Milk and Lower Marias River Watersheds:

Assessing and Maintaining the Health of Wetland Communities

Prepared for:

The Bureau of Reclamation

By:

W. Marc Jones

Montana Natural Heritage Program
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INTRODUCTION

Historically, wetlands have been considered unproductive lands with little value to society (Mitsch and Gosselink 1993). Consequently, wetlands have long been drained, filled, or otherwise manipulated to produce goods and services valued by society. This has resulted in significant wetland destruction and degradation in the United States. Dahl (1990) estimated that over half of the wetlands acres in the conterminous United States have been lost since 1780, and that approximately 25% of Montana's wetland acres have been lost in the same period.

In the last 20 years, as awareness of the cumulative loss and damage to wetlands in the United States has grown, so too has society's appreciation of the ecological importance and economic benefits of wetlands. This recognition has increased the regulatory oversight on wetland-disturbing activities and expanded opportunities for wetland conservation.

In the semi-arid northern Great Plains, where water demand may exceed supply, water resource management has a direct bearing on the condition and persistence of remaining wetlands. The Bureau of Reclamation is one of the main government agencies charged with managing water flows and availability in the region. The Bureau is involved with settling a dispute between Native American tribes and the government over availability of water in the Milk River drainage. Settlement of these water rights may change water diversions and distributions in the area, consequently affecting the functional and ecological integrity of wetlands and riparian areas.

The purpose of this study is to provide the Bureau information on riparian and wetland resources and to document remaining high quality wetlands within the study area. Understanding the diversity, location, and condition of wetland and riparian areas will help to minimize potential impacts to these resources.

STUDY AREA

Physical Setting

The study area is in north central Montana in Liberty, Choteau, Hill, Blaine, Phillips, and Valley Counties. It is within the Montana Glaciated Plains subsection of the Great Plains ecological unit and includes the lower Milk and Marias River watersheds below Fresno and Tiber Dams, respectively (Figure 1). Milk River tributaries, such as Battle, Assiniboine, and Whitewater Creeks, are within the study location. This region is characterized by plains, terraces, and floodplains that formed in glacial till, gravel deposits, and alluvium over clay shale, sandstone, and siltstone (Nesser et al. 1997).

The prairie landscape of the study area has modest vertical relief. Elevations along the Milk River range from 600 m at Glasgow to 750 m near Fresno Dam. Elevations along the Marias River range from 750 m at its confluence with the Missouri River to 900 m at Tiber Dam. The gently rolling nature of today's landscape was created by episodes of past glaciation when this area was scoured by the Keewatin ice sheet. Glacial till, outwash, and drift up to 100 feet thick mantle the rolling terrain (Nesser et al. 1997). In areas lacking surface drainage, small wetlands are sporadically distributed and may have formed in partially filled kettle holes created when stranded ice blocks melted following glaciation. These small wetlands, termed prairie potholes, are especially prevalent in the northern portion of the study area.

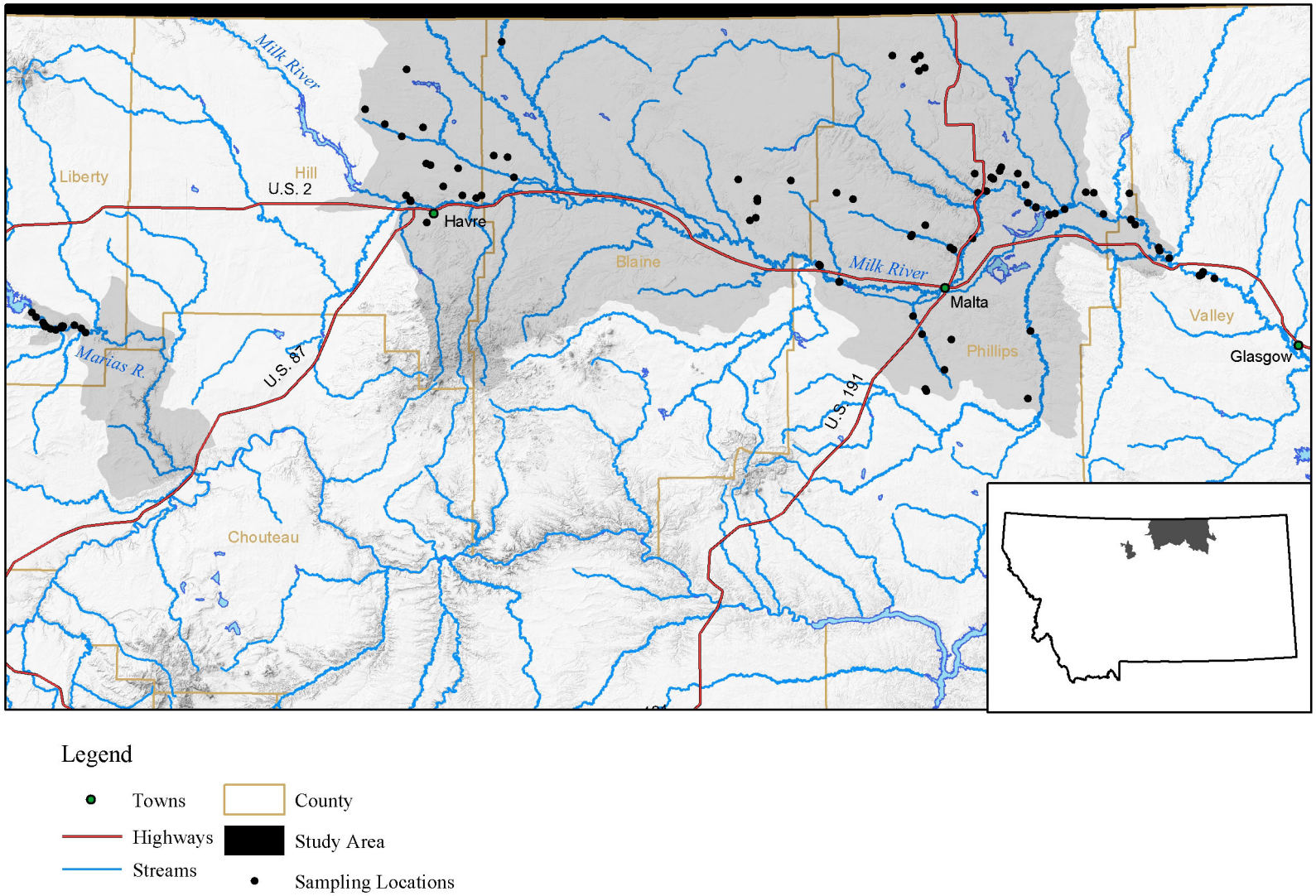

Figure 1. Map of study area and locations sampled.

The most extensive geologic substrate in the study area, extending from Canada to the Missouri River, is marine-origin clay shale and shale of the Bearpaw and Claggett formations. Sandstone and sandy shale is locally common in the study area and is most abundant in the breaks along the Marias and Milk Rivers. Quaternary age alluvium fills most of the valley bottom of the Milk River.

This part of Montana is considered semi-arid with a precipitation average from 10 to 12 inches annually. The climate is continental and temperate with frigid winters and warm to hot summers. Average temperatures at Havre range from a minimum of 3.6ºF in January to a maximum of 84.7ºF in July (Western Regional Climate Center 2003). The precipitation regime peaks in late spring-early summer with steady, soaking frontal system rains. Summer rainfall comes mainly from convection thunderstorms that typically deliver bursts of intense rain in scattered locations. These storms are often accompanied by large-diameter hail and flashfloods. Where rainfall exceeds evapotranspiration, conditions are suitable for agriculture, particularly cereal grains. The growing season is typically 110-130 days with approximately 70-80% of annual precipitation falling within that period.

Another aspect of semi-arid, continental climates is extreme year-to-year variability in precipitation. Severe drought conditions occur on average in two out of every ten years. Climate data from Redstone, Montana, which is comparable to the study area, indicate that one year in ten will have a total annual precipitation of less than 8.0 inches or more than 18.0 inches (Richardson and Hanson 1977).

Snow can be a significant ecological factor in the northern Great Plains. Snow depths on level surfaces seldom exceed 3-6 inches at any time. However, wind redistributes snow to lee positions (usually northeast- to east-facing exposures) and swales, where subsequent compaction results in considerably higher moisture content than on flats. Snow redistribution may play an underappreciated role in the distribution of plant communities in plains environments. The heaviest snowfalls consistently occur in late winter to early spring and are often accompanied by high winds causing blizzard conditions and massive drifting.

Vegetation and Ecological Processes

Riparian habitats along the Milk and Marias Rivers are characterized by oxbow marshes, shrub-dominated terraces, and cottonwood gallery forests. In the semi-arid Great Plains, these riparian areas provide critically important wildlife habitat as well as economic and recreational benefits (Finch and Ruggiero 1993). They also provide habitat for several plant and animal species of concern (Table 1). Cottonwood forests and woodlands are the most characteristic riparian vegetation and are one of the few native habitats dominated by trees. Three species of cottonwood occur in the study area: plains cottonwood (*Populus deltoides*), narrowleaf cottonwood (*Populus angustifolia*), and black cottonwood (*Populus balsamifera* ssp. *trichocarpa*). Plains cottonwood is the most common species and dominates most stands, although narrowleaf cottonwood is also common. Black cottonwood occurs only incidentally along the Marias River.

Cottonwood stands range from open canopied woodlands to closed canopy forests. More mesic floodplain stands can be lush, with a well-developed and diverse shrub and small tree layer including boxelder (*Acer negundo*), peachleaf willow (*Salix amygdaloides*), red-osier dogwood (*Cornus sericea*), yellow willow (*Salix lutea*), chokecherry

Table 1. Plants and animals tracked by the Montana Natural Heritage Program as species of concern that are associated with wetland and riparian systems in the study area.

		Conservation Rank		Management Status*	
Scientific Name	**Common Name**	**State**	**Global**	**USFWS**	**BLM**
Vascular Plants					
Ammannia coccinea	Scarlet Ammannia	SH	G5		
Bacopa rotundifolia	Roundleaf Water-hyssop	S1	G5		W
Anagallis minima (=*Centunculus minimus*)	Chaffweed	S2	G5		W
Elodea longivaginata	Long Sheath Waterweed	S2	G4G5		W
Mentzelia nuda	Bractless Mentzelia	S1	G5		W
Mimulus ringens	Square-stem Monkeyflower	S1	G5		
Phacelia thermalis	Hot Spring Phacelia	S1	G3G4		W
Plagiobothrys leptocladus	Slender-branched Popcorn-flower	S1	G4		W
Potentilla nivea var. *pentaphylla* (=*Potentilla quinquifolia*)	Five-leaf Cinquefoil	S2	G5T4		
Psilocarphus brevissimus var. *brevissimus*	Dwarf Woolly-heads	S2	G4		W
Ranunculus pedatifidus	Northern Buttercup	S1	G5		W
Scirpus heterochaetus	Slender Bulrush	S1	G5		
Suckleya suckleyana	Poison Suckleya	S1	G5		
Fish					
Scaphirhynchus albus	Pallid Sturgeon	S1	G1	E	
Margariscus margarita	Pearl Dace	S2	G5		S
Cycleptus elongatus	Blue Sucker	S2S3	G3G4		S
Phoxinus eos x Phoxinus neogaeus	Northern Redbelly X Finescale Dace	S3	HYB		S
Amphibians					
Bufo cognatus	Great Plains Toad	S3	G5		
Spea bombifrons	Plains Spadefoot	S3	G5		
Rana pipiens	Northern Leopard Frog	S3	G5		
Reptiles					
Apalone spinifera	Spiny Softshell	S3	G5		S
Birds					
Pelecanus erythrorhynchos	American White Pelican	S3B	G3		
Nycticorax nycticorax	Black-crowned Night-heron	S3B	G5		
Plegadis chihi	White-faced Ibis	S1B	G5		S
Charadrius melodus	Piping Plover	S2B	G3	T	
Charadrius montanus	Mountain Plover	S2B	G2	PT	
Larus pipixcan	Franklin's Gull	S3B	G4G5		
Sterna caspia	Caspian Tern	S2B	G5		
Sterna hirundo	Common Tern	S3B	G5		
Sterna forsteri	Forster's Tern	S2B	G5		
Chlidonias niger	Black Tern	S3B	G4		
Mammals					
Corynorhinus townsendii	Townsend's Big-eared Bat	S2S3	G4		S

* BLM = Bureau of Land Management, USFWS = U.S. Fish and Wildlife Service; E = listed endangered, PT = proposed threatened, S = sensitive, T = listed threatened, W = watch

(*Prunus virginiana*), western snowberry (*Symphoricarpos occidentalis*), Wood's rose (*Rosa woodsii*), and silver buffaloberry (*Shepherdia argentea*). Drier stands on terraces often have no shrub component at all or a less diverse shrub layer dominated by western snowberry or Wood's rose. The native grasses that once characterized these stands, such as western wheatgrass (*Pascopyrum smithii*) and thickspike wheatgrass (*Elymus lanceolatus*), have now largely been replaced by exotic pasture grasses, primarily Kentucky bluegrass (*Poa pratensis*) and smooth brome (*Bromus inermis*). Grazing has also greatly altered these communities in places by shifting shrub composition to favor less palatable species, such as rose and snowberry, or in more extreme cases, by reducing or eliminating shrub cover overall.

Cottonwoods are highly dependent on fluvial processes for regeneration. Cottonwoods produce abundant seeds that are released from May to July (Braatne et al. 1996), generally after peak flood flows. These seeds need bare, moist substrate to successfully germinate. Most successful cottonwood reproduction is associated with floods that recur on average every 5 to 10 years (Bradley and Smith 1986, Scott et al. 1997, Mahoney and Rood 1998). These moderate floods drive erosional and depositional processes and deposit fresh alluvium on point and lateral bars, thereby creating suitable "regeneration niches" for cottonwood recruitment. Five to 10 year flood flows allow seedlings to establish high enough on these fluvial surfaces to survive subsequent flooding and ice scour (Auble and Scott 1998, Smith and Pearce 2000). After initial establishment, seedlings require a gradual decline in streamflow (approximately 2.5 cm/day) to prevent mortality due to desiccation (Amlin and Rood 2002). Given these limitations, successful seedling recruitment is episodic and relatively rare, even along free-flowing streams (Mahoney and Rood 1998). These constraints on recruitment are especially true for the dominant cottonwood in the study area, plains cottonwood, which primarily reproduces through seed, although it can also propagate vegetatively through stem and stump sprouting (Rood et al. 1994).

Milk River tributaries are generally small and often ephemeral. Many streams have floodplains with narrow, discontinuous bands of plains cottonwood and somewhat broader terraces with silver sage / western wheatgrass communities. Saltgrass (*Distichlis spicata*), three-square bulrush (*Schoenoplectus pungens*), and black greasewood (*Sarcobatus vermiculatus*) are common along more alkaline streams. In general, small, ephemeral streams have greater year-to-year hydrologic variability than larger rivers, such as the Milk or Marias (Friedman and Lee 2002). Cottonwood regeneration on these streams is therefore likely to be highly episodic.

Other riparian vegetation types include marsh communities associated with back channels and oxbows, such as broadleaf cattail (*Typha latifolia*) and hardstem bulrush (*Schoenoplectus acutus*), and shrub communities associated with river terraces. These terraces, which no longer receive flood flows but may still be subirrigated, often support stands of silver sagebrush (*Artemisia cana*) with an herbaceous layer dominated by western wheatgrass or, on more alkaline sites, black greasewood with an herbaceous layer of saltgrass.

Depressional wetlands occur in the Milk River Valley primarily in the area around the Bowdoin National Wildlife Refuge. These include small glacially-formed potholes and the large Lake Bowdoin, which

originated as an oxbow of the pre-glacial Missouri River. Depressional wetlands, known as prairie potholes, occur throughout the study area but are most abundant north of the Milk River on gently rolling prairie terrain. Prairie potholes form in small, shallow glacial depressions. In the study area, these wetlands average less than 1 acre in size and are only ephemerally flooded. Potholes flood seasonally in the spring to early summer and are sometimes inundated for as little as a few weeks in spring (Kantrud et al. 1989). Vegetation in these wetlands is primarily structured along a hydrological gradient. Plant communities occur as concentric zonal bands, depending on each zone's relative period of inundation. Drier, temporarily flooded potholes are dominated by western wheatgrass and needle spikerush (*Eleocharis acicularis*). As the inundation period increases and wetlands become seasonally flooded, foxtail barley (*Hordeum jubatum*) and common spikerush (*Eleocharis palustris*) become dominant. Prairie potholes receiving saline groundwater inputs or in more alkaline soils are often dominated by halophytes, salt-tolerant species. These include Nuttall's alkaligrass (*Puccinellia nuttalliana*), saltgrass, spangletop (*Scolochloa festucacea*), and three-square bulrush. Semipermanently flooded wetlands, which retain water into late summer and support hydrophytic vegetation, such as broadleaf cattail and hardstem bulrush, are rare in the study area.

The native upland vegetation is a mix of short- and mid-grass prairie communities intermixed with shrub steppe. Steppe vegetation is the result of a semi-arid continental climate: the highly variable precipitation favors shallow-rooted herbaceous perennial grasses and deep-rooted shrubs over forests or woodlands. Shrub steppe vegetation is characterized by open stands of silver sagebrush or Wyoming big sagebrush (*Artemisia tridentata* ssp. *wyomingensis*) over an herbaceous layer dominated by western wheatgrass, blue grama (*Bouteloua gracilis*), or needle-and-thread (*Hesperostipa comata*). The co-occurrence of short- and mid-grass prairies is also due to climatic variability. Shorter, drought-resistant grasses such as blue grama increase in abundance during times of drought. Mid-grasses, such as the rhizomatous western wheatgrass and the bunch-forming prairie junegrass (*Koeleria macrantha*) and needle-and-thread, increase under more favorable moisture conditions.

METHODS

Data Collection

Wetlands and riparian areas were surveyed during the summers of 2001 and 2002. Montana Natural Heritage Program ecologists used a standardized methodology based on Bourgeron et al. (1992) to assess site condition, catalog community types, and document rare plant and animal occurrences. Specifically, we attempted to walk through all wetland plant communities at any given site, except where prevented by deep water or denial of landowner permission. We noted dominant species in each stratum, made ocular estimates of their canopy coverage, and estimated the acreage of each community. Where applicable, we classified each wetland plant community using existing plant community classifications (Hansen et al. 1995, NatureServe 2003). The condition of each community was assessed using criteria such as the presence of exotic species, evidence of logging, hummocking or pugging, presence of ditches, dikes, riprap, and other geomorphic and hydrologic modifications. We also noted the depth of standing water and presence of beaver activity. We collected detailed plot data for plant communities not previously described or which were deemed uncommon.

Elevation, aspect, slope, and the hydrogeomorphic (HGM) class and subclass (Smith et al. 1995) were recorded at each site, as were the Cowardin system/subsystem, class/subclass, and hydrologic regime (Cowardin et al. 1979). We also recorded offsite land uses and spoke to landowners/managers about land use history whenever possible. A cursory search for rare plants was conducted during the walk-through of each wetland. Montana Natural Heritage Program zoologists conducted faunal surveys of selected wetlands.

Although no formal wetland delineations or functional assessments were conducted as part of this project, Heritage Program ecologists did use two regional HGM models developed by researchers at the Flathead Lake Biological Station (Hauer et al. 2002a, b). For example, we measured the depth of the O and A soil horizons at some sites. This variable is relevant in the intermontane pothole HGM model; it represents the long-term store of nutrients in the soil and acts as an index of the characteristic decomposer community in the wetland (Hauer et al. 2002a). A very thick A horizon may indicate an excessive amount of upland erosion is taking place.

Data Management

The Montana Natural Heritage Program maintains four types of database records for information gathered in the wetland inventory: community plot records, community and species occurrence records, site records, and community abstracts. Wetland community plot information (i.e., species composition and cover and environmental data) was entered into a relational database that is similar to the U.S. Forest Service Ecodata system used for managing ecological data (Jensen et al. 1994).

We created a community occurrence record for each wetland community ranked as having outstanding quality or considered rare or imperiled. Community occurrence information (e.g., HGM class, Cowardin class/subclass, dominant species, hydrology, landscape setting) was summarized and entered in the Biological and Conservation Data System (BCD), a database developed by The Nature Conservancy and used by programs throughout the Natural Heritage Network.

Summary information about each site as a whole (e.g., general site descriptions, ecological diversity, on- and offsite land uses, management needs) was also entered into a site file in BCD. Detailed plant community abstracts were created to characterize both common and uncommon wetland plant communities. These include information from a variety of sources documenting community range, typical landscape setting, typical species composition, succession, and management. This information is being stored temporarily in a word processing template, for later uploading into a BCD file under development. The boundaries of each wetland site were digitized as polygons and stored in a Geographic Information System.

