine System, Scrub-Shrub Wetland Class, Broad-Leaved Deciduous Subclass. In the interagency ecological land classification framework (Driscoll and others, 1984), the community belongs to the Shrubland Class, Deciduous Shrubland Subclass, Cold-Deciduous Shrubland Group, Deciduous Alluvial Shrubland Formation. Stands apparently can occur on a variety of range sites (USDA Soil Conservation Service, 1988), including:

10-14" High Plains Southeast: Subirrigated
12-14" Southern Plains: Subirrigated
15-17" Southern Plains: Subirrigated
15-19" Mountains Southeast: Subirrigated
10-14" Northern Plains: Subirrigated
15-19" Northern Plains: Subirrigated

Unclassified Coyote Willow Stands

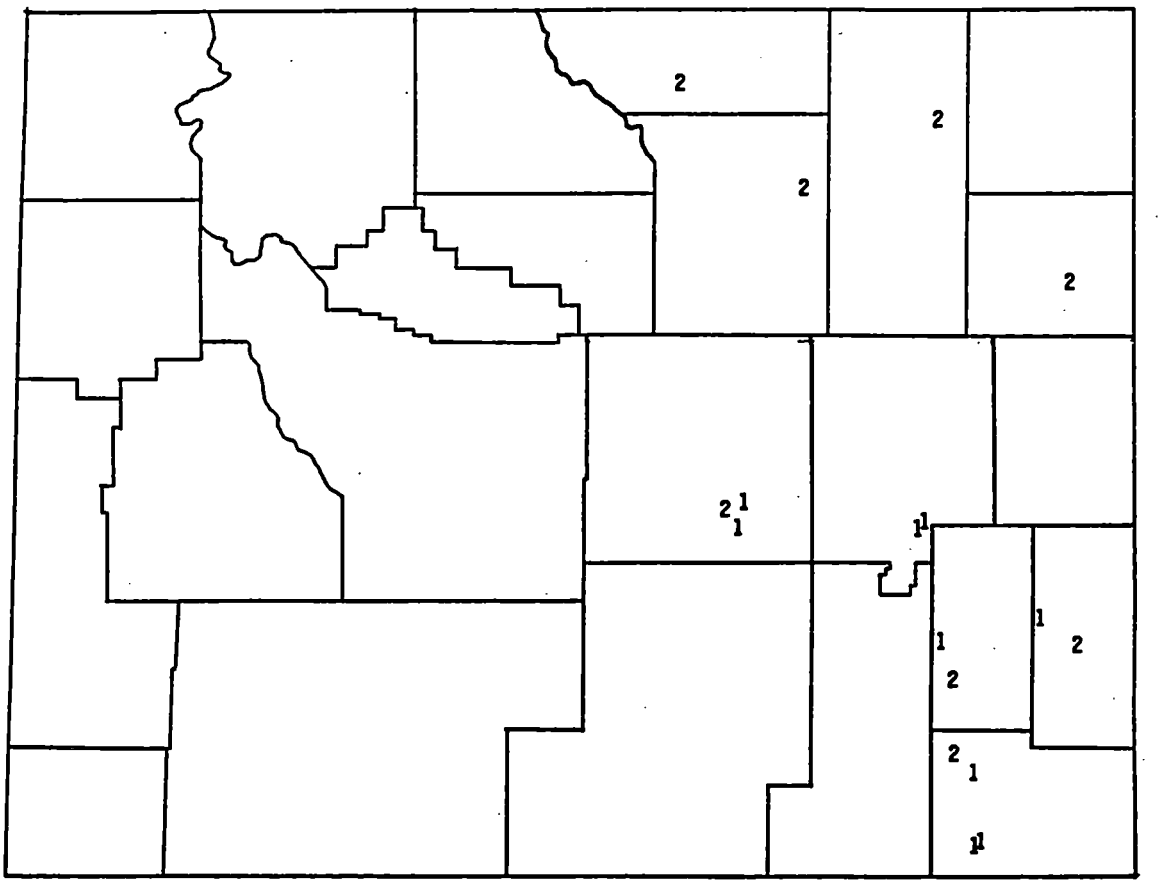
We found eight stands of coyote willow that did not fit into our coyote willow/mesic grass community and did not resemble other communities described in the literature (Figure 32). Understories in some of these stands were heavily dominated by exotic plants. These stands occurred throughout the eastern part of the state (Figure 30).

Three stands of the coyote willow dominance type were unique in their composition from the other stands sampled. One stand on the narrow, steep banks of an entrenched river had 6-foot-tall coyote willow with a dense western snowberry understory. A sand bar with 80% coarse material in the surface soil horizon was colonized by plains cottonwood saplings in addition to the dominant coyote willow. Another coyote willow stand (MCG111) contained scattered peachleaf willow saplings and had 30% coarse material in the surface horizon. As Hansen and others (1991) note, tree seedlings often become established with coyote willow, and the willow stands are replaced by tree stands as the slower-growing trees overtop and shade out the shrubs.

Five stands with coyote willow overstories had understories dominated by exotics and lacked mesic grass species. Chinese tamarisk (Tamarix chinensis) was present in one stand along Powder River.

Figure 32. Map of Wyoming counties showing the approximate locations of sites with stands of the coyote willow/mesic grass community and unclassified coyote willow stands.

Map Symbol	Vegetation Type
1	Coyote willow/mesic grass community (9 stands)
2	Unclassified coyote willow stands (8 stands)



Black Greasewood (Sarcobatus vermiculatus) Dominance Type

VEGETATION: Black greasewood dominates the shrub layer in stands of this type and may share dominance with basin big sagebrush (Artemisia tridentata ssp. tridentata). Other common shrubs are rubber rabbitbrush (Chrysothamnus nauseosus), silver sagebrush (Artemisia cana), and western snowberry (Symphoricarpos occidentalis). The understory is dominated by short grasses. Forbs are present in small amounts. Black greasewood stands generally occur on the highest riparian surface on the margin of the riparian area, adjacent to upland communities. Greasewood is able to grow in alkaline or saline soils. By producing taproots 20 to 55 feet in length, these shrubs can survive on surfaces up to 25 feet above the water table (Mozingo, 1987). The species reproduces primarily by adventitious buds on its roots.

We've named four riparian communities within the black greasewood dominance type.

Black Greasewood-Basin Big Sagebrush/Western Wheatgrass (Sarcobatus vermiculatus-Artemisia tridentata ssp. tridentata/ Elymus smithii) Community

(3 stands sampled)

VEGETATION STRUCTURE & COMPOSITION: Black greasewood and basin big sagebrush occur in nearly equal amounts (Table 18), creating an upper shrub layer as tall as 8 feet (2.5 m). Rubber rabbitbrush (Chrysothamnus nauseosus) provides less cover and is sometimes taller than the co-dominant shrubs. The lower shrub layer may have western snowberry (Symphoricarpos occidentalis) present.

The herbaceous layer is dominated by thickspike wheatgrass (Elymus lanceolatus) or western wheatgrass (Elymus smithii). These two species are difficult to distinguish from each other morphologically, and although they occupy somewhat different soils (USDA Forest Service, 1937) and differ slightly in palatability (USDA Forest Service, 1937; USDA Soil Conservation Service, 1988), we considered them to be ecological equivalents and grouped them together.

LOCATION: We sampled three stands of this community in central Wyoming (Figure 33) between 5400 and 5700 feet elevation on a perennial stream draining a small basin. Basin big sagebrush is a shrub primarily of western Wyoming (Beetle and Johnson, 1982), so this community only occurred at the edge of our study area.

ENVIRONMENT: Our three stands of black greasewood-basin big sagebrush/western wheatgrass vegetation occurred on terraces 3 feet (1 m) to 130 feet (40 m) from the channel and 1.5 feet (0.5 m) to 13 feet (4 m) above the channel.

SOIL: Soil horizons were consistently clay loam, sandy clay loam or silty clay loam to a depth of 1.6 feet (0.5 m). Electrical conductivity was only moderate, indicating moderate salinity. Soils showed neither mottling nor gleying within 1.6 feet (50 cm) of the surface (Figure 27), indicating that the water table seldom (if ever) comes close to the soil surface.

EXOTICS: Cheatgrass brome (Bromus tectorum) was present in all stands, usually in large amounts. Smooth brome (Bromus inermis) occurred in varying amounts.

ECOLOGY: Because stands of this community occur high above the stream channel, small changes in the depth to the water table are unlikely to have much effect on the vegetation. Changes in the vegetation are likely to come only from floods large enough to reach the higher surfaces or from changes in management. Hansen and others (1991) note that prolonged overgrazing reduces the amount of western wheatgrass and allows the annual brome grasses to increase.

ADJACENT RIPARIAN VEGETATION: At the sites where we found the greasewood-basin big sagebrush/western wheatgrass community, coyote willow (Salix exigua) stands or narrowleaf cottonwood (Populus angustifolia) stands with medium-sized and large trees grew closer to the channel.

OTHER CLASSIFICATIONS: A black greasewood/basin big sagebrush community found along drainages in the Pryor Mountains of south-central Montana (DeVelice and Lesica, 1993) is similar to our community but lacks the rubber rabbitbrush that averaged 16% cover in our stands. In Colorado, Baker (1984) identified an Artemisia tridentata ssp. tridentata-Sarcobatus vermiculatus/Elymus smithii shrub association that may be the same as our community.

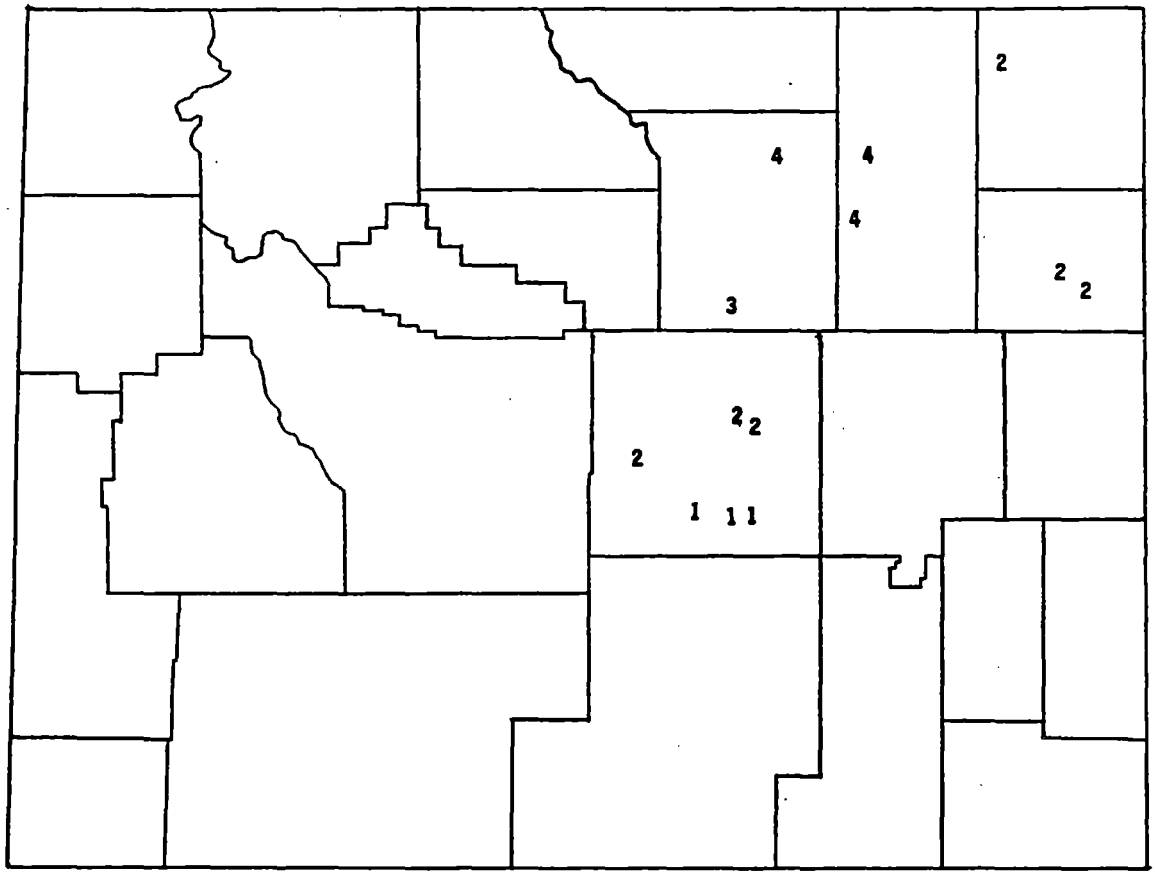
In the wetland habitat classification (Cowardin and others, 1979), stands of the black greasewood-basin big sagebrush community growing on hydric soils would belong to the Palustrine System, Scrub-Shrub Wetland Class, Broad-Leaved Deciduous Subclass. In the interagency ecological land classification framework (Driscoll and others, 1984), this community belongs to the Shrubland Class, Deciduous Shrubland Subclass, Cold-Deciduous Shrubland Group, Deciduous Alluvial Shrubland Formation.

Stands of this dominance type apparently can occur on the following range sites (USDA Soil Conservation Service, 1988):

5-9" Wind River Basin: Saline Lowland, Saline Lowland (drained)

Figure 33. Map of Wyoming counties showing the approximate locations of stands of communities in the black greasewood dominance type and of unclassified black greasewood stands.

Map Symbol	Vegetation Type
1	Black greasewood-basin big sagebrush/western wheatgrass community (3 stands)
2	Black greasewood/western wheatgrass community (6 stands)
3	Black greasewood/alkali dropseed community (1 stand)
4	Unclassified black greasewood stands (3 stands)



Black Greasewood/Western Wheatgrass (Sarcobatus vermiculatus/ Elymus smithii) Community

(6 stands sampled)

VEGETATION STRUCTURE & COMPOSITION: Black greasewood dominates a patchy shrub layer (Table 18) and ranges in height from 1.5 to 5 feet (0.5-1.5 m) tall. Sparse plains silver sagebrush (Artemisia cana spp. cana) may occur below the black greasewood. The herbaceous layer is usually sparse beneath the shrubs and dense between the shrub patches, and is dominated by western wheatgrass. Sandberg bluegrass (Poa secunda) and plains prickly pear cactus (Opuntia polyacantha) are usually present.

Stands of this community cover large areas on terraces.

LOCATION: We found examples of this community in Natrona, Weston, and Crook Counties (Figure 33) on low gradient, meandering streams in small drainage basins (Figure 23). Elevations of sites ranged from 3,810 feet to 6,050 feet (Figure 22).

ENVIRONMENT: Black greasewood/western wheatgrass stands are located on terraces at least 3.3 feet (1 m) above the channel (Figure 26). They may be on the first terrace adjacent to the channel or on the highest terrace 160 feet (50 m) from the channel (Figure 25).

SOIL: The stands we sampled grew on soils with clay, silty clay, sandy clay, and sandy clay loam horizons within 1.6 feet (0.5 m) of the soil surface. The highest salinity in the surface horizons we sampled occurred beneath a stand of this community, and half the stands we sampled grew on soils with considerable amounts of salt (Figure 28).

EXOTICS: Cheatgrass brome (Bromus tectorum) and Japanese brome (Bromus japonicus) are common exotic grasses. Common dandelion (Taraxacum officinale) is found in small amounts.

ADJACENT RIPARIAN VEGETATION: Western wheatgrass (Elymus smithii), baltic rush (Juncus balticus), or inland saltgrass (Distichlis stricta) stands typically occur at lower levels, between the black greasewood/western wheatgrass stand and the channel. In broad riparian zones, silver sagebrush/western wheatgrass vegetation may also lie between the black greasewood/western wheatgrass stand and the channel.

ECOLOGY: According to Hansen and others (1991), prolonged heavy grazing in this community reduces the amount of western wheatgrass and allows annual brome grasses to increase. Heavy spring and summer grazing can decrease the canopy cover of black greasewood.

OTHER CLASSIFICATIONS: This type has been described from Wyoming's Bighorn Basin (Hamner 1964; Olson and Gerhart 1982), Wind River Basin (Olson and Gerhart 1982), Cheyenne River Basin (Thilenius and Brown 1990), Laramie Basin, and Hanna Basin. It is also found in central, eastern and southwestern Montana (Mueggler and Stewart 1980; Hansen and Hoffman 1988).

In the wetland habitat classification (Cowardin and others, 1979), stands of the black greasewood/western wheatgrass community growing on hydric soils belong to the Palustrine System, Scrub-Shrub Wetland Class, Broad-Leaved Deciduous Subclass. In the interagency ecological land classification framework (Driscoll and others, 1984), this community belongs to the Shrubland Class, Deciduous Shrubland Subclass, Cold-Deciduous Shrubland Group, Deciduous Alluvial Shrubland Formation.

We found stands of this community on the following range sites (USDA Soil Conservation Service, 1988):

10-14" High Plains Southeast: Saline Lowland
15-17" Northern Plains: Saline Lowland

Black Greasewood/Alkali Dropseed (Sarcobatus vermiculatus/ Sporobolus airoides) Community
(1 stand sampled)

VEGETATION STRUCTURE & COMPOSITION: Black greasewood dominates a sparse shrub overstory (Table 18) and plains silver sagebrush (Artemisia cana spp. cana) occurs in small amounts. Alkali dropseed forms the herbaceous understory with some western wheatgrass (Elymus smithii), blue grama grass (Bouteloua gracilis), and prickly pear cactus (Opuntia polyacantha).

LOCATION: We sampled one stand of this previously-described community on a perennial draw in the Powder River Basin of Johnson County at 4,630 feet elevation (Figure 33). The channel drains a small basin and is controlled upstream by a small dam.

ENVIRONMENT: Our single stand was located on the first terrace 6.5 feet (2 m) above the channel.

SOIL: Soil texture beneath our stand was silty clay loam to a depth of 1.6 feet (0.5 m). Neither gleying nor mottling were evident at this depth (Figure 27), indicating that the water table seldom comes close to the soil surface. Electrical conductivity, an indicator of soil salinity, was relatively low in this stand.

EXOTICS: Kochia (Kochia scoparia) was present with 3% cover. A small amount of Japanese brome (Bromus japonicus) and clasping pepperweed (Lepidium perfoliatum) were also present.

ADJACENT RIPARIAN VEGETATION: A western wheatgrass (Elymus smithii) stand with substantial amounts of American licorice (Glycyrrhiza lepidota) grew along the stream banks up to the terrace with the greasewood.

OTHER CLASSIFICATIONS: This community has been described from the Powder River Basin (Terwilliger and others, 1979) where stands occur on sites near streams and playas. The soils are clay loams high in soluble salts other than sodium. It has also been reported from south-central Wyoming growing on saline lowland range sites along the upper North Platte River and the Sweetwater River (Warren, no date).

In the classification of wetland and aquatic habitats (Cowardin and others, 1979), stands of this community growing on hydric soils belong to the Palustrine System, Scrub-Shrub Wetland Class, Broad-Leaved Deciduous Subclass. In the interagency ecological land classification framework (Driscoll and others, 1984), this community belongs to the Shrubland Class, Deciduous Shrubland Subclass, Cold-Deciduous Shrubland Group, Deciduous Alluvial Shrubland Formation.

The single stand of this community that we sampled occurred on the following range site (USDA Soil Conservation Service, 1988):

10-14" Northern Plains: Saline Lowland

Unclassified Black Greasewood Stands

We sampled three black greasewood stands in the Powder River Basin (Figure 33) that do not fit into any of the communities that we describe or into communities described in other studies (Table 18). One stand had an understory dominated by alkali bluegrass (Poa juncifolia). The other two stands had understories dominated by exotic plants, primarily Japanese brome (Bromus japonicus). Both stands were on high terraces with clay soils to at least 1.3 feet (40 cm) below the surface. They may represent disturbed stands of the black greasewood/western wheatgrass community, in which the annual brome has increased at the expense of the western wheatgrass, as suggested by Hansen and others (1991).

Silver Buffaloberry (Shepherdia argentea) Dominance Type

(3 stands sampled)

VEGETATION AND STRUCTURE: Silver buffaloberry dominates the upper shrub layer at 11 feet (3.3 m) in height (Table 19). The lower shrub layer is commonly occupied by western snowberry (Symphoricarpos occidentalis). The shrubs usually grow in dense, narrow bands parallel to the channel, and the undergrowth beneath the shrubs is sparse. Openings between the shrub patches may have dense herbaceous layers dominated by a mix of native and exotic grasses and rushes.

LOCATION: We sampled three stands in the southeastern quarter of Wyoming (Figure 34) at 4500 to 5300 feet elevation (Figure 22). These stands were along low gradient, perennial or intermittent streams.

ENVIRONMENT: We found stands of silver buffaloberry on the first terrace 8 feet (2.5 m) above the channel (Figure 26) and 30 feet to 140 feet from the channel.

SOIL: Soil horizons were of sandy loam, silty loam, sandy clay loam, or silty clay loam texture.

EXOTICS: Canada thistle (Cirsium arvense), sweetclover (Melilotus sp.), and common burdock (Arctium minus) are common exotic forbs usually found in small amounts, although they may contribute substantial cover. Common (and sometimes abundant) exotic grasses include smooth brome (Bromus inermis), Kentucky bluegrass (Poa pratensis), meadow fescue (Festuca pratensis), and cheatgrass brome (Bromus tectorum).

ADJACENT RIPARIAN VEGETATION: Silver buffaloberry stands are often separated from the channel by coyote willow (Salix exigua) stands. Plains cottonwood (Populus deltoides) stands, narrowleaf cottonwood (P. angustifolia) stands, or boxelder (Acer negundo) stands often occur next to silver buffaloberry stands on the same surface.

ECOLOGY: Silver buffaloberry is common along streams and moist terraces where soil is only moderately saline (Mozingo 1987). The shrub may also occur in non-riparian sites such as moist hillsides or valleys (Hansen and others, 1991). Hansen and others (1991) state that silver buffaloberry stands are grazing-induced or browsing-induced stages of green ash or boxelder woodlands, but we found no evidence that our stands were formerly woodlands. Repeated heavy use opens the silver buffaloberry layer and allows western snowberry to form a denser, lower shrub layer.