Site and Community Ranking

Community Rarity Ranks (State and Global Ranks)

We ranked the rarity and conservation significance of individual plant community types using criteria analogous to those used for ranking plant and animal species. This ranking system is intended to help managers identify elements at risk and determine management and conservation priorities. Community ranks are based primarily on the total number of occurrences and area occupied by the community type, either rangewide (for global or G ranks) or statewide (for state or

S ranks). In addition, information on condition, threats, trend, and fragility are considered when known. The ranks are scaled from 1 to 5, with G1 indicating that the community is critically imperiled rangewide, and a G5 indicating no risk of extinction. Guidelines used to assign community ranks are included in Appendix A.

Community Viability Ranks

Each individual wetland community occurrence was also quality-ranked using criteria developed by The Nature Conservancy and the Natural Heritage Network (NatureServe 2002). For each community, we evaluated its condition, landscape context, and size. We then assigned an overall rank of A – D, with A being excellent and D being poor. Wetland and riparian communities usually occur as small patches or as linear features in the landscape, and they are highly dependent on external factors, such as flooding and upland condition. Therefore, when evaluating a community's overall quality, we considered condition and landscape context to be of primary importance and size secondary.

Site Ranks

Wetland sites were evaluated using similar criteria. In addition to condition, landscape context, and size, two other factors important for assessing conservation significance were considered: diversity and rarity. We developed these criteria in conjunction with regional wetland assessment protocols (Washington State Department of Ecology 1991, Chadde et al. 1998, Greenlee 1999, Jankovsky-Jones 1999), regional hydrogeomorphic functional assessments (Hruby et al. 1999, Jankovsky-Jones et al. 1999a, b, Hruby et al. 2000, Hauer et al. 2002a, b), and plant community ranking specifications developed by other Natural Heritage Programs (Chappell and Christy 2000, Rondeau and Sanderson 2000).

Table 2 shows the indicators for and relative importance of each factor; the complete criteria are presented in Appendix C. Similar to community viability ranks, each site is evaluated by the five factors and assigned an overall rank of A – D. Each factor is weighted by its relative importance in assessing a site's overall ecological and conservation significance. Condition and landscape context are of primary importance; each factor accounts for 25% of a site's overall rank. Diversity and rarity are secondary factors, each accounting for 20% of the site rank, and the tertiary factor is size, which accounts for 10% of the overall site rank. The general characteristics of A – D sites are described below.

A-ranked Sites

These wetlands have the greatest ecological and conservation significance. A-ranked sites are in good to excellent condition with intact, high quality examples of native plant communities, and there are few to no exotic species. There are minimal anthropogenic influences at these sites or in their surrounding uplands, therefore, wetland functions are largely intact and will most likely fall within the range of natural variation. These sites often support a diverse array of plant communities and other important wetland features, including peatlands, beaver ponds, and springs. They also may provide habitat for numerous state and/or globally rare plant and animal species. Impacts to these sites cannot be fully mitigated, and any alterations could lead to significant loss of their distinctive characteristics and value.

B-ranked Sites

Wetland sites in this category generally support diverse, high quality plant communities, but they are distinguished from A-ranked

Table 2. Indicators and relative importance of criteria used to rank the ecological and conservation significance of wetland sites.

Factor	% of Overall Rank	Indicators
Condition	25%	Alteration of hydrologic, geomorphic, or biogeochemical processes. Presence of intact, representative native plant communities with characteristic structure and composition. Presence of exotic species or cultural vegetation.
Landscape Context	25%	Extent of land uses in the surrounding uplands that disrupt hydrologic and habitat connectivity among the site, uplands, and adjacent wetlands.
Diversity	20%	Number of plant communities, number of structural vegetation types, number of hydrologic classes.
Rarity	20%	Number and condition of rare plants, animals, or plant communities present at the site.
Size	10%	Size of site.

wetlands by having a greater degree of anthropogenic disturbance either on- or off-site (e.g., logging in the uplands near the site, grazing on a portion of the site). These disturbances are localized or minimal and are restorable. B-ranked sites may support a number of state rare plant or animal species. Most of the wetland plant communities at these sites are in excellent condition, but a few have moderate impacts. Improvement in resource management at these sites, such as changing grazing management plans or reducing trapping pressure on beaver, would improve the overall suite of wetland functions at these sites.

C-ranked Sites

Generally, C-ranked wetlands have been degraded by systematic hydrologic or geomorphic modifications or by disruptive land uses in the wetland or its surrounding uplands. These sites may still support high quality native plant communities, but exotic species are often widespread. Alternatively, these sites may be homogenous wetlands in good condition dominated by structurally simple, common communities, such as broadleaf cattail (*Typha latifolia*) monocultures. Although these wetlands are often degraded, they still provide important functional values, such as moderating flood flows, removing particulates or nutrients, or as habitat for wetland-dependent wildlife, such as waterfowl. These sites may also support populations of rare species or communities.

D-ranked Sites

D-ranked sites have been significantly affected by hydrologic or geomorphic alterations and often provide poor functional or habitat values. Vegetation at these sites is often degraded with little to no regeneration and exotic weeds or cultural vegetation may be widespread. The uplands may have been converted from native vegetation to agricultural or residential land uses, or the site may have become hydrologically isolated or with excessive sedimentation, erosion, and nutrient loading. Although these sites are generally in poor condition, they may still provide locally important habitat values in areas where natural habitats have been largely converted to urban or agricultural land uses.

Plant Community Classification

We defined plant associations based on the International Classification of Ecological

Communities (NatureServe 2003). This database, developed by The Nature Conservancy and NatureServe, forms the basis for a standardized National Vegetation Classification. This classification is currently being developed by NatureServe, the Ecological Society of America, and the U.S. Geological Survey. It incorporates and expands on published state and regional plant community classifications, such as Pfister et al. (1977), Mueggler and Stewart (1980), and Hansen et al. (1995). For aquatic communities, we referred to a classification of aquatic vegetation in western Montana and northern Idaho (Pierce and Jensen 2002).

NatureServe (2003) recognizes many of the wetland and riparian communities described in Hansen et al. (1995), with several exceptions. Hansen et al. (1995) was designed as a management tool and not specifically to address biological diversity. Therefore, it lumps together several dominant and indicator species with similar ecological requirements or management prescriptions. In general, we do not follow Hansen et al.'s ecological equivalents. Therefore, we recognize Booth's willow (*Salix boothii*) distinct from Geyer's willow (*Salix geyeriana*), inflated sedge (*Carex vesicaria*) distinct from beaked sedge (*Carex utriculata*), woolly sedge (*Carex pellita*) and Buxbaum's sedge (*Carex buxbaumii*) distinct from slender sedge (*Carex lasiocarpa*), narrow-spiked reedgrass (*Calamagrostis stricta*) distinct from bluejoint reedgrass (*Calamagrostis canadensis*), softstem bulrush (*Schoenoplectus tabernaemontani*) distinct from hardstem bulrush (*Schoenoplectus acutus*), black hawthorn (*Crataegus douglasii*) distinct from succulent hawthorn (*Crataegus succulenta*), prickly rose (*Rosa acicularis*) distinct from Wood rose (*Rosa woodsii*), and the native ticklegrass (*Agrostis scabra*) distinct from the exotic redtop (*Agrostis stolonifera*).

Nomenclature

We used Hitchcock et al. (1955-1969), Dorn (1984), and Great Plains Flora Association (1986) to identify plant species in the study area. In keeping with the International Classification of Ecological Communities (NatureServe 2003), we followed the nomenclature presented in Kartesz (1999) for vascular plants.

RESULTS AND DISCUSSION

Status of Wetland Resources

Riparian Wetlands

Riparian areas in the study area have been greatly affected by hydrological and land use changes. Fresno and Tiber Dams have substantially altered the downstream hydrology of the Milk and Marias Rivers. In addition, riparian forests along the Milk River have been reduced and fragmented by conversion of significant portions of the floodplain to irrigated agriculture and pasture. The Milk River becomes increasingly incised below Fresno Dam, and in many segments it does not appear to be able to access its historic floodplain. Little cottonwood regeneration was observed at any sample locations. Although still critically important in supporting regional biological diversity, these changes have greatly reduced the quantity and quality of riparian habitats, especially cottonwood communities. Table 3 presents site condition ranks for selected riverine areas sampled in the study area.

Riparian areas along the lower Marias are still relatively robust. This reach supports extensive stands of mature plains cottonwood with dense shrub understories. However, similar to the Milk, cottonwood regeneration is extremely limited. Since the construction of Tiber Dam, the absence of flood flows has greatly changed the formation and

Table 3. Condition ranks of selected riverine wetlands sampled in the study area.

Name	Ranking Factors: Condition	Landscape Context	Diversity	Rarity	Size	Overall Rank
Milk River						
Rookery Wildlife Management Area	C	C/D	A	C	A	**C**
Vandalia Dam	C	C/D	A	C	A	**C**
Milk River near Rock Creek	C	D	A	C	A	**C**
Hewitt Lake National Wildlife Refuge	C	D	B	C	C	**C**
Dodson Wildlife Management Area	B	D	A	0	B	**C**
Milk River near Little Cottonwood Creek	C/D	D	B	0	A	**D**
Milk River Tributaries						
Assiniboine Creek Springs	A	B	A	C	B	**B**
Alkali Creek	A	B	A	C	C	**B**
Beaver Creek	B	B	A	D	B	**B**
DHS Creek	C	B	A	C	C	**C**
Little Cottonwood Creek	C	C	C	0	B	**D**
Red Rock Coulee	C/D	D	A	0	C	**D**
Marias River						
Marias River	B/C	C/D	B	C	A	**C**

character of point and lateral bars and has led to channel incisement (Rood and Mahoney 1995). These areas have become densely vegetated with grasses and sedges, such as reed canarygrass (*Phalaris arundinacea*) and woolly sedge (*Carex pellita*), and shrubs, such as silver buffaloberry. The operation of Tiber and Fresno Dams is probably the most important factor determining the long-term persistence of cottonwood stands on both rivers.

In general, the effects of river damming on meandering rivers, such as the Milk and Marias, is to reduce rates of channel migration by decreasing peak flows and sediment loads (Friedman et al. 1998). Bradley and Smith (1984) compared meandering reaches of the Milk River upstream and downstream of Fresno Dam and Reservoir. For the downstream reach near Havre, they found that the operation of Fresno Dam had decreased the rate of channel meander by 1.3 m/year, decreased channel width by 16.8 m, and caused the channel bed to degrade by 1.5 m. These changes are due in part to a 60% reduction in peak flows. Prior to the construction of Fresno Dam, bankfull discharge was approximately 7,000 cubic feet per second and recurred about every 4 to 8 years; a similar flow now recurs approximately only every 20 years (Bradley and Smith 1984). These hydrological and geomorphological changes have dramatic effects on cottonwood regeneration. When the densities of cottonwoods recruited since construction of Fresno Dam were compared between the upstream and downstream reaches, the downstream densities were significantly lower (Bradley and Smith 1986). Furthermore, the long-term persistence of cottonwoods on the lower Milk is unlikely given current operation of Fresno Dam (Bradley and Smith 1986).

Similar changes have occurred on the Marias River. Figure 2 illustrates changes to the daily mean discharge above and below Tiber Dam. In an analysis of the effect of Tiber Dam on flood flows, Rood and Mahoney (1995) found that downstream peak floodflows were reduced by 90% during major flood events. For example, peak flows in 1964 and 1975, which had recurrence

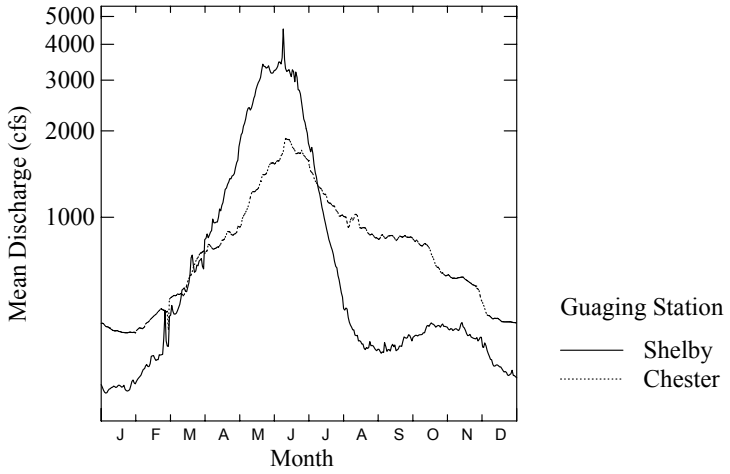

Figure 2. Mean daily flows for the Marias River above (Shelby) and below (Chester) Tiber Dam.

intervals of 1 in 90 and 1 in 45 years, respectively, were reduced to 1 in 5-year events below Tiber Dam (Rood and Mahoney 1995). In fact, since the construction of Tiber Dam, there have only been a handful of times when flood flows have approached the magnitude needed for successful cottonwood recruitment.

Cottonwood recruitment is also largely nonexistent on most of the Milk River tributaries. Despite their small size and ephemeral nature, even small tributaries, such as Red Rock Coulee, Savoy, Assiniboine, and Little Cottonwood Creeks contain relictual stands of plains cottonwood. Given the extreme hydrologic variability of these streams, cottonwood recruitment was probably always highly episodic. Successful recruitment events are probably now even rarer, given widespread irrigation diversions, small dams, and livestock grazing in these tributaries.

Cottonwood communities on the Milk and Marias Rivers are also threatened by invasion of the exotic tree Russian olive (*Elaeagnus angustifolia*) (Lesica and Miles 1999, 2001, Pearce and Smith 2001). Russian olive was and still is widely planted as a windbreak and it has invaded many riparian habitats throughout the western United States (Olson and Knopf 1986). Russian olive does not require flood disturbance to regenerate, and, as cottonwood mature cottonwoods die, it can dominate many floodplain and terrace sites (Shafroth et al. 1995, Lesica and Miles 2001). Although Russian olive is beneficial to some wildlife species, conversion of cottonwood stands to stands dominated by Russian olive is detrimental to many species of cavity-nesting and insectivorous birds (Knopf and Olson 1984, Olson and Knopf 1986). Russian olive is able to reproduce under its own canopy and occurs as multiple-age stands; therefore, in the absence of cottonwood-regenerating flood disturbance, it may be able to perpetually hold riparian terraces and limit the establishment of native late-successional communities, such as western wheatgrass, western snowberry, and green ash (*Fraxinus pennsylvanica*) (Lesica and Miles 2001).

On regulated rivers, such as the Milk and Marias, the lack of flood disturbance may allow Russian olive to colonize floodplains, thereby further limiting regeneration oppor-

tunities for native cottonwoods (Lesica and Miles 2001). On portions of the Milk River floodplain, Russian olive is more abundant than plains cottonwood (Pearce and Smith 2001). In time, Russian olive may replace cottonwood communities on both these streams.

Depressional Wetlands

Prairie potholes have also been affected by altered hydrology and land use. Given the semi-arid nature of the region, many of these potholes have been physically altered to improve the ponding of surface water. An examination of U.S. Fish and Wildlife Service National Wetland Inventory maps in the study area (4th order U.S. Geological Survey hydrologic unit codes 10050004 [Middle Milk], 10050007 [Lodge], 10040008 [Battle], 10050010 [Cottonwood], and 10050011 [Whitewater]) revealed that 13,690 acres of palustrine wetlands have been ditched, diked, or excavated. This accounts for 15% of all palustrine acres identified. Similarly, a wetland health assessment of prairie potholes in the Whitewater watershed found that 44% of wetland acres inventoried had compromised functionality, primarily due to hydrological modifications (Jones 2003). By changing inundation periods, these hydrological modifications can dramatically alter the functional and habitat values of these wetlands.

Many potholes have also been affected by agricultural practices in the study area. Based on an analysis of satellite imagery (30-m resolution Satellite Imagery Land Cover Classification, Wildlife Spatial Analysis Lab, University of Montana), approximately 10% of the Middle Milk hydrologic unit is used for dryland and irrigated agriculture. Within this area, an indeterminate number of prairie potholes have been converted to cropland. In addition to the direct loss of wetlands, agriculture changes functional and habitat relationships. Wetlands in a landscape context dominated by agriculture have different vegetation characteristics than wetlands nested in native prairie (Kantrud and Newton 1996).

In general, prairie potholes have fared better than riparian habitats. These systems are adapted to extreme climatic fluctuations and respond dynamically to decadal wet and dry cycles (Kantrud et al. 1989). They may therefore be also more resilient to other types of disturbance, such as grazing. Despite the hydrological and land use modifications mentioned above, there still remain large areas with high densities of prairie potholes in a natural prairie context. These areas occur on Bureau of Land Management lands in extreme northern Blaine and Phillips Counties within the Cottonwood, Little Cottonwood, and Whitewater drainages.

Conservation Implications

Riparian communities along the Milk and Marias Rivers and their tributaries produce many important benefits to both humans and wildlife. These areas provide important functional attributes, including floodwater storage and attenuation, reduction in floodwater velocity, streambank stability, filtration and trapping of sediments, nutrients, and pollutants, and groundwater recharge (Hauer et al. 2002b). Riparian habitats are also critical for maintaining regional biological diversity and provide structural habitat diversity otherwise lacking in semi-arid areas (Patten 1998). Riparian areas and the important services they provide depend on dynamic fluvial disturbance regimes. In the absence of necessary flood events, some habitat types, such as cottonwood forests and woodlands, will not persist.

Fortunately, it is not dams *per se*, but the alteration of flow regimes that primarily limits cottonwood regeneration. It may, therefore, be possible to reinitiate cottonwood recruitment by reoperating Fresno or Tiber Dams to allow 5 to 10 year flood events to occur and to moderate flow recession so that newly established cottonwood seedlings can survive initial drought mortality. The St. Mary River in Alberta provides an example of dam reoperation allowing for cottonwood recruitment. In the 1990's, St. Mary Dam operation was changed to increase instream flows and target a gradual stage decline of 4 cm/day. This management change, in conjunction with high flood flows in June of 1995, created the opportunity for extensive seedling recruitment along the lower St. Mary River that year (Rood and Mahoney 2000). One way to assess the feasibility of restoring regeneration flows is to create synthesized flow models and estimated flood damage curves. Bovee and Scott (2002) applied this approach for the National Wild and Scenic reach of the Missouri River. They found some physically and economically feasible scenarios that would provide cottonwood-regenerating flows on the Missouri, the most likely of which required opportunistic releases from Tiber Dam. Without some reoperation of Tiber and Fresno Dams, cottonwood communities are unlikely to persist on either the Milk or Marias Rivers. This outcome would seriously affect the numerous animal species dependent on these habitats for at least a portion of their life history requirements.

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APPENDIX A. GLOBAL/STATE RANK DEFINITIONS

Heritage Program Ranks

The international network of Natural Heritage Programs employs a standardized ranking system to denote global (range-wide) and state status (NatureServe 2002). Species are assigned numeric ranks ranging from 1 (critically imperiled) to 5 (demonstrably secure), reflecting the relative degree to which they are "at-risk". Rank definitions are given below. A number of factors are considered in assigning ranks — the number, size and distribution of known "occurrences" or populations, population trends (if known), habitat sensitivity, and threat. Factors in a species' life history that make it especially vulnerable are also considered (e.g., dependence on a specific pollinator).

Rank Definitions

G1 S1	Critically imperiled because of extreme rarity and/or other factors making it highly vulnerable to extinction.
G2 S2	Imperiled because of rarity and/or other factors making it vulnerable to extinction.
G3 S3	Vulnerable because of rarity or restricted range and/or other factors, even though it may be abundant at some of its locations.
G4 S4	Apparently secure, though it may be quite rare in parts of its range, especially at the periphery.
G5 S5	Demonstrably secure, though it may be quite rare in parts of its range, especially at the periphery.
GU SU	Possibly imperiled, but status uncertain; more information needed.
GA SA	Native in nearby states, but in Montana believed to be accidentally introduced, deliberately planted, or escaped from plantings.
GH SH	Historical, known only from records over 50 year ago; may be rediscovered.
GX SX	Believed to be extinct; historical records only.

Combination Ranks

G#G# or S#S# Indicates a range of uncertainty about the rarity of the species.

Subranks

T#	Rank of a subspecies or variety; appended to the species' global rank of the full species, e.g. G4T3.

Qualifiers

Q	Taxonomic questions or problems exist, more information needed; appended to the global rank, e.g. G3Q.
?	Denotes uncertainty or for numeric ranks, inexactness.

APPENDIX B. SITE DESCRIPTIONS

Alkali Creek

Location

This site is located along a small tributary to Alkali Creek. From Malta, travel south on U.S. 191. Turn left on a road near the edge of town where U.S. 191 bends to the southwest. Continue on this road for about 3 miles and turn right at a T intersection. Turn right onto a two-track after about 9 miles. The site is to the left.

Description

This small tributary of Alkali Creek supports a well-vegetated floodplain interspersed with open pools. The vegetation is robust and includes *Schoenoplectus pungens* (Threesquare Bulrush) and *Carex praegracilis* (Clustered Field Sedge) communities in wet swales that connect open water pools. Wetter areas have high cover of *Eleocharis palustris* (Common Spikerush). The floodplain supports a *Juncus balticus* (Baltic Rush) community interspersed with *Carex praegracilis*. Smaller feeder swales are more obviously alkaline and are dominated by *Distichlis spicata* (Saltgrass) and *Puccinellia nuttalliana* (Nuttall's Alkaligrass).

The surrounding uplands are native prairie interspersed with cultivated lands. Uplands immediately adjacent to the site are mostly native prairie, although a wheat field occurs approximately 300 m from the stream channel.

Key Environmental Factors

The hydrologic regime that maintains flooded or saturated conditions are the main factor structuring vegetation at this site.

Rarity

No rare plants or plant communities were documented.

Condition

The site's hydrology appears to be relatively intact and native vegetation is dominant with no exotic species noted. This area is subject to grazing, although little pugging was observed in the wetter channel and floodplain areas.

Plant Community Information

	Rarity Ranks	
Plant Association/Dominance Type	**State**	**Global**
Carex praegracilis Herbaceous Vegetation	S3S4	G3G4
Distichlis spicata Herbaceous Vegetation	S4	G5
Juncus balticus Herbaceous Vegetation	S5	G5
Schoenoplectus pungens Herbaceous Vegetation	S3	G3G4

Assiniboine Creek Springs

Location

This site is located along the middle reach of Beaver Creek. From Malta, travel north on U.S. 191 for approximately 6 miles. Turn left onto the county road past the bridge over Assiniboine Creek. Travel about 1.5 miles; the site is along Assiniboine Creek to the right.

Description

This site occurs along the floodplain of Assiniboine Creek. Springs feed groundwater discharge into this area, creating a relatively wet riparian area in contrast to areas both up and downstream. The stream channel is discontinuous and alternates between sloughs and pools and higher sedge-dominated areas. The wettest areas support a *Typha latifolia* (Broadleaf Cattail) community interspersed by areas of open water. The adjacent floodplain supports intermingled communities dominated by *Schoenoplectus pungens* (Threesquare Bulrush), *Carex praegracilis* (Clustered Field Sedge), *Juncus balticus* (Baltic Rush), and *Hordeum jubatum* (Foxtail Barley). Slopes leading up to the first terrace are dominated by shrub thickets of *Symphoricarpos occidentalis* (Western Snowberry), *Shepherdia argentea* (Silver Buffaloberry), and *Rhus trilobata* (Skunkbush). These become a more open *Symphoricarpos occidentalis* / *Pascopyrum smithii* (Western Wheatgrass) community on the first terrace, while the second terrace is dominated by *Artemisia cana* (Silver Sagebrush) and *Pascopyrum smithii*. A few scattered *Populus deltoides* (Plains Cottonwood) are also present.

Key Environmental Factors

Groundwater discharge maintains these mesic floodplain wetlands.

Rarity

No rare plants or plant communities were documented.

Condition

The site's hydrology appears to be relatively intact, although surface flows may be reduced by upstream irrigation withdrawals. Groundwater discharge, which is responsible for the mesic nature of the site, is still occurring. Vegetation at the site reflects the relatively wet nature of the floodplain and is free of exotic species. This site has not been heavily grazed recently, although there is some pugging in wetter areas.

Plant Community Information

	Rarity Ranks	
Plant Association/Dominance Type	**State**	**Global**
Artemisia cana / *Pascopyrum smithii* Shrubland	S4	G4
Carex praegracilis Herbaceous Vegetation	S3S4	G3G4
Hordeum jubatum Herbaceous Vegetation	S4	G4
Juncus balticus Herbaceous Vegetation	S5	G5
Schoenoplectus pungens Herbaceous Vegetation	S3	G3G4
Shepherdia argentea Shrubland	S3	G3G4
Symphoricarpos occidentalis Shrubland	S4S5	G4G5
Typha latifolia Western Herbaceous Vegetation	S5	G5

Beaver Creek

Location

This site is located along the middle reach of Beaver Creek. From Malta, travel east on U.S. 2 and take the turnoff for Bowdoin National Wildlife Refuge. Where the road forks, veer right and travel for approximately 15 miles to where the road crosses Beaver Creek. The site is along the creek downstream of the bridge.

Description

This site occurs along the floodplain of Beaver Creek. The creek channel is incised but a new floodplain has established itself within this incised channel. Plant communities are arranged zonally depending on their frequency of inundation. The wettest vegetated area observed was a *Schoenoplectus pungens* (Threesquare Bulrush) community that occurred on a channel shelf below bankfull. The lower portion of the floodplain is occupied by *Carex nebrascensis* (Nebraska Sedge) and *Distichlis spicata* (Saltgrass) communities. Higher portions of the floodplain support *Glycyrrhiza lepidota* (American Licorice) and *Acer negundo / Prunus virginiana* (Boxelder / Chokecherry) communities.

Key Environmental Factors

The hydrologic regime associated with Beaver Creek is the main factor structuring vegetation at this site.

Rarity

No rare plants or plant communities were documented.

Condition

The site's hydrology appears to be relatively intact and native vegetation is dominant with few exotic species noted. Despite evidence of past flooding, no regeneration was noted in the *Acer negundo* stand. This area is grazed in the winter and some pugging was observed.

Plant Community Information

	Rarity Ranks	
Plant Association/Dominance Type	**State**	**Global**
Acer negundo / Prunus virginiana Forest	S3	G3
Carex nebrascensis Herbaceous Vegetation	S4	G4
Distichlis spicata Herbaceous Vegetation	S4	G5
Glycyrrhiza lepidota Dominance Type	*	*
Schoenoplectus pungens Herbaceous Vegetation	S3	G3G4

* Rank not assigned

Bjornberg Bridge

Location

This site is a fishing access site on the Milk River near its confluence with Frenchman Creek. From Saco go east on U.S. 2 to the road north that crosses Bjornberg Bridge. The site is on the northeast side of the bridge.

Description

This site occurs on a gently undulating terrace with a drop off into the incised channel of the Milk River. The channel banks support a *Pascopyrum smithii* (western wheatgrass) community, and *Salix lutea* (Yellow Willow) is establishing along the lower portion of the bank. The terrace supports *Populus deltoides / Symphoricarpos occidentalis* (Plains Cottonwood / Western Snowberry) and *Salix amygdaloides* (Peachleaf Willow) communities. The herbaceous layer of the terrace communities is dominated by *Bromus inermis* (Smooth Brome).

Key Environmental Factors

Flooding was a major factor in the distribution of the plant communities at this site. The advent of flood control and irrigation withdrawals is changing this distribution and has led to a general "drying" of the terrace. Currently, flooding only regularly affects the lower portion of the channel bank.

Rarity

This site supports a *Populus deltoides / Symphoricarpos occidentalis* community. This community is restricted to the western Great Plains and has been adversely affected by hydrologic alterations and grazing disturbances throughout its range. Both these factors have degraded the community at this site.

Condition

The lack of flooding due to flood control has resulted in a decadent stand of *Populus deltoides* and no regeneration to replace it. The *Salix amygdaloides* (Peachleaf Willow) community has a similar lack of regeneration. It also appears that in the past the site has experienced heavy grazing pressure. The slope, which is still influenced by flooding, has willow regeneration. This area is still being heavily grazed with most of the ground cover being bare soil. *Salix lutea* (Yellow Willow) is regenerating but it also being hedged. *Bromus inermis* (Smooth Brome) is the dominant grass on both areas. *Euphorbia esula* (Leafy Spurge) is also present on both areas.

Plant Community Information

	Rarity Ranks	
Plant Association/Dominance Type	**State**	**Global**
Pascopyrum smithii Herbaceous Vegetation	S4	G3G5Q
Populus deltoides / Symphoricarpos occidentalis Woodland	S2S3	G2G3
Salix amygdaloides Woodland	S3	G3

DHS Creek

Location

This site is located along DHS Creek, which is a tributary of Beaver Creek. From Malta, travel south on U.S. 191. Turn left on a road near the edge of town where U.S. 191 bends to the southwest. Continue on this road for about 3 miles, turn left at a T intersection, and after 0.5 mile, veer to the right. Continue on this road for approximately 18 miles. The site is along DHS Creek about 1.5 miles before the road crosses Beaver Creek.

Description

This site occurs along DHS Creek, which is an ephemeral tributary of Beaver Creek. Despite the ephemeral nature of the stream, this section of the creek is characterized by a mature stand of large diameter *Salix amygdaloides* (Peachleaf Willow) and *Acer negundo* (Boxelder). This stand has an understory of *Symphoricarpos occidentalis* (Western Snowberry) and an herbaceous layer dominated by *Elymus repens* (Quackgrass). The active channel supports a weedy community dominated by *Hordeum jubatum* (Foxtail Barley) and *Poa palustris* (Fowl Bluegrass). The terraces are dominated by *Symphoricarpos occidentalis*, *Artemisia cana* (Silver Sagebrush), and *Pascopyrum smithii* (Western Wheatgrass).

Key Environmental Factors

Highly episodic flood events maintain these riparian wetlands.

Rarity

A mature stand of *Salix amygdaloides* was documented at the site.

Condition

This reach was one of the few Milk River tributaries inventoried where woody vegetation dominated the riparian zone. This reach may once have been wetter before upstream hydrologic modifications, although an episodic flood event could also explain the dominance of woody vegetation. Currently, the site receives heavy grazing pressure. The channel is incised and there is extensive bank slumping. No regeneration of woody species was observed, likely due in part to livestock grazing. Grazing has also likely facilitated the dominance of exotic grasses at the site, including *Poa palustris*, *Elymus repens*, and *Bromus japonicus* (Japanese Brome).

Plant Community Information

	Rarity Ranks	
Plant Association/Dominance Type	**State**	**Global**
Artemisia cana / *Pascopyrum smithii* Shrubland	S4	G4
Hordeum jubatum Herbaceous Vegetation	S4	G4
Salix amygdaloides Woodland	S3	G3
Symphoricarpos occidentalis Shrubland	S4S5	G4G5

Dodson Wildlife Management Area

Location

This site is located along the Milk River at Dodson Wildlife Management Area. To get there travel 1.5 miles west of Dodson then left on a paved road. Proceed to the Wildlife Area and go left before crossing tracks.

Description

Dodson Dam impounds the Milk River and creates a series of wetlands in old oxbows and on the floodplain. The microtopography is gently undulating, which creates a diversity of mesic to hydric sites and allows for a variety of plant communities. The wettest sites are characterized by moist depressions and areas of open water and support *Typha latifolia* (Broad-Leaf Cattail) communities. *Juncus balticus* (Baltic Rush) and *Symphoricarpos occidentalis* (Western Snowberry) communities dominate more mesic areas. The driest portions of the site are occupied by *Pascopyrum smithii* (Western Wheatgrass) and *Sarcobatus vermiculatus / Pascopyrum smithii* (Black Greasewood / Western Wheatgrass) communities. No *Populus deltoides* (Plains Cottonwood) was observed.

Key Environmental Factors

Dodson Dam and its attendant elevated water levels have created these wetlands. These communities may still be adjusting to the new hydrologic regime.

Rarity

No rare plants or plant communities were documented.

Condition

Water backed up behind Dodson Dam has created the plant communities found here. It is not known what existed before the dam was built. Populations of *Cirsium arvense* (Canada thistle) and *Euphorbia esula* (Leafy Spurge) are scattered throughout the site.

Plant Community Information

	Rarity Ranks	
Plant Association/Dominance Type	**State**	**Global**
Juncus balticus Herbaceous Vegetation	S5	G5
Pascopyrum smithii Herbaceous Vegetation	S4	G3G5Q
Sarcobatus vermiculatus / *Pascopyrum smithii* - *(Elymus lanceolatus)* Shrub Herbaceous Vegetation	S4	G4
Symphoricarpos occidentalis Shrubland	S4S5	G4G5
Typha latifolia Western Herbaceous Vegetation	S5	G5

Hewitt Lake National Wildlife Refuge

Location

This site is located along the Milk River just upstream from Nelson Reservoir. From Malta take U.S. 2 east to Sleeping Buffalo. Go north to Nelson Reservoir and continue past the second head gate. Take the right hand road at the three-way intersection and go north.

Description

This site consists of gently undulating terraces and channel of the Milk River. The lower terrace was probably the historic floodplain of the Milk River; however, the channel is now incised and bankfull flood events no longer access this landform. Along the lower bank near the active channel there is a *Salix exigua* (Sandbar Willow) community. This portion of the incised channel bank still receives floodwaters. In contrast, the higher portion of the bank seems much drier and is dominated by *Pascopyrum smithii* (Western Wheatgrass). A *Populus deltoides / Symphoricarpos occidentalis* (Plains Cottonwood / Western Snowberry) community occurs on what was probably the historic floodplain next to the bank. This community is characterized by an open canopy of mature and senescent cottonwoods with many dead stems. The highest terrace probably once supported an *Artemisia cana / Pascopyrum smithii* (Silver Sagebrush / Western Wheatgrass) community, but it has largely been converted to an *Agropyron cristatum* (Crested Wheatgrass) and *Medicago sativa* (Alfalfa) dominated field.

Key Environmental Factors

This site has been largely shaped by past flooding regimes. Changes to the site's hydrological and geomorphological context have greatly changed the composition and succession of plant communities at the site.

Rarity

This site supports a relictual stand of *Populus deltoides / Symphoricarpos occidentalis*, which a regionally rare community type.

Condition

The reduction in the frequency and magnitude of flood events has greatly altered the vegetation and geomorphology of this site. Cottonwood regeneration is not occurring and this habitat will likely disappear with the death of existing trees. Parts of this site have been intensively grazed by livestock. This has reduced the cover of native grasses and facilitated the spread of *Bromus inermis*, which now dominates the herbaceous layer in the drier portion of the site. The high terrace was put into agricultural production, and the native plant communities have been replaced by an oldfield community dominated by *Agropyron cristatum*.

Plant Community Information

	Rarity Ranks	
Plant Association/Dominance Type	**State**	**Global**
Salix exigua Temporarily Flooded Shrubland	S5	G5
Pascopyrum smithii Herbaceous Vegetation	S4	G3G5Q
Populus deltoides / Symphoricarpos occidentalis Woodland	S?	G2G3

Little Cottonwood Creek

Location

This site is located along Little Cottonwood Creek near its confluence with the Milk River. From Malta, travel north on U.S. 191 for approximately 17.5 miles to where it crosses Little Cottonwood Creek.

Description

This site consists of the small floodplain of Little Cottonwood Creek. The channel of Little Cottonwood is incised and the floodplain appears to receive less flooding as a result. The floodplain now supports an *Artemisia cana* / *Pascopyrum smithii* (Silver Sagebrush / Western Wheatgrass) community interspersed with mature and decadent *Populus deltoides* (Plains Cottonwood). Although this community is still influenced by its proximity to the creek channel, upland grasses, such as *Hesperostipa comata* (Needle-and-Thread) and *Nassella viridula* (Green Needlegrass), are relatively abundant. Wetter areas along the channel shelf are dominated by *Pascopyrum smithii*.

Key Environmental Factors

The hydrologic regime that maintains flooded or saturated conditions are the main factor structuring vegetation at this site.

Rarity

No rare plants or plant communities were documented.

Condition

The creek channel appears to be incised, perhaps due to the incised nature of the Milk River. Much of the floodplain no longer appears to receive floodflows. This may be due to changes in the channels geomorphology or due to upstream hydrological modifications or perhaps a combination of both of these factors. Scattered mature *Populus deltoides* are present on both the floodplain and terrace, and no regeneration was observed on either of these landforms.

Plant Community Information

	Rarity Ranks	
Plant Association/Dominance Type	**State**	**Global**
Artemisia cana / *Pascopyrum smithii* Shrubland	S4	G4
Pascopyrum smithii Herbaceous Vegetation	S4	G3G5Q

Marias River

Location

This site includes the reach of the Marias River downstream from Tiber Dam to County Road 223. From Fort Benton, travel north on County Road 223 for approximately 40 miles. Turn west on a gravel road about 5 miles after crossing the Marias River and travel approximately 7 miles to Tiber Dam.

Description

This site encompasses the floodplain and terraces of the Marias River from Tiber Dam to County Road 223. Due to lack of floodflows, point and lateral bars and the lower portion of the floodplain are stabilized. These landforms support an odd mix of *Salix exigua* (Sandbar Willow), which often colonizes point bars, and later-successional shrubs, such as *Shepherdia argentea* (Silver Buffaloberry) and *Symphoricarpos occidentalis* (Western Snowberry). Herbaceous communities, such as *Phalaris arundinacea* (Reed Canarygrass) and *Carex pellita* (Woolly Sedge), also occur in these areas. Higher portions of the floodplain and the adjacent low terrace are largely occupied by cottonwood communities. *Populus deltoides* (Plains Cottonwood) is the dominant cottonwood along this reach, although *Populus angustifolia* (Narrowleaf Cottonwood) and *Populus balsamifera* ssp. *trichocarpa* (Black Cottonwood) are also present. These stands usually have a well-developed and relatively dense shrub understory. *Symphoricarpos occidentalis* is the dominant shrub in most stands; other common shrub species include *Rosa woodsii* (Wood's Rose), *Salix lutea* (Yellow Willow), *Shepherdia argentea*, *Prunus virginiana* (Chokecherry), and *Cornus sericea* (Red-Osier Dogwood). The herbaceous layer is largely dominated by the exotic grasses *Poa pratensis* (Kentucky Bluegrass) and *Bromus inermis* (Smooth Brome). A second terrace is largely dominated by an *Artemisia cana* (Silver Sagebrush) community. Although *Pascopyrum smithii* (Western Wheatgrass) typically dominates the herbaceous layer in this community, in places it has been replaced by *Agropyron cristatum* (Crested Wheatgrass).

Key Environmental Factors

Vegetation communities have largely been structured by the historic flooding regime. The character of these riparian habitats is changing with diminution of flood frequency and magnitude.

Rarity

The Plains cottonwood communities with shrub understories are considered rare, largely due to the lack of regeneration of these stands region-wide.

Condition

Tiber Dam has significantly altered the hydrology of the lower Marias River and has drastically reduced the magnitude and frequency of flood events along this reach. Dynamic early-successional landforms, such as point bars, are stabilized and well vegetated with little evidence of recent sediment deposition. Although portions of the lower Marias floodplain have been converted to agriculture, a fair amount of riparian habitat remains. Remaining cottonwood stands provide excellent habitat; however, no cottonwood regeneration was observed, and this regionally significant habitat resource will not persist without restoration of 5 to 10 year flood events.

Pasture grasses are well established and often dominant in the ground layer of most cottonwood stands. *Poa pratensis* (Kentucky Bluegrass) and *Bromus inermis* (Smooth Brome) are the most widespread and abundant dominants. *Bromus tectorum* (Cheatgrass), *Agropyron cristatum* (Crested Wheatgrass), and *Phalaris arundinacea* (Reed Canarygrass) are locally abundant. Other common weedy species are *Cynoglossum officinale* (Hound's Tongue), *Taraxacum officinale* (Common Dandelion), and *Cirsium*

arvense (Canada Thistle). Notably absent was *Euphorbia esula* (Leafy Spurge), which is abundant along the Marias River upstream of Tiber dam. *Elaeagnus angustifolia* (Russian Olive) occurs as small patches of a few individuals. Abundance of this species is likely to increase with time.

Plant Community Information

	Rarity Ranks	
Plant Association/Dominance Type	**State**	**Global**
Artemisia cana / *Pascopyrum smithii* Shrubland	S4	G4
Populus angustifolia / *Symphoricarpos occidentalis* Forest	S?	*
Populus balsamifera ssp. *trichocarpa* / *Symphoricarpos occidentalis* Forest	S?	*
Populus deltoides / *Cornus sericea* Forest	S2S3	G2G3
Populus deltoides / Mesic Graminoids Forest	SW	*
Populus deltoides / *Symphoricarpos occidentalis* Woodland	S2S3	G2G3
Shepherdia argentea - *Salix exigua* Dominance Type	*	*
Symphoricarpos occidentalis Shrubland	S4S5	G4G5

* Rank not assigned

Milk River near Buffalo Coulee

Location

This site is located along the Milk River below Vandalia Dam. From Hinsdale go about eight miles east on US 2 then take a gravel road south towards Vandalia. About 1.8 miles south on this road turn right at the block management sign. Stay to the right and walk to the river.