OTHER CLASSIFICATIONS: Our silver buffaloberry dominance type resembles the thorny buffaloberry (Shepherdia argentea) community

type described for southwestern, central, and eastern Montana (Hansen and others, 1991). A silver buffaloberry community has also been described from the Yampa River Basin of Colorado (Kittel and Lederer 1993), but it differs from our community in having an understory dominated by basin wildrye (Elymus cinereus).

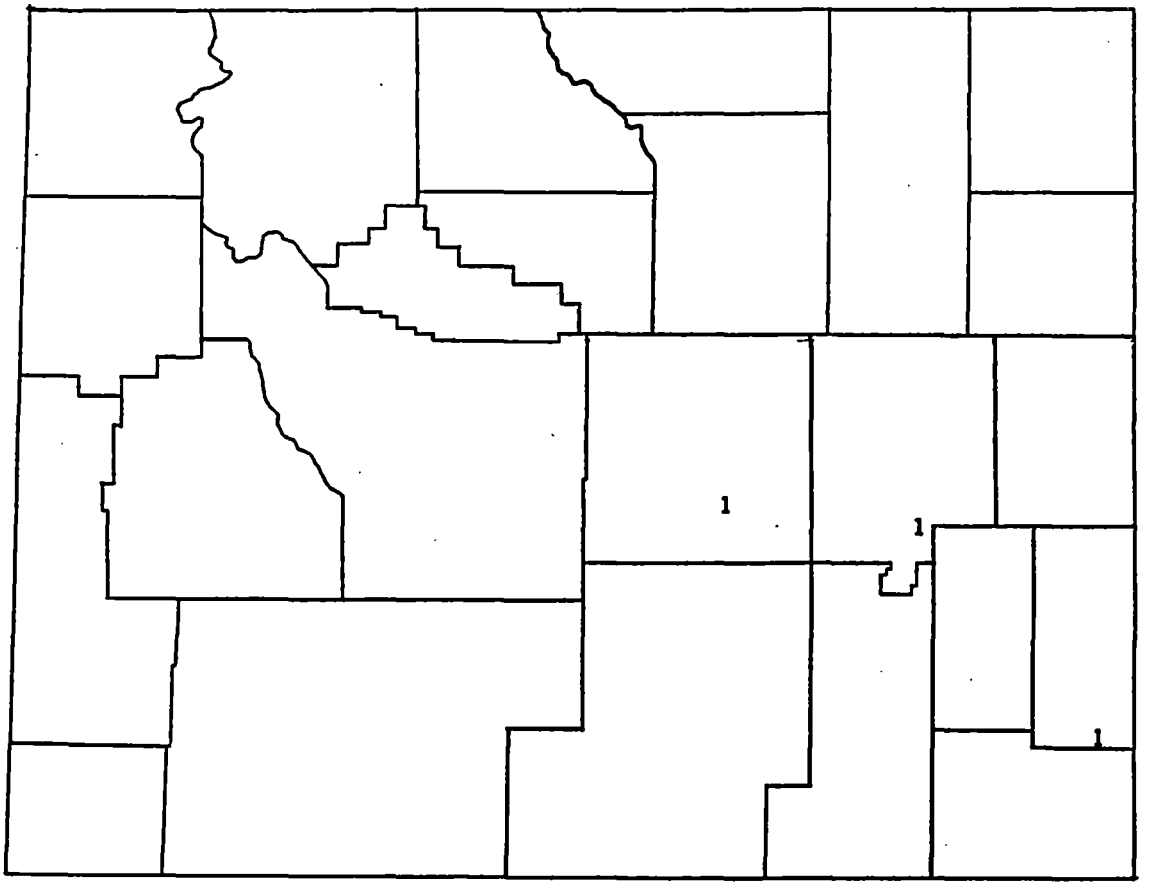
In the classification of wetland habitats (Cowardin and others, 1979), our silver buffaloberry dominance type belongs to the Palustrine System, Scrub-Shrub Wetland Class, Broad-Leaved Deciduous Subclass. In the interagency ecological land classification framework (Driscoll and others, 1984), the silver buffaloberry dominance type belongs to the Shrubland Class, Deciduous Shrubland Subclass, Cold-Deciduous Shrubland Group, Deciduous Alluvial Shrubland Formation.

Stands of this dominance type apparently can occur on the following range sites (USDA Soil Conservation Service, 1988):

10-14" High Plains Southeast: Subirrigated
15-17" Southern Plains: Subirrigated, Saline Subirrigated
10-14" Northern Plains: Subirrigated

Figure 34. Map of Wyoming counties showing the approximate locations of stands of the silver buffaloberry dominance type.

Map Symbol	Vegetation Type
1	Silver buffaloberry dominance type (3 stands)



Western Snowberry (Symphoricarpos occidentalis) Dominance Type

(5 stands sampled)

VEGETATION: Western snowberry (Symphoricarpos occidentalis) forms a moderately-dense to dense shrub layer over 1.5 feet tall (Table 20). Rose usually is present in small amounts. One of our stands contained substantial cover of green ash (Fraxinus pennsylvanica) and boxelder (Acer negundo) saplings in the shrub layer and green ash seedlings in the understory, and another had a sparse overstory of boxelder and green ash poles. Understories may be sparse or moderately dense and they vary in composition. Dominant understory species in our stands included Virginia wildrye (Elymus virginicus), American licorice (Glycyrrhiza lepidota), crested wheatgrass (Agropyron cristatum), cheatgrass (Bromus tectorum), Canada bluegrass (Poa compressa), and Kentucky bluegrass (Poa pratensis).

Because we could discern no vegetation differences between stands that correspond to environmental differences, we did not identify any communities, but placed all of the stands into a snowberry dominance type.

LOCATION: We found western snowberry stands in the northern and the southeastern parts of our study area (Figure 35) within an elevation range of 3,745 to 5,090 feet (Figure 22). Sites were found primarily on intermittent creeks with small drainage basins (Figure 23).

ENVIRONMENT: Stands of western snowberry typically are found on the first terrace above the floodplain, 1.5 to 10 feet (0.5-3 m) above low-gradient channels (Figure 26).

SOIL: The upper soil horizon is fairly thick (1.5 feet, or 45 cm) unless the site has recently been flooded, in which case a thin layer of fine sand forms the surface horizon. The soil horizon textures are typically sandy clay loam, clay loam, or silty clay. Soils usually have low electrical conductivity (Figure 28), indicating little salt.

EXOTICS: Japanese brome (Bromus japonicus) and Kentucky bluegrass (Poa pratensis) may be present in substantial amounts. A large quantity of Canada bluegrass (Poa compressa) dominated the understory of one stand.

ADJACENT RIPARIAN VEGETATION: Stands of the western snowberry community may be adjacent to plains cottonwood (Populus deltoides) stands on the same or a higher surface, to silver buffaloberry (Shepherdia argentea) stands on the same surface, and to western wheatgrass stands (Elymus smithii) on lower surfaces.

ECOLOGY: Western snowberry sprouts from the roots and rhizomes and so can form dense stands that exclude other species. With heavy browsing, the shrub layer may open up and cheatgrass, Kentucky bluegrass, western wheatgrass (Elymus smithii), and western yarrow (Achillea millefolium) increase in the understory (Hansen and others, 1991).

Hansen and others (1991) report that some stands of snowberry in Montana are disturbance-induced vegetation growing on sites that can support green ash/chokecherry vegetation or boxelder/chokecherry vegetation, while others represent the potential vegetation of the site. One of our stands contained small boxelder trees and saplings of boxelder and green ash, suggesting that it could eventually become a tree stand with a snowberry understory, but the other stands contained no trees. As Hansen and others point out, whether a snowberry stand will eventually give way to a boxelder or ash woodland depends on the characteristics of the site.

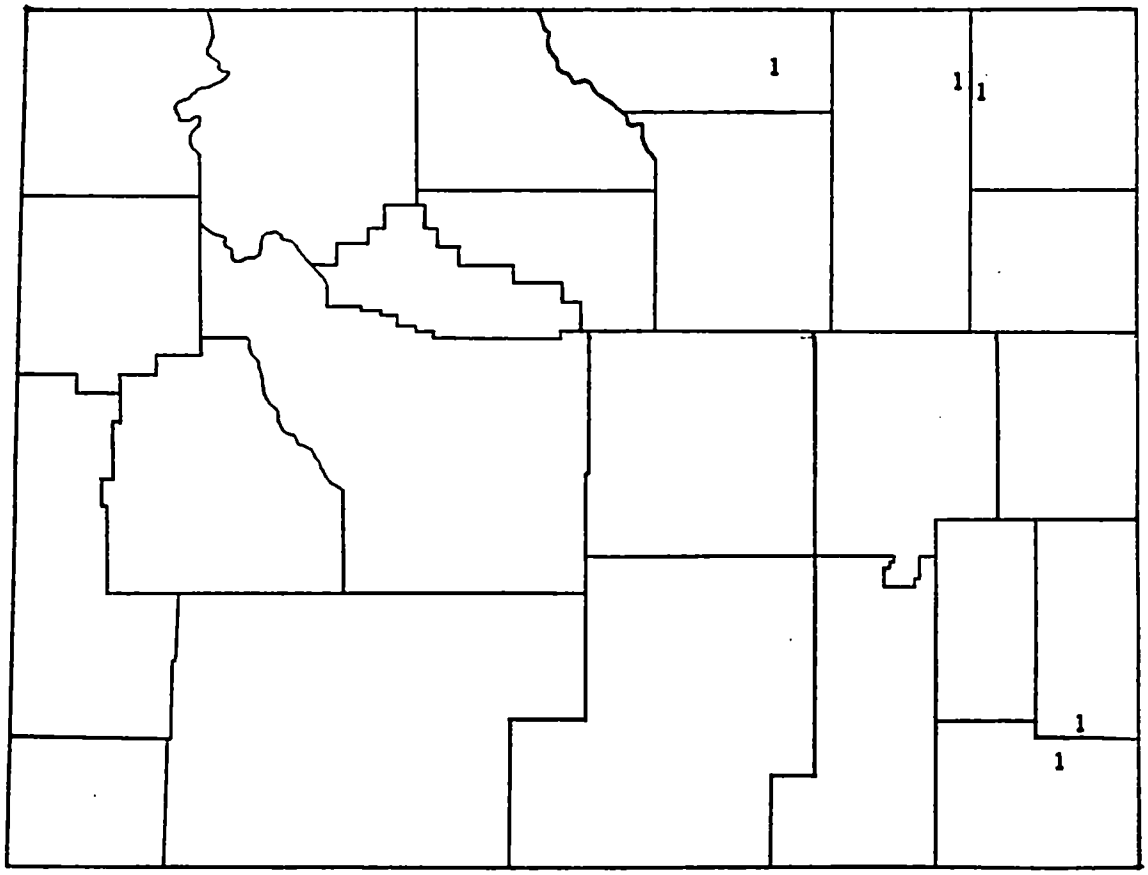
OTHER CLASSIFICATIONS: Hansen and others (1991) describe a riparian western snowberry community type from central and eastern Montana very similar to our dominance type. Thilenius and Brown (1990) mention two riparian western snowberry communities from the Cheyenne River Basin of Wyoming, but they do not described the vegetation. Both of their communities are included in our dominance type.

In the classification of wetland habitats (Cowardin and others, 1979), our snowberry dominance type belongs to the Palustrine System, Scrub-Shrub Wetland Class, Broad-Leaved Deciduous Subclass. In the interagency ecological land classification framework (Driscoll and others, 1984), the snowberry dominance type belongs to the Shrubland Class, Deciduous Shrubland Subclass, Cold-Deciduous Shrubland Group, Deciduous Alluvial Shrubland Formation. We found stands on the following range sites (USDA Soil Conservation Service, 1988):

15-17" Northern Plains: Lowland, Loamy Overflow
15-17" Southern Plains: Lowland, Overflow, Clayey Overflow

Figure 35. Map of Wyoming counties showing the approximate locations of stands of the western snowberry dominance type.

Map Symbol	Vegetation Type
1	Western snowberry dominance type (5 stands)



FOREST AND WOODLAND PHYSIOGNOMIC TYPES

Riparian forest and woodland types have tree canopy cover of at least 10%. The tree cover usually is patchy; a riparian woodland often consists of groves of trees separated by grassy openings or shrub stands. Large stands with dense, continuous canopy cover are rare. Along small streams, the woodlands may occur as small groves on the insides of meanders. Along large streams, woodlands often form long, narrow stands marking the edges of the modern channel or old channels. The structure of the vegetation varies from dense stands of young trees to open, park-like stands of old trees. In cottonwood stands, the trees are all about the same size and the same age.

Trees also occur as scattered individuals in riparian zones, but the presence of a tree doesn't make a forest or a woodland. Stands of tree seedlings and saplings are discussed here because they are the early steps in a sequence leading to tree stands. But from the point of view of vegetation structure, sapling stands are shrub types and seedling stands are dwarf-shrub types.

In our forest and woodland physiognomic type, we have grouped together tree-dominated stands that fall into three vegetation classes of the interagency land classification framework of Driscoll and others (1984): the forest class (tree canopy cover 61% to 100%); the woodland class (tree canopy cover 26% to 60%); and the herbaceous class, medium-tall grassland subclass, medium tall grassland with a tree layer group (tree canopy cover 11% to 25%).

Within the Classification of Wetlands and Deepwater Habitats of the United States (Cowardin and others, 1979), the stands of our forest and woodland physiognomic types belong to the Palustrine System, Forested Wetland Class, Broad-leaved Deciduous Subclass.

Correspondence of our vegetation types with Montana riparian types (Hansen and others, 1991) and with range sites (USDA Soil Conservation Service, 1988) is described for each of our vegetation types.

Figure 36. Elevations of sites with plots in the forest and woodland physiognomic type. Labels on the x-axis refer to the following dominance types:

SALAMY = Peachleaf willow
ACENEG = Boxelder
POPACU = Lanceleaf cottonwood
POPANG = Narrowleaf cottonwood
POPDEL = Plains cottonwood
FRAPEN = Green ash

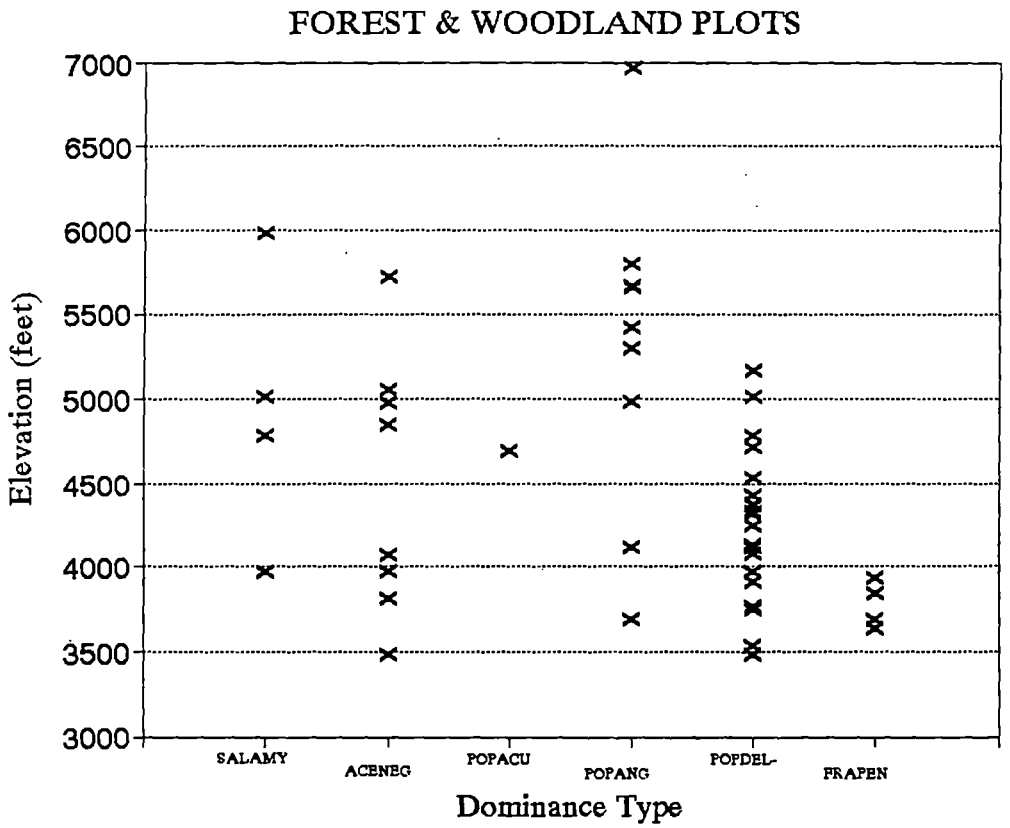


Figure 37. Square miles of drainage basin upstream from sites with plots of the forest and woodland physiognomic type. Labels on the x-axis refer to the following dominance types:

SALAMY = Peachleaf willow
ACENEG = Boxelder
POPACU = Lanceleaf cottonwood
POPANG = Narrowleaf cottonwood
POPDEL = Plains cottonwood
FRAPEN = Green ash

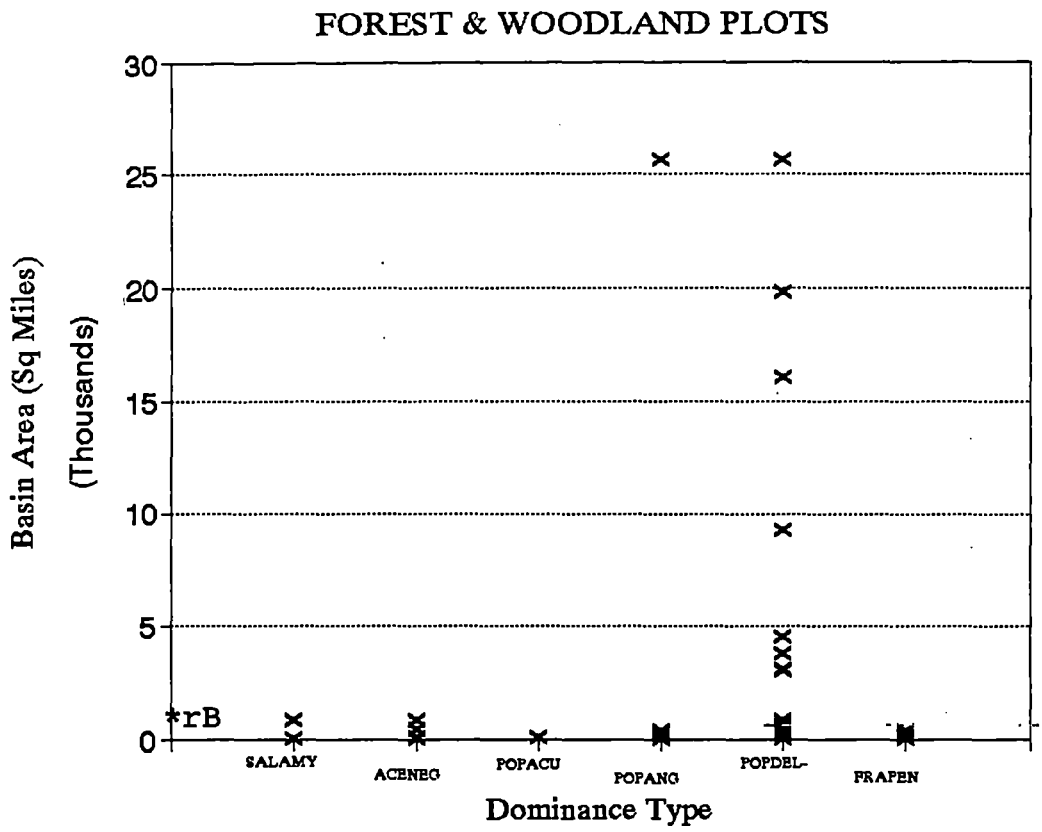


Figure 38. Widths of channels along which we sampled plots of the forest and woodland physiognomic type. Labels on the x-axis refer to the following dominance types:

SALAMY = Peachleaf willow
ACENEG = Boxelder
POPACU = Lanceleaf cottonwood
POPANG = Narrowleaf cottonwood
POPDEL = Plains cottonwood
FRAPEN = Green ash

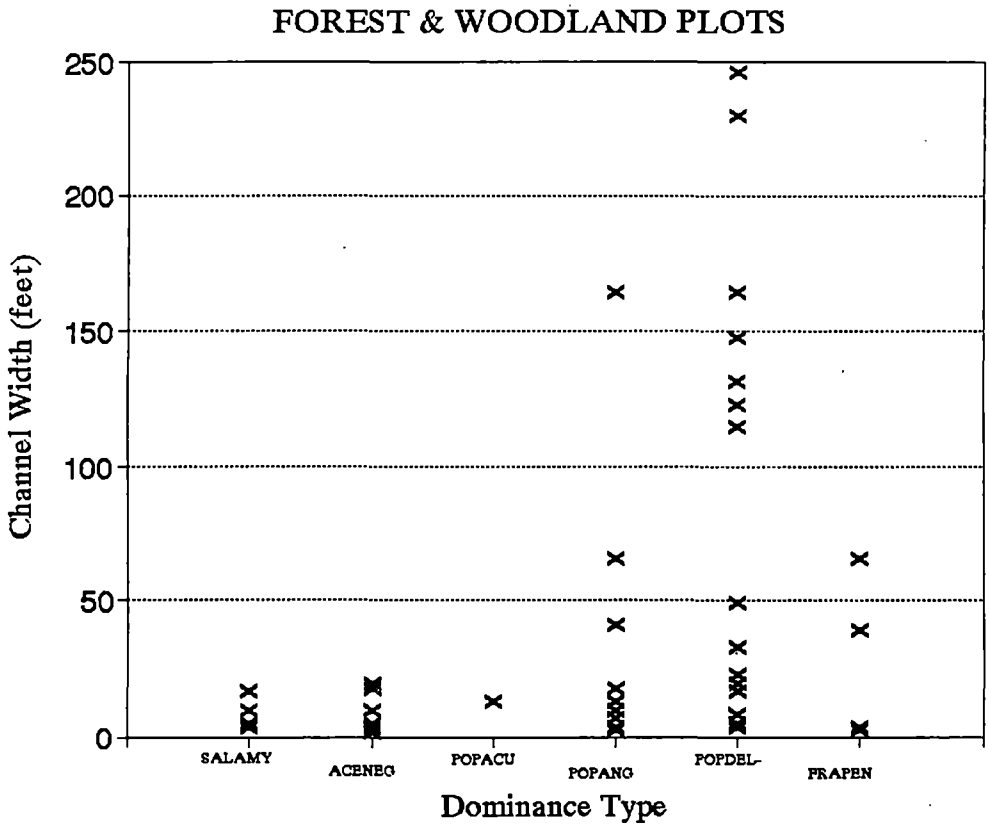


Figure 39. Distances in feet between plots of the forest and woodland physiognomic type and the nearest active stream channel. Labels on the x-axis refer to the following dominance types:

SALAMY = Peachleaf willow
ACENEG = Boxelder
POPACU = Lanceleaf cottonwood
POPANG = Narrowleaf cottonwood
POPDEL = Plains cottonwood
FRAPEN = Green ash

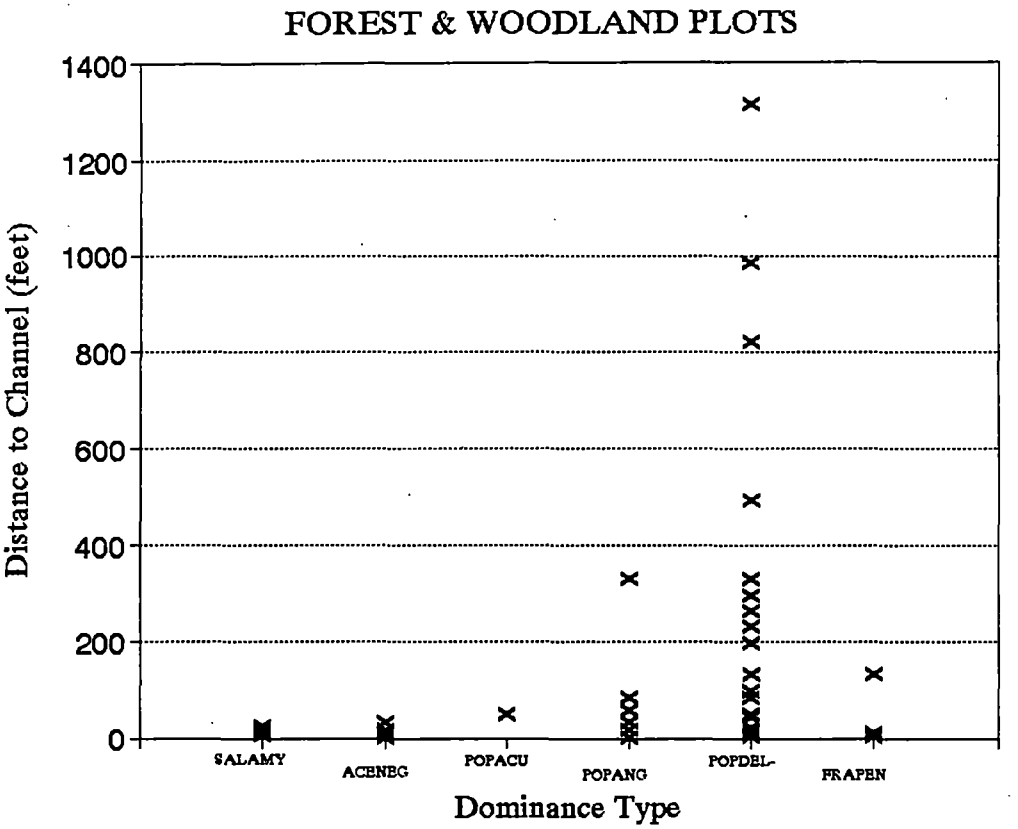


Figure 40. Heights of plots of the forest and woodland physiognomic type above the nearest active stream channel. Labels on the x-axis refer to the following dominance types:

SALAMY = Peachleaf willow
ACENEG = Boxelder
POPACU = Lanceleaf cottonwood
POPANG = Narrowleaf cottonwood
POPDEL = Plains cottonwood
FRAPEN = Green ash

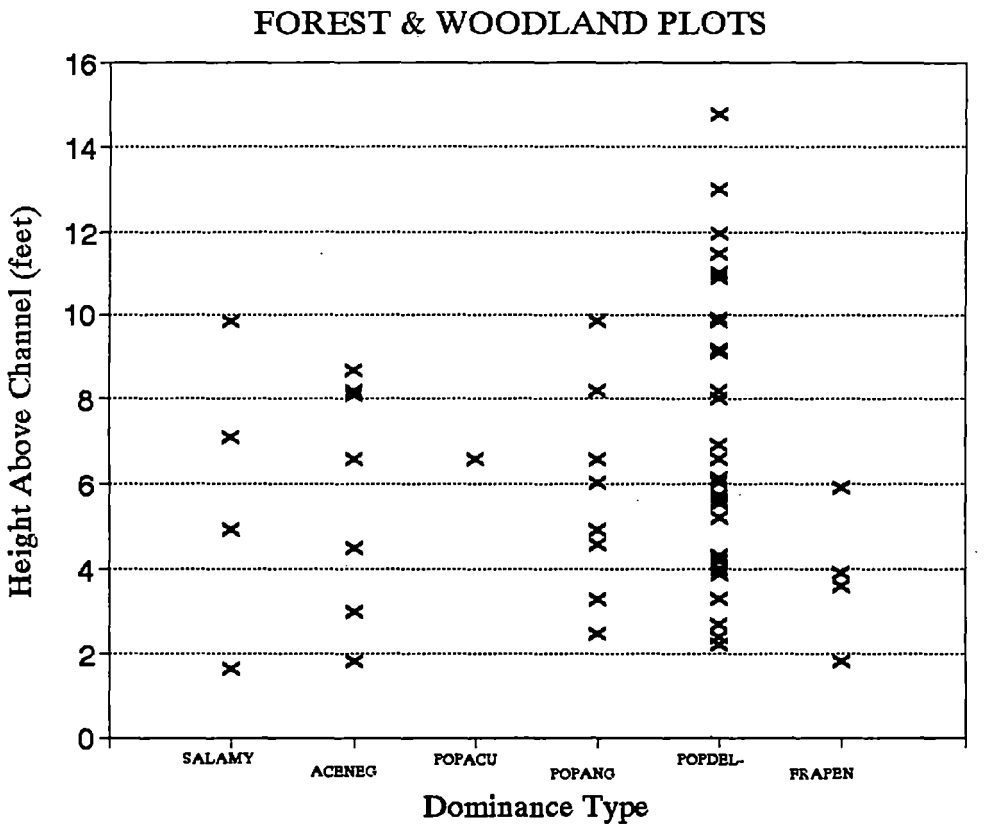


Figure 41. Depth of soil mottling (indicating a fluctuating water table) or gleying (indicating a high water table) beneath plots of the forest and woodland physiognomic type. Labels on the x-axis refer to the following dominance types:

SALAMY = Peachleaf willow
ACENEG = Boxelder
POPACU = Lanceleaf cottonwood
POPANG = Narrowleaf cottonwood
POPDEL = Plains cottonwood
FRAPEN = Green ash

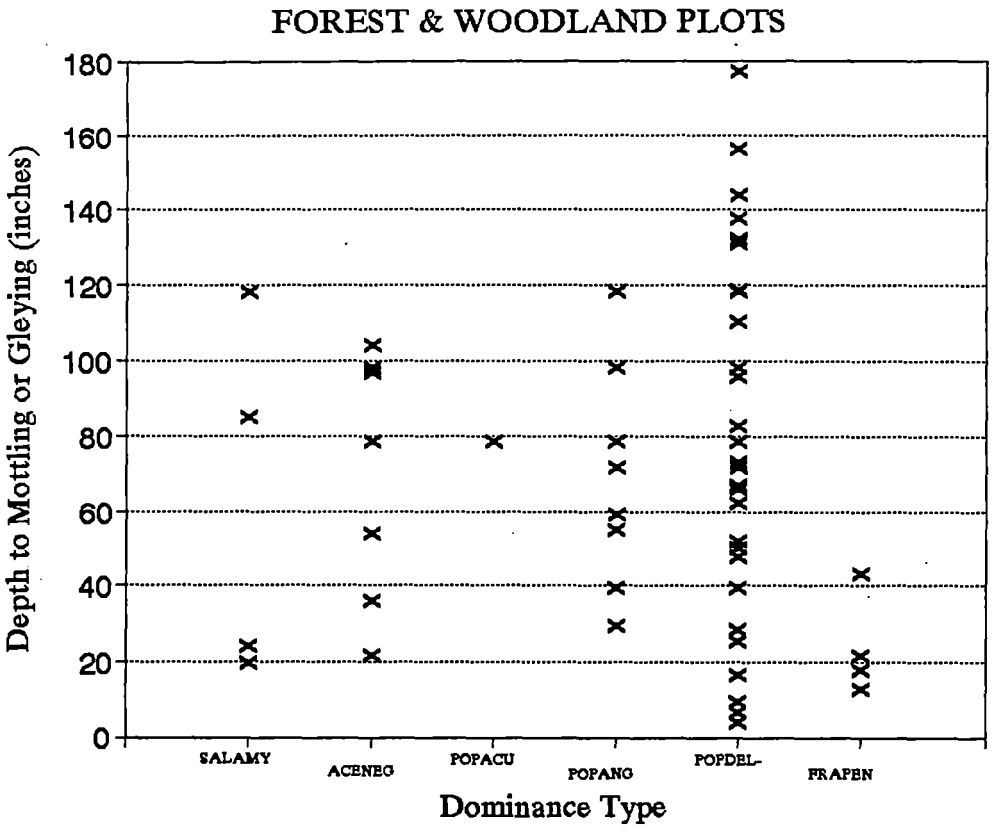
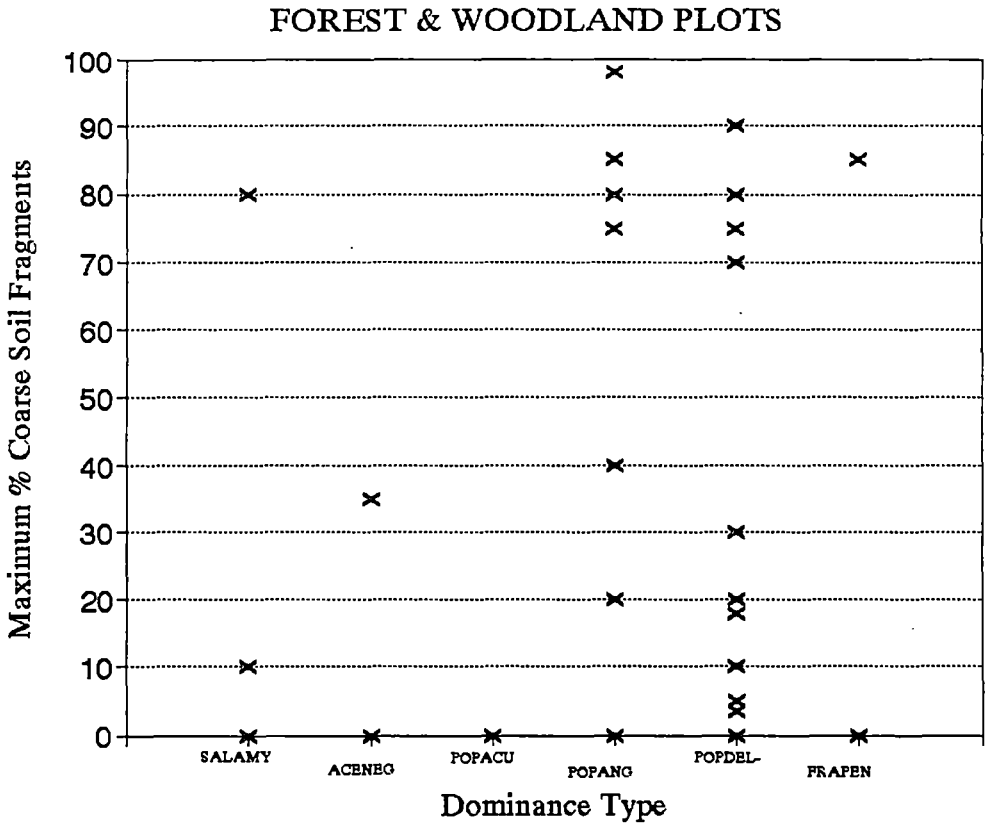


Figure 42. Percent by volume of coarse fragments (larger than 2 mm) in the soil horizons with the most coarse fragments beneath plots of the forest and woodland physiognomic type. Labels on the x-axis refer to the following dominance types:

SALAMY = Peachleaf willow
ACENEG = Boxelder
POPACU = Lanceleaf cottonwood
POPANG = Narrowleaf cottonwood
POPDEL = Plains cottonwood
FRAPEN = Green ash



Peachleaf Willow (Salix amygdaloides) Dominance Type

(5 stands sampled)

VEGETATION: The peachleaf willow dominance type occurs as small patches or narrow bands of trees. The tree layer is open: our stands had 160 to 680 trees/acre, and canopy cover of 40% or less (Table 21). Peachleaf willow (Salix amygdaloides), Wyoming's only native tree-form willow, is the dominant tree. Other trees may be present in lesser amounts (in our stands, narrow-leaf cottonwood and boxelder). The willows usually are small or medium-sized trees (less than 21" in diameter), and often have many dead branches. Shrubs generally are absent. The herbaceous layer in three of our five stands was dominated by introduced grasses, most commonly smooth brome. Western wheatgrass was common in one stand. In another stand near the channel and only a few feet above it, creeping spikerush and woolly sedge, both species of wet sites, were common.

ENVIRONMENT: The peachleaf willow type occurs over a broad range of elevation (Figure 36). Judging from the five stands we sampled, this type occurs in small drainage basins (Figure 37) on narrow floodplains along narrow (Figure 38), usually unconfined streams. Stands occur within 100 feet of the stream channel (Figure 39). Heights above the stream channel vary widely, from 1.5 feet to nearly 10 feet (Figure 40). The water table may approach the soil surface at least part of the year, as indicated by mottling in the soil (Figure 41), or it may remain deep beneath the soil surface.

SOIL: Stands of the peachleaf willow dominance type occur on a variety of soils. In most of the stands we sampled, the soil horizons contained at least 50% sand (Table 3), and only five of the horizons contained soil fragments of gravel size (2 mm) or larger.

EXOTIC PLANTS: Exotic plants are common in the understory of this dominance type, perhaps because most exotics are well adapted to frequently disturbed areas like riparian zones. Hay meadows near riparian areas provide a ready source of seed of hay grasses and alfalfa. Two grasses -- smooth brome and Canada bluegrass -- dominated understories in two of the stands we studied. Noxious weeds (Canada thistle [Cirsium arvense] and hounds tongue [Cynoglossum officinale]) were present in three stands but only in small amounts.

ADJACENT RIPARIAN VEGETATION: Cattail (Typha spp.), leafy bulrush (Scirpus pungens), and Nebraska sedge (Carex nebrascensis) types occupy wetter areas, usually nearer to the channel. Plains cottonwood, boxelder, and western wheatgrass types occur on higher terraces.

LOCATION: We found only five sites with peachleaf willow stands (Figure 43), but the broad distribution of these stands suggests that this dominance type occurs throughout eastern Wyoming.

ECOLOGY: Peachleaf willow is a pioneer species that requires moist, sparsely-vegetated alluvium to become established from seed (Johnson, 1992). Consequently, stands of the Peachleaf Willow Dominance Type are seral; a stand does not persist for longer than the lifespan of the original trees that become established after a flood, and the stand becomes another vegetation type as the willows die. Maintenance of the peachleaf willow type along a stream requires that the stream flood enough to deposit new alluvial bars on which new trees can grow.

The vegetation that replaces the peachleaf willow type varies from one stand to another. Johnson (1992) notes that boxelder can reproduce beneath the canopy of willow stands, and Hansen and others (1991) describe the peachleaf willow vegetation type as a successional stage leading to other tree types, including the boxelder/chokecherry type. Boxelder was present in three of the stands we studied, and those stands may convert to boxelder stands. One of our stands contained narrowleaf cottonwood trees smaller than the peachleaf willows, and that stand may eventually become a narrowleaf cottonwood stand. Our fifth stand had no trees besides peachleaf willow, and that stand probably will become a wet meadow of woolly sedge and creeping spikerush.

COMMUNITIES: We did not describe any communities in the peachleaf willow dominance type because the composition of the vegetation in the few stands we found was so variable. Hansen and others (1991) describe a peachleaf willow community from Montana, but our stands lack the shrub layer present in their stands.

OTHER CLASSIFICATIONS: Hansen and others (1991) describe a peachleaf willow community from Montana that contains a variety of shrubs, grasses, and forbs. In the classification of wetland habitats (Cowardin and others, 1979), the Peachleaf Willow Dominance Type belongs to the Palustrine System, Forested Wetland Class, Broad-leaved Deciduous Subclass. In the ecological land classification framework (Driscoll and others, 1984), the Peachleaf Willow Dominance Type belongs to several categories. Stands with more than 60% tree canopy cover belong to the Forest Class, Deciduous Forest Subclass, Cold-deciduous Forest Group, Cold-deciduous Alluvial Forest Formation. Stands with 25% to 60% canopy cover belong to the Woodland Class, Deciduous Woodland Subclass, Cold-deciduous Woodland Group, Broad-leaved Deciduous Woodland Formation. Stands with 10% to 24% canopy cover belong to the Herbaceous Vegetation Class, Medium-tall Grassland Subclass, Medium-tall Grassland with Tree Layer Group, Woody Layer Broad-leaved Deciduous Formation.

Stands of the Peachleaf Willow Dominance Type may occur on the following range sites (USDA Soil Conservation Service, 1988):

10-14"	High Plains Southeast:	Wetland, Subirrigated, Lowland
12-14"	Southern Plains:	Subirrigated, Loamy lowland, Sandy lowland
15-17"	Southern Plains:	Wetland, Subirrigated, Saline Subirrigated, Lowland
10-14"	Northern Plains:	Subirrigated, Saline Subirrigated, Lowland
15-17"	Northern Plains:	Wetland, Subirrigated, Saline Subirrigated, Lowland, Saline Lowland
15-19"	Black Hills:	Wetland, Subirrigated, Lowland, Saline Lowland

Figure 43. Map of Wyoming counties showing approximate locations of sites with stands of the peachleaf willow dominance type.

Map Symbol	Community
1	Peachleaf Willow Community (5 stands)

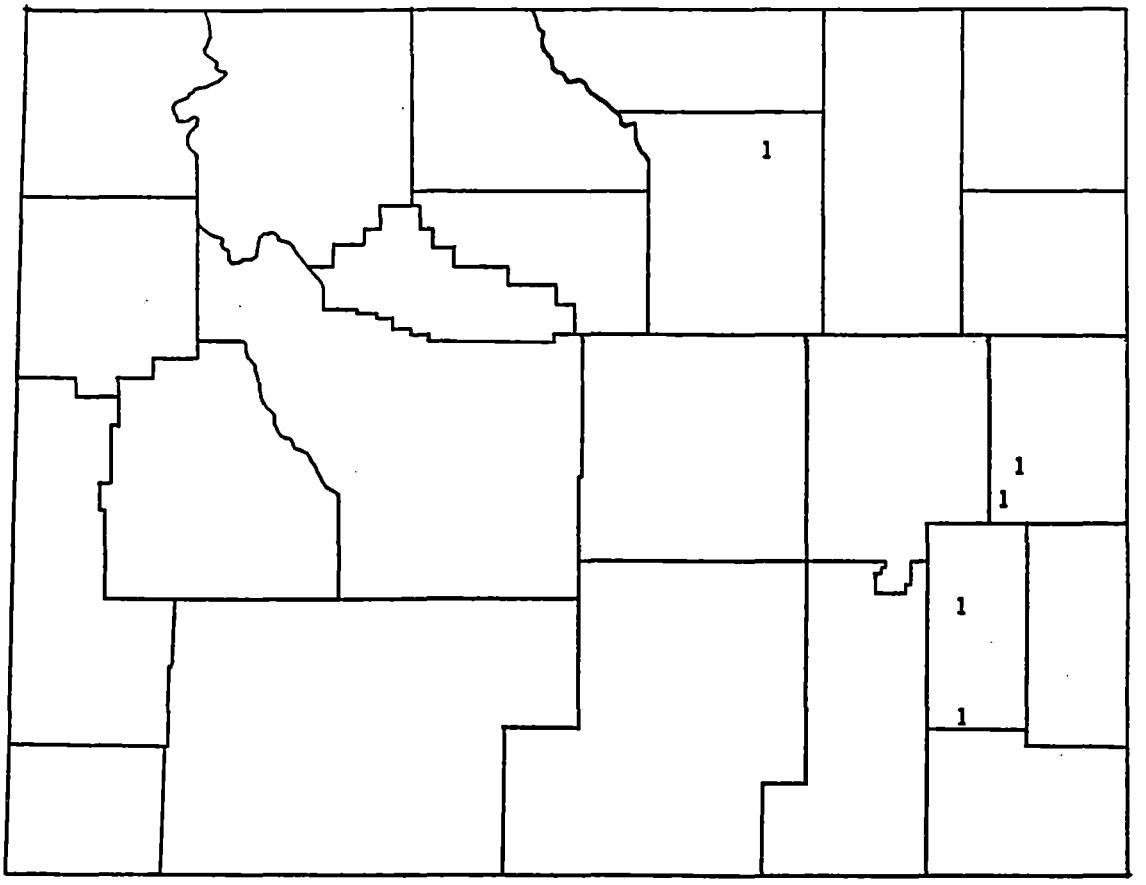


Table 3. Textural classes of soil horizons below five stands of the peachleaf willow dominance type.