Description

This site consists of the gently undulating historic floodplain of the Milk River and a gentle slope dropping off to the active river channel. *Bromus inermis* (Smooth Brome) dominates the channel bank, although young *Fraxinus pennsylvanica* (Green Ash) is also present and growing slowly. The terrace supports a mature stand of *Populus deltoides* (Plains Cottonwood) that is developing into a *Fraxinus pennsylvanica / Prunus virginiana* (Green Ash / Common Chokecherry) habitat type. Beaver have been cutting some of the *Fraxinus pennsylvanica*, but this species is regenerating. Recruitment of *Fraxinus pennsylvanica* has not progressed past the seedling stage at the site.

Key Environmental Factors

Flooding in the past was a key factor in creating this landscape.

Rarity

This area supports a *Fraxinus pennsylvanica / Prunus virginiana* community, which is relatively rare in Montana.

Condition

Flood control and extraction of water for irrigation has altered the distribution and composition of vegetation at this site. *Populus deltoides*, which once dominated the historic floodplain, is no longer able to regenerate and is being displaced by *Fraxinus pennsylvanica*. *Bromus inermis* dominates the herbaceous layer throughout the site, perhaps facilitated by heavy cattle grazing in the past. *Euphorbia esula* (Leafy Spurge) is present on the slope down to the Milk River. Although *Fraxinus pennsylvanica* seedlings were numerous, no saplings were observed.

Plant Community Information

	Rarity Ranks	
Plant Association/Dominance Type	**State**	**Global**
Bromus inermis - (Pascopyrum smithii) Semi-natural Herbaceous Vegetation	SW	GW
Fraxinus pennsylvanica / Prunus virginiana Forest	S2S3	G3?

Milk River near Dodson Creek

Location

This site is located along the Milk River south of the town of Dodson. From Dodson, travel south on Road 204 for about 1 mile. Turn left just before crossing the Milk River.

Description

The active channel of the Milk River is deeply incised at this site, as is the channel of Dodson Creek. A *Salix lutea* (Yellow Willow) community, co-dominated by *Salix exigua* (Sandbar Willow) and *Symphoricarpos occidentalis* (Western Snowberry), occupies the steep bank adjacent to the Milk River channel. *Carex nebrascensis* (Nebraska Sedge), *Glycyrrhiza lepidota* (American Licorice), and *Solidago canadensis* (Canadian Goldenrod) dominate the herbaceous layer, and the exotics *Bromus inermis* (Smooth Brome) and *Cirsium arvense* (Canada Thistle) are well represented. This community still probably gets flooded on an annual basis. A *Fraxinus pennsylvanica / Prunus virginiana* (Green Ash / Chokecherry), co-dominated by *Populus deltoides* (Plains Cottonwood), occurs along the deeply incised channel of Dodson Creek. No cottonwood regeneration was observed in this community.

Above these incised banks is the historic floodplain of the Milk River. Before channel incisement, this area probably supported a *Populus deltoides / Cornus sericea* (Plains Cottonwood / Red-Osier Dogwood) community. This area now supports an *Artemisia cana / Pascopyrum smithii* (Silver Sagebrush / Western Wheatgrass) community, although large, mature cottonwoods are still present. The herbaceous layer of this community has been largely converted to the exotic species *Bromus inermis* (Smooth Brome) and *Agropyron cristatum* (Crested Wheatgrass).

Key Environmental Factors

Fresno Dam has greatly reduced the chance of flooding and both Fresno and Dodson dams remove water for irrigation. This has greatly changed the hydrological and geomorphological context of this site, and has resulted in changes to plant community composition.

Rarity

No rare plants or plant communities were documented.

Condition

Flood control and water extraction for irrigation has reduced the amount of flooding and water this area gets. *Agropyron cristatum* (Crested Wheatgrass) and *Bromus inermis* (Smooth Brome) are the dominant grasses at this site.

Plant Community Information

	Rarity Ranks	
Plant Association/Dominance Type	**State**	**Global**
Artemisia cana / *Pascopyrum smithii* Shrubland	S4	G4
Fraxinus pennsylvanica / *Prunus virginiana* Forest	S2S3	G3?
Salix lutea / *Carex nebrascensis* Dominance Type	*	*

* Rank not assigned

Milk River near Frenchman Creek

Location

This site is located along the Milk River between Nelson Reservoir and Frenchman Creek. From Saco go north on the paved road and take a right after crossing the Milk River. Go about two miles to a small gravel pit and a road to the south.

Description

This site occurs on a gently undulating terrace with a drop off into the channel of the Milk River. The lower portion of the channel bank is dominated by *Carex aquatilis* (Water Sedge). Higher areas support a *Rosa woodsii* (Woods Rose) community. The herbaceous layer in this community is largely dominated by the exotics *Bromus inermis* (Smooth Brome) and *Euphorbia esula* (Leafy Spurge). A *Salix lutea* (Yellow Willow) community occurs on the terrace. This area probably supported a *Populus deltoides / Cornus sericea* (Plains Cottonwood / Red-Osier Dogwood) community prior to flood control, and a few large, senescent *Populus deltoides* are still present. The herbaceous layer of this community is also dominated by *Bromus inermis* and *Euphorbia esula*.

Key Environmental Factors

Flood control and removal of water for irrigation has greatly reduced the chance of flooding for the community on the terrace. Periodic flooding still maintains the community on the slope to the river.

Rarity

No rare plants or plant communities were documented.

Condition

A lack of flooding has probably led to a great reduction in flooding of the terrace community and a consequent reduction of *Populus deltoides*. *Bromus inermis* (Smooth Brome) is the only graminoid in the terrace community and also occurs in the upper portion of the *Rosa woodsii* community. *Euphorbia esula* (Leafy Spurge) is common in the terrace community and is the dominant forb on the slope. *Elaeagnus angustifolia* (Russian Olive) is present on the terrace.

Plant Community Information

	Rarity Ranks	
Plant Association/Dominance Type	**State**	**Global**
Carex aquatilis Herbaceous Vegetation	S4	G5
Rosa woodsii Shrubland	S5	G5
Salix lutea / *Bromus inermis* Dominance Type	*	*

* Rank not assigned

Milk River near Horse Camp Coulee

Location

This site is located along the Milk River north of Malta. From Malta, travel north on U.S. 191. The site is one half mile past Horse Camp Creek on the east side. Walk to the left side on the peninsula.

Description

The majority of this site consists of an old, gently undulating floodplain with a steep slope down to the Milk River. Within the incised Milk River channel, a *Carex aquatilis* (Water Sedge) community occurs on the lower portion of the bank. The river is cutting into this bank and some sluffing is occurring. Further up the bank the vegetation is dominated by an *Artemisia cana / Pascopyrum smithii* (Silver Sagebrush / Western Wheatgrass) community type. No trees are present, and the community is slowly sliding into the river. The *Artemisia cana / Pascopyrum smithii* community extends onto the adjacent bench above the bank. Historically (prior to hydrologic alterations), this area was dominated by a *Populus deltoides* (Plains Cottonwood) community. At the time of the field inventory, only a few trees remained. *Hesperostipa comata* (Needle-and-Thread) is the dominant grass and may be indicating the site is switching from wetland to upland. The site is about 20 feet above the river.

Key Environmental Factors

Flood control and extraction of water for irrigation has made this site drier than it once was. Only the *Carex aquatilis* community now appears to be in the floodplain.

Rarity

No rare plants or plant communities were documented.

Condition

Flood control and extraction of water for irrigation has fundamentally altered the hydrology of this site. Only the lowest portion of the bank now receives annual flood flows, and the highest landform at the site is in the process of converting from wetland to upland vegetation. *Bromus inermis* (Smooth brome) is well established at the site in both the *Carex aquatilis* and *Artemisia cana* / *Pascopyrum smithii* communities. *Poa pratensis* (Kentucky bluegrass) is also present.

Plant Community Information

	Rarity Ranks	
Plant Association/Dominance Type	**State**	**Global**
Artemisia cana / *Hesperostipa comata* Shrub Herbaceous Vegetation	S3	G3
Artemisia cana / *Pascopyrum smithii* Shrubland	S4	G4
Carex aquatilis Herbaceous Vegetation	S4	G5

Milk River near Little Cottonwood Creek

Location

This site is located along the Milk River below its confluence with Cottonwood Creek. From Malta, travel north on U.S. 191. After about 19 miles, just before the road leaves the Milk river valley, turn right on a gravel road then take the first right on another gravel road and proceed to the river.

Description

The Milk River channel is deeply incised and fairly narrow at this site. Mature *Populus deltoides* (Plains Cottonwood) still occupy portions of the historic floodplain. This may once have been a *Populus deltoides* / *Symphoricarpos occidentalis* (Western Snowberry) community, but the understory is now largely dominated by *Poa pratensis* (Kentucky Bluegrass) and *Bromus inermis* (Smooth Brome). No cottonwood recruitment is evident. As individual trees die, the stand will be replaced by an *Artemisia cana / Pascopyrum smithii* (Silver Sagebrush / Western Wheatgrass) community. This community is already well established at the site, and in places supports a high cover of native grasses, including *Pascopyrum smithii* (Western Wheatgrass), *Koeleria macrantha* (Junegrass), and *Hesperostipa comata* (Needle-and-Thread). A *Carex aquatilis* (Water Sedge) community occurs on the lower portion of the steep banks of the Milk River. This area still receives occasional flooding.

Key Environmental Factors

Flood control has greatly reduced the chance of flooding leading to a change of plant communities. Old decadent *Populus deltoides* trees indicate a more mesic and dynamic past.

Rarity

No rare plants or plant communities were documented.

Condition

Flood control and water removal for irrigation has dried most of this area. Cottonwood communities at the site have changed and are still changing to reflect this. The exotic pasture grass *Poa pratensis* occupies much of the site.

Plant Community Information

	Rarity Ranks	
Plant Association/Dominance Type	**State**	**Global**
Artemisia cana / *Pascopyrum smithii* Shrubland	S4	G4
Carex aquatilis Herbaceous Vegetation	S4	G5
Populus deltoides / Mesic Graminoids Dominance Type	*	*

* Rank not assigned

Milk River near Rock Creek

Location

This site is located in two sections along the Milk River above its confluence with Rock Creek. From Hinsdale, travel north on the paved road and cross the bridge over the Milk River. To reach the downstream section, take the first left. To reach the upper section, travel about 1 mile and inquire about access at the house on the left.

Description

This site is characterized by the gently undulating topography of the historic floodplain of the Milk River as well as the sloping bank to the active channel. The lower section of the site is on a fill bank and the channel bank has a gentle slope. This area is at the upper end of the Vandalia Dam impoundment. The lower bank slope, which is the area most influenced by current flooding regimes, supports a *Carex aquatilis* (Water Sedge) community. A *Salix exigua* (Sandbar Willow) community occurs on a slightly higher portion of the bank. The terrace here supports a decadent stand of *Populus deltoides* (Plains Cottonwood) that is being replaced by an extensive forest of *Fraxinus pennsylvanica* (Green Ash). There is good *Fraxinus pennsylvanica* recruitment in this stand despite high cover of *Bromus inermis* (Smooth Brome) browsing by deer.

The upper area has a similar morphology, although the channel bank is steeper in this section. The channel bank supports stands of *Salix exigua* (Sandbar Willow) and *Salix lutea* (Yellow Willow). In places, the willows have died and the bank is dominated by *Bromus inermis* (Smooth Brome). The upper channel bank/lower historic floodplain is occupied by a *Fraxinus pennsylvanica / Prunus virginiana* (Green Ash / Common Chokecherry) community with an open canopy of mature *Populus deltoides*. Higher on the historic floodplain, old decadent cottonwoods dominate the stand. The *Fraxinus pennsylvanica* are young and vigorous with good regeneration; in contrast, no cottonwood regeneration was observed.

Key Environmental Factors

Historic flooding regimes were the primary influence on the structure and composition of vegetation at this site. Diminished flood regimes since the construction of Fresno Dam are altering historic vegetation composition.

Rarity

This area supports a *Fraxinus pennsylvanica / Prunus virginiana* community, which is relatively rare in Montana.

Condition

Flood control has greatly reduced flood frequency and magnitude and has consequently also nearly eliminated regeneration of *Populus deltoides*, although two saplings of this species were found. Past grazing pressure may be responsible for the dominance of *Bromus inermis* at the site. The forest also had no forbs, probably due to competition from *Bromus inermis*. It is unclear what is causing the willow mortality. Other exotic species documented were *Cirsium arvense* (Canada Thistle), *Poa pratensis* (Kentucky Bluegrass), *Euphorbia esula* (Leafy Spurge), and *Elaeagnus angustifolia* (Russian Olive).

Plant Community Information

Plant Association/Dominance Type	Rarity Ranks	
	State	Global
Bromus inermis - *(Pascopyrum smithii)* Semi-natural Herbaceous Vegetation	SW	GW
Carex aquatilis Herbaceous Vegetation	S4	G5
Fraxinus pennsylvanica / Prunus virginiana Forest	S2S3	G3?
Salix exigua Temporarily Flooded Shrubland	S5	G5

Milk River near Whitewater Creek

Location

This site is located along the Milk River below Nelson Reservoir. From Malta, go east on U.S. 2 to the Sleeping Buffalo. From here go north to Nelson Reservoir and continue to Creek Crossing Road. Follow it across the Milk River to the end and make a right. Go about one mile past the Cole Ponds fishing area.

Description

This site is characterized by gently undulating terrace with a steep drop off into the incised channel of the Milk River. Much of the channel banks were until recently dominated by *Salix exigua* (Sandbar Willow). However, most of these willows are now dead, due in part to beaver mortality and perhaps drought, and *Symphoricarpos occidentalis* (Western Snowberry) now dominates the area. The terrace is occupied by a *Populus deltoides* (Plains Cottonwood) community with an herbaceous understory dominated by *Bromus inermis* (Smooth Brome). No *Populus deltoides* regeneration was observed.

Key Environmental Factors

Flood control and the removal of water for irrigation has greatly reduced the chance of flooding in the *Populus deltoides* community.

Rarity

No rare plants or plant communities were documented.

Condition

This site has been affected by changes in hydrology and the reduction in floodflows. Cottonwood stands are mature to senescent and no cottonwood regeneration was noted or is likely. *Elaeagnus angustifolia* is replacing native cottonwood habitat at the site, and the exotic *Bromus inermis* dominates the herbaceous layer throughout most of the site. *Agropyron cristatum* (Crested Wheatgrass) is also present.

Plant Community Information

	Rarity Ranks	
Plant Association/Dominance Type	**State**	**Global**
Populus deltoides / Mesic Graminoids Forest	SW	*
Symphoricarpos occidentalis Shrubland	S4S5	G4G5

* Rank not assigned

Milk River Wildlife Management Area

Location

This site is located along the Milk River below Nelson Reservoir. From Malta, travel on U.S. 2 east to Sleeping Buffalo. Go north to Nelson Reservoir and cross the first outlet gate. Take a road to the right before the hill and proceed about 1.8 miles to where it is close to the Milk River.

Description

The site occurs along a series of stepped terraces leading down to the active channel of the Milk River. The "wettest" and most frequently inundated plant communities occur in an establishing floodplain within the incised Milk River channel. These include communities dominated by *Carex aquatilis* (Water Sedge) and *Salix exigua* (Sandbar Willow). The landform above the channel bank was probably the river's historic floodplain. This area now receives little flooding and is occupied by a relictual *Populus deltoides* (Plains Cottonwood) stand that is converting to a *Fraxinus pennsylvanica / Prunus virginiana* (Green Ash / Common Chokecherry) community. A slightly higher terrace is occupied *Artemisia cana / Pascopyrum smithii* (Silver Sagebrush / Western Wheatgrass) and *Populus deltoides / Cornus sericea* (Plains Cottonwood / Red-Osier Dogwood) communities. *Elaeagnus angustifolia* (Russian Olive) is well established in the latter community and will come to dominate the stand as individual cottonwoods die.

Key Environmental Factors

Past hydrological regimes have largely shaped vegetation and the geomorphological setting of the site. Changes to flooding regimes and encroachment by exotic species have altered vegetation composition and recruitment and caused the incisement of the active channel.

Rarity

Two rare communities were documented at this site: *Fraxinus pennsylvanica / Prunus virginiana* and *Populus deltoides / Cornus sericea*. No regeneration was observed in the *Populus deltoides / Cornus sericea* community, and it is likely that this community will not persist over time.

Condition

Changes to historical flooding regimes have altered channel morphology and led to a general drying of the site. Although mature cottonwoods occupy portions of the site, no cottonwood recruitment was observed, nor is it likely given the current flood regime. In contrast, *Fraxinus pennsylvanica* appeared to be successfully reproducing at the site. *Elaeagnus angustifolia* is becoming established in the existing cottonwood stands, and it is likely that this species will come to dominate these areas in time. *Bromus inermis* (Smooth Brome) is another problem species that is increasing and already displays considerable coverage.

Plant Community Information

	Rarity Ranks	
Plant Association/Dominance Type	**State**	**Global**
Artemisia cana / Pascopyrum smithii Shrubland	S4	G4
Carex aquatilis Herbaceous Vegetation	S4	G5
Fraxinus pennsylvanica / Prunus virginiana Forest	S2S3	G3?
Populus deltoides / Cornus sericea Forest	S2S3	G2G3

Nelson Reservoir Outlet

Location

This site is located at the outlet to Nelson Reservoir near the Milk River. From Malta, take U.S. 2 east to the Sleeping Buffalo and go north to Nelson Reservoir. From here continue until the first outlet gate is crossed. Park by the gravel road on the right.

Description

This site probably supported upland communities prior to the construction of Nelson Reservoir and the irrigation canal that provides this site with water. Only a few native species are found here. The area is flat except for a berm along the canal. Exotic species dominate the entire site. *Elaeagnus angustifolia* (Russian Olive) occupies much of the area, and exotic grasses, such as *Poa pratensis* (Kentucky Bluegrass) and *Bromus inermis* (Smooth Brome), mostly dominate the herbaceous layer. The exotic forbs *Taraxacum officinale* (Common Dandelion) and *Cirsium arvense* (Canada Thistle) are also well represented.

Key Environmental Factors

This area probably once supported upland communities. With the construction of Nelson Reservoir and irrigation canal, the area has become more mesic, and the vegetation has changed to reflect this.

Rarity

No rare plants or plant communities were documented.

Condition

This site is grazed fairly heavily by cattle and is receiving water from Nelson Reservoir that it probably did not get before the reservoir was constructed. Exotic species dominate the site. The most common species include *Agropyron cristatum* (Crested Wheatgrass), *Bromus inermis* (Smooth Brome), *Taraxacum officinale* (Dandelion), *Medicago sativa* (Alfalfa), *Convolvulus arvense* (Field Morning-Glory), *Cirsium arvense* (Canada Thistle), and *Elaeagnus angustifolia* (Russian Olive).

Plant Community Information

	Rarity Ranks	
Plant Association/Dominance Type	**State**	**Global**
Elaeagnus angustifolia Semi-natural Woodland	SW	GW
Poa pratensis Semi-natural Seasonally Flooded Herbaceous Vegetation	SW	GW

Nelson Reservoir Oxbow

Location

This site is located along an old oxbow of the Milk River near Nelson Reservoir. From Malta, travel east on U.S. 2 to Sleeping Buffalo, then go north to Nelson Reservoir. Continue until the first outlet gate has been crossed. Park by the gravel road on the right from where the site can be seen.

Description

This site consists of a portion of old oxbow associated with the Milk River. A canal passes through and partitions the oxbow, the deepest and wettest portion of which supports a *Typha latifolia* (Broadleaf Cattail) community. Other plant communities are arranged in concentric bands along a soil moisture gradient. The wettest areas adjacent to the *Typha latifolia* community support an open stand of *Juncus balticus* (Baltic Rush). As soil moisture decreases, *Elaeagnus angustifolia* (Russian Olive) and exotic pasture grasses, such as *Phleum pratense* (Common Timothy) and *Poa pratensis* (Kentucky Bluegrass), become well established and begin to displace the *Juncus balticus*. A *Pascopyrum smithii* (Western Wheatgrass) community occupies the driest zone at the site.

Key Environmental Factors

It is not known what this site looked like prior to the construction of Nelson Reservoir. The Nelson Canal that bisects the site may be increasing water inputs into the oxbow and making the site wetter.

Rarity

No rare plants or plant communities were documented.

Condition

The site may be getting water from Nelson Reservoir and an associated irrigation canal. This site was heavily grazed last year, and soils in the wetter *Juncus balticus* community are heavily pugged. The exotic forb and noxious weed *Cirsium arvense* (Canada Thistle) is well established in the wetter portions of the site, while *Elaeagnus angustifolia* and *Poa pratensis* have become established in drier portions of the site.