Soil Textural Class	Number of Horizons in Class
Sand*	2
Loamy sand*	3
Sandy loam*	1
Sandy clay loam*	4
Sandy clay*	1
Silty clay loam	3
Silty clay	1
Silt loam	3

* Textural class with at least 50% sand

Plains Cottonwood (Populus deltoides) Dominance Type

The Plains Cottonwood Dominance Type includes stands of trees dominated by plains cottonwood (Populus deltoides). Often the tree layer also includes boxelder, green ash, or peachleaf willow. Vegetation structure ranges from dense stands of poles and small trees to open, park-like stands of scattered large trees. Shrubs usually are sparse. The herbaceous layer usually is dominated by grasses.

Along small streams, the plains cottonwood dominance type usually occurs as small groves of trees on the insides of meanders. Along large streams like Powder River or the North Platte River, plains cottonwoods often form large groves or narrow bands of trees along the modern channel or along abandoned channels.

We described six communities in the Plains Cottonwood Dominance Type. Each of these communities, and additional stands not classified into communities, are described below.

Figure 44. Map of Wyoming counties showing approximate locations of sites with plains cottonwood stands.

Map Symbol	Community
1	Plains cottonwood/western wheatgrass (13 stands)
2	Plains cottonwood/Kentucky bluegrass (5 stands)
3	Plains cottonwood/smooth brome (5 stands)
4	Plains cottonwood/western snowberry (1 stand)
5	Plains cottonwood/recent alluvial bar (4 stands)
6	Plains cottonwood/panic switchgrass (2 stands)
7	Unclassified plains cottonwood stands (9 stands)

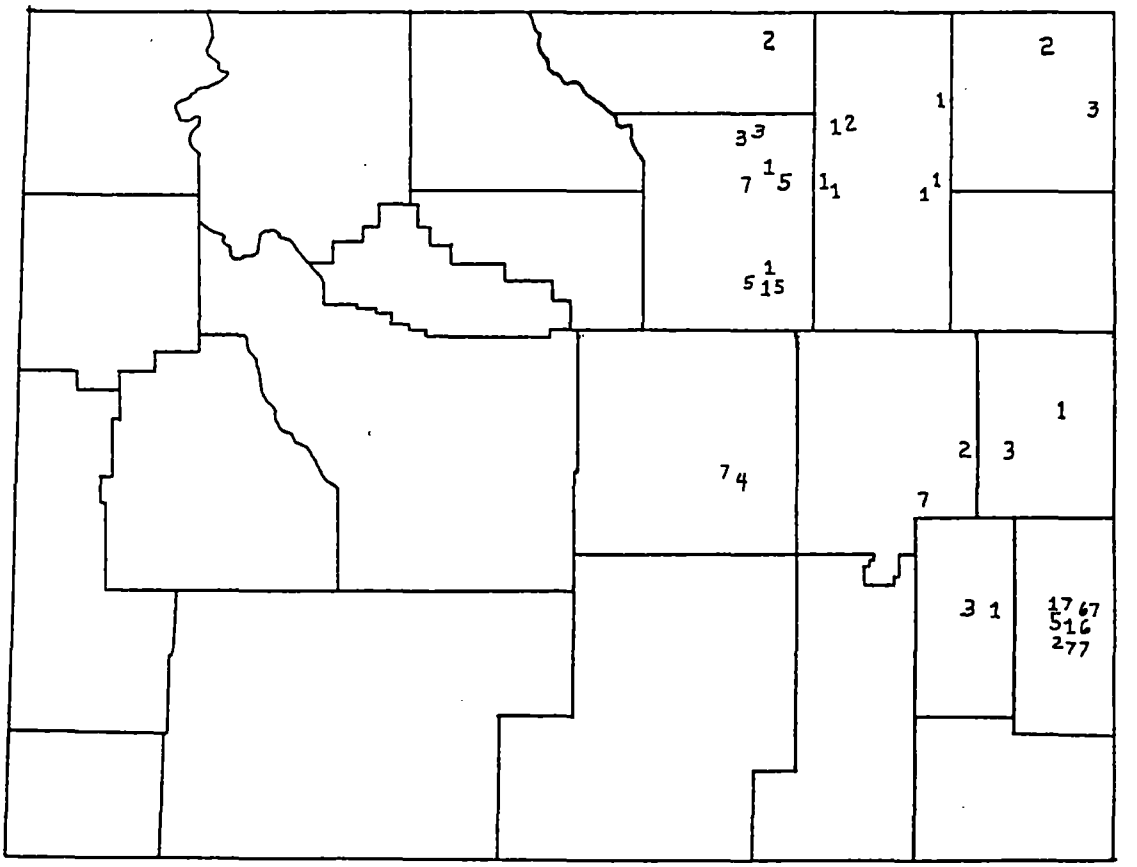


Figure 45. Elevations of sites with stands of the plains cottonwood communities. Each plains cottonwood community is represented on the x-axis by the name of the dominant understory species, except that the recent alluvial bar community is labeled "Bar".

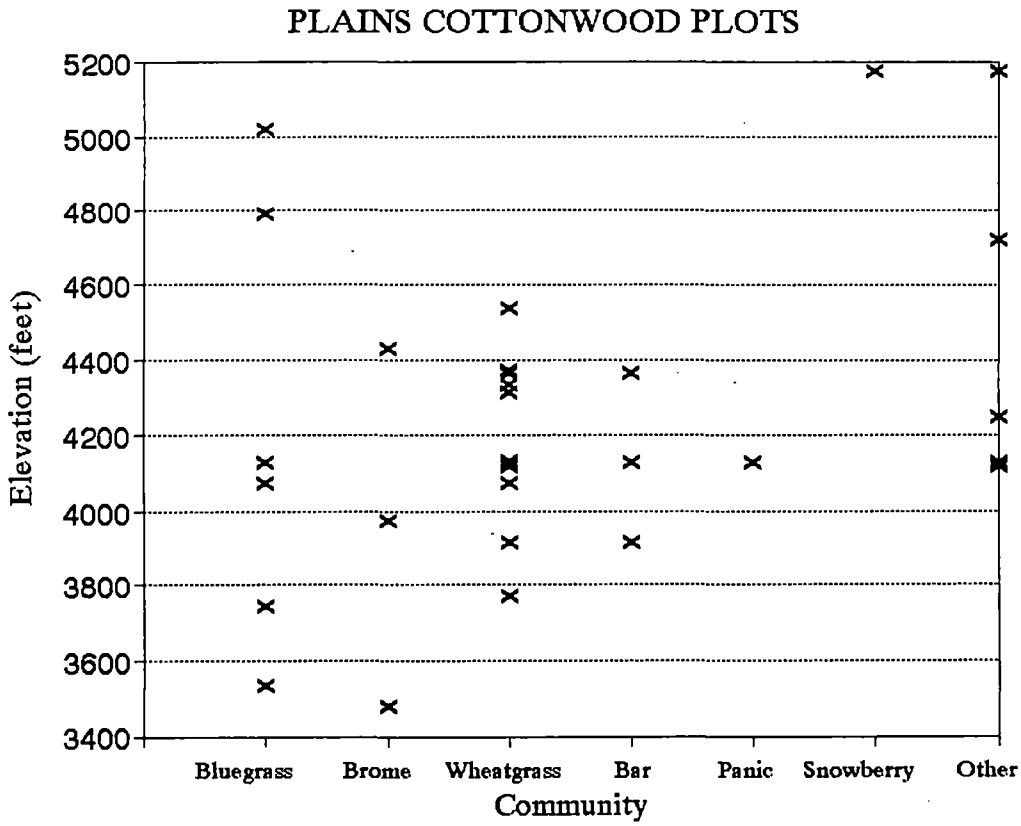


Figure 46. Widths of channels along which we sampled plains cottonwood stands. Each plains cottonwood community is represented on the x-axis by the name of the dominant understory species, except that the recent alluvial bar community is labeled "Bar".

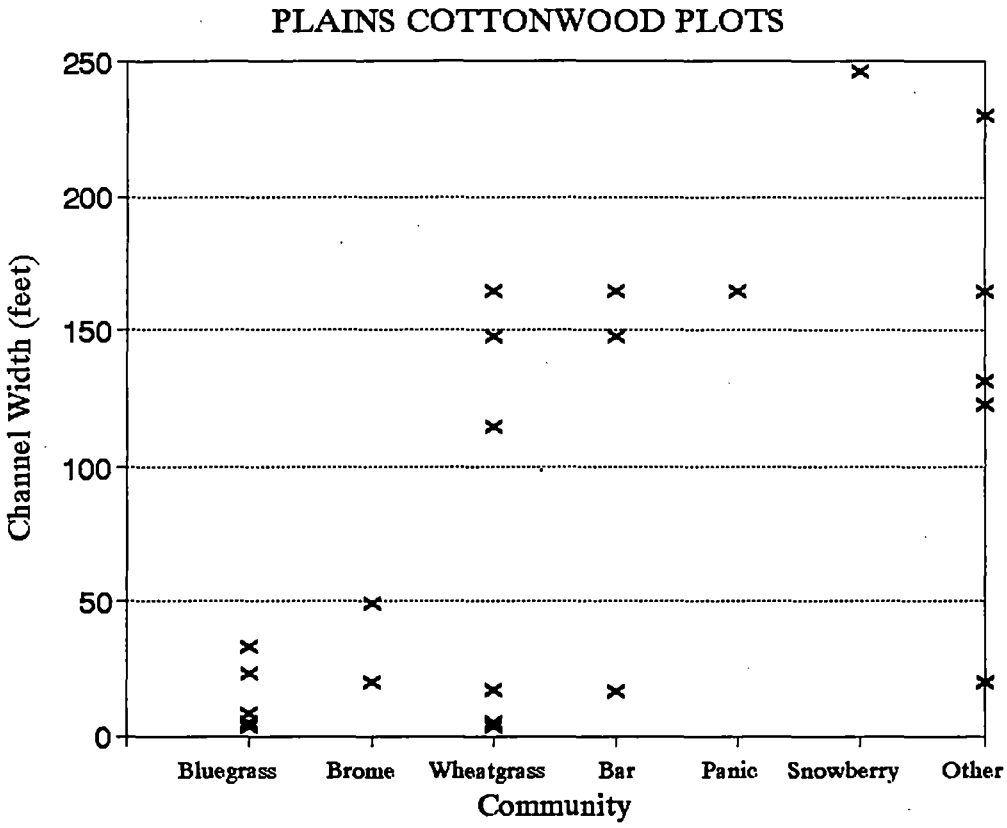


Figure 47. Heights of plots in plains cottonwood stands above the nearest active stream channel. Each plains cottonwood community is represented on the x-axis by the name of the dominant understory species, except that the recent alluvial bar community is labeled "Bar".

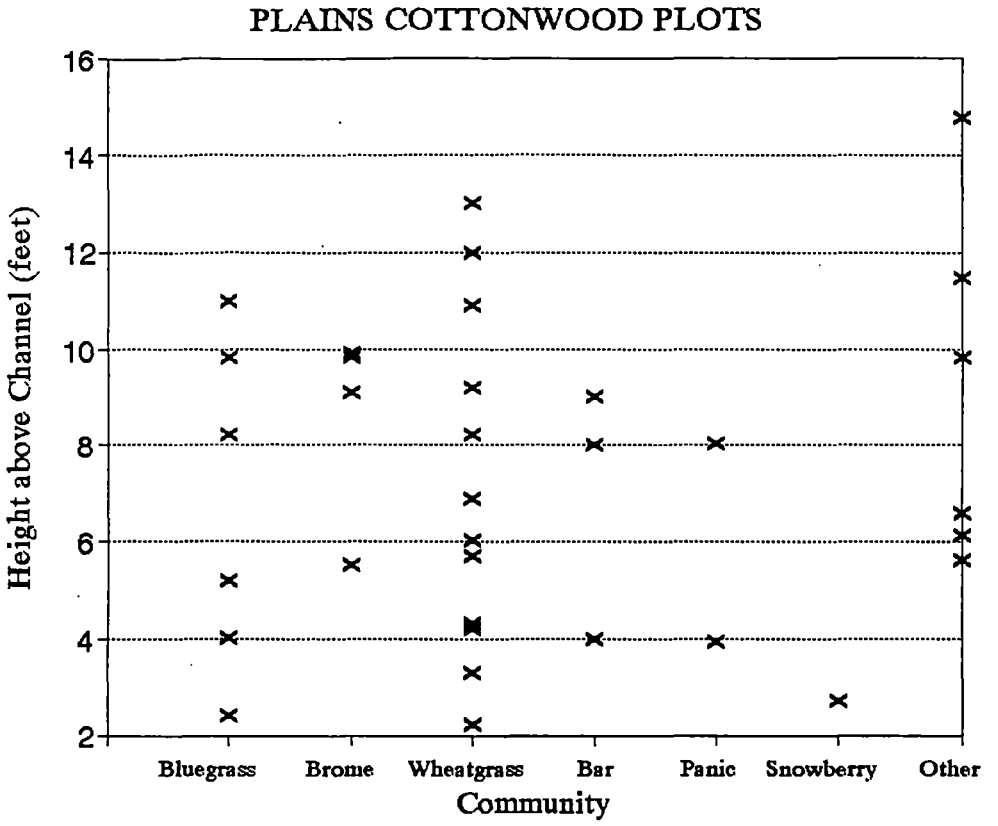
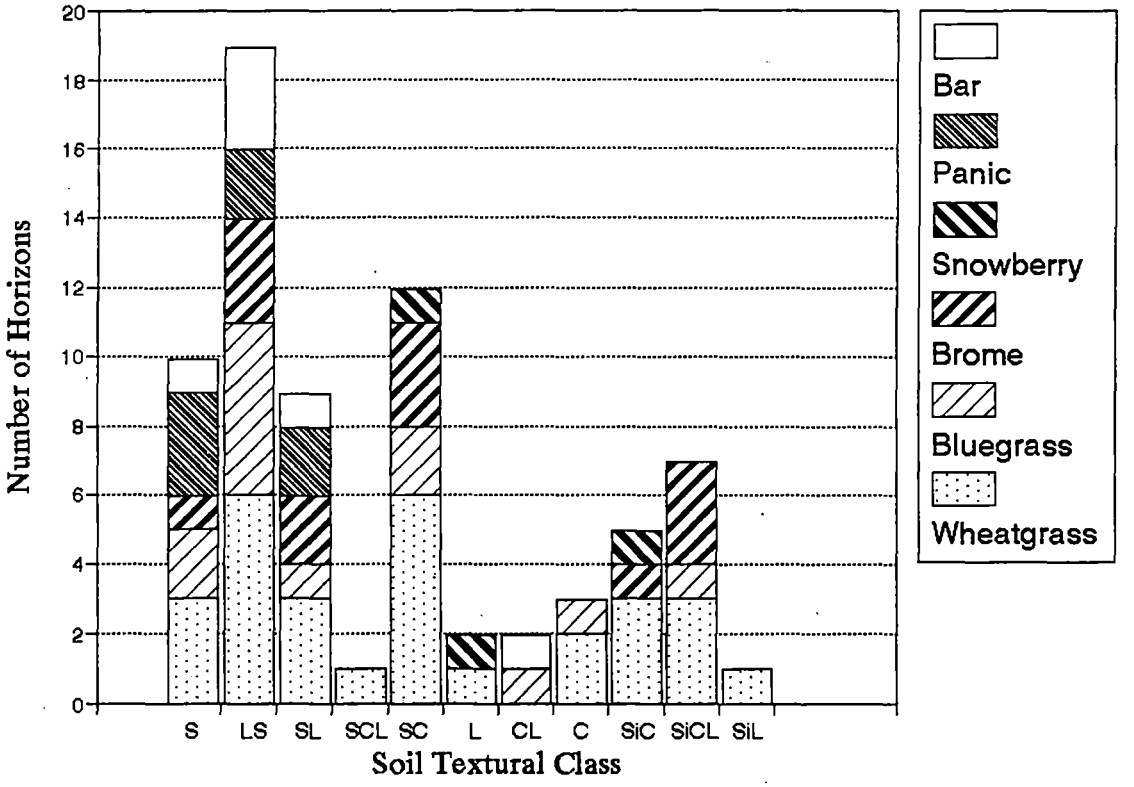


Figure 48. Distribution among textural classes of soil horizons beneath plains cottonwood stands. Species names and "Bar" represent plains cottonwood communities. Labels on the x-axis represent the following soil textural classes:

S = Sand
LS = Loamy sand
SL = Sandy loam
SCL = Sandy clay loam
SC = Sandy clay
L = Loam
CL = Clay loam
C = Clay
SiC = Silty clay
SiCL = Silty clay loam
SiL = Silty loam



Plains Cottonwood/Western Wheatgrass (Populus deltoides/Elymus smithii) Community

(13 stands sampled)

VEGETATION STRUCTURE & COMPOSITION: Plains cottonwood (Populus deltoides) dominates the tree layer, which varies from a grove of widely-spaced, large trees to a relatively dense stand of small trees (Table 22). Tree canopy cover may range from 10% to 70%. Most stands have at least a few shrubs, especially basin silver sagebrush (Artemisia cana ssp. cana), but the shrub layer is sparse. Western wheatgrass (Elymus smithii) or thickspike wheatgrass (E. lanceolatus) usually are present in substantial amounts in the understory, although they may be absent. Kentucky bluegrass (Poa pratensis) may be present but does not dominate. Stands lacking western wheatgrass or thickspike wheatgrass are still considered members of this community because of the presence of basin silver sagebrush and the small amount of Kentucky bluegrass. Annual and biennial grasses and forbs are common, no doubt because these species are well-adapted to environments with frequent disturbance.

LOCATION: We found stands of this community throughout eastern Wyoming (Figure 44), at elevations from ca 3800 feet to ca 4550 feet (Figure 45), primarily in small drainage basins. This community probably is widespread in central and eastern Wyoming.

ENVIRONMENT: The stands that we studied occurred along a variety of channel sizes (Figure 46). Stands occurred from ca 2 feet to 13 feet above the stream channel (Figure 47). This community appears to occupy drier sites than do stands of the other plains cottonwood communities.

SOIL: Soil horizons beneath stands of this community belonged to a variety of textural classes, but loamy sands and sandy clay loams predominated (Figure 48).

EXOTICS: Annual exotic plants often are present, especially Japanese brome (Bromus japonicus), cheatgrass (B. tectorum), or fireweed summercypress (Kochia scoparia). These species are well adapted to frequently disturbed environments like riparian zones. Perennial exotics are less common.

ADJACENT RIPARIAN VEGETATION: Stands of the Plains Cottonwood/ Western Wheatgrass Community often occur in a pattern with several other vegetation types. Nebraska sedge stands and prairie cordgrass stands often are found on the lowest surfaces next to the channel. Sandbar willow stands and stands of plains cottonwood seedlings and saplings may be found on sediment bars close to the channel. Terraces above the plains cottonwood/ western wheatgrass stands commonly support basin silver sagebrush/western wheatgrass vegetation, and black greasewood

stands often occupy the highest terraces at the transition area between riparian and upland vegetation.

ECOLOGY: Plains cottonwood is a pioneer species that requires moist, sparsely-vegetated alluvium to become established from seed (Johnson, 1992). Consequently, stands of this community are seral; a stand does not persist for longer than the lifespan of the original trees that become established after a flood, and the stand becomes another vegetation type as the trees die. Maintenance of the plains cottonwood vegetation along a stream requires that the stream flood enough to deposit new alluvial bars on which new trees can grow.

Stands of the Plains Cottonwood/Western Wheatgrass Community give way to western wheatgrass meadows or basin silver sagebrush stands as the cottonwoods die.

OTHER CLASSIFICATIONS: In the classification of wetland habitats (Cowardin and others, 1979), the Plains Cottonwood/Western Wheatgrass Community belongs to the Palustrine System, Forested Wetland Class, Broad-leaved Deciduous Subclass. In the ecological land classification framework (Driscoll and others, 1984), this community belongs to several categories. Stands with more than 60% tree canopy cover belong to the Forest Class, Deciduous Forest Subclass, Cold-deciduous Forest Group, Cold-deciduous Alluvial Forest Formation. Stands with 25% to 60% canopy cover belong to the Woodland Class, Deciduous Woodland Subclass, Cold-deciduous Woodland Group, Broad-leaved Deciduous Woodland Formation. Stands with 10% to 24% canopy cover belong to the Herbaceous Vegetation Class, Medium-tall Grassland Subclass, Medium-tall Grassland with Tree Layer Group, Woody Layer Broad-leaved Deciduous Formation.

Stands of the Plains Cottonwood/Western Wheatgrass Community may occur on the following range sites (USDA Soil Conservation Service, 1988):

10-14" High Plains Southeast: Lowland
12-14" Southern Plains: Loamy lowland, Sandy lowland
15-17" Southern Plains: Lowland
10-14" Northern Plains: Saline Subirrigated, Lowland, Saline lowland
15-17" Northern Plains: Saline subirrigated, Lowland, Saline lowland
15-19" Black Hills: Lowland, Saline Lowland

Plains Cottonwood/Kentucky Bluegrass (Populus deltoides/Poa pratensis) Community

(5 stands sampled)

VEGETATION STRUCTURE & COMPOSITION: Plains cottonwood (Populus deltoides) dominates the tree layer, which varies from a grove of widely-spaced, large trees to a relatively dense stand of small trees (Table 23). Tree canopy cover may range from 20% to 70%. Shrub cover is sparse, but most stands have at least a few shrubs, especially basin silver sagebrush (Artemisia cana ssp. cana). Kentucky bluegrass (Poa pratensis) is a primary understory species. Western wheatgrass often is present as a minor species. A variety of native and exotic grasses and forbs may be present, usually in small amounts.

LOCATION: We found stands of the Plains Cottonwood/Kentucky Bluegrass Community scattered widely throughout the study area (Figure 44) at elevations from ca 3550 feet to ca 4150 feet (Figure 45), primarily in small drainage basins.

ENVIRONMENT: Most of the stands we studied of this community grew along narrow channels (Figure 46). Stands occurred from 2 feet to 11 feet above the stream channel (Figure 47). This community appears to occupy moister sites than do stands of the plains cottonwood/western wheatgrass community.

SOIL: Soil horizons beneath our stands of this community belonged to a variety of textural classes, but loamy sands predominated (Figure 48).

EXOTICS: Kentucky bluegrass, the dominant understory species, apparently is an exotic species introduced from Europe (USDA Forest Service, 1937; Hitchcock, 1950), although some botanists think that some populations represent a nearly-identical native species (Cronquist and others, 1977; Weber, 1972). Kentucky bluegrass is ubiquitous in moist sites throughout North America and is a desirable forage species in many areas.

Canada thistle (Cirsium arvense), a noxious weed, occurred in small amounts in this type.

ADJACENT RIPARIAN VEGETATION: Stands of this community often occur in a pattern with other riparian vegetation types. Nebraska sedge stands and prairie cordgrass stands often are found on the lowest terraces next to the channel. Sandbar willow stands and stands of plains cottonwood seedlings and saplings may be found on sediment bars close to the channel. In broad riparian areas, terraces above the plains cottonwood/Kentucky bluegrass stands may support plains cottonwood/western wheatgrass vegetation or basin silver sagebrush/western wheatgrass vegetation, and black

greasewood stands often occupy the highest terraces at the transition area between riparian and upland vegetation.

ECOLOGY: Plains cottonwood is a pioneer species that requires moist, sparsely-vegetated alluvium to become established from seed (Johnson, 1992). Consequently, stands of this community are seral; a stand does not persist for longer than the lifespan of the original trees that become established after a flood, and the stand becomes another vegetation type as the trees die. Maintenance of the plains cottonwood vegetation along a stream requires that the stream flood enough to deposit new alluvial bars on which new trees can grow.

Hansen and others (1991) consider the Great Plains Cottonwood/Kentucky Bluegrass Community to be a grazing-induced type derived from other plains cottonwood types with more shrub cover. Repeated, season-long grazing reduces the cover of shrubs and increases the amount of Kentucky bluegrass in a stand, until finally the vegetation consists only of a cottonwood overstory above a bluegrass-dominated herbaceous understory. According to Hansen and others (1991), in some cases a change in grazing management may restore the shrub layer and decrease the amount of Kentucky bluegrass in the herbaceous layer, but this vegetation type is very stable once established and it may persist even after a change in management. In higher-elevation riparian zones (Youngblood and others, 1985), a shift to dominance of the understory by Kentucky bluegrass often is accompanied by a drop in the water table, and the vegetation will remain a Kentucky bluegrass stand until some hydrologic change raises the water table. Although Kentucky bluegrass provides good forage with the right management, the species is less effective at holding soil against erosion than are the deeper-rooted species it replaces in those higher-elevation areas. It is unclear what species formerly dominated the lower-elevation stands that we studied, so whether Kentucky bluegrass replaced deeper-rooted species in our stands is an open question.

OTHER CLASSIFICATIONS: Our community apparently is the same as the Great Plains Cottonwood/Kentucky Bluegrass Community Type described by Hansen and others (1991) from Montana. In the classification of wetland habitats (Cowardin and others, 1979), the Plains Cottonwood/Kentucky Bluegrass Community belongs to the Palustrine System, Forested Wetland Class, Broad-leaved Deciduous Subclass. In the ecological land classification framework (Driscoll and others, 1984), this community belongs to several categories. Stands with more than 60% tree canopy cover belong to the Forest Class, Deciduous Forest Subclass, Cold-deciduous Forest Group, Cold-deciduous Alluvial Forest Formation; stands with 25% to 60% canopy cover belong to the Woodland Class, Deciduous Woodland Subclass, Cold-deciduous Woodland Group, Broad-leaved Deciduous Woodland Formation; and stands with 10% to 24% canopy cover belong to the Herbaceous Vegetation Class, Medium-tall

Grassland Subclass, Medium-tall Grassland with Tree Layer Group, Woody Layer Broad-leaved Deciduous Formation.

Stands of the Plains Cottonwood/Kentucky Bluegrass Community may occur on the following range sites (USDA Soil Conservation Service, 1988):

10-14" High Plains Southeast: Lowland
12-14" Southern Plains: Loamy lowland, Sandy lowland
15-17" Southern Plains: Lowland
10-14" Northern Plains: Saline Subirrigated, Lowland, Saline lowland
15-17" Northern Plains: Saline subirrigated, Lowland, Saline lowland
15-19" Black Hills: Lowland, Saline Lowland

Plains Cottonwood/Smooth Brome (Populus deltoides/Bromus inermis) Community

(5 stands sampled)

VEGETATION STRUCTURE & COMPOSITION: Plains cottonwood (Populus deltoides) dominates the tree layer, which usually consists of a moderately open stand of medium-sized to large trees (Table 24). Boxelder, green ash, and peachleaf willow may be present, usually as saplings or small trees. Tree canopy cover in the stands we studied ranged from 40% to 60%. Shrubs are essentially absent. Smooth brome (Bromus inermis) dominates the understory, which may contain a variety of annual, mostly exotic, forbs and grasses. Western wheatgrass and Kentucky bluegrass are absent or present only in small amounts.

LOCATION: This is a widespread community in eastern Wyoming (Figure 44). The stands we studied occurred at elevations from 3550 feet to 4800 feet (Figure 45).

ENVIRONMENT: We found stands of the plains cottonwood/smooth brome community along small channels (Figure 46). Stands occurred from 5.5 feet to 10 feet above the stream channel (Figure 47). This community appears to occupy moister sites than do stands of the Plains Cottonwood/Western Wheatgrass community.

SOIL: Soil horizons beneath stands of this community belonged to a variety of loamy textural classes (Figure 48).

EXOTICS: Smooth brome, the dominant understory species, is a major hay grass in Wyoming. Three of the five stands we studied were next to hay meadows, which provide a ready seed source for brome.

ADJACENT RIPARIAN VEGETATION: Stands of the plains cottonwood/ smooth brome community usually occur in a pattern with other riparian types. Prairie cordgrass may occur in the stream channel, with smooth brome or other grasses of moist sites on a higher terrace. Boxelder woodlands occurred on slightly higher terraces in some of the sites we studied, just below the plains cottonwood stands. Terraces above the plains cottonwood often supported basin silver sagebrush stands, and black greasewood shrublands occurred along the edge of the riparian zone.

ECOLOGY: Plains cottonwood is a pioneer species that requires moist, sparsely-vegetated alluvium to become established from seed (Johnson, 1992). Consequently, stands of this community are seral; a stand does not persist for longer than the lifespan of the original trees that become established after a flood, and the stand becomes another vegetation type as the trees die. Maintenance of the plains cottonwood vegetation along a stream

requires that the stream flood enough to deposit new alluvial bars on which new trees can grow.

The strong dominance of the understory by smooth brome suggests that stands of the Plains Cottonwood/Smooth Brome Community will change to brome meadows as the cottonwoods die.

OTHER CLASSIFICATIONS: In the classification of wetland habitats (Cowardin and others, 1979), the Plains Cottonwood/Smooth Brome Community belongs to the Palustrine System, Forested Wetland Class, Broad-leaved Deciduous Subclass. In the ecological land classification framework (Driscoll and others, 1984), all the stands we studied of this community belong to the Woodland Class, Deciduous Woodland Subclass, Cold-deciduous Woodland Group, Broad-leaved Deciduous Woodland Formation. Other stands of this community may have less canopy cover or more canopy cover than the stands we studied, and they would belong to other categories of the ecological land classification framework.

Stands of the Plains Cottonwood/Smooth Brome Community may occur on the following range sites (USDA Soil Conservation Service, 1988):

10-14" High Plains Southeast: Lowland
12-14" Southern Plains: Loamy lowland, Sandy lowland
15-17" Southern Plains: Lowland
10-14" Northern Plains: Lowland
15-17" Northern Plains: Lowland
15-19" Black Hills: Lowland

Plains Cottonwood/Western Snowberry (Populus deltoides/ Symphoricarpos occidentalis) Community

(1 stand)

VEGETATION STRUCTURE & COMPOSITION: The single stand we studied of this community had a tree overstory of medium-sized plains cottonwood (Populus deltoides) with ca. 40% canopy cover above a dense shrub layer of western snowberry (Symphoricarpos occidentalis) (Table 25). The herb layer had substantial amounts of slender wheatgrass (Elymus trachycaulus), Baltic rush (Juncus balticus), saltbush (Atriplex heterosperma), smooth brome (Bromus inermis), Canada thistle (Cirsium arvense), and lens-padded hoary cress (Cardaria chalepensis). Stands described by Thilenius and Brown (1990) in the Cheyenne River Basin usually have understories with western wheatgrass (Elymus smithii), Sandberg bluegrass (Poa secunda), and common dandelion (Taraxacum officinale) as the major understory species.

LOCATION: Our stand was in southeastern Natrona County (Figure 44) along the North Platte River. The community also occurs in the Cheyenne River Basin (Thilenius and Brown, 1990) and probably throughout eastern and central Wyoming.

ENVIRONMENT: Our stand occurred at an elevation of 5175 feet, 2.5 feet above and 200 feet from the river channel. In the Cheyenne River Basin (Thilenius and Brown, 1990), stands of this community occur on seasonally-flooded, subirrigated floodplains.

SOIL: The soil beneath our stand had horizons belonging to the silty clay, sandy clay, and sandy clay loam textural classes. Mottles were present at 2 feet beneath the soil surface. Soils beneath stands in the Cheyenne River Basin (Thilenius and Brown, 1990) are medium- and coarse-textured.

EXOTICS: Exotic grasses and forbs are common in stands of this community. Canada thistle, a noxious weed, was present in the stand we studied.

ADJACENT RIPARIAN VEGETATION: The site containing the stand that we studied also contained a large sandbar willow stand lower and closer to the river than the cottonwood/snowberry stand; a western snowberry stand at the same level above the river as the cottonwood/snowberry stand; and a stand of large, scattered plains cottonwood trees above and farther from the river than the cottonwood/snowberry stand.

ECOLOGY: Plains cottonwood is a pioneer species that requires moist, sparsely-vegetated alluvium to become established from seed (Johnson, 1992). Consequently, stands of this community are seral; a stand does not persist for longer than the lifespan of the original trees that become established after a flood, and the

stand becomes another vegetation type as the trees die. Maintenance of the plains cottonwood vegetation along a stream requires that the stream flood enough to deposit new alluvial bars on which new trees can grow.

According to Thilenius and Brown (1990), western snowberry is abundant in stands of this community because the stands are not grazed by livestock. With heavy livestock use, the snowberry becomes sparse and the remaining shrubs are heavily browsed, and rubber rabbitbrush (Chrysothamnus nauseosus) increases. In contrast, Hansen and others (1991) describe plains cottonwood/western snowberry stands in Montana as grazing-induced stages of the Great Plains Cottonwood/Red-Osier Dogwood (Populus deltoides/Cornus stolonifera) Community Type, in which grazing has shifted the shrub layer from a mix of red-osier dogwood, serviceberry, chokecherry, and currant to dominance by western snowberry. With continued heavy grazing, the snowberry disappears and the stand shifts to the Plains Cottonwood/Kentucky Bluegrass Community.

OTHER CLASSIFICATIONS: Thilenius and Brown (1990) describe a Plains Cottonwood/Western Snowberry Community in the Cheyenne River Basin of Wyoming with different understory dominant species, but our stand matches their description closely enough that we consider our stand to be part of the same community. Hansen and others (1991) describe plains cottonwood/western snowberry vegetation as a grazing-induced stage of their Great Plains Cottonwood/Red-Osier Dogwood Community Type, but they do not name it as a separate community.

In the classification of wetland habitats (Cowardin and others, 1979), the plains cottonwood/western snowberry community belongs to the Palustrine System, Forested Wetland Class, Broad-leaved Deciduous Subclass. In the ecological land classification framework (Driscoll and others, 1984), stands of this community belong to the Woodland Class, Deciduous Woodland Subclass, Cold-deciduous Woodland Group, Broad-leaved Deciduous Woodland Formation.

Stands of the plains cottonwood/western snowberry community probably occur on the following range sites (USDA Soil Conservation Service, 1988):

10-14" High Plains Southeast: Lowland
12-14" Southern Plains: Loamy lowland, Sandy lowland
15-17" Southern Plains: Lowland
10-14" Northern Plains: Lowland
15-17" Northern Plains: Lowland
15-19" Black Hills: Lowland

Plains Cottonwood/Switchgrass Panic (Populus deltoides/Panicum virgatum) Community

(2 stands)

VEGETATION STRUCTURE & COMPOSITION: The two stands we studied were savanna-like stands of plains cottonwood (Populus deltoides) with open canopies (20% cover) growing over moderately dense herbaceous layers dominated by grasses (Table 25). Shrubs contributed little cover. The cottonwoods in one stand were small and medium-sized, and the trees in the other were medium-sized and large trees. Switchgrass panic (Panicum virgatum) was present in both stands and dominated one. The understory in the other stand was strongly dominated by little bluestem (Schizachyrium scoparium), which contributed little cover in the other stand. Several other species were present in minor amounts in each stand.

LOCATION: Both stands were located along the North Platte River in southeastern Wyoming (Figure 44).

ENVIRONMENT: Our stands occurred at 4130 feet elevation. The stand with the larger trees lay 8 feet above the channel, and the stand with the smaller trees lay 4 feet above the channel. Both stands grew 750 feet from channel.

SOIL: Soils beneath the stands of this community consisted of surface horizons of sandy loam or very sandy loam above horizons of loamy sand, with sand and coarse sand deeper in the soil.

EXOTICS: Exotic species were minor constituents of both stands during 1992. Small amounts of Russian olive shrubs (Elaeagnus angustifolia) were present in both stands. Kentucky bluegrass (Poa pratensis) contributed little cover to both stands, and a few other exotic herbaceous species were present in one stand. Interestingly, although sweet clover (Melilotus sp.) was not growing in either stand during the 1992 field season, in late June 1991, sweetclover was a major understory species in the stand in which switchgrass panic dominates the understory.

ADJACENT RIPARIAN VEGETATION: Stands of sandbar willow (Salix exigua) and cottonwood saplings grew on bars closer to the river channel. Stands of the plains cottonwood/Kentucky bluegrass and the plains cottonwood/western wheatgrass communities grew on the same surfaces as the stands of this plains cottonwood/switchgrass panic community.

ECOLOGY: Plains cottonwood is a pioneer species that requires moist, sparsely-vegetated alluvium to become established from seed (Johnson, 1992). Consequently, stands of this community are seral; a stand does not persist for longer than the lifespan of the original trees that become established after a flood, and the stand becomes another vegetation type as the trees die.

Maintenance of the plains cottonwood vegetation along a stream requires that the stream flood enough to deposit new alluvial bars on which new trees can grow. The plains cottonwood/switchgrass panic stands will probably become grassy meadows as the trees die, unless they are eroded away by the river.

OTHER CLASSIFICATIONS: We did not find descriptions of the plains cottonwood/switchgrass panic community in the literature. The community was named by Steve Kettler of the Colorado Natural Heritage Program, who collected data from stands in eastern Colorado (Steve Kettler, personal communication).

In the classification of wetland habitats (Cowardin and others, 1979), the plains cottonwood/switchgrass panic community belongs to the Palustrine System, Forested Wetland Class, Broad-leaved Deciduous Subclass. In the ecological land classification framework (Driscoll and others, 1984), stands of this community belong to the Woodland Class, Deciduous Woodland Subclass, Cold-deciduous Woodland Group, Broad-leaved Deciduous Woodland Formation.

Stands of the plains cottonwood/switchgrass panic community probably occur on the following range sites (USDA Soil Conservation Service, 1988):

12-14" Southern Plains: Sandy Lowland

Plains Cottonwood/Recent Alluvial Bar (Populus deltoides/Recent Alluvial Bar) Community

(4 stands sampled)

VEGETATION STRUCTURE & COMPOSITION: Plains cottonwood (Populus deltoides) seedlings or saplings dominate or codominate the vegetation (Table 26). In stands of seedlings (plants less than 4.5 feet tall), the vegetation is low and includes few species other than cottonwood. In stands of saplings (plants taller than 4.5 feet but less than 5 inches in diameter at 4.5 feet), the vegetation may include a sapling layer with shrubs above a sparse herbaceous layer. Two of the sapling stands we studied were located at the same site, and both contained flaxleaf rabbitbrush (Chrysothamnus linifolius) and Chinese tamarisk (Tamarix chinensis) in the sapling layer and a substantial cover of inland saltgrass (Distichlis stricta) and tumbleweed (Salsola colina) in the understory.

LOCATION: We found stands of this community in southeastern Wyoming and at two sites in north-central Wyoming (Figure 44) along wide channels (Figure 46). Elevations were 3900 feet to 4350 feet (Figure 45). The community probably is widespread.

ENVIRONMENT: Stands of this community occurred up to 4 feet above the stream channel (Figure 46).

SOIL: Soil horizons beneath the plains cottonwood/recent alluvial bar stands all were in sandy textural classes (Figure 48). No mottles were observed in the soils.

EXOTICS: Tamarisk, an exotic shrub, was present in all three of our sapling stands and codominated one (Table 26). Exotic forbs and grasses were common. Because they are located so close to the stream channel, stands of this community probably are flooded frequently, and so provide good habitat for these exotic species.

ADJACENT RIPARIAN VEGETATION: The seedling stand we sampled occupied the lowest terrace adjacent to the stream, and was bordered by a sandbar willow stand on the next-higher terrace. Plains cottonwood tree stands occurred on higher terraces. The sapling stands occupied intermediate terraces at their sites, with softstem bulrush, alkali cordgrass, or sandbar willow stands on the lower terraces next to the channel; plains cottonwood/western wheatgrass stands on terraces above the sapling stands; and black greasewood on the highest terrace at one site.

ECOLOGY: Plains cottonwood is a pioneer species that requires moist, sparsely-vegetated alluvium to become established from seed (Johnson, 1992), and stands of the Plains Cottonwood/Recent Alluvial Bar Community represent the earliest stages of cottonwood succession. If these stands survive browsing and future floods,

they will become stands of other plains cottonwood communities as floodwaters deposit sediment onto the current alluvial bars (thereby raising the soil surface farther above the stream channel and out of reach of many floods) and the trees grow.

OTHER CLASSIFICATIONS: This community is the same as the Great Plains Cottonwood (Populus deltoides)/Recent Alluvial Bar Community Type described from Montana by Hansen and others (1991). In the classification of wetland habitats (Cowardin and others, 1979), this community belongs to the Palustrine System, Scrub-Shrub Wetland Class, Class, Broad-leaved Deciduous Subclass. In the ecological land classification framework (Driscoll and others, 1984), stands of this community belong to the Shrubland Class, Deciduous Shrubland Subclass, Cold-deciduous Shrubland Group, Deciduous Alluvial Shrubland Formation.

Stands of the plains cottonwood/recent alluvial bar community probably occur on the following range sites (USDA Soil Conservation Service, 1988):

10-14" High Plains Southeast: Lowland
12-14" Southern Plains: Loamy Lowland, Sandy Lowland
15-17" Southern Plains: Lowland
10-14" Northern Plains: Saline Subirrigated, Lowland, Saline Lowland
15-17" Northern Plains: Saline Subirrigated, Lowland, Saline Lowland
15-19" Black Hills: Lowland, Saline Lowland

Other Plains Cottonwood Stands

(9 stands sampled)

Plains cottonwood trees dominated nine stands so different from each other and from communities described elsewhere that we could not place them into communities (Table 25). Six of these stands occurred at one site along the North Platte River in southeastern Wyoming (Figure 44). A high-elevation stand in central Wyoming contained lanceleaf cottonwood (Populus acuminata) in the tree layer. Green ash (Fraxinus pennsylvanica) dominated the smaller size-classes in one of the southeastern stands and occurred in two other southeastern stands. Western snowberry was present in substantial amounts in two stands, but the understories of these stands were distinct from the understory of the plains cottonwood/western snowberry community.

Understories were diverse. Prairie sandreed (Calamovilfa longifolia) dominated one stand that grew on a deep loamy sand soil and codominated another with Kentucky bluegrass on a loamy sand with a sandy clay loam surface horizon. Switchgrass (Panicum virgatum), a grass of the tallgrass prairie, dominated one of the southeastern stands growing on a deep sand soil with a sandy loam surface 4 feet above the stream channel. Another southeastern stand with a sparse tree overstory was dominated by little bluestem (Schizachyrium scoparium), also growing on deep sand soil but lying ca 8 feet above the channel. Understories in the other stands were a mix of species.

The unclassified stands were not markedly different from other plains cottonwood stands in the elevations at which they grew (Figure 45), the sizes of streams they grew along (Figure 46) the heights above the stream channels (Figure 47), or the soils on which they occurred (Figure 48).

Narrowleaf Cottonwood (*Populus angustifolia*) Dominance Type

The Narrowleaf Cottonwood Dominance Type includes stands of trees dominated by narrowleaf cottonwood (*Populus angustifolia*). The tree layer may also include plains cottonwood (*Populus deltoides*) and boxelder (*Acer negundo*), and small amounts of peachleaf willow (*Salix amygdaloides*) and green ash (*Fraxinus pennsylvanica*). Vegetation structure ranges from dense stands of poles and small trees to stands of scattered large trees with understories of small trees, poles, and saplings. Narrowleaf cottonwood stands often contain a greater mix of tree sizes than do plains cottonwood stands, probably because narrowleaf cottonwood has a greater ability to sprout than does plains cottonwood (Hansen and others, 1991) and sprouts form seedling and sapling size classes. Shrubs usually are sparse. The herbaceous layer usually is dominated by grasses.

We described five communities in the narrowleaf cottonwood dominance type. Each of these communities, and one additional stand not classified into a community, are described below.

Figure 49. Map of Wyoming counties showing approximate locations of sites with narrowleaf cottonwood stands.