Plant Community Information

	Rarity Ranks	
Plant Association/Dominance Type	**State**	**Global**
Elaeagnus angustifolia Semi-natural Woodland	SW	GW
Juncus balticus Herbaceous Vegetation	S5	G5
Pascopyrum smithii Herbaceous Vegetation	S4	G3G5Q
Typha latifolia Western Herbaceous Vegetation	S5	G5

Red Rock Coulee

Location

This site is located along the lower reach of Red Rock Coulee. From Havre, travel east on U.S. 2 for approximately 18 miles to Lohman. After crossing the Milk River, turn north on a gravel road approximately 0.25 mile after the bridge. Follow this road for about 2 miles. Turn right onto a smaller gravel road; the site is on the left after about 0.5 mile.

Description

This site consists of the deeply incised channel of Red Rock Coulee. The stream is ephemeral and the streambed consists of deep pools alternating with a shallow channel. Pool areas, which were mostly dry, support hygric *Schoenoplectus pungens* (Threesquare Bulrush) and *Carex praegracilis* (Clustered Field Sedge) communities co-dominated by *Eleocharis palustris* (Common Spikerush). *Hordeum jubatum* (Foxtail Barley) and *Juncus balticus* (Baltic Rush) dominate drier channel areas as well as the narrow floodplain. A small terrace perched within the greater incised channel supports a *Pascopyrum smithii* (Western Wheatgrass) community, while the slopes leading to the uplands are dominated by *Symphoricarpos occidentalis* (Western Snowberry). The uplands have been seeded to *Agropyron cristatum* (Crested Wheatgrass) and few native grasses remain, although *Artemisia cana* (Silver Sagebrush) occurs at low cover.

Key Environmental Factors

The hydrologic regime that maintains flooded or saturated conditions are the main factor structuring vegetation at this site.

Rarity

No rare plants or plant communities were documented.

Condition

The creek channel is deeply incised and has begun to reestablish a floodplain within this larger incisement. Small rock dams have been placed across the channel of this ephemeral stream to increase the duration of ponded water for livestock use. Livestock use is correspondingly high and concentrated within the coulee. Wetter areas of the "active" channel are deeply pugged. The vegetation within the riparian zone is largely dominated by natives. This is in contrast to the uplands that have been seeded to *Agropyron cristatum*.

Plant Community Information

	Rarity Ranks	
Plant Association/Dominance Type	**State**	**Global**
Artemisia cana / *Agropyron cristatum* Dominance Type	*	*
Hordeum jubatum Herbaceous Vegetation	S4	G4
Pascopyrum smithii Herbaceous Vegetation	S4	G3G5Q
Schoenoplectus pungens Herbaceous Vegetation	S3	G3G4
Symphoricarpos occidentalis Shrubland	S4S5	G4G5

* Rank not assigned

Rookery Wildlife Management Area

Location

Rookery Wildlife Management Area is located along the Milk River west of Havre. From Havre, travel north on Road 232; after crossing railroad tracks and the Milk River, take the first gravel road to the left before Road 232 goes up a hill. Travel approximately 3.5 miles to the site.

Description

This site encompasses several miles of the Milk River below Fresno Dam. The site includes the Milk River floodplain and associated terraces that lie in a valley about three quarters of a mile wide. The valley gently slopes towards the river and has a few shallow depressions. Plant communities are distributed along a topographical/flood disturbance gradient from the active channel to terrace. Seasonally wetter areas along the channel that still receive annual flooding are dominated by willow communities, such as *Salix exigua* (Sandbar Willow) and *Salix lutea* (Yellow Willow). Pasture grasses, such as *Poa pratensis* (Kentucky Bluegrass), *Elymus repens* (Quackgrass), and *Bromus inermis* (Smooth Brome) have largely replaced the native grasses in these communities, although native forbs are still represented, including *Maianthemum stellatum* (Starry False Solomon's-Seal), *Solidago canadensis* (Canadian Goldenrod), and *Equisetum arvense* (Field Horsetail). Higher portions of the floodplain support a relictual *Populus deltoides* / *Cornus sericea* (Plains Cottonwood / Red-Osier Dogwood) community. This community, which occurs in arcuate bands parallel to the stream channel, typifies historic flooding regimes prior to the construction of Fresno Dam. Large portions of the floodplain are occupied by an *Artemisia cana* / *Pascopyrum smithii* (Silver Sagebrush / Western Wheatgrass) community. Although *Pascopyrum smithii* and *Puccinellia nuttalliana* (Nuttall's Alkaligrass) still largely dominate the herbaceous layer, native grasses have been largely displaced from some portions of this community. Small shallow depressions in the terrace that receive groundwater from upland areas support small patches of *Elymus trachycaulus* (Slender Wild Rye).

Key Environmental Factors

The interplay of the hydrological regime with channel migration is the dominant process that affects the structure and composition of vegetation at this site.

Rarity

The *Populus deltoides* / *Cornus sericea* community type is restricted to the western Great Plains and has been adversely affected by hydrologic alterations and grazing disturbances throughout its range. The relictual stand at this site is typical of these disturbances.

Condition

Riparian communities developed in response to the historic flood regimes of the Milk River. This is especially true of *Populus deltoides* communities. Fresno Dam has greatly reduced the frequency and magnitude of flooding, and it is unlikely that cottonwood stands will persist at this site. No young *Populus deltoides* were found as a result of this change. It also appears that *Agropyron cristatum* (Crested Wheatgrass) has been planted where *Pascopyrum smithii* once grew. Two exotic pasture grasses, *Bromus inermis* and *Poa pratensis*, are common at the site.

Plant Community Information

Plant Association/Dominance Type	Rarity Ranks	
	State	Global
Artemisia cana / *Pascopyrum smithii* Shrubland	S4	G4
Pascopyrum smithii – Elymus trachycaulus Clay Pan Herbaceous Vegetation	S?	G?
Populus deltoides / *Cornus sericea* Forest	S2S3	G2G3
Salix exigua Temporarily Flooded Shrubland	S5	G5
Salix lutea / *Bromus inermis* Dominance Type	*	*
Symphoricarpos occidentalis Shrubland	S4S5	G4G5

* Rank not assigned

Vandalia Dam

Location

This site is located along the Milk River both upstream and downstream of Vandalia Dam. From Hinsdale, travel east on U.S. 2 for approximately 5.3 miles to the Vandalia Dam road. Go south to the dam.

Description

This site occurs along the Milk River both up and downstream of Vandalia Dam. The site is characterized by the gently undulating historic floodplain and steep incised channel of the Milk River. The lower portion of the channel slope is still regularly inundated by floodwaters. This area supports *Carex aquatilis* (Water Sedge) and *Salix exigua* (Sandbar Willow) communities. There is some *Populus deltoides* recruitment in the *Carex aquatilis* community; however, it is being heavily browsed by deer and may not get to the sapling stage. Higher portions of the channel slope are dominated by *Bromus inermis* (Smooth Brome). Limited *Populus deltoides* regeneration is also occurring in this community. The terrace is occupied by a *Fraxinus pennsylvanica / Prunus virginiana* (Green Ash / Common Chokecherry) community, areas of which are still dominated by *Populus deltoides*, and a *Populus deltoides* stand with an understory dominated by *Bromus inermis*. No cottonwood regeneration was observed in either of these communities.

Upstream of Vandalia Dam, the reservoir has inundated the channel slope. There, the community adjacent to the slack water is a *Fraxinus pennsylvanica / Prunus virginiana* community. This community also supports a healthy stand of *Salix exigua* and is probably inundated fairly regularly. A great deal of beaver activity was observed in this stand. Old backchannels and oxbows remain saturated and are dominated by mesic to hydric stands of *Salix exigua* and *Typha latifolia* (Broadleaf Cattail). A narrow natural levee supports a relictual stand of *Populus deltoides*.

Key Environmental Factors

The historic flood regime was primarily responsible for structuring the vegetation at this site. With the diminution of the flood frequency and magnitude, cottonwood regeneration is very limited and will likely be lost from the historic floodplain, as will *Salix amygdaloides* (Peachleaf Willow). Above Vandalia Dam, higher water and more saturated conditions are also altering vegetation patterns.

Rarity

This area supports a *Fraxinus pennsylvanica / Prunus virginiana* community, which is relatively rare in Montana.

Condition

The lack of flooding is changing the distribution and kind of plant communities. *Populus deltoides* and *Salix amygdaloides* are being lost from the terrace, and while some cottonwood regeneration is occurring within the channel slope, it is likely that most seedlings are being killed by deer or cattle browsing. *Fraxinus pennsylvanica* is also regenerating, although only seedlings were observed. Both *Bromus inermis* and *Euphorbia esula* (Leafy Spurge) are widespread, with *Bromus inermis* being the dominant graminoid in most communities. Other exotic species present include *Cirsium arvense* (Canada Thistle), *Poa pratensis* (Kentucky Bluegrass) and *Elaeagnus angustifolia* (Russian Olive).

Plant Community Information

Plant Association/Dominance Type	Rarity Ranks	
	State	Global
Bromus inermis - *(Pascopyrum smithii)* Semi-natural Herbaceous Vegetation	SW	GW
Carex aquatilis Herbaceous Vegetation	S4	G5
Fraxinus pennsylvanica / Prunus virginiana Forest	S2S3	G3?
Populus deltoides / Mesic Graminoids Dominance Type	*	*
Salix exigua Temporarily Flooded Shrubland	S5	G5
Typha latifolia Western Herbaceous Vegetation	S5	G5

* Rank not assigned

APPENDIX C. SITE RANK CRITERIA FOR WETLANDS AND RIPARIAN AREAS

Site Rank Criteria for Wetlands and Riparian Areas

Minimum Site Size: 1 acre (0.5 acre for peatlands)

Rank Procedure: The following site ranking specifications have been modified from and informed by criteria presented in regional wetland assessment protocols (Washington State Department of Ecology 1991, Chadde et al. 1998, Greenlee 1999, Jankovsky-Jones 1999), hydrogeomorphic functional assessments (Hruby et al. 1999, Jankovsky-Jones et al. 1999a, 1999b, Hauer et al. 2000a, 2000b, Hruby et al. 2000), and plant community ranking specifications developed by other Natural Heritage programs (Chappell and Christy 2000, Rondeau and Sanderson 2000). This ranking procedure has been developed to be consistent with standard Heritage methodology described in the Draft Element Occurrence Data Standard (TNC and ABI 1999). The data standard was developed for ranking an element occurrence's viability by evaluating its condition, landscape context, and size. We propose similar criteria to evaluate a wetland site's viability. In addition to condition, context, and size, two other factors important in determining a site's conservation significance, diversity and rarity, are considered.

In the Rocky Mountains and Great Plains of Montana, wetlands occur as small patch and linear systems on the landscape (although there may be localized large patch occurrences, as in the Centennial Valley). Because of their small size and high dependence on external processes, the primary factors affecting site viability and significance are condition and context. Secondary factors are diversity and rarity, and the tertiary factor is size. These variables, their weighting factors, and rank thresholds are described below.

Condition Specifications (weight factor = .25): This factor is a combination of environmental factors (hydrologic, geomorphic, and biogeochemical) and vegetation and habitat parameters. A site's condition should be representative of the overall condition of individual plant associations present at the site. In addition to the condition of native plant associations, the presence of exotic-dominated communities is an important factor. The presence of weedy, modified, or cultural vegetation types should reduce the site condition rank, even where native associations are in pristine condition. An important point to consider in this case is the potential for the exotic species to spread. Note: not all of the factors listed below are applicable to all wetland systems (e.g., surface flooding is primarily a process associated with riverine systems, whereas subsurface flooding/saturation is important for all wetland types).

The following rank thresholds are not mutually exclusive. It is possible to have a site with minor hydrologic or geomorphic modification with highly degraded plant communities. For example, a cottonwood stand with an exotic-dominated understory along a free-flowing river (hydrology and geomorphology rank of A or B, vegetation and habitat rank of D) would warrant an overall condition rank of C.

A-rated condition

Hydrology, geomorphology, and biogeochemistry. Natural hydrologic processes are intact and the site has no geomorphic modifications. Indicators include:

- In all systems, subsurface flooding and saturation of low areas (swales, oxbows, old channels, depressions) occurs in most years as indicated by soils, vegetation, photographs.
- Overbank flooding occurs regularly (approximately every other year or more frequently) as indicated by soils, vegetation, photographs. This factor is important primarily for riverine systems with well developed floodplains.
- The floodplain is being actively developed, with multiple macrotopographic features present (e.g., oxbows, overflow/abandoned channels, floodplain, terraces, bars).
- Stream banks and channels have representative shape, are not riprapped, and are not unvegetated by excessive grazing or trampling.
- There is no evidence of geomorphic modification, excessive erosion, sediment deposition, or nutrient loading.

Vegetation and habitat

- Plant communities have representative structure and composition (e.g., cottonwood stands have a diverse and well developed shrub component).
- Regeneration is occurring and seedlings, saplings, or clonal shoots are present. In riverine floodplain systems, channel bar formation is creating substrate for woody vegetation colonization (this may be occurring in the system though not at the site).
- There is a high level of interspersion and connectivity among plant communities.
- Within native plant communities, no or very few exotic species are present, with no potential for expansion. Cultural or modified vegetation types are absent or are a very minor component of the site.

B-rated condition

Hydrology, geomorphology, and biogeochemistry. Hydrologic and geomorphic modifications are minimal and/or localized and are easily restorable. Indicators include:

- Overbank and subsurface flooding still occurs frequently, but flooding regimes may be slightly modified by irrigation withdrawal, small headwaters dams, or localized and minimal geomorphic alteration (roads, bridges, ditching, diking, bank revetment, soil compaction, clearing).
- Floodplain riverine systems have few macrotopographic features, but there is evidence of recent floodplain development.
- Stream banks may show some local adverse effects from excessive grazing or other activity.
- Any excessive erosion, deposition, or nutrient loading is restricted to localized pockets.

Vegetation and habitat

- Native plant community structure and composition has been somewhat altered by logging, grazing (including browse from native ungulates), fire suppression, etc. (e.g., the native shrub component is structurally and compositionally diverse, but browsing pressure has altered the structure and abundance, especially that of palatable species).
- Native species that increase with disturbance or changes in hydrology or nutrients are restricted to microsites.
- Limited regeneration and channel bar formation is occurring.
- There is a moderate level of interspersion and connectivity among plant communities.
- Exotic species and cultural vegetation are a minor component of the site and have little potential for expansion.

C-rated condition

Hydrology, geomorphology, and biogeochemistry. Hydrologic and geomorphic modifications are more systematic, and require either a long time (decades) or significant effort to restore. Indicators include:

- Subsurface flooding or saturation occurs relatively frequently, but overbank flooding occurs only during high floods. Hydrologic or geomorphic modifications have systematically altered the hydrologic regime. Modifications include regional hydropower or flood control dams, extensive irrigation withdrawals or return flows, widespread ditching, moderate bank revetment, etc.
- Floodplain riverine systems have few macrotopographic features and there is no evidence of recent floodplain development.
- Stream banks are significantly altered by excessive grazing, bank stabilization, channelization, road construction, etc.
- Excessive erosion, deposition, or nutrient loading is common.

Vegetation and habitat

- Native plant community structure and composition has been substantially altered by logging, grazing (including browse from native ungulates), fire suppression, etc.
- Native species that increase with disturbance or changes in hydrology or nutrients are widespread.

- Native species regeneration is not occurring or very restricted; no evidence of woody species colonization of channel bars.
- There is a low level of interspersion and connectivity among plant communities.
- Exotic species and cultural vegetation are widespread but potentially controllable.

D-rated condition

Hydrology, geomorphology, and biogeochemistry. Hydrology and geomorphology are significantly altered at both local and regional scales; restoration is unlikely.

- Surface/subsurface flooding occurs only during extreme flood events.
- Geomorphic modifications are extensive and a significant proportion of the channel is revetted.
- Stream banks are severely degraded.

Vegetation and habitat

- Community structure and composition is significantly affected by exotic species (e.g., understories of cottonwood stands have been converted from native shrubs or grasses to exotic graminoids).
- Native plant communities are fragmented by cultural vegetation.
- Exotic species, cultural vegetation, or native increasers are dominant and restoration is unlikely.

Landscape Context Specifications (weight factor = .25): This factor is a composite of context ranks for individual plant associations present at the site. The site context should be representative of the overall landscape context of these communities.

A-rated context

The site's hydrologic regime is not altered by flow regulation, augmentation, or reduction by upstream reservoirs, groundwater pumping, or irrigation withdrawal. Site is connected hydrologically and by suitable habitat (e.g., riparian vegetation along stream corridors) to other wetlands via unaltered surface or subsurface channels. Native vegetation in good condition occupies a 100-m buffer zone around the wetland. Adjacent uplands and the upstream watershed are unaltered (> 90% natural vegetation) by urban, agricultural, or other landuses (e.g., logging) that might affect hydrology or habitat connectivity. Habitat connectivity allows natural processes and species migration to occur.

B-rated context

Hydrologic regime is largely unaltered with few small reservoirs or irrigation withdrawals upstream. Hydrologic and habitat connectivity still largely intact, but a few barriers or gaps are present. Landuse in the wetland buffer is restricted to light grazing or selective logging. Adjacent uplands and the upstream watershed are moderately altered (60 to 90% natural vegetation) by urban, agricultural, or other uses.

C-rated context

Natural hydrological regimes are altered by upstream reservoirs or irrigation practices. Hydrologic connections are functional, but habitat connections are fragmented and multiple barriers are present. Landuse in the wetland buffer includes moderate grazing, logging, or haying. Adjacent uplands and upstream watershed are fragmented (20-60% natural vegetation) by urban, agricultural, or other uses.

D-rated context

Hydrology substantially altered by upstream reservoirs or irrigation practices (e.g., stream may go completely dry in most years, marsh may experience complete drawdown). Site may be hydrologically isolated due to hydrological or geomorphological modifications. Wetland buffer is heavily grazed, roaded, or tilled. Habitat is extremely fragmented and adjacent uplands and upstream watershed are largely converted to urban, agricultural, or other uses.

Diversity Specifications (weight factor = .20): This factor has three components: floristic diversity (measured by number of plant associations), plant physiognomic diversity (measured by number of Cowardin

classes/subclasses), and geomorphic diversity (measured by Cowardin water regimes). Cowardin classes are forest-evergreen, forest-deciduous, scrub-shrub, emergent, and aquatic bed. Cowardin water regimes include temporarily flooded, seasonally flooded, semipermanently flooded, and permanently flooded. Each component is considered separately, and the overall rank is the average score of the three components. Each component is weighted equally. To be counted, each component should occupy or occur over at least 10% of the site or 0.5 acres.

A-rated diversity

4 or more plant communities; 4 or more Cowardin classes; 4 or more Cowardin water regimes.

B-rated diversity

3 plant communities; 3 Cowardin classes; 3 Cowardin water regimes.

C-rated diversity

2 plant communities; 2 Cowardin classes; 2 Cowardin water regimes.

D-rated diversity

1 plant community; 1 Cowardin class; 1 Cowardin water regime.

Rarity Specifications (weight factor = .20): This factor is evaluated by the number and condition of rare or imperiled plants, animals, or communities present at the site. Sites with no rare elements as described below rank 0 for this factor. Peatlands are automatically ranked at A-level rarity.

A-rated rarity

One A-ranked G1 occurrence, four or more A or B-ranked G1 or G2 occurrences, four or more A-ranked G3 occurrences, or peatland associations form a significant component of the site.

B-rated rarity

One B through D-ranked G1 occurrence, one A or B-ranked G2 occurrence, one A-ranked G3 occurrence, or four or more B-ranked G3 or C-ranked G2 occurrences.

C-rated rarity

One C or D-ranked G2 occurrence, one B-ranked G3 occurrence, or four or more A or B-ranked S1 (G4 or G5) occurrences.

D-rated rarity

One C-ranked G3 occurrence, one A or B-ranked S1 (G4 or G5) occurrence, one A-ranked S2 (G4 or G5) occurrence, or four or more B-ranked S2 (G4 or G5) or A-ranked S3 (G4 or G5) occurrences.

Size Specifications (weight factor = .10): This factor will vary depending on the type of wetland being evaluated (e.g., slope, depressional, riverine, lacustrine fringe). If site boundaries are defined by land ownership or similar factors, evaluate this factor based on the size of the site's ecological boundaries.

A-rated size

> 100 acres for riverine; > 50 acres for slope, depressional, or lacustrine fringe; > 10 acres for peatland

B-rated size

50 to 100 acres for riverine; 25 to 50 acres for slope, depressional, or lacustrine fringe; 5 to 10 acres for peatland

C-rated size

10 to 50 acres for riverine; 5 to 25 acres for slope, depressional, or lacustrine fringe; 1 to 5 acres for peatland

D-rated size

< 10 acres for riverine; < 5 acres for slope, depressional, or lacustrine fringe; < 1 acre for peatland

Calculating Site Ranks: To calculate the overall site rank, the A – D ranks for each factor are given numeric equivalents, such that A = 4, B = 3, C = 2, and D = 1. These numeric equivalents are then multiplied by the weighting assigned to each factor and then added together, as illustrated by the following formula:

$$(R_{cond}*w_{cond}) + (R_{cont}*w_{cont}) + (R_{div}*w_{div}) + (R_{rare}*w_{rare}) + (R_{size}*w_{size}) = \text{overall site rank}$$

where R_{cond} = numeric equivalent for condition rank
R_{cont} = numeric equivalent for landscape context rank
R_{div} = numeric equivalent for diversity rank
R_{rare} = numeric equivalent for rarity rank
R_{size} = numeric equivalent for size rank

and w_{cond} = weight factor for condition
w_{cont} = weight factor for landscape context
w_{div} = weight factor for diversity
w_{rare} = weight factor for rarity
w_{size} = weight factor for size

The overall site rank is then determined given the following correspondence:

Site Rank	Numeric Range
A	>3.25 and ≤4.00
B	>2.50 and ≤3.25
C	>1.75 and ≤2.50
D	>0.80 and ≤1.75

For example, a site with B-ranked condition, A-ranked landscape context, C-ranked diversity, D-ranked rarity, and C-ranked size would have an overall site rank of B, as illustrated below:

(3*0.25) + (4*0.25) + (2*0.20) + (1*0.20) + (2*0.10) = 2.55

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Author: Marc Jones
Date: March 19, 2001

APPENDIX D. PLANT COMMUNITY DESCRIPTIONS

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I. FOREST

ACER NEGUNDO TEMPORARILY FLOODED FOREST ALLIANCE

Box-elder Temporarily Flooded Forest Alliance

ALLIANCE CONCEPT

Environment: These forests are common on large rivers in the active floodplain and on sandbars, and may form farther from the riverfront following disturbance. These forests also occur in the Arkansas River Valley, with marginal examples on larger rivers in the Ouachita Mountains. These deciduous riparian forests occur from near sea level in the Southeast to over 2300 m in elevation in western Colorado. They are common on large rivers in the active floodplain and on sandbars, and may form farther from the riverfront following disturbance. They also occur within narrow, box canyons about 2-3 m above the channel bankfull level, in V-shaped ravines, on colluvial deposits, and on narrow, confined terraces where the stream channel has been downcut. Stream channels can be steep and narrow or moderately wide and sinuous (Hansen et al. 1995). Flooding frequency is usually infrequent, but *Acer negundo* is tolerant of prolonged flooding. Water tables are generally near the soil surface in the spring, but can commonly be below 1 m during dry periods. Soils are clay loams to sandy loams.

Vegetation: This alliance is widespread but sporadic in the southeastern United States, and occurs at scattered locations in the Western Great Plains, lower montane Rocky Mountains, and Intermountain West. It is made up of temporarily flooded forests dominated by *Acer negundo*. In the Southeast, characteristic species include *Platanus occidentalis, Acer rubrum, Celtis laevigata, Liquidambar styraciflua, Acer saccharinum, Ulmus alata, Ulmus rubra, Carpinus caroliniana, Morus rubra*, and *Populus deltoides*. The shrub and herb layers range from sparse to relatively lush, and the vine component often is heavy. Pure stands occur on the Mississippi River batture on second ridges with heavy vine cover by *Berchemia scandens* and *Vitis* spp.

In the western part of its range, this alliance is represented by deciduous broad-leaved riparian forests typically with an open to closed tree canopy (>60% canopy cover) to 20 m in height. Generally, these forests have a dense shrub layer with a sparse herbaceous layer. *Acer negundo* may dominate the tree canopy or may codominate with *Populus angustifolia, Populus deltoides, Populus fremontii*, or *Salix amygdaloides* depending on the geographic region and age of the stand. Other tree species that may be present include *Acer grandidentatum, Juglans major, Fraxinus americana*, or *Fraxinus pennsylvanica*. The shrub canopy is often a nearly impenetrable thicket dominated by *Prunus virginiana* or *Cornus sericea*. Other shrub species are occasionally present, including *Alnus incana, Betula occidentalis, Crataegus rivularis, Amorpha fruticosa, Celtis laevigata var. reticulata (= Celtis reticulata), Rosa woodsii, Salix exigua*, or *Salix lutea*. Woody vines commonly present include *Clematis ligusticifolia, Vitis arizonica, Parthenocissus quinquefolia (= Parthenocissus inserta)*, or *Toxicodendron radicans*. The herbaceous layer is diverse but moderately sparse due to the intense shading of the shrub layer. Perennial forbs are the most abundant species, including *Cirsium* spp., *Rudbeckia laciniata, Solidago gigantea*, and *Maianthemum stellatum*, which is the most consistently present. Most of the graminoid species present are introduced 'hay' species, but a few native species are present in small amounts, including *Carex hoodii, Carex pellita (= Carex lanuginosa), Carex microptera*, and *Poa palustris*. Adjacent vegetation may be forest, woodland, shrubland, or grassland depending upon the geographic region.

Dynamics: In the Southeast, forests dominated by *Carya illinoinensis* often succeed these forests. The rangewide occurrence of this type is complicated by the 'weedy' nature of *Acer negundo*. For example, disturbed stands in the (A.286) often become dominated by *Acer negundo*.

Hydrologic regimes and disturbance are important factors in the ecological functions of these systems. In the Rocky Mountains, many stands of this alliance are composed of large, mature cottonwood and box-elder trees. Channel migration and meander movement along these rivers result in stands being immediately adjacent to, but 1-3 m above, the channel. Only along actively flooding rivers, with an unaltered flood regime and depositional features such as point bars, will seedlings of cottonwood become established and possibly develop into stands of this alliance. Little information is available on the regeneration requirements of box-elder. Also, the dominance of *Acer negundo* varies with the stand age. In mid-seral stages, *Acer negundo* is often subdominant to *Populus* spp. until the *Populus* decline with age. Then *Acer negundo* becomes dominant in late-seral stages.

Disturbance from grazing can greatly impact the density and composition of the understory as well as the density of the tree canopy cover. Moderate grazing reduces the abundance of the shade-tolerant herbaceous layer and reduces tree regeneration. Damage to saplings and poles and reductions in regeneration results in an opening up

of the tree canopy. Understory shrub and herbaceous species composition shifts to shade-intolerant species such as *Symphoricarpos* spp. and *Poa pratensis*. Continued heavy grazing will result in conversion from a forest type.

ALLIANCE SOURCES

Authors: D.J. ALLARD, MOD. D. CULV, MP, Southeast **Identifier:** A.278
References: Evans 1991, Faber-Langendoen et al. 1996, Foti 1994b, Foti et al. 1994, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, Hoagland 1997, Hoagland 1998a, Jones and Walford 1995, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1999a, Padgett et al. 1989, Richard et al. 1996, Szaro 1989, Youngblood et al. 1985a

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ACER NEGUNDO / PRUNUS VIRGINIANA FOREST

Box-elder / Choke Cherry Forest

ELEMENT CONCEPT

Environment: This community is found in mesic situations, usually near streams or rivers or broad alluvial floodplains at warm elevations (CONHP pers. comm. 1998).
Vegetation: This is an early successional community dominated by *Acer negundo*. *Populus deltoides* may also be present. Tree density may be moderate to high. Shrubs are common and vary from short (<1 m) to tall (>2 m). *Prunus virginiana* and *Cornus sericea (= Cornus stolonifera)* are common. At Wind Cave National Park, these woodlands vary in composition, with *Acer negundo* usually present, but *Prunus virginiana* frequently absent. Tree cover typically is in the 10-25% range. Other tree species may be present or even common, including *Ulmus americana, Quercus macrocarpa, Fraxinus pennsylvanica*, and *Populus deltoides*. Total shrub cover (tall and short shrubs) is often greater than 50%. Common species, in addition to *Prunus virginiana*, include *Rhus trilobata, Symphoricarpos occidentalis, Ribes aureum* and *Toxicodendron pubescens*. Herbaceous cover is variable, but usually less than 50%. Species composition also varies; common species include *Poa pratensis, Monarda fistulosa* and *Apocynum cannabinum* (Hollis Marriott pers. comm. 1999). In Colorado, dense thickets of *Prunus virginiana* may occur. When left undisturbed, the shrub canopy can be very thick and nearly impenetrable. However, many stands in Colorado are in severely degraded states with very sparse shrub canopies (CONHP pers. comm. 1998).
GRank & Reasons: G3 (96-02-01).

ELEMENT DISTRIBUTION

Range: This riparian forest grows on broad alluvial floodplains at warm elevations in the western and northern Great Plains of the United States, ranging from Colorado to Montana.
Nations: US
States/Provinces: CO:S2, MT:S3, SD:S?, WY:S2S3

ELEMENT SOURCES

Authors: J. Drake, mod. H. Marriott, WCS **Confidence:** 1 **Identifier:** CEGL000628
References: Bourgeron and Engelking 1994, Driscoll et al. 1984, Hansen et al. 1991, Hansen et al. 1995, Kittel et al. 1994, Kittel et al. 1999a

POPULUS DELTOIDES TEMPORARILY FLOODED FOREST ALLIANCE

Eastern Cottonwood Temporarily Flooded Forest Alliance

ALLIANCE CONCEPT

Environment: Stands of this alliance are found primarily along riverfronts, where they develop on bare, moist soil on newly formed sand bars, front-land ridges, low streambanks, overflow areas, and well-drained flats along major streams, rivers and lake margins. Stands can also be found on abandoned fields and well-drained ridges in the first bottoms. These sites tend to be further from the main channel. Elevations range from 600 m in Montana to 1300 m in Colorado. Soils are formed in alluvium, are deep, medium-textured, and with adequate or excessive moisture available for vegetation during the growing season. Typically, the soil profile is highly stratified, but with distinct soil development (B) layers. Textures are predominately loose, friable sands interspersed with narrow bands of clay loams and sandy clays.
Vegetation: This alliance, found throughout the central Midwest and Southeast of the United States, contains riverfront floodplain forests. The tree canopy is tall (to 30 m) and dominated by *Populus deltoides* and *Salix nigra*, although *Fraxinus pennsylvanica, Acer negundo, Acer rubrum, Acer saccharinum, Platanus occidentalis*, and *Ulmus americana* are also commonly encountered in various parts of this alliance's range. Tree diversity is limited due to

the dynamics of flooding and deposition/scouring of sediments. The shrub layer is often sparse, but species such as *Salix exigua, Carpinus caroliniana, Lindera benzoin, Cornus drummondii, Cornus sericea* and, in the southeastern United States, *Ilex vomitoria, Ilex opaca var. opaca*, and *Forestiera acuminata* can be found. Herbaceous growth can be thick and lush but is often patchy and sparse due to frequent inundation. Herbaceous species found throughout the range of this alliance are not well known, but in parts of the range, species can include *Carex* spp., *Leersia oryzoides, Bidens* spp., Asteraceae spp., *Eragrostis hypnoides, Lipocarpha micrantha, Rumex maritimus, Potentilla paradoxa*, and, more commonly in the Southeast, *Leptochloa panicea ssp. mucronata (= Leptochloa mucronata)* and *Mikania scandens*.

Dynamics: Cottonwood forests grow within an alluvial environment that is continually changing due to the ebb and flow of the river. Riparian vegetation is constantly being 're-set' by flooding disturbance. Cottonwood communities are early, mid- or late-seral, depending on the age class of the trees and the associated species of the stand. Mature cottonwood stands do not regenerate in place, but regenerate by 'moving' up and down a river reach. Over time, a healthy riparian area supports all stages of cottonwood communities. The process of cottonwood regeneration is well documented. Periodic flooding events can leave sandbars of bare, mineral substrate. Cottonwood seedlings germinate and become established on newly-deposited, moist sandbars. In the absence of large floods in subsequent years, seedlings begin to trap sediment. In time, the sediment accumulates and the sandbar rises. The young forest community is then above the annual flood zone of the river channel.

In this newly elevated position, with an absence of excessive browsing, fire, or agricultural conversion, this cottonwood community can grow into a mature riparian forest. At the same time, the river channel continually erodes streambanks and creates fresh, new surfaces for cottonwood establishment. This results in a dynamic patchwork of different age classes, plant associations and habitats.

As cottonwoods mature, other tree species may become established. If the land surface is subject to reworking by the river, the successional processes will start over with erosion and subsequent flooding deposition. If the land surface is not subject to alluvial processes, for example on a high terrace, the cottonwoods will be replaced by upland shrub or tree species from adjacent areas.

ALLIANCE SOURCES

Authors: D.J. ALLARD, MOD. D. CULV, MP, Midwest **Identifier:** A.290

References: Allard 1990, Ambrose 1990a, Evans 1991, Eyre 1980, Faber-Langendoen et al. 1996, Foti 1994b, Foti et al. 1994, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, Hoagland 1998a, Klimas 1988b, MTNHP n.d., Oberholster 1993, Smith 1996a, TNC 1996b, Van Auken and Bush 1988, Vankat 1990, Voigt and Mohlenbrock 1964, Wieland 1994b

POPULUS DELTOIDES - FRAXINUS PENNSYLVANICA FOREST

Eastern Cottonwood - Green Ash Forest

ELEMENT CONCEPT

Environment: This community occurs along rivers and streams and around ponds and lakes. The soils are developed from alluvium. In southwest North Dakota, Girard et al. (1989) found this community on silty clay loam, clay loam, clay, and loam. The soils were alkaline. Johnson (1971) found sandy loams, loamy sands, and silty clays along the Missouri River.

Vegetation: This community is a riparian forest with and open to closed canopy dominated by deciduous trees. Girard et al. (1989) sampled two stands in southwestern North Dakota that had an average of 293 trees/ha. Hansen et al. (1984) sampled four stands that had an average basal area of 41 m2/ha and 427 trees/ha. They found that the average cover by strata was shrubs 76.8%, graminoids 64.2%, and forbs 43.5%. *Populus deltoides* and *Fraxinus pennsylvanica* are the most abundant mature trees. *Acer negundo, Salix amygdaloides*, and *Juniperus scopulorum* may also be present in the tree layer. This community is seral and in younger stands *Populus deltoides* is the dominant, but as stands age *Fraxinus pennsylvanica* becomes more prominent until the stand becomes a different community. The closed canopy leads to poor reproduction by *Populus deltoides* in stands of all ages. The shrub layer is often vigorous. Species such as *Rosa woodsii, Symphoricarpos occidentalis, Juniperus scopulorum, Juniperus communis*, and *Cornus sericea ssp. sericea* can be abundant. The composition of the herbaceous layer is variable. Along the Missouri River, Keammerer (1972) found *Poa pratensis* to be the most prevalent species, with *Amphicarpaea bracteata, Bromus inermis*, and *Elymus virginicus* common. *Carex* spp., *Juncus* spp., *Leymus cinereus, Lysimachia ciliata, Thalictrum venulosum*, and *Elymus canadensis* are common. Weedy species are almost ubiquitous, among them *Poa* spp., *Bromus inermis, Melilotus officinalis, Ambrosia* spp., and *Urtica* spp.

Dynamics: The species dominating this community are pioneers of bare soil. The community is sometimes considered a 'postclimax' type that exists in otherwise arid areas because of groundwater along streams and rivers. It is often subject to flooding, deterioration during periodic droughts, and destruction by herbicides, after which it reappears following natural seeding. In the southern portion of its range, cottonwood-willow forests on river bottomlands often contain an understory of *Juniperus virginiana* that has developed as a result of seed dissemination by birds from individuals in windbreak plantings on adjacent uplands. This conifer component may be gradually altering the type.

Similar Associations:

- Populus deltoides / Cornus sericea Forest (CEGL000657)--shares species.
- Populus deltoides / Juniperus scopulorum Woodland (CEGL002152)--similar in the western part of the *Populus deltoides - Fraxinus pennsylvanica* Forest (CEGL000658) range; considered to be a earlier seral stage found on younger sites. Similar in central South Dakota; develops on terraces that no longer flood, thereby allowing the juniper to invade.
- Fraxinus pennsylvanica - (Ulmus americana) / Symphoricarpos occidentalis Forest (CEGL002088)--This type may represent a later successional stage, or it occurs on smaller rivers.

GRank & Reasons: G2G3 (00-02-27). The total number of occurrences is unknown. Three have been documented in Nebraska, where the community is ranked S3. Although no other occurrences have been documented, the community is also reported from Montana and may occur in North Dakota (SP), South Dakota (SP), and Saskatchewan (SP). It occurs in nine northern Great Plains ecoregional sections. The community is found on a variety of soils along streams and rivers and around ponds and lakes.

Comments: In North and South Dakota, woodland cottonwood types may only occur in the western half of the state, e.g., *Populus deltoides / Juniperus scopulorum* Woodland (CEGL002152), where such species as *Celtis occidentalis* do not occur. Further comparisons are needed between these stands and those in Nebraska, which may contain a different set of species.

ELEMENT DISTRIBUTION

Range: This cottonwood - green ash riparian forest community occurs throughout the northern and central Great Plains of the United States and adjacent Canada, ranging from the Dakotas northwest to Montana and Saskatchewan, and south to Nebraska.

Nations: CA? US

States/Provinces: MB?, MT:S2Q, ND:S?, NE:S?, SD:S?, SK?

ELEMENT SOURCES

Authors: D. Faber-Langendoen, MCS **Confidence:** 3 **Identifier:** CEGL000658

References: Driscoll et al. 1984, Eyre 1980, Girard 1985, Girard et al. 1989, Hansen et al. 1984, Hansen et al. 1990, Johnson 1971, Johnston 1987, Keammerer 1972, MTNHP n.d., South Dakota Geological Survey n.d., Steinauer and Rolfsmeier 2000

POPULUS DELTOIDES / CORNUS SERICEA FOREST

Eastern Cottonwood / Red-osier Dogwood Forest

ELEMENT CONCEPT

Summary: This association is found in the Great Plains of central and eastern Montana, southern Alberta, southern Saskatchewan, and possibly western North Dakota, generally between 550 and 1100 m in elevation. It occurs primarily in the floodplains of major alluvial streams and rivers but may also occur around the margins of lakes and ponds. This is a seral community associated with fluvial processes such as flooding and substrate deposition. It colonizes moist, freshly deposited alluvium and in the absence of further flood disturbance will often develop into *Fraxinus pennsylvanica*- or *Acer negundo*-dominated associations. *Populus deltoides* dominates the overstory, forming an open to closed canopy (average cover is 60%). *Populus balsamifera ssp. trichocarpa, Populus angustifolia*, and *Salix amygdaloides* may be present as subordinate canopy species. The shrub layer is diverse and well-established. *Cornus sericea* is the diagnostic species, and its cover value may vary from 1-90%. Other common shrubs are *Prunus virginiana, Salix lutea, Symphoricarpos occidentalis*, and *Rosa woodsii*. Exotic grasses, such as *Bromus inermis* and *Elymus repens (= Elytrigia repens)*, often dominate the herbaceous layer. Common native herbaceous species include *Pascopyrum smithii, Glycyrrhiza lepidota, Maianthemum stellatum*, and *Solidago canadensis*.

Similar Associations:
- Populus deltoides / Symphoricarpos occidentalis Woodland (CEGL000660)

GRank & Reasons: G2G3 (00-12-19). This riparian forest association is ranked G2G3 because it has a relatively restricted range, narrow ecological amplitude, and is highly susceptible to grazing disturbance. Stands are restricted to the northern portion of the Northern Great Plains Steppe ecoregion of eastern Montana, southern Alberta, southern Saskatchewan, and probably western North Dakota. It is a seral community associated with fluvial processes, and it occurs primarily on alluvial terraces along major rivers. Although only a few occurrences are documented, most of its range has not been surveyed. It is likely that livestock grazing has impacted most occurrences of this community. In many *Populus deltoides* stands the native shrub component has been removed and the understory is dominated by exotic grasses. Improper grazing by livestock continues to threaten these riparian forests, as does competition with exotic graminoids, such as *Bromus inermis*, and woody species, such as *Elaeagnus angustifolia* and *Tamarix chinensis*.