Map Symbol	Community
1	Narrowleaf cottonwood/western wheatgrass (2 stands)
2	Narrowleaf cottonwood/carpet bentgrass (4 stands)
3	Narrowleaf cottonwood/Kentucky bluegrass (2 stands)
4	Narrowleaf cottonwood/smooth brome (3 stands)
5	Narrowleaf cottonwood/recent alluvial bar (2 stands)
6	Unclassified narrowleaf cottonwood stand (1 stand)

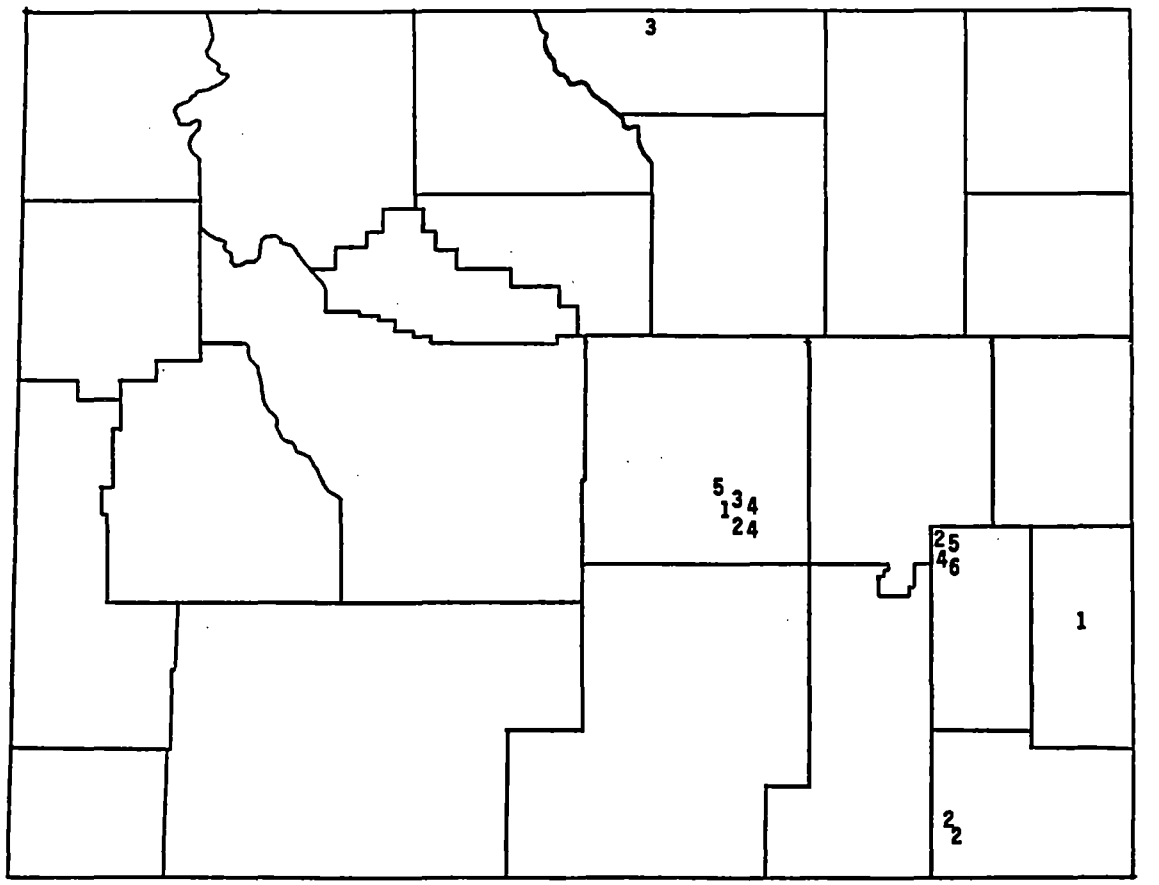


Figure 50. Percentage of narrowleaf cottonwood stands and plains cottonwood stands with and without coarse fragments in the soil.

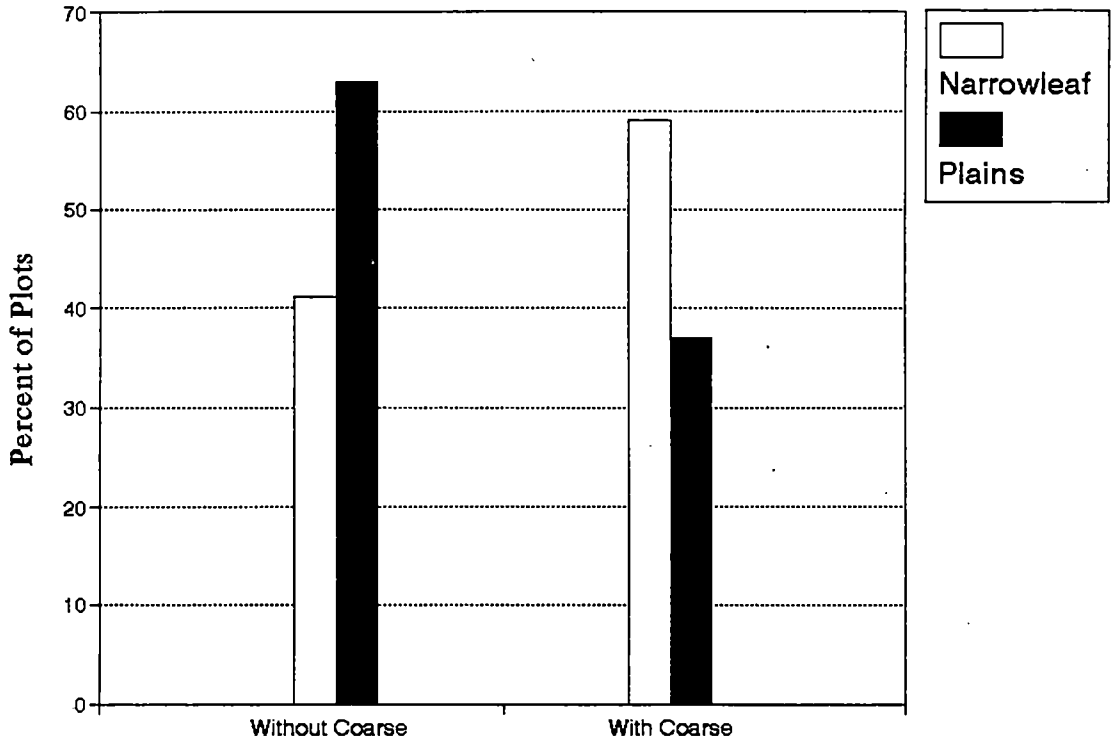


Figure 51. Elevations of sites with narrowleaf cottonwood stands. Each narrowleaf cottonwood community is represented on the x-axis by the name of the dominant understory species, except that the recent alluvial bar community is labeled "Bar".

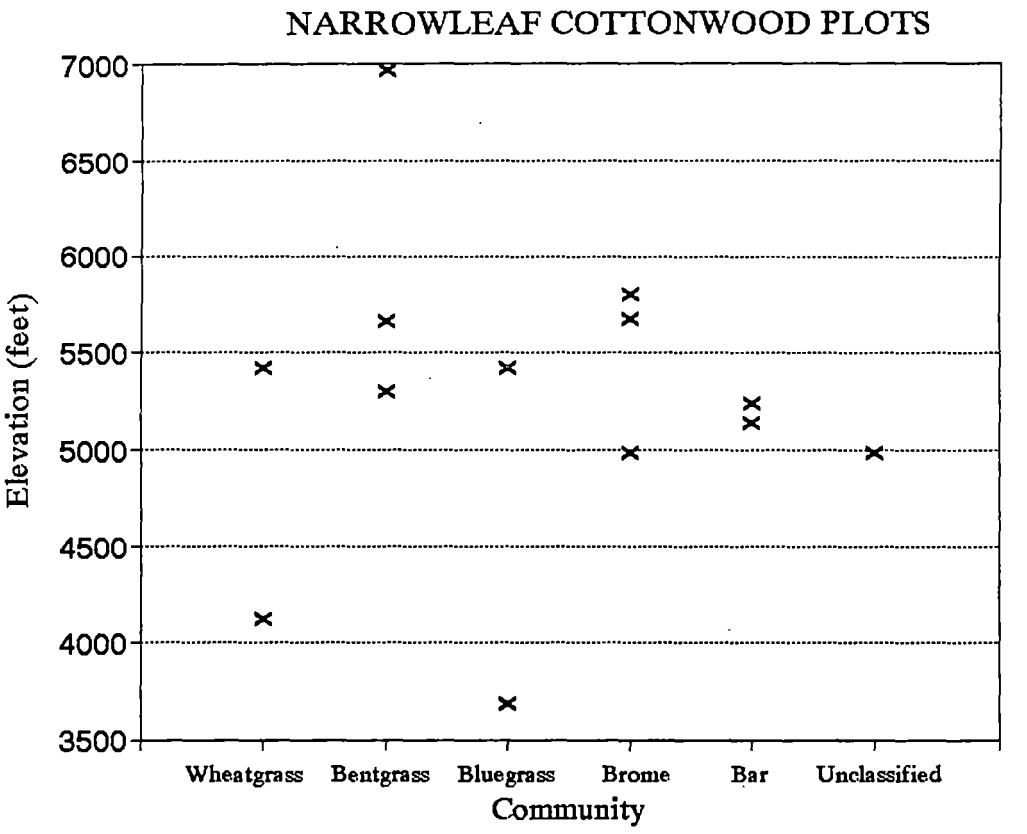


Figure 52. Widths of channels along which we sampled narrowleaf cottonwood stands. Each narrowleaf cottonwood community is represented on the x-axis by the name of the dominant understory species, except that the recent alluvial bar community is labeled "Bar".

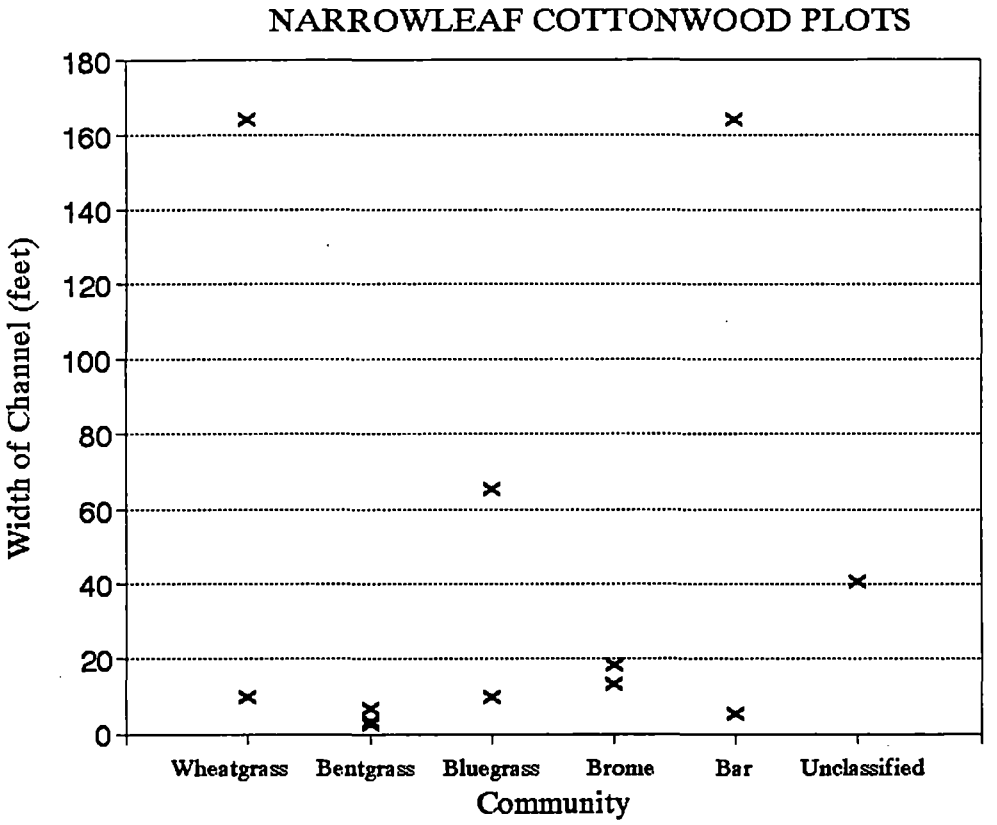


Figure 53. Heights of plots in narrowleaf cottonwood stands above the nearest active stream channel. Each narrowleaf cottonwood community is represented on the x-axis by the name of the dominant understory species, except that the recent alluvial bar community is labeled "Bar".

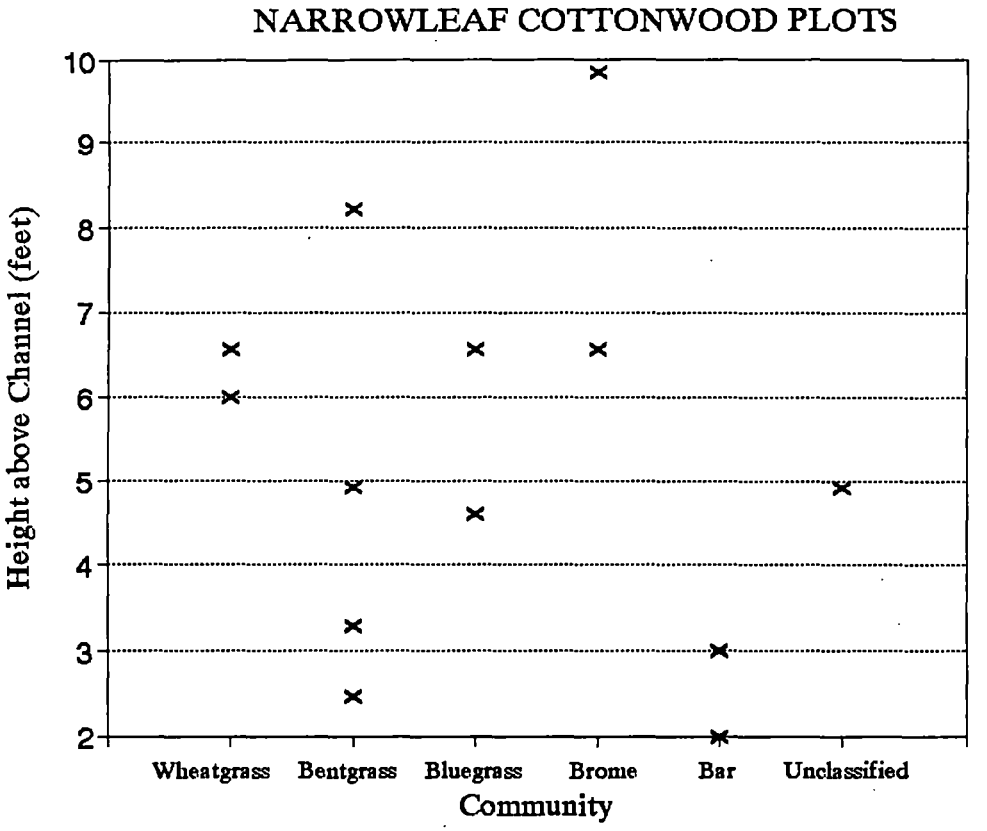


Figure 54. Distances in feet between plots of the narrowleaf cottonwood communities and the nearest active stream channel. Each narrowleaf cottonwood community is represented on the x-axis by the name of the dominant understory species, except that the recent alluvial bar community is labeled "Bar".

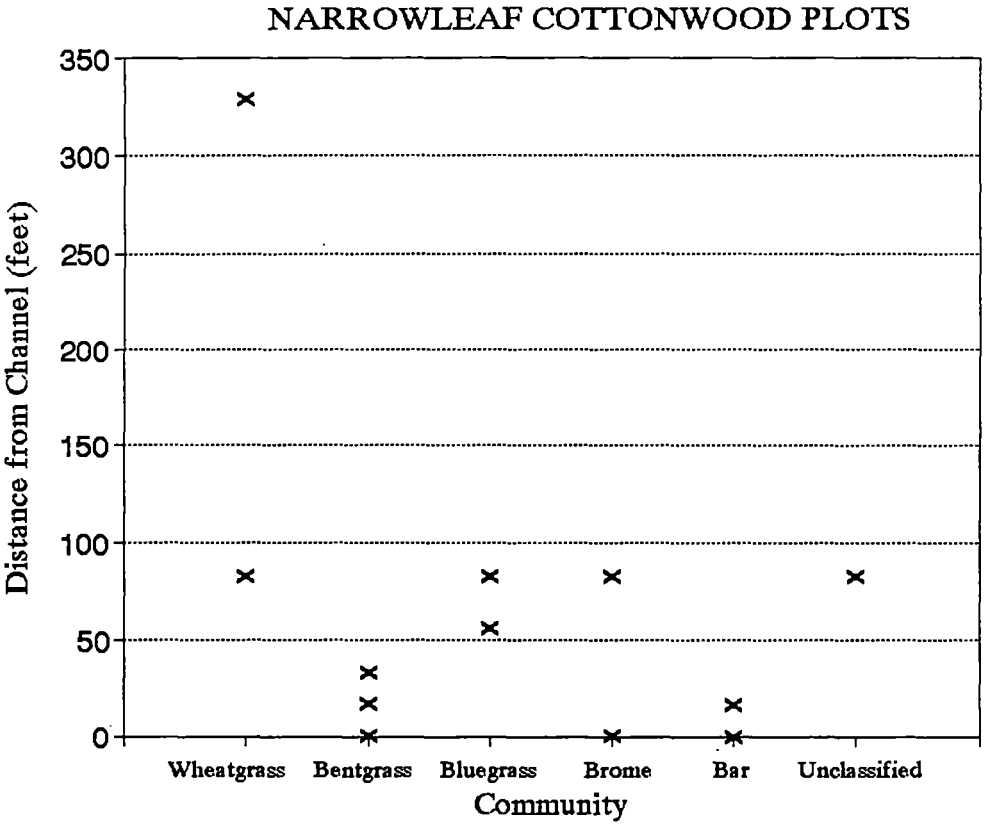
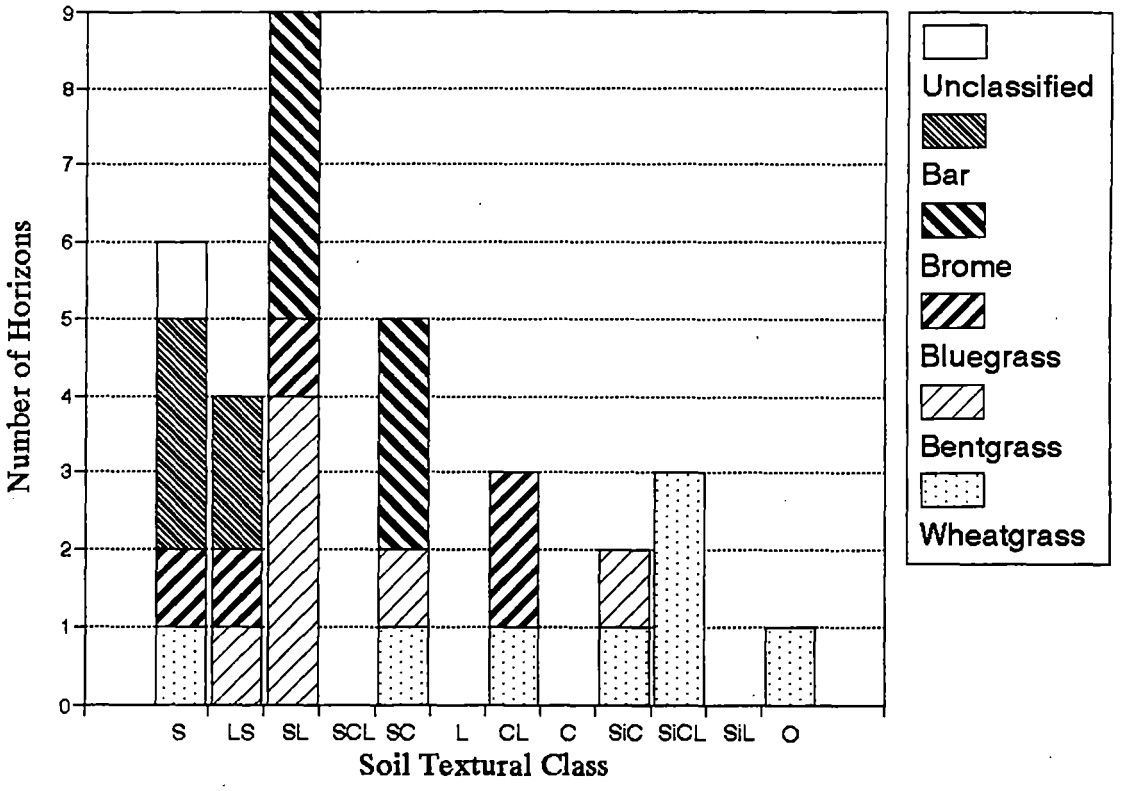


Figure 55. Distribution among textural classes of soil horizons beneath narrowleaf cottonwood stands. Species names and "Bar" represent narrowleaf cottonwood communities. Labels on the x-axis represent the following soil textural classes:

S = Sand
LS = Loamy sand
SL = Sandy loam
SCL = Sandy clay loam
SC = Sandy clay
L = Loam
CL = Clay loam
C = Clay
SiC = Silty clay
SiCL = Silty clay loam
SiL = Silty loam
O = Organic



Narrowleaf Cottonwood/Western Wheatgrass (Populus angustifolia/ Elymus smithii) Community

(2 stands sampled)

VEGETATION STRUCTURE & COMPOSITION: We studied two stands of this community, both of which had sparse tree canopies with many sprouts in the seedling and sapling size classes (Table 27). In one stand, shrubs formed a sparse layer. In both stands, western wheatgrass or thickspike wheatgrass (Elymus lanceolatus) dominated the herbaceous layers, which contained a mix of grasses and forbs. Carpet bentgrass (Agrostis stolonifera), Kentucky bluegrass (Poa pratensis), and smooth brome (Bromus inermis), if present, contributed substantially less cover than did the wheatgrasses.

LOCATION: We found this community in two quite different places (Figure 49). One stand occurred along the North Platte River, a very large stream (Figure 52) with a large drainage basin, at 4100 feet elevation. The other stand was along a smaller stream (Figure 52) in a small drainage basin at 5500 feet elevation. This community apparently occurs at low elevations for a narrowleaf cottonwood type.

ENVIRONMENT: Both stands lay at least six feet above the stream channel (Figure 53) and a long distance from the channel (Figure 54).

SOIL: Soils beneath stands of this community were primarily in clay loam or finer textural classes (Figure 55), and were relatively fine-textured for narrowleaf cottonwood types. One soil horizon was primarily organic matter.

EXOTICS: Numerous species of exotic grasses and forbs were present in both stands, but only Kentucky bluegrass contributed more than a trace of cover (Table 27).

ADJACENT RIPARIAN VEGETATION: At the lower elevation site, the narrowleaf cottonwood/western wheatgrass stand grew on an island with unclassified plains cottonwood stands. At the higher elevation site, the adjacent vegetation was narrowleaf cottonwood/Kentucky bluegrass and, closer to the stream channel, a basin wildrye (Elymus cinereus) stand.

ECOLOGY: Narrowleaf cottonwood is a pioneer species that requires moist, sparsely-vegetated alluvium to become established from seed. Consequently, narrowleaf cottonwood stands are seral, and maintenance of narrowleaf cottonwood stands along a stream requires that the stream flood enough to deposit new alluvial bars on which new trees can grow. Young narrowleaf cottonwoods can sprout after browsing (Youngblood and others, 1985; Hansen and others, 1991), and the seedlings and saplings in stands of this community are mostly sprouts. These stands will probably become

western wheatgrass meadows as the trees die, unless some event raises the water tables beneath them.

Hansen and others (1991) note that, in the narrowleaf cottonwood communities they've described from Montana, heavy grazing reduces the cover of shrubs and eventually can remove the shrub layer altogether. Further investigations may show that the narrowleaf cottonwood/western wheatgrass community is derived by grazing from other communities with shrub layers.

OTHER CLASSIFICATIONS: The narrowleaf cottonwood/western wheatgrass community has not been described elsewhere.

In the classification of wetland habitats (Cowardin and others, 1979), the narrowleaf cottonwood/western wheatgrass community belongs to the Palustrine System, Forested Wetland Class, Broad-leaved Deciduous Subclass. In the ecological land classification framework (Driscoll and others, 1984), this community belongs to several categories. Stands with 25% to 60% canopy cover belong to the Woodland Class, Deciduous Woodland Subclass, Cold-deciduous Woodland Group, Broad-leaved Deciduous Woodland Formation. Stands with 10% to 24% canopy cover belong to the Herbaceous Vegetation Class, Medium-tall Grassland Subclass, Medium-tall Grassland with Tree Layer Group, Woody Layer Broad-leaved Deciduous Formation.

We found stands of this community on the following range sites (USDA Soil Conservation Service, 1988):

12-14" Southern Plains: Loamy lowland
5-9" Wind River Basin: Lowland

Narrowleaf Cottonwood/Carpet Bentgrass (Populus angustifolia/ Agrostis stolonifera) Community

(4 stands sampled)

VEGETATION STRUCTURE & COMPOSITION: Narrowleaf cottonwood dominates the tree layer, which may vary from an open stand of old trees to a dense stand of pole-sized trees (Table 28). Other tree species may be present in small amounts. Shrubs are present, but contribute little canopy cover. The understory may be dense or sparse, depending in part on how recently a stand has been flooded, but in either case, carpet bentgrass (Agrostis stolonifera) is a primary understory species.

Stands of this community may best be considered part of the narrowleaf cottonwood/Kentucky bluegrass community, but we are placing them in a separate community for several reasons. First, the communities differ in composition; Kentucky bluegrass is a minor species in these stands, and the stands we found of the narrowleaf cottonwood/Kentucky bluegrass community have little carpet bentgrass. Associated species are different, too. Moreover, the published descriptions of the narrowleaf cottonwood/Kentucky bluegrass community (Youngblood and other, 1985; Padgett and other, 1989; Hansen and others, 1991) suggest that carpet bentgrass is a minor species. Second, and perhaps more importantly, the limited data we have suggests that stands of this community occur at higher elevations (Figure 51) and closer to the stream channel (Figure 54) than do stands of the narrowleaf cottonwood/Kentucky bluegrass community. If the two communities occupy different sites, as these data suggest, then their responses to management probably also differ and they should be considered separate.

LOCATION: Stands of this community occurred in the southeastern part of the state (Figure 49), along small streams (Figure 52) in small basins above 5300 feet elevation (Figure 51).

ENVIRONMENT: We found stands of this community up to eight feet above the stream channel (Figure 53) and as far as ca 30 feet from the channel (Figure 54).

SOIL: Soils were primarily sandy loams (Figure 55).

EXOTICS: Carpet bentgrass, or redtop, is an exotic introduced from Europe as a hay grass (Cronquist and others, 1977). Other exotic grasses and forbs often occur in substantial amounts.

ADJACENT RIPARIAN VEGETATION: In two of the sites we studied, the narrowleaf cottonwood stands were the only riparian vegetation present. At the other site, the narrowleaf cottonwood/carpet bentgrass stand grew above a nearly bare channel, and the higher terrace supported a basin big sagebrush shrubland.

ECOLOGY: Narrowleaf cottonwood is a pioneer species that requires moist, sparsely-vegetated alluvium to become established from seed. Consequently, narrowleaf cottonwood stands are seral, and maintenance of narrowleaf cottonwood stands along a stream requires that the stream flood enough to deposit new alluvial bars on which new trees can grow. Young narrowleaf cottonwoods can sprout after browsing (Youngblood and others, 1985; Hansen and others, 1991), and the seedlings and saplings in stands of this community are mostly sprouts. These stands will probably become carpet bentgrass meadows as the trees die, unless some event raises the water tables beneath them.

Hansen and others (1991) note that, in Montana, heavy browsing reduces the cover of shrubs and eventually can remove the shrub layer altogether. The composition of the herbaceous layers in stands of this community may also show the effects of prolonged animal use, with the composition being shifted from the original native grasses to carpet bentgrass. We don't know what the original understory was, but one of our stands has a substantial amount of slender wheatgrass (Elymus trachycaulus), which is listed as an important decreaser in the 5-9" Wind River Basin lowland range site where the stand was found. Perhaps herbaceous layers in this community originally were dominated by slender wheatgrass.

OTHER CLASSIFICATIONS: The narrowleaf cottonwood/carpet bentgrass community has not been described elsewhere. It may represent a browsing-induced stage of the Narrowleaf Cottonwood/Red-Osier Dogwood Community Type described by Hansen and others (1991) from Montana.

In the classification of wetland habitats (Cowardin and others, 1979), the narrowleaf cottonwood/carpet bentgrass community belongs to the Palustrine System, Forested Wetland Class, Broad-leaved Deciduous Subclass. In the ecological land classification framework (Driscoll and others, 1984), this community belongs to several categories. Stands with over 60% tree canopy cover belong to the Forest Class, Deciduous Forest Subclass, Cold-deciduous Forest Group, Broad-leaved Deciduous Forest Formation. Stands with 25% to 60% canopy cover belong to the Woodland Class, Deciduous Woodland Subclass, Cold-deciduous Woodland Group, Broad-leaved Deciduous Woodland Formation. Stands with 10% to 24% canopy cover belong to the Herbaceous Vegetation Class, Medium-tall Grassland Subclass, Medium-tall Grassland with Tree Layer Group, Woody Layer Broad-leaved Deciduous Formation.

We found stands of this community on the following range sites (USDA Soil Conservation Service, 1988):

15-17" Southern Plains: Lowland
10-14" Northern Plains: Lowland
5-9" Wind River Basin: Lowland

Narrowleaf Cottonwood/Kentucky Bluegrass (Populus angustifolia/Poa pratensis) Community

(2 stands sampled)

VEGETATION STRUCTURE & COMPOSITION: Narrowleaf cottonwood dominates a tree overstory that may include a mix of tree sizes and other species of trees (Table 29). Shrubs are absent or present only in minor amounts. The herbaceous layer includes a variety of grasses and forbs, of which Kentucky bluegrass (Poa pratensis) is the main species. Carpet bentgrass may be present, but is a minor species.

LOCATION: We found this community in central Wyoming and in northern Wyoming (Figure 49), below 5500 feet elevation (Figure 51) on small to medium-sized streams (Figure 52) in small drainage basins. The community is widespread in the mountains of western Wyoming (Youngblood and others, 1985) and in Montana (Hansen and others, 1991), and probably also is widespread on the margins of the plains and basins of eastern and central Wyoming.

ENVIRONMENT: Our stands lay over four feet above the stream channel (Figure 53) and over 50 feet from the channel (Figure 54).

SOIL: Textures of soil horizons beneath stands of this community ranged from sand to clay loam (Figure 55).

EXOTICS: Kentucky bluegrass, the dominant understory species, apparently is an exotic species introduced from Europe (USDA Forest Service, 1937; Hitchcock, 1950), although some botanists think that some populations represent a nearly-identical native species (Cronquist and others, 1977; Weber, 1972). Kentucky bluegrass is ubiquitous in moist sites throughout North America and is a desirable forage species in many areas. Many other exotic species, both annuals and perennials, usually are present as well.

ADJACENT RIPARIAN VEGETATION: Stands of this community may occur with other narrowleaf cottonwood types. At one of our sites, a lower terrace supported a stand of small green ash trees, and at the other site, a stand of basin wildrye grew nearer to the stream. Higher terraces in central Wyoming may support basin big sagebrush stands.

ECOLOGY: Narrowleaf cottonwood is a pioneer species that requires moist, sparsely-vegetated alluvium to become established from seed. Consequently, narrowleaf cottonwood stands are seral, and maintenance of narrowleaf cottonwood stands along a stream requires that the stream flood enough to deposit new alluvial bars on which new trees can grow. Young narrowleaf cottonwoods can sprout after browsing (Youngblood and others, 1985; Hansen and others, 1991), and the seedlings and saplings in stands of this

community are mostly sprouts. These stands will probably become Kentucky bluegrass meadows as the trees die, unless some event raises the water tables beneath them.

Hansen and others (1991) consider the narrowleaf cottonwood/Kentucky bluegrass community to be a grazing-induced type derived from other narrowleaf cottonwood types with more shrub cover. Repeated, season-long grazing reduces the cover of shrubs and increases the amount of Kentucky bluegrass in a stand, until finally the vegetation consists only of a cottonwood overstory above a bluegrass-dominated herbaceous understory. According to Hansen and others (1991), in some cases a change in grazing management may restore the shrub layer and decrease the amount of Kentucky bluegrass in the herbaceous layer, but this vegetation type is very stable once established and it may persist even after a change in management. According to Youngblood and others (1985), a shift to dominance of the understory by Kentucky bluegrass often is accompanied by a drop in the water table, and the vegetation will remain a Kentucky bluegrass stand until some hydrologic change raises the water table. Although Kentucky bluegrass provides good forage with the right management, the species is less effective at holding soil against erosion than are the deeper-rooted species it replaces. It is unclear what species formerly dominated the stands that we studied, so whether Kentucky bluegrass replaced deeper-rooted species in our stands is unknown.

OTHER CLASSIFICATIONS: This community has been described from western Wyoming and eastern Idaho (Youngblood and others, 1985), Montana (Hansen and others, 1991), and Utah (Padgett and others, 1989). In the classification of wetland habitats (Cowardin and others, 1979), the narrowleaf cottonwood/Kentucky bluegrass community belongs to the Palustrine System, Forested Wetland Class, Broad-leaved Deciduous Subclass. In the ecological land classification framework (Driscoll and others, 1984), this community belongs to the Woodland Class, Deciduous Woodland Subclass, Cold-deciduous Woodland Group, Broad-leaved Deciduous Woodland Formation.

We found stands of this community on the following range sites (USDA Soil Conservation Service, 1988):

10-14" Northern Plains: Lowland
5-9" Wind River Basin: Lowland

Narrowleaf Cottonwood/Smooth Brome (Populus angustifolia/Bromus inermis) Community

(3 stands sampled)

VEGETATION STRUCTURE & COMPOSITION: Stands of this community have a tree overstory dominated by narrowleaf cottonwood (Table 30). A variety of tree sizes may be present, partly due to the presence of sprouts in the seedling and sapling size classes. Boxelder (Acer negundo) also is common in the tree layer and understory. Shrubs are common but usually contribute little cover. Smooth brome (Bromus inermis) is a major species in the herbaceous layer, which contains a variety of other forbs and grasses. Kentucky bluegrass (Poa pratensis) and carpet bentgrass (Agrostis stolonifera) may be present but are minor species.

LOCATION: We found stands of this community in central Wyoming (Figure 49), along small streams (Figure 52) in small basins between 5000 feet and 6000 feet elevation (Figure 51).

ENVIRONMENT: Our stands occurred from 6 to 10 feet above the stream channel (Figure 53), and from next to the channel up to 75 feet away (Figure 54).

SOIL: Stands of this community occurred on loamy sands and sandy clay loams (Figure 55).

EXOTICS: Smooth brome, a common, introduced hay grass, is the primary understory species. A variety of other exotic grasses and forbs is present (Table 30).

ADJACENT RIPARIAN VEGETATION: We encountered stands of this community growing with stands of the Narrowleaf Cottonwood/Recent Alluvial Bar Community and with spikerush (Eleocharis sp.) vegetation on lower terraces, and with basin big sagebrush (Artemisia tridentata spp. tridentata) or black greasewood (Sarcobatus vermiculatus) stands on higher terraces, on the edge of the riparian zone. Hay meadows occurred at two of our sites.

ECOLOGY: Narrowleaf cottonwood is a pioneer species that requires moist, sparsely-vegetated alluvium to become established from seed. Consequently, stands of this community are seral; a stand does not persist for longer than the lifespan of the original trees that become established after a flood, and the stand becomes another vegetation type as the trees die. Maintenance of narrowleaf cottonwood vegetation along a stream requires that the stream flood enough to deposit new alluvial bars on which new trees can grow.

Stands with boxelder in the smaller tree size classes may become boxelder stands as the cottonwoods die, because boxelder can reproduce beneath cottonwood overstories (Johnson, 1992).

Stands of this community without boxelder probably will change to brome meadows as the cottonwoods die.

Hansen and others (1991) note that, in the narrowleaf cottonwood communities they've described from Montana, heavy browsing reduces the cover of shrubs and eventually can remove the shrub layer altogether. The presence of small amounts of shrubs in stands of the Narrowleaf Cottonwood/Smooth Brome Community suggest that this community may be derived from other shrub-rich communities through browsing.

OTHER CLASSIFICATIONS: This community has not been described elsewhere, but it may be a grazing-induced stage of the Narrowleaf Cottonwood/Red-Osier Dogwood Community Type described by Hansen and others (1991) from Montana.

In the classification of wetland habitats (Cowardin and others, 1979), the Narrowleaf Cottonwood/Smooth Brome Community belongs to the Palustrine System, Forested Wetland Class, Broad-leaved Deciduous Subclass. In the ecological land classification framework (Driscoll and others, 1984), stands with 25% to 60% tree canopy cover belong to the Woodland Class, Deciduous Woodland Subclass, Cold-deciduous Woodland Group, Broad-leaved Deciduous Woodland Formation, and stands with less than 25% canopy cover belong to the Herbaceous Vegetation Class, Medium-tall Grassland Subclass, Medium-tall Grassland with Tree Layer Group, Woody Layer Broad-leaved Deciduous Formation.

We found stands of this community on the following range sites (USDA Soil Conservation Service, 1988):

10-14" Northern Plains: Lowland
5-9" Wind River Basin: Lowland

Narrowleaf Cottonwood/Recent Alluvial Bar (Populus angustifolia)/ Recent Alluvial Bar) Community

(2 stands sampled)

VEGETATION STRUCTURE & COMPOSITION: Narrowleaf cottonwood (Populus angustifolia) seedlings or saplings dominate or codominate the vegetation (Table 31). In stands of seedlings (plants less than 4.5 feet tall), the vegetation is low and includes few species other than cottonwood. In stands of saplings (plants taller than 4.5 feet but less than 5 inches in diameter at 4.5 feet), the vegetation may include a sapling layer with shrubs above a sparse herbaceous layer.

LOCATION: We found stands of this community in central Wyoming (Figure 49), on both small and large streams (Figure 52) just over 5000 feet elevation (Figure 51).

ENVIRONMENT: This community occurs close to the stream channel (Figures 53 and 54) on recently-deposited cobble and gravel bars.

SOIL: Soils supporting stands of this community are sands and loamy sands (Figure 55) with a large amount of gravel and cobbles.

EXOTICS: Our stands contained only a few exotic annuals and biennials (Table 31).

ADJACENT RIPARIAN VEGETATION: Our seedling stand occurred in a small riparian area with sedge and spikerush closer to the channel. The sapling stand (Table 31) occurred next to the channel, with a sandbar willow stand on a slightly higher terrace, a silver buffaloberry stand in an overflow channel, and basin big sagebrush on the highest terrace in the riparian zone.

ECOLOGY: Narrowleaf cottonwood is a pioneer species that requires moist, sparsely-vegetated alluvium to become established from seed, and stands of the Narrowleaf Cottonwood/Recent Alluvial Bar Community represent the earliest stages of cottonwood succession. If these stands survive browsing and future floods, they will become stands of other narrowleaf cottonwood communities as floodwaters deposit sediment onto the current alluvial bars (thereby raising the soil surface farther above the stream channel and out of reach of many floods) and the seedlings and saplings grow into trees.

OTHER CLASSIFICATIONS: Hansen and others (1991) describe this community from Montana. In the classification of wetland habitats (Cowardin and others, 1979), this community belongs to the Palustrine System, Scrub-Shrub Wetland Class, Broad-leaved Deciduous Subclass. In the ecological land classification framework (Driscoll and others, 1984), stands of this community belong to the Shrubland Class, Deciduous Shrubland Subclass, Cold-

deciduous Shrubland Group, Deciduous Alluvial Shrubland Formation.

We found stands of this community on the following range sites (USDA Soil Conservation Service, 1988):

10-14" Northern Plains: Lowland
5-9" Wind River Basin: Lowland

Unclassified Narrowleaf Cottonwood Stand

We studied one narrowleaf cottonwood stand that we could not place into any community. This stand occurred in central Wyoming (Figure 49) on a medium-sized stream (Figure 52) in a small drainage basin at 5000 feet elevation (Figure 51), growing on sand (Figure 55) at some distance from the active stream channel (Figures 53 and 54). Small trees and poles formed an overstory (Table 32), with many saplings and seedlings present. Only a few other plants were present. The stand had been flooded recently and sediment covered most of the understory.

This stand illustrates the role of flooding in shaping the composition and structure of cottonwood stands. Floods deposit sediment that buries the existing understory plants, and the composition of the understory after the flood depends on which species can best grow up through the new sediment and which species can quickly germinate in it. Each successive flood raises the soil surface higher above the groundwater, until only the trees and shrubs and a few herbaceous plants are able to draw on groundwater, and most of the herbaceous species must rely on soil water.

Lanceleaf Cottonwood (Populus acuminata) Dominance Type

(1 stand sampled)

We found one forest stand dominated by lanceleaf cottonwood (Populus acuminata). This species, considered to be a hybrid between plains cottonwood and narrowleaf cottonwood, is widely scattered but uncommon throughout Wyoming (Porter, 1967). None of the classifications of riparian types of which we are aware has described a lanceleaf cottonwood type.

VEGETATION: Large and medium-sized lanceleaf cottonwoods form an overstory above boxelder poles and saplings (Table 33). A sparse layer of chokecherry is present. The dense herbaceous layer is composed almost entirely of smooth brome.

Excepting the presence of lanceleaf cottonwood, this stand resembles some plains cottonwood/smooth brome stands, narrowleaf cottonwood/smooth brome stands, and boxelder stands. It may be better considered a member of one of those groups.

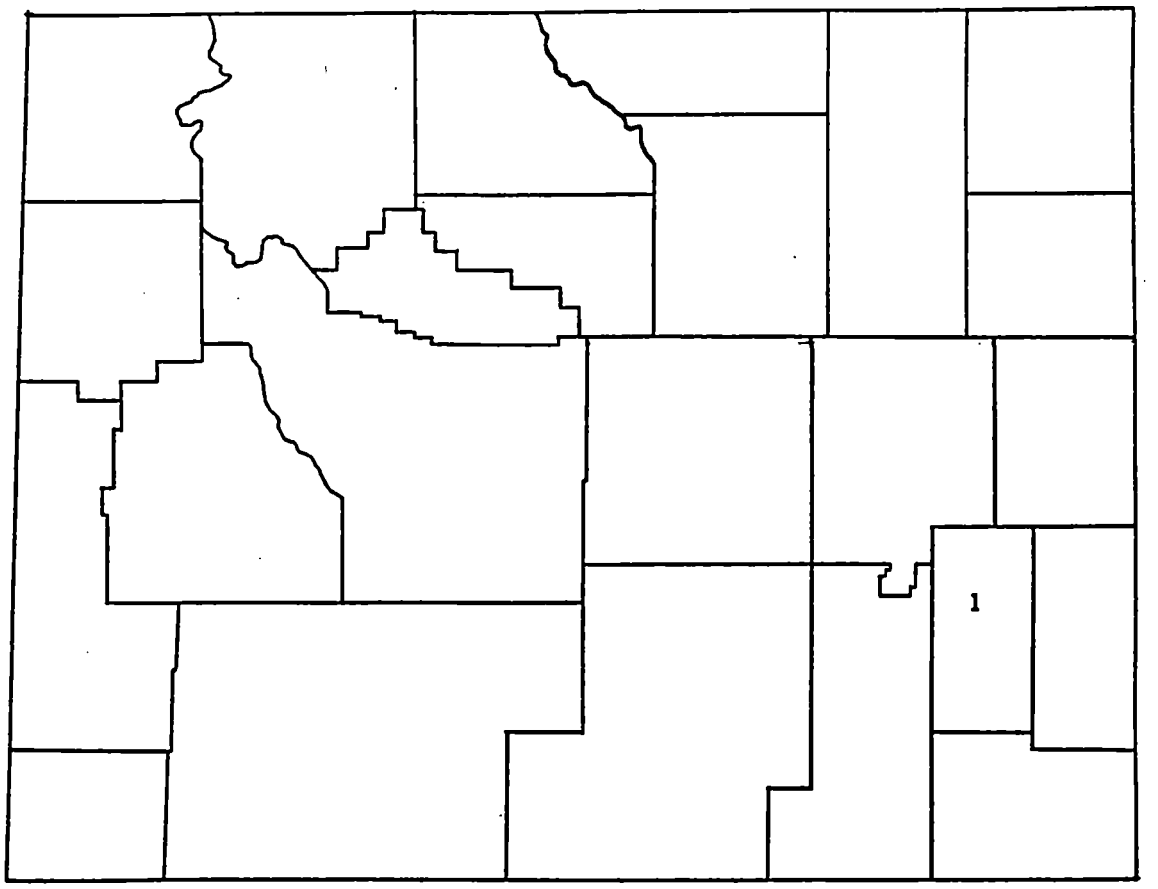
LOCATION: The sole stand of this type occurred in southeastern Wyoming (Figure 56) at 4700 feet elevation (Figure 36) in a small basin with a small channel (Figure 38).