Comments: Hansen et al. (1995) base their description of this community on 11 plots. However, only six of these plots would key to *Populus deltoides / Cornus sericea* Forest (CEGL000657). Godfrey et al. (2000) documented an additional 11 plots in Alberta and Saskatchewan, Canada. This community is delimited from *Populus deltoides / Symphoricarpos occidentalis* Woodland (CEGL000660) by the presence of *Cornus sericea* at a cover value greater than 1% (Hansen et al. 1995). *Cornus sericea* is a very palatable shrub, and Hansen et al. (1995) contend that mature stands of *Populus deltoides* that lack or only have trace amounts of *Cornus sericea* cover are grazing disclimaxes. While grazing is certainly an important influence, it is unclear from their research how other factors, such as soils or depth to groundwater, might influence the distribution of *Cornus sericea*.

ELEMENT DISTRIBUTION

Range: This community is restricted to the northern portion of the Northern Great Plains Steppe ecoregion of eastern Montana, southern Alberta, southern Saskatchewan, and probably western North Dakota, where it occurs primarily on alluvial terraces along major rivers.

Nations: CA US

States/Provinces: AB:S?, MT:S2S3, ND?, SK:S?

ELEMENT SOURCES

Authors: M. Jones, WCS **Confidence:** 2 **Identifier:** CEGL000657

References: Bourgeron and Engelking 1994, Driscoll et al. 1984, Godfrey et al. 2000, Hansen et al. 1991, Hansen et al. 1995, MTNHP n.d.

II. WOODLAND

JUNIPERUS SCOPULORUM TEMPORARILY FLOODED WOODLAND ALLIANCE

Rocky Mountain Juniper Temporarily Flooded Woodland Alliance

ALLIANCE CONCEPT

Environment: Vegetation types within this alliance may occur throughout low to mid-montane areas in the western United States. Stands in Colorado typically are limited to a distinct band at the high-water mark of gently meandering, moderate-gradient stream channels having little to moderate floodplain development. In Montana, communities form either a narrow band along streams of V-shaped canyons, or relatively broad stands on older alluvial terraces of floodplains of major streams or rivers such as along the upper Yellowstone River and lower Madison River. Elevation ranges from 1170 m in Montana to 2800 m in Utah. These woodlands are intolerant of frequent and prolonged flooding; however, they are tolerant of periodic flooding and high water tables. Typically, the soils are shallow, derived from coarse alluvial substrates. Soil textures are sandy clay loams to sandy loams with a high percentage of coarse fragments.

Dry woodlands dominated by *Pinus edulis* and *Juniperus monosperma* occupy south-facing slopes. *Pinus ponderosa* may also occur on adjacent hillslopes.

Vegetation: Vegetation in this woodland alliance has a tree canopy dominated by *Juniperus scopulorum* with typically 25-60% canopy cover. A sparse to moderately dense emergent-tree stratum (0-60% cover) is usually present, and is composed of *Populus angustifolia, Populus deltoides*, or *Populus balsamifera ssp. trichocarpa (= Populus trichocarpa)*. Shrub species that may be present include up to 60% cover of *Cornus sericea*. Typically shrub cover ranges from 10-25%. Shrub composition can include any of the following: *Amelanchier alnifolia, Rhus aromatica, Rosa woodsii*, or *Solanum dulcamara*. Herbaceous undergrowth occurs beneath the tree canopy as well

as on exposed point bars. The understory consists of native graminoids, including 10-25% cover each of *Piptatherum micranthum (= Oryzopsis micrantha), Panicum virgatum*, and the fern ally *Equisetum arvense*. Forb cover is sparse (10-25%) and can include *Glycyrrhiza lepidota, Apocynum androsaemifolium* or *Maianthemum stellatum (= Smilacina stellata)*. In some stands, both the forb and graminoid strata may be dominated by adventive, weedy species (Hansen et al. 1995, Kittel et al. 1999).
Dynamics: In riparian areas, *Juniperus scopulorum* generally occurs with *Populus angustifolia*. However, in narrow, V-shaped canyons and at the margins of older terraces, *Juniperus scopulorum* can occur as the single dominant tree species. *Populus angustifolia - Juniperus scopulorum* Woodland (CEGL002640) may convert to *Juniperus scopulorum* as *Populus angustifolia* dies and does not regenerate. Therefore, the dominance of *Juniperus scopulorum* indicates a late seral stage of a riparian community (Hansen et al. 1995). *Juniperus scopulorum / Cornus sericea* Woodland (CEGL000746) occurs as older, relict stands along the Colorado River on streambanks and terraces approximately 2 m above the active stream channel (Kittel et al. 1999).

ALLIANCE SOURCES

Authors: D. CULVER, MOD. K.A. SCHU, West **Identifier:** A.563
References: Hansen et al. 1991, Hansen et al. 1995, Kittel et al. 1994, Kittel et al. 1996, Kittel et al. 1999a, Welsh et al. 1987

JUNIPERUS SCOPULORUM / CORNUS SERICEA WOODLAND
Rocky Mountain Juniper / Red-osier Dogwood Woodland

ELEMENT CONCEPT

Summary: In Colorado, this riparian woodland is common along desert streams and arroyos, and can occur on upper terraces with *Populus angustifolia - Juniperus scopulorum* woodlands on the lower floodplain. Stands have an open tree canopy of *Juniperus scopulorum* with an occasional upland species, such as *Juniperus monosperma*. The understory contains a few shrubs, such as *Cornus sericea*, and little herbaceous growth. Information on stands that occur outside Colorado will be added later.
GRank & Reasons: G4 (96-02-01).

ELEMENT DISTRIBUTION

Nations: US
States/Provinces: CO:S2, MT:S4

ELEMENT SOURCES

Authors: WCS **Confidence:** 1 **Identifier:** CEGL000746
References: Bourgeron and Engelking 1994, Driscoll et al. 1984, Hansen et al. 1991, Hansen et al. 1995, Kittel et al. 1994, Kittel et al. 1996, Kittel et al. 1999a

SALIX AMYGDALOIDES TEMPORARILY FLOODED WOODLAND ALLIANCE
Peachleaf Willow Temporarily Flooded Woodland Alliance

ALLIANCE CONCEPT

Environment: The vegetation in this alliance occurs in riparian habitats in the Columbia Basin, Rocky Mountains, northern Great Plains, and northeastern Utah. Stands are located in backwater areas and overflow channels of large rivers, on narrow floodplains of small creeks, and on the edges of ponds and lakes. Stands are found between 500 and 1800 m elevation. Stands occur on a wide range of soil textures with the exception of clay. Soils are classified predominantly as Entisols (Fluvents) or Mollisols (Borolls). The water table is within 1 m of the soil surface during the growing season (Hansen et al. 1995), and the vegetation is tolerant of prolonged flooding. Adjacent riparian vegetation includes *Acer negundo, Fraxinus pennsylvanica*, and *Populus deltoides* woodlands and *Schoenoplectus pungens* and *Typha latifolia* herbaceous communities.
Vegetation: The vegetation in this alliance occurs in riparian habitats in the Columbia Basin, Rocky Mountains, northern Great Plains, and northeastern Utah. Stands are located near the active channel of large rivers and small creeks, and on the edges of ponds and lakes. The overstory canopy is moderately open and dominated by the small tree *Salix amygdaloides*. *Acer negundo, Populus angustifolia, Populus deltoides*, and *Populus fremontii* may be present with low cover values. One or more willow species may occur in the shrub canopy, including *Salix ligulifolia (= Salix eriocephala var. ligulifolia), Salix exigua, Salix lucida ssp. caudata*, and *Salix lutea*. The

herbaceous layer is generally dominated by exotic species. *Bromus inermis, Cirsium arvense, Melilotus officinalis (= Melilotus albus)*, and *Poa pratensis* are the most common non-native species present. *Carex pellita (= Carex lanuginosa), Glycyrrhiza lepidota, Pascopyrum smithii, Poa palustris*, and the invasive native *Phalaris arundinacea* are the most common native associates.
Dynamics: *Salix amygdaloides* is an early-seral species that requires a moist, mineral substrate for seeds to germinate. Seeds can germinate under a sparse canopy of vegetation (Johnson 1992 in Jones and Walford 1995).

ALLIANCE SOURCES

Authors: M. DAMM, West **Identifier:** A.645
References: Faber-Langendoen et al. 1996, Hansen et al. 1991, Hansen et al. 1995, Hinschberger 1978, Jones and Walford 1995, Kittel et al. 1996, Moseley et al. 1992, Welsh et al. 1987

SALIX AMYGDALOIDES WOODLAND
Peachleaf Willow Woodland

ELEMENT CONCEPT

Summary: The peachleaf willow woodland type is found in the Northern Rocky Mountains, and possibly into parts of the western Great Plains. Stands occur in riparian areas. The vegetation is dominated by *Salix amygdaloides*.
GRank & Reasons: G3 (96-02-01).
Comments: In the Black Hills, Peachleaf Willow Woodland has been documented from a single site, along Iron Creek near its confluence with Spearfish Creek. In this stand, peachleaf willow (*Salix amygdaloides*) forms a tall-shrub stratum with Bebb willow (*Salix bebbiana*) and red-osier dogwood (*Cornus sericea*). Stands occur as intermittent patches in a narrow zone along the creek. The overall size is less than 0.5 acre, and peachleaf willow forms a shrubland rather than a woodland. The very limited extent of the type and its atypical structure suggest that Peachleaf Willow Woodland may not be a valid type for the area (Marriott and Faber-Langendoen 2000).

ELEMENT DISTRIBUTION

Range: The peachleaf willow woodland type is found in the Northern Rocky Mountains, ranging from Idaho to Montana and possibly into parts of the western Great Plains.
Nations: US
States/Provinces: ID:S2, MT:S3, SD?, WY?

ELEMENT SOURCES

Authors: WCS **Confidence:** 1 **Identifier:** CEGL000947
References: Bourgeron and Engelking 1994, Driscoll et al. 1984, Hansen et al. 1991, Hansen et al. 1995, Marriott and Faber-Langendoen 2000, Moseley et al. 1992

III. SHRUBLAND

ARTEMISIA CANA TEMPORARILY FLOODED SHRUBLAND ALLIANCE
Silver Sagebrush Temporarily Flooded Shrubland Alliance

ALLIANCE CONCEPT

Environment: These shrublands occur throughout the northern half of the Intermountain West, usually at middle elevations (1000-2500 (3000) m), and into the northern Great Plains at 500-1000 m in elevation. Across the range of the alliance there is great variation in precipitation, with less than 25 cm in semi-arid basins of the western Great Basin. In the northwestern Great Plains this alliance is found on flat alluvial deposits on floodplains, terraces or benches, or alluvial fans. The soils are moderately deep to deep and either silt loam, clay loam, or sandy loam. Flooding may occur periodically and this tends to retard soil development. In the northern Great Basin (Oregon) stands are found in playas on sites that are flooded for several months during the winter and early spring but which rapidly dry up as the weather warms. Soils are saline. In more saline soils at slightly lower elevations on the playa, *Artemisia cana / Eleocharis palustris* and *Eleocharis palustris* communities occur. In general, these communities show an affinity for mild topography, fine to somewhat coarse alluvial soils, and some source of subsurface moisture.
Vegetation: This vegetation is reported from the northwestern Great Plains and interior northwestern United States. In all stands, *Artemisia cana* is the dominant, and often, only shrub, but *Ericameria nauseosa (= Chrysothamnus*

nauseosus) is usually present. Other shorter shrubs may occur or even be common, including *Symphoricarpos occidentalis, Artemisia frigida, Rosa woodsii*, and *Gutierrezia sarothrae*. There is usually a well-developed graminoid layer, with cover often exceeding the cover of the shrub layer. The dominant species include *Pascopyrum smithii*, or *Poa secunda*. Other important grasses include *Distichlis spicata, Elymus elymoides, Nassella viridula, Hesperostipa comata (= Stipa comata), Bouteloua gracilis, Koeleria macrantha*, or *Eleocharis palustris*. Forbs are present but do not contribute much of the vegetation cover. Among the forbs that are typically found in Great Plains stands are *Achillea millefolium, Gaura coccinea, Sphaeralcea coccinea*, and *Lactuca tatarica var. pulchella*. In Oregon stands, forbs include *Lupinus argenteus, Trifolium gymnocarpon, Astragalus lentiginosus, Polyctenium fremontii*, and *Camissonia tanacetifolia*.

Dynamics: These communities occur in mild alluvial terrain which is often grazed by domestic livestock and is strongly preferred during the growing season (Padgett et al. 1988). Prolonged livestock use of these habitats can cause decreases in the abundance of native bunch grasses and increases in cover of shrubs and non-native species, such as *Poa pratensis*.

Artemisia cana resprouts vigorously following spring fire, and this method may serve to increase shrub coverage of stands. Conversely, fire in the fall may decrease shrub abundance (Hansen et al. 1995). Sarr (1995) noted that *Artemisia cana* was associated with higher floodplain terraces of alluvial meadows where the late summer water table averaged 0.8-1.5 m below the surface. Gully erosion of meadows led to an invasion of this type to formerly wet meadows. Comparisons of grazed and protected floodplain sites showed a tendency for *Artemisia cana* to occur more commonly in grazed than ungrazed habitats of the similar groundwater hydrology.

ALLIANCE SOURCES

Authors: D. SARR, West **Identifier:** A.843

References: Chappell et al. 1997, Faber-Langendoen et al. 1996, Hansen et al. 1984, Hansen et al. 1991, Hansen et al. 1995, Hanson and Whitman 1938, Johnston 1987, Manning and Padgett 1991, Manning and Padgett 1995, ORNHP unpubl. data n.d., Sarr 1995, USFS 1992

ARTEMISIA CANA / PASCOPYRUM SMITHII SHRUBLAND

Silver Sagebrush / Western Wheatgrass Shrubland

ELEMENT CONCEPT

Environment: This community occurs on flat alluvial deposits on floodplains, terraces or benches, or alluvial fans. The soils are moderately deep to deep (USFS 1992) and either silt loam, clay loam, or sandy loam (Johnston 1987, Hansen and Hoffman 1988). The soils may have moderate salt content (Hanson and Whitman 1938). Flooding occurs periodically and this tends to retard soil profile development (Hirsch 1985).

Vegetation: This community is dominated by a combination of shrubs and graminoids. The total vegetation cover is typically moderate, but depends on frequency of flooding. The tallest and most conspicuous stratum is a shrub layer that is usually 0.6-1.2 m (Hansen and Hoffman 1988). In 14 stands in western North Dakota shrubs averaged 28% canopy cover, graminoids 59%, and forbs 2% (USFS 1992). Stands in Nebraska often have less than 15% cover. The variation in soils within and between stands of this community results in variable species composition. *Artemisia cana* is the dominant shrub. *Symphoricarpos occidentalis* is frequently present. There are also shorter shrubs such as *Artemisia frigida, Krascheninnikovia lanata, Rosa woodsii*, and *Gutierrezia sarothrae*. The most abundant graminoid is *Pascopyrum smithii*. This species is typically 0.5-1.0 m tall. It is often accompanied by *Nassella viridula* and sometimes *Koeleria macrantha, Poa pratensis*, and *Hesperostipa comata (= Stipa comata)*. *Bouteloua gracilis* is the most abundant short graminoid. Typical forb constituents of this community are *Achillea millefolium, Gaura coccinea, Sphaeralcea coccinea*, and *Lactuca tatarica var. pulchella*.

Dynamics: Periodic flooding occurs in many stands of this community.

GRank & Reasons: G4 (96-02-01).

ELEMENT DISTRIBUTION

Range: This silver or coaltown sagebrush shrubland is found in the northwestern Great Plains and Rocky Mountains of the western United States, ranging from Montana and North Dakota, south to Nebraska.

Nations: US

States/Provinces: MT:S4, ND:S2S3?, NE:S?, SD:SU

ELEMENT SOURCES

Authors: J. Drake, WCS **Confidence:** 1 **Identifier:** CEGL001072

References: Bourgeron and Engelking 1994, Driscoll et al. 1984, Hansen and Hoffman 1988, Hansen et al. 1984, Hansen et al. 1991, Hansen et al. 1995, Hanson and Whitman 1938, Hirsch 1985, Johnston 1987, Nelson 1961, Steinauer and Rolfsmeier 2000, USFS 1992

TAMARIX SPP. SEMI-NATURAL TEMPORARILY FLOODED SHRUBLAND ALLIANCE

Salt-cedar species Semi-natural Temporarily Flooded Shrubland Alliance

ALLIANCE CONCEPT

Environment: The riparian shrublands included in this alliance occur across the western Great Plains, interior western and southwestern U.S., and northern Mexico. These widespread shrublands are common along larger streams, rivers, and around playas. Elevation ranges from 75 m below sea level to 1860 m. *Tamarix* spp. have become naturalized in various sites, including riverbanks, floodplains, basins, sandbars, side channels, springs, salt flats, and other saline habitats. Stands grow especially well along regulated rivers where flood-regenerated native species of *Populus* are declining. Substrates are commonly thin sandy loam soil over alluvial deposits of sand, gravel or cobbles.

Vegetation: This semi-natural shrubland alliance occurs along streams, rivers and playas where it forms a moderate to dense tall-shrub layer that is solely or strongly dominated by species of *Tamarix* including *Tamarix ramosissima, Tamarix chinensis, Tamarix gallica*, and *Tamarix parviflora*. Other shrubs may include species of *Salix* (especially *Salix exigua*) and *Prosopis, Rhus trilobata*, and *Sarcobatus vermiculatus*, but with low cover (if shrub species are codominant, then stand is classified as a natural shrubland). Scattered *Acer negundo, Salix amygdaloides, Populus* spp., or *Elaeagnus angustifolia* trees may also be present. Depending on stand age and density of the shrub layer, an herbaceous layer may be present. Associated species include *Distichlis spicata, Sporobolus airoides*, and introduced forage species such as *Agrostis gigantea, Agrostis stolonifera*, and *Poa pratensis*. Introduced herbaceous species such as *Polypogon monspeliensis, Conyza canadensis, Lepidium latifolium*, and others have been reported from shrublands in this association. *Tamarix* spp. have become a critical nuisance along most large rivers in the semi-arid western U.S. and, because of the difficulty to remove, may have irreversibly changed the vegetation along many rivers.

Dynamics: *Tamarix* spp. are highly competitive shrubs that have invaded many riparian and wetland environments in the western U.S. Hansen et al. (1995) report that these shrubs are extremely drought- and salt-tolerant, produce prolific wind-dispersed seeds over much of the growing season, can resprout after burning or cutting, and, if kept moist, buried or broken branches will develop adventitious roots and grow. Stands seem to favor disturbed and flow-regulated rivers, but establish well in pristine areas, too. Under optimum conditions riparian areas can be converted to a dense thicket in less than 10 years (Hansen et al. 1995). Once established, stands are extremely difficult to eradicate, requiring cutting and herbicide application on stumps to prevent resprouting (Smith 1989).

ALLIANCE SOURCES

Authors: M.S. REID, MOD. K.A. SCHU, JT, West **Identifier:** A.842

References: Brown 1982, Campbell and Dick-Peddie 1964, Dick-Peddie 1993, Hansen et al. 1995, Hefley 1937, Hoagland 1998a, Holland 1986b, Little 1996, Muldavin et al. 2000a, Nachlinger and Reese 1996, Paysen et al. 1980, Powell 1988b, Sawyer and Keeler-Wolf 1995, Smith 1989, Szaro 1989, U.S. Bureau of Reclamation 1976, Von Loh et al. 2002

TAMARIX SPP. TEMPORARILY FLOODED SHRUBLAND

Salt-cedar species Temporarily Flooded Shrubland

ELEMENT CONCEPT

Environment: These widespread shrublands are common along larger streams, rivers, and around playas in the western U.S. and Mexico. Elevation ranges from 75 m below sea level to 1860 m. *Tamarix* spp. have become naturalized in various sites including riverbanks, floodplains, basins, sandbars, side channels, springs, salt flats, and other saline habitats. Stands grow especially well along regulated rivers where flood-regenerated native species like *Populus* are declining. Substrates are commonly thin sandy loam soil over alluvial deposits of sand, gravel or cobbles.

Vegetation: This semi-natural shrubland occurs along streams, rivers and playas where it forms a moderate to dense tall-shrub layer that is solely or strongly dominated by species of *Tamarix* including *Tamarix ramosissima, Tamarix chinensis, Tamarix gallica*, and *Tamarix parviflora*. Other shrubs may include species of *Salix* (especially *Salix exigua*) and *Prosopis, Rhus trilobata*, and *Sarcobatus vermiculatus* but with low cover (if shrub species are codominant then stand is classified as a natural shrubland). Scattered *Acer negundo, Salix amygdaloides, Populus* spp., or *Elaeagnus angustifolia* trees may also be present. Depending on stand age and density of the shrub layer, an herbaceous layer may be present. Associated species include *Distichlis spicata, Sporobolus airoides*, and introduced forage species such as *Agrostis gigantea, Agrostis stolonifera*, and *Poa pratensis*. Introduced herbaceous species such as *Polypogon monspeliensis, Conyza canadensis, Lepidium latifolium*, and others have been reported from shrublands in this association.
Dynamics: *Tamarix* spp. are highly competitive shrubs that have invaded many riparian and wetland environments in the western U.S. Hansen et al. (1995) report that these shrubs are extremely drought- and salt-tolerant, produce prolific wind-dispersed seeds over much of the growing season, can resprout after burning or cutting, and if kept moist, buried or broken branches will develop adventitious roots and grow. Stands seem to favor disturbed and flow-regulated rivers, but establish well in pristine areas, too. Under optimum conditions riparian areas can be converted to a dense thicket in less than 10 years (Hansen et al. 1995). Once established stands are extremely difficult to eradicate, requiring cutting with herbicide application on stumps to prevent resprouting (Smith 1989).
Similar Associations:
- Tamarix spp. - (Baccharis halimifolia) Shrubland (CEGL004918)

GRank & Reasons: GW (01-07-24).
Comments: *Tamarix* spp. Temporarily Flooded Shrubland (CEGL003114) is a broadly defined plant association that is composed of many diverse *Tamarix* spp.-dominated vegetation communities from a wide variety of environments. Muldavin et al. (2000a) described 8 community types that will be reviewed as possible USNVC associations.

ELEMENT DISTRIBUTION

Range: This semi-natural shrubland is found along drainages in the semi-arid western Great Plains, interior and southwestern U.S. and northern Mexico, from central and eastern Montana, south to Colorado, western Oklahoma and Texas, west to California.
Nations: MX US
States/Provinces: AZ:SW, CA:SW, CO:SW, MT:SW, MXCH:S?, MXCO:S?, MXSO:S?, NM:SW, NV:SW, OK:S?, TX:S?, UT:SW, WY?

ELEMENT SOURCES

Authors: K.A. Schulz, WCS **Confidence:** 2 **Identifier:** CEGL003114
References: Baalman 1965, Coles et al. 2003, Cowardin et al. 1979, Hansen et al. 1995, Hoagland 2000, Holland 1986b, Muldavin et al. 2000a, Nachlinger and Reese 1996, Ortenberger and Bird 1933, Paysen et al. 1980, Sawyer and Keeler-Wolf 1995, Smith 1989, Stevens and Shannon 1917, Szaro 1989, Ungar 1968, Von Loh et al. 2002, Ware and Penfound 1949

SALIX (EXIGUA, INTERIOR) TEMPORARILY FLOODED SHRUBLAND ALLIANCE

(Coyote Willow, Sandbar Willow) Temporarily Flooded Shrubland Alliance

ALLIANCE CONCEPT

Environment: Plant associations within this alliance are located on floodplains and gravel bars at an elevational range between 780 and 1760 m in the West, and at lower elevations (to below 100 m) in the midwestern and southeastern United States. These shrublands are found on open sandbars without canopy shading on larger, well-developed drainages and along larger sandy rivers, or on coarser-textured substrates. They are associated with annual flooding and inundation and will grow well into the channel, where it is flooded, even in drier years. Even though flooding is frequent, surface water is not present for much of the growing season and the water table is well below the surface. Some stands form large, wide stands on mid-channel islands on larger rivers, or narrow stringer bands on small, rocky tributaries. Stream reaches range widely from moderately sinuous and moderate-gradient

reaches to broad, meandering rivers with wide floodplains or broad, braided channels. Many stands also occur within highly entrenched or eroding gullies.

Soils of this alliance are typically coarse alluvial deposits of sand, silt and cobbles that are highly stratified with depth from flooding scour and deposition. The stratified profiles consist of alternating layers of clay loam and organic material with coarser sand or thin layers of sandy loam over very coarse alluvium. Occasionally, stands may occur on deep pockets of sand. The pH of the substrate ranges from 6.0-6.8 (Johnson 1987).

In the West, adjacent upland plains communities include agricultural fields and rolling hills of *Artemisia filifolia*, xeric tall-grass prairies and *Bouteloua gracilis* shortgrass prairies. In the steep canyons of the foothills, upslope vegetation includes *Pseudotsuga menziesii* and *Pinus ponderosa* forests, *Pinus edulis* and *Juniperus* spp. woodlands, oak, sagebrush, and greasewood scrub. In the lower montane, upslope vegetation includes *Pinus contorta* and *Populus tremuloides* forests.

Vegetation: Plant associations within this alliance are characterized as temporarily flooded cold-deciduous shrubland dominated by *Salix exigua* or *Salix interior*. The tall-shrub layer has 15-90% cover, ranging in height between 2-5 m. Other willows can occur in the canopy including *Salix eriocephala, Salix lutea, Salix ligulifolia* and *Salix monticola*. Occasionally the taller *Salix amygdaloides* or *Populus deltoides* occur within the tree subcanopy. The herbaceous layer varies greatly over the broad range of the alliance. It has at least 20-35% cover of various graminoid species including *Carex nebrascensis, Carex pellita (= Carex lanuginosa), Spartina pectinata, Phalaris arundinacea, Equisetum arvense, Panicum bulbosum*, and *Muhlenbergia rigens*. The forb cover is usually sparse. The understory can be dominated by barren ground or gravel bar. In Oklahoma, some associates can include *Cephalanthus occidentalis, Eupatorium serotinum, Panicum virgatum, Parthenocissus quinquefolia, Pluchea odorata, Tamarix chinensis*, and *Vitis acerifolia* (Hoagland 2000).

Dynamics: This alliance represents an early seral primary successional stage on newly deposited sediments that may persist under a regime of repeated fluvial disturbance. *Salix exigua* and *Salix interior* are highly adapted to most forms of disturbance. Both species are prolific sprouters and will reestablish themselves on sites dominated by other disturbance associated species, e.g., *Glycyrrhiza lepidota* and *Pascopyrum smithii*.

ALLIANCE SOURCES

Authors: GREAT PLAINS PROGRAM 1-95, JT, West **Identifier:** A.947

References: Brown 1982, Brown et al. 1979, Christy 1973, Cooper and Cottrell 1990, Dick-Peddie et al. 1984, Dorn 1997, Evenden 1990, Faber-Langendoen et al. 1996, Foti et al. 1994, Hansen et al. 1989, Hansen et al. 1991, Hansen et al. 1995, Hoagland 1998c, Hoagland 2000, Johnston 1987, Jones and Walford 1995, Kagan 1997, Kittel 1994, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1996, Kittel et al. 1999a, Kovalchik 1987, Muldavin et al. 1993a, Muldavin et al. 1994a, Muldavin et al. 2000a, Myhre and Clements 1972, Padgett et al. 1988b, Padgett et al. 1989, Phillips 1977, Sawyer and Keeler-Wolf 1995, Shelford 1954, Tuhy and Jensen 1982, Youngblood et al. 1985a

SALIX EXIGUA TEMPORARILY FLOODED SHRUBLAND

Coyote Willow Temporarily Flooded Shrubland

ELEMENT CONCEPT

Environment: This community is found on recently deposited or disturbed alluvial material. The parent material is alluvial sand, although silt, clay, or gravel may be present. Soil development is poor to absent.

Vegetation: This community is dominated by shrubs, generally between 2 and 4 m tall. The most common of these is *Salix exigua* (*Salix interior* or intermediates of the two willow species may be present in the eastern part of the range). *Salix irrorata* and saplings of *Populus deltoides* or *Salix amygdaloides* are also frequently found in the shrub layer in lower elevation stands. This stratum can have moderate to high stem density in the community as a whole. The species in the shrub layer do not form a closed canopy, allowing significant light to reach the ground layer. There are often patches where the shrub layer is absent. The herbaceous cover is sparse to moderate, but rarely exceeds 30%. Older stands and places with less competition from the shrubs have greater herbaceous cover. The composition of the herbaceous layer can vary greatly. Species that are often found in this community are *Cenchrus longispinus, Polygonum lapathifolium, Schoenoplectus americanus (= Scirpus americanus), Triglochin maritima, Xanthium strumarium, Juncus balticus, Eleocharis palustris, Elymus repens (= Elytrigia repens), Poa pratensis, Phleum pratense, Agrostis scabra, Bromus inermis, Heracleum maximum, Achillea millefolium, Solidago* sp., *Equisetum arvense*, and *Linaria vulgaris*.

Dynamics: This type originates after flash floods that create new deposits or scour existing alluvial material. This community is a primary or early secondary community and requires floods to create new areas on which it can

develop. Once established, without further flooding disturbance and sediment deposition, this community may not exist for more than 10-20 years before it is replaced by a later seral stage.

Similar Associations:

- Salix exigua / Mesic Graminoids Shrubland (CEGL001203)--This type may be essentially the same, or this type is a later successional stage.
- Salix interior - Salix eriocephala Sandbar Shrubland (CEGL005078)--of the Great Lakes states/provinces.
- Salix interior Temporarily Flooded Shrubland (CEGL008562)--is a related type from the central states dominated by a different nominal *Salix* species.

GRank & Reasons: G5 (99-05-06). This type is widespread and common throughout its range.

Comments: This type may be an early successional shrubland that develops into *Salix exigua* / Mesic Graminoids Shrubland (CEGL001203), or the two types may be essentially synonymous. This plant association occupies a wide geographic range. The range of this type was reviewed and it was split into eastern, *Salix interior* Temporarily Flooded Shrubland (CEGL008562), and western components. The western stands may all be composed of *Salix exigua* (*sensu stricto*) and Great Plains stands may contain either *Salix exigua, Salix interior*, or intermediates of the two willow species, the *Salix interior* being an entirely Great Plains and eastwardly distributed species (Kartesz 1999).

ELEMENT DISTRIBUTION

Range: This willow shrubland community is found along rivers and streams at lower elevations throughout the northwestern United States and Great Plains, ranging sporadically from Oklahoma northwest to the Dakotas and Manitoba, and west to Washington. Part of this type's former range in the Great Plains and eastward is actually occupied, at least in part, by *Salix interior* [see *Salix interior* Temporarily Flooded Shrubland (CEGL008562)].

Nations: CA US

States/Provinces: CO:S?, ID:S3?, MB:S?, MT:S5, ND:S?, NE:S4S5, OK:S?, OR:S1, SD:S2, WA:S?, WY:S3Q

ELEMENT SOURCES

Authors: J.F. Drake, WCS **Confidence:** 1 **Identifier:** CEGL001197

References: Bellah and Hulbert 1974, Bourgeron and Engelking 1994, Driscoll et al. 1984, Evenden 1990, Foti et al. 1994, Hansen et al. 1989, Hansen et al. 1991, Hansen et al. 1995, Hoagland 1998c, Hoagland 2000, Kartesz 1999, Kittel and Lederer 1993, Kovalchik 1987, Phillips 1977, Steinauer 1989, Steinauer and Rolfsmeier 2000, Wilson 1970

SALIX LUTEA TEMPORARILY FLOODED SHRUBLAND ALLIANCE

Yellow Willow Temporarily Flooded Shrubland Alliance

ALLIANCE CONCEPT

Environment: Communities within this alliance occur on alluvial terraces adjacent to mountain rivers and streams. They occupy broad floodplains (0-6% slope), stream and river edges, ditches, seeps, and moist alluvial terraces. Elevations range from 1100-3600 m. Soils can range from Entisols to Mollisols. Soils on the alluvial terraces are usually a deep silt or sand. Stands adjacent to stream channels consist of a thin sandy loam overlying gravel or cobbles. These soils are saturated early in spring and often remain moist throughout the growing season. Adjacent upland communities include forests dominated by *Pinus contorta* and *Populus tremuloides*.

Vegetation: Vegetation types within this alliance are characterized as cold-deciduous, temporarily flooded shrublands. The tall-shrub canopy is continuous and dominated by *Salix lutea* with varying amounts of *Salix exigua, Salix bebbiana*, and *Salix boothii*. The short-shrub layer's cover is typically 25% or greater and consist of *Ribes aureum, Ribes inerme*, and *Rosa woodsii*. The graminoid layer ranges from sparse to dense percent cover. Major herbaceous species include *Calamagrostis canadensis, Carex utriculata, Calamagrostis stricta*, and *Carex microptera*.

Dynamics: If browsing pressure is heavy, willow coverages will decrease, resulting in more open communities. Grazing pressure by livestock will cause a decrease in the more desirable grasses with a corresponding increase in weedy species such as *Phleum pratense, Poa pratensis*, and *Agrostis stolonifera*.

ALLIANCE SOURCES

Authors: D. CULVER, West **Identifier:** A.980

References: Dorn 1997, Evenden 1990, Great Plains Flora Association 1986, Hansen et al. 1991, Hansen et al. 1995, Kagan 1997, Kartesz 1999, Kearney and Peebles 1969, Manning and Padgett 1992, Manning and Padgett 1995, Padgett 1982, Sawyer and Keeler-Wolf 1995

SALIX LUTEA / CALAMAGROSTIS CANADENSIS SHRUBLAND
Yellow Willow / Bluejoint Shrubland

ELEMENT CONCEPT

GRank & Reasons: G3? (96-02-01).

ELEMENT DISTRIBUTION

Nations: US
States/Provinces: MT:S3?, WY:S2

ELEMENT SOURCES

Authors: WCS **Confidence:** 2 **Identifier:** CEGL001219
References: Bourgeron and Engelking 1994, Driscoll et al. 1984, Hansen et al. 1991, Hansen et al. 1995

SHEPHERDIA ARGENTEA TEMPORARILY FLOODED SHRUBLAND ALLIANCE
Silver Buffaloberry Temporarily Flooded Shrubland Alliance

ALLIANCE CONCEPT

Environment: The vegetation in this alliance occurs in riparian habitats in the Rocky Mountains and in moist swales in the glaciated region of the northern Great Plains. It occurs where moisture is more plentiful than on the surrounding landscape, such as in swales, ravines, near streams, and on northwest- to east-facing slopes (Hansen and Hoffman 1988, DeVelice et al. 1995). This trend is more pronounced in Wyoming where Jones and Walford (1995) found this alliance only near streams and may be less pronounced in Saskatchewan and northern Montana. Stands are located on terraces above the floodplain of large rivers, on small and intermittent creeks, and on hillsides below springs or seeps in the Rockies and in moist depressions in rolling, prairie uplands. Stands are found between 500-1600 m elevation on the plains and in the northern Rockies and between 1950-2150 m in Colorado. Soils are classified predominantly as Entisols (Fluvents) or Mollisols (Borolls). Soil textures range from well-drained loamy sands to somewhat poorly drained silty clay loams and are derived from glacial drift, siltstone, or sandstone (USFS 1992, DeVelice et al. 1995). The vegetation is tolerant of brief flooding. Adjacent riparian vegetation includes *Acer negundo, Fraxinus pennsylvanica, Populus angustifolia, Populus deltoides*, and *Salix amygdaloides* woodlands and *Cornus sericea* and *Salix exigua* shrublands.
Vegetation: The vegetation in this alliance occurs in riparian habitats in the Rocky Mountains and moist swales in the northern Great Plains. *Shepherdia argentea* dominates the upper shrub canopy and occurs in small, open patches or in narrow bands parallel to a stream channel. *Symphoricarpos occidentalis* is often present in a lower shrub layer, and *Juniperus horizontalis, Prunus virginiana, Rhus aromatica, Ribes* spp., and *Rosa woodsii* occur in some stands. Native and exotic herbaceous species occur in the understory and form a sparse to dense ground cover. Grass species, such as *Bromus inermis, Bromus tectorum, Calamagrostis montanensis, Leymus cinereus, Pascopyrum smithii*, and *Poa pratensis*, and forbs, such as *Achillea millefolium, Cirsium arvense, Galium boreale, Maianthemum stellatum, Parietaria pensylvanica*, and *Solidago* spp. are present in different stands (Hansen and Hoffman 1988, USFS 1992). DeVelice et al. (1995) stated that stands in northeastern Montana were typically smaller than 0.1 ha.

ALLIANCE SOURCES

Authors: M. DAMM, West **Identifier:** A.960
References: DeVelice et al. 1995, Faber-Langendoen et al. 1996, Hansen and Hoffman 1988, Hansen et al. 1984, Hansen et al. 1988a, Hansen et al. 1991, Hansen et al. 1995, Jones and Walford 1995, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1999a, USFS 1992, Welsh et al. 1987

SHEPHERDIA ARGENTEA SHRUBLAND
Silver Buffaloberry Shrubland

ELEMENT CONCEPT

Environment: This community is found on stream terraces, rolling uplands, and badlands. It occurs where moisture is more plentiful than on the surrounding landscape, such as in swales, ravines, near streams, and on northwest- to east-facing slopes (Hansen and Hoffman 1988, DeVelice et al. 1995). This trend is more pronounced in Wyoming where Jones and Walford (1995) only found this community near streams, and it may be less pronounced in Saskatchewan and northern Montana. Soils are loamy sand, sandy loam, silty loam, or loam and are derived from

glacial drift, siltstone, or sandstone (USFS 1992, DeVelice et al. 1995). This community does not flood often, but some sites show evidence of a high water table (DeVelice et al. 1995).
Vegetation: The vegetation is dominated by a moderate to dense canopy of medium-tall shrubs. The most abundant of these, *Shepherdia argentea*, is typically 1.5-3 m tall. Other species commonly found in the shrub layer are *Juniperus horizontalis, Prunus virginiana, Ribes* spp., *Rhus aromatica, Rosa woodsii*, and *Symphoricarpos occidentalis*. Herbaceous species are not important in this community. Graminoids and forbs may have only half the coverage of the shrub layer (Hansen and Hoffman 1988, USFS 1992). Graminoids include *Poa pratensis, Pascopyrum smithii*, and *Bromus* spp. Common forbs are *Achillea millefolium, Artemisia ludoviciana*, and *Parietaria pensylvanica*. Litter may accumulate in this community (DeVelice et al. 1995).
Similar Associations:
- Fraxinus pennsylvanica - Ulmus americana / Prunus virginiana Woodland (CEGL000643)--The similarity is based on overall composition, but there are few *Fraxinus pennsylvanica* individuals in CEGL001128.

GRank & Reasons: G3G4 (96-02-01). The number of occurrences is unknown. The community is reported from Montana (where it is ranked S3?), Wyoming (?), Colorado (S1), Saskatchewan (S?), and possibly North Dakota (SP).

ELEMENT DISTRIBUTION

Range: This mesic buffaloberry shrubland community is found in the northern Great Plains of the United States and Canada, extending from Colorado northward to the Dakotas and Saskatchewan. This mesic shrubland community is found in the northern Great Plains on stream terraces, rolling uplands, and badlands.
Nations: CA US
States/Provinces: CO:S1, MT:S3?, ND:S?, SD:S?, SK:S?, WY:S?

ELEMENT SOURCES

Authors: J. Drake, WCS **Confidence:** 2 **Identifier:** CEGL001128
References: Bourgeron and Engelking 1994, DeVelice et al. 1995, Driscoll et al. 1984, Hansen and Hoffman 1988, Hansen et al. 1984, Hansen et al. 1991, Hansen et al. 1995, Jones and Walford 1995, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1999a, USFS 1992

SYMPHORICARPOS OCCIDENTALIS TEMPORARILY FLOODED SHRUBLAND ALLIANCE

Western Snowberry Temporarily Flooded Shrubland Alliance

ALLIANCE CONCEPT

Environment: The vegetation in this alliance occurs in riparian habitats in the northern Great Plains and in foothill canyons of the Rocky Mountains. Stands are located on terraces above the floodplain of large rivers, on small and intermittent creeks, and on hillsides below springs or seeps. Stands are found between 600-2000 m elevation. Soils are classified as Entisols (Fluvents) or Mollisols (Borolls). The soils are fertile and well-drained to imperfectly drained silts and loams (Johnston 1987, Jones and Walford 1995). The upper soil horizon is usually deep, although a thin layer of sand may be present if the site has been recently flooded (Jones and Walford 1995). Soil textures range from well-drained loamy sands to poorly drained silty clays. The upper soil horizon is relatively thick. The vegetation is tolerant of brief flooding. Adjacent riparian vegetation includes *Acer negundo, Fraxinus pennsylvanica, Populus deltoides*, or *Populus angustifolia* woodlands and *Alnus incana, Salix exigua*, and *Shepherdia argentea* shrublands.
Vegetation: The vegetation in this alliance occurs in riparian habitats in the northern Great Plains and in foothill canyons of the Rocky Mountains. Shrub cover is typically greater than 50%, and in places it can approach 100% (Hansen et al. 1984, Hansen and Hoffman 1988, Meyer 1985). *Symphoricarpos occidentalis* dominates the shrub canopy and occurs in large, thick patches or in narrow bands parallel to the stream channel. Dense thickets exclude other shrub species, but more open stands have *Prunus virginiana, Rhus aromatica*, and *Rosa* spp. Occasionally small trees are present, such as *Acer negundo, Fraxinus