ENVIRONMENT: The lanceleaf cottonwood stand grew near the stream channel (Figure 39) and over 6 feet above the channel (Figure 40) on soil with sand and sandy loam horizons.

ECOLOGY: Like the other cottonwoods, lanceleaf cottonwood probably requires sparsely-vegetated, damp alluvium for establishment of seedlings, and cannot reproduce in its own shade. Consequently it is a pioneer vegetation type and will be replaced by other vegetation -- in the case of our stand, by a boxelder stand.

Figure 56. Map of Wyoming counties showing the approximate location of the site with the lanceleaf cottonwood stand.

Map Symbol	Vegetation Type
1	Lanceleaf cottonwood dominance type (1 stand)



Boxelder (Acer negundo) Dominance Type

(9 stands sampled)

VEGETATION: Boxelder (Acer negundo) dominates a tree layer that often includes other tree species, especially peachleaf willow (Table 34). In most of our stands, boxelder poles, small trees, or medium-sized trees dominated, but large trees often were present. Shrubs were sparse, with western snowberry the most common shrub. No single grass or forb species was present in all stands, but three grasses (western wheatgrass [Elymus smithii], smooth brome [Bromus inermis], and cheatgrass [Bromus tectorum]) and five forbs (common yarrow [Achillea millefolium], field horsetail [Equisetum arvense], Canada thistle [Cirsium arvense], common dandelion [Taraxacum officinale], and field pennycress [Thlaspi arvense]) occurred in at least half of the stands. Smooth brome was a major species in five stands, and Kentucky bluegrass was a major species in two others. One of our stands was a mixture of boxelder seedlings (plants less than 4.5 feet tall) and smooth brome (Table 35).

LOCATION: The boxelder dominance type occurs throughout eastern Wyoming (Figure 57) from 3500 to at least 7000 feet elevation (Figure 36). Our stands occurred in small drainage basins on small channels (Figure 38).

ENVIRONMENT: Boxelder stands lie close to the stream channels horizontally (Figure 39) and less than ten feet above them (Figure 40). Along meandering streams, boxelder stands are most common on the insides of meanders.

SOIL: Soil horizons beneath our stands were predominantly sandy loams, sandy clay loams, clay loams, and clays (Figure 58). Mottles occurred beneath several stands.

EXOTIC PLANTS: Exotic species abound in stands of this dominance type, in part because boxelder stands within our study area often occur near hay meadows. Understories in most of our stands were dominated by exotic grasses.

ADJACENT RIPARIAN VEGETATION: Sedge-dominated vegetation often grows in wetter spots along stream channels. Stands of western snowberry or chokecherry may occur mixed with the boxelder groves on the same terrace. Terraces above the boxelder stands may support plains cottonwood woodlands, basin silver sagebrush/western wheatgrass stands, and hay meadows.

ECOLOGY: Boxelder seedlings can become established in the shade of tree canopies (Johnson, 1992), and boxelder stands may replace cottonwood stands or other tree stands (Johnson, 1992; Hansen and others, 1991).

According to Hansen and others (1991), boxelder stands exposed to only light disturbance have the following characteristics: a mix of tree sizes; dense shrub layers dominated by chokecherry (Prunus virginiana), serviceberry (Amelanchier alnifolia), and currant (Ribes spp.); and rich herbaceous layers with meadow rue (Thalictrum spp.), northern bedstraw (Galium boreale), and starry false Solomon's-seal (Maianthemum stellatum). With moderate grazing or browsing, tree reproduction is reduced, less palatable species (western snowberry [Symphoricarpos occidentale], rose [Rosa spp.], and hawthorn [Crataegus spp.]) come to dominate the shrub layer, and Kentucky bluegrass (Poa pratensis) increases greatly in the herbaceous understory. Severe, prolonged grazing will remove even the unpalatable shrubs and much of the Kentucky bluegrass, leaving much bare ground. Eventually, severe grazing may eliminate the boxelder stand altogether and the site will support a shrub stand of snowberry, hawthorn, or silver buffaloberry (Shepherdia argentea).

COMMUNITIES: We described no communities in the Boxelder Dominance Type because we could discern no consistent patterns of species composition in the stands we studied. None of our stands seemed to belong to the boxelder communities that have been described elsewhere.

OTHER CLASSIFICATIONS: Hansen and others (1991) describe boxelder woodlands growing on their Boxelder/Common Chokecherry Habitat Type in central and eastern Montana. In the classification of wetland habitats (Cowardin and others, 1979), the Boxelder Dominance Type belongs to the Palustrine System, Forested Wetland Class, Broad-leaved Deciduous Subclass. In the ecological land classification framework (Driscoll and others, 1984), stands with more than 60% canopy cover belong to the Forest Class, Deciduous Forest Subclass, Cold-deciduous Forest Group, Cold-deciduous Alluvial Forest Formation. Stands with 25% to 60% canopy cover belong to the Woodland Class, Deciduous Woodland Subclass, Cold-deciduous Woodland Group, Broad-leaved Deciduous Woodland Formation. Stands with 10% to 24% canopy cover belong to the Herbaceous Vegetation Class, Medium-tall Grassland Subclass, Medium-tall Grassland with Tree Layer Group, Woody Layer Broad-leaved Deciduous Formation.

Stands of the Boxelder Dominance Type apparently occur on the following range sites (USDA Soil Conservation Service, 1988):

10-14" Northern Plains: Lowland
15-17" Northern Plains: Lowland
15-19" Northern Plains: Subirrigated, Lowland
15-19" Black Hills: Lowland

Figure 57. Map of Wyoming counties showing approximate locations of sites with stands of the boxelder dominance type.

Map Symbol	Vegetation Type
1	Boxelder dominance type (9 stands)

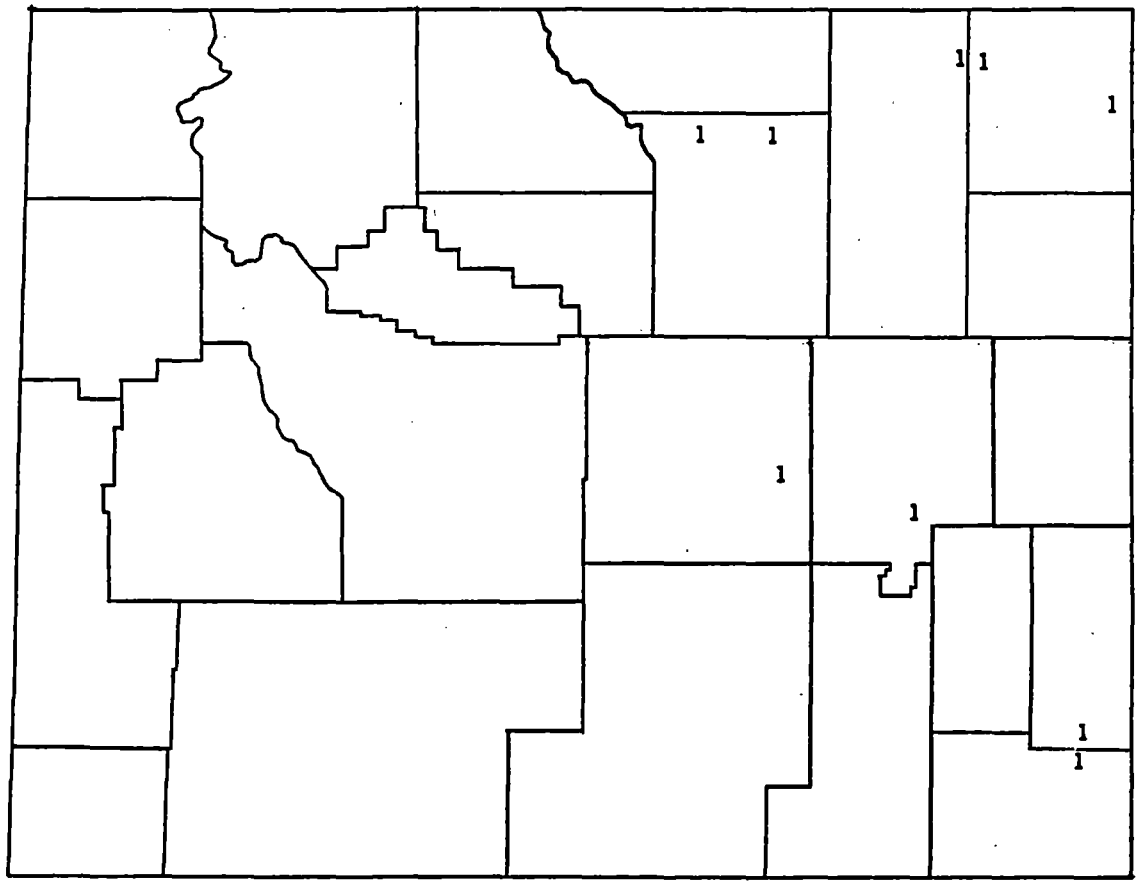
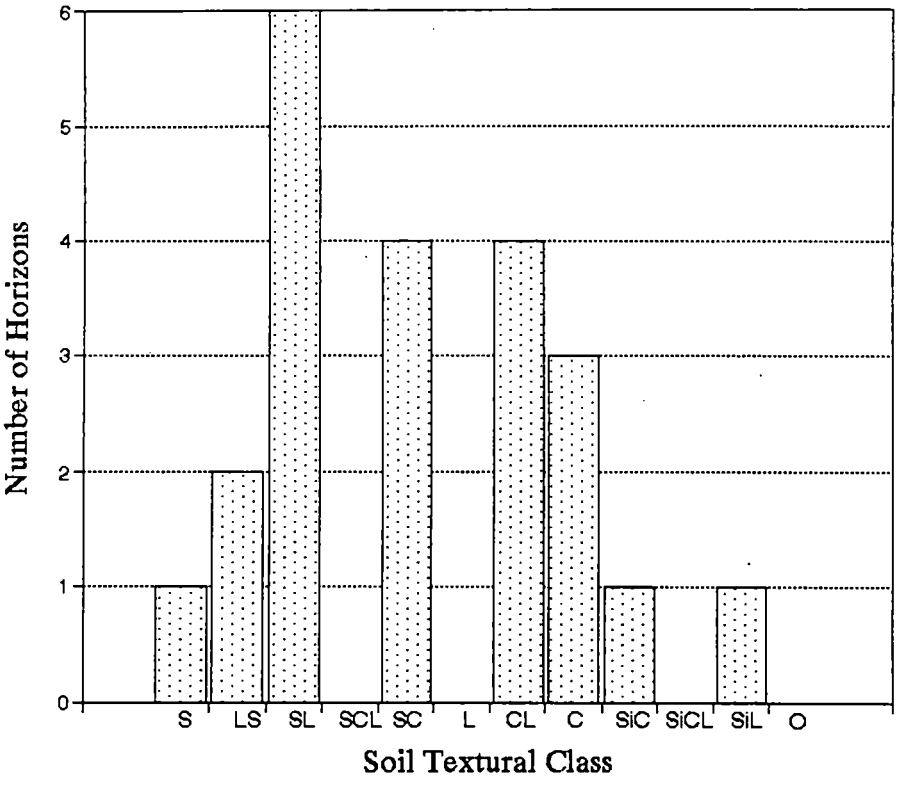


Figure 58. Distribution among textural classes of soil horizons beneath boxelder stands. Labels on the x-axis represent the following soil textural classes:

S = Sand
LS = Loamy sand
SL = Sandy loam
SCL = Sandy clay loam
SC = Sandy clay
L = Loam
CL = Clay loam
C = Clay
SiC = Silty clay
SiCL = Silty clay loam
SiL = Silty loam



Green Ash (Fraxinus pennsylvanica) Dominance Type

(4 stands sampled)

VEGETATION: Green ash (Fraxinus pennsylvanica) dominates a tree layer that often includes other tree species, especially boxelder (Acer negundo) (Table 36). Green ash in our stands ranged in size from poles to medium-sized trees. Shrubs often were present, especially western snowberry (Symphoricarpos occidentalis), but they contributed little cover in our stands. No grass or forb species was present in all stands, but three species -- Kentucky bluegrass (Poa pratensis), Canada thistle (Cirsium arvense), and common houndstongue (Cynoglossum officinale) -- were present in most stands and usually contributed substantial cover. Understories in all of our stands were heavily dominated by exotic species.

LOCATION: We found stands of the Green Ash Dominance Type in far north-central Wyoming and in the Black Hills (Figure 59), below 4000 feet elevation (Figure 36) in small drainage basins (Figure 37) with small streams (Figure 38).

ENVIRONMENT: The green ash stands we sampled lay close to the stream channel (Figure 39) and less than 6 feet above the channel (Figure 40).

SOIL: The most common soil textural class beneath our green ash stands was sandy clay loam.

EXOTIC PLANTS: Exotic species, especially Kentucky bluegrass, Canada thistle, and common houndstongue, are abundant in the understories of green ash stands.

ADJACENT RIPARIAN VEGETATION: In narrow valleys, green ash may be the only riparian type present. In broader valleys, sandbar willow stands may occur closer to the channel and narrowleaf cottonwood (Populus angustifolia) stands farther from the channel.

ECOLOGY: Green ash can reproduce beneath cottonwood understories (Johnson, 1992), and in Montana green ash stands commonly replace cottonwood stands (Hansen and others, 1991).

According to Hansen and others (1991), green ash stands exposed to only light disturbance exhibit the following characteristics: a mix of tree sizes; dense shrub layers of chokecherry (Prunus virginiana), serviceberry (Amelanchier alnifolia), and currant (Ribes spp.); and rich herbaceous understories with substantial amounts of northern bedstraw (Galium boreale), starry false-Solomon's seal (Maianthemum stellatum), and meadow rue (Thalictrum spp.). With moderate grazing or browsing, tree reproduction is reduced, less palatable species (western snowberry [Symphoricarpos occidentalis], rose [Rosa spp.], and

hawthorn [Crataegus spp.]) come to dominate the shrub layer, and Kentucky bluegrass increases greatly in the herbaceous understory. Severe, prolonged grazing can remove most of the unpalatable shrubs and much of the Kentucky bluegrass, leaving extensive areas of bare ground, or it can convert the green ash stand to a shrub stand of snowberry, hawthorn, or silver buffaloberry.

COMMUNITIES: We were unable to describe communities in the green ash dominance type because we could discern no consistent patterns of species composition in the stands we studied. None of our stands seemed to belong to the green ash communities that have been described elsewhere.

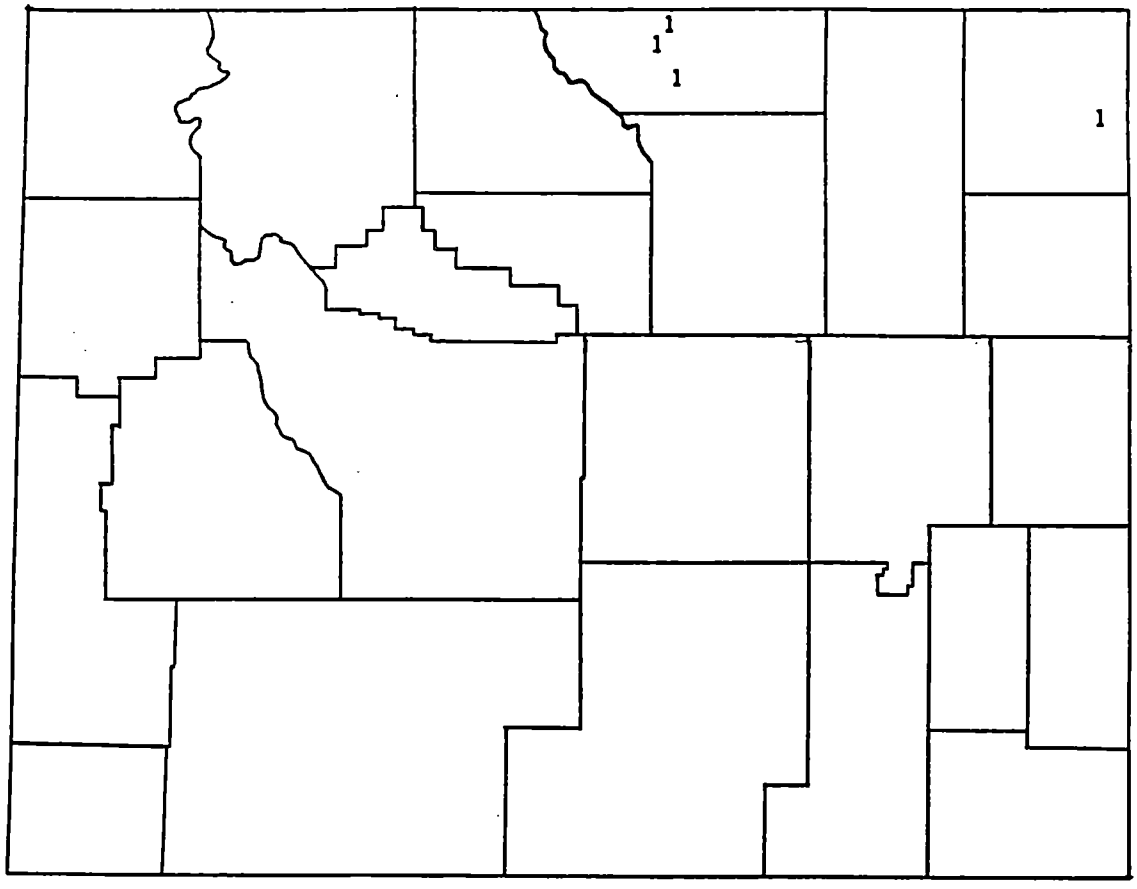
OTHER CLASSIFICATIONS: Hansen and others (1991) describe green ash woodlands growing on their Green Ash/Common Chokecherry Habitat Type in central and eastern Montana. In the classification of wetland habitats (Cowardin and others, 1979), the green ash dominance type belongs to the Palustrine System, Forested Wetland Class, Broad-leaved Deciduous Subclass. In the ecological land classification framework (Driscoll and others, 1984), stands with 60% or more canopy cover belong to the Forest Class, Deciduous Forest Subclass, Cold-deciduous Forest Group, Cold-deciduous Alluvial Forest Formation. Stands with 25% to 60% canopy cover belong to the Woodland Class, Deciduous Woodland Subclass, Cold-deciduous Woodland Group, Broad-leaved Deciduous Woodland Formation. Stands with 10% to 24% canopy cover belong to the Herbaceous Vegetation Class, Medium-tall Grassland Subclass, Medium-tall Grassland with Tree Layer Group, Woody Layer Broad-leaved Deciduous Formation.

Stands of the green ash dominance type apparently occur on the following range sites (USDA Soil Conservation Service, 1988):

10-14" Northern Plains: Lowland
15-19" Northern Plains: Lowland
15-19" Black Hills: Lowland

Figure 59. Map of Wyoming counties showing approximate locations of sites with stands of the green ash dominance type.

Map Symbol	Vegetation Type
1	Green Ash dominance type (4 stands)



DISCUSSION

Our intentions with this study were (1) to describe the major riparian vegetation types of Wyoming's eastern plains, (2) to show the relationships between vegetation and physical environmental factors, and (3) to show the relationship between vegetation and land use. With the information collected on the vegetation at our study sites, we realized our first intention: we were able to describe the major herbaceous, shrub, and tree riparian types of the study area. Several of the stands we studied did not fit into these major types, and future work may show these stands to be examples of minor vegetation types in eastern Wyoming.

Unfortunately, we were less successful at finding strong relationships between the physical environment and the vegetation; most of the vegetation types occur over a broad range of the environmental factors that we studied. This overlap may result from three causes. First, the dominant riparian plants, which form the basis for our classification, may tolerate a broad range of soil salinity, soil water conditions, and other factors. In this regard, we note that other studies in the West showing a stronger relationship between vegetation types and environmental factors have been conducted over a broader range of environments. Had our study area included the plains and the adjacent mountains, we're confident that we would have found marked differences in the environments occupied by different vegetation types.

Second, our measurements of environmental factors may have been too imprecise to show the effects of those factors on the vegetation. If so, those effects are so subtle that knowledge of them probably will be of limited use in land management. We are still analyzing our data, but we doubt that we'll find striking relationships.

Third, land use in the study area may have obscured vegetation/environment patterns to the point that soil salinity, height above the water table, elevation, and other factors are now poor predictors of what vegetation type will occur on a spot. Had we been able to collect more precise information on the history of each site, we might be able to show this overriding influence of land use. But in a study covering as large an area as this one did, collecting detailed information on land use history is an overwhelming task.

Despite the shortcomings in our results, we believe that our vegetation classification will prove useful to land owners and managers because it helps to tie Wyoming's riparian areas into a large body of literature on ecology and management of riparian zones. Much of that information has been summarized in the detailed report on Montana riparian areas published by the Montana Riparian Association (Hansen and others, 1991), so we have related our riparian types to theirs whenever possible. We would very

much like to see a single document for Wyoming similar to the Montana document, and we will explore avenues for working with other groups to expand our classification into such a document.

We already are expanding the geographic scope of our vegetation classification with a study of riparian areas in the Bighorn Basin. The results of that study should be incorporated into the framework of the eastern Wyoming report by 1995. We hope to shift our work into the Green River Basin during the 1995 field season.

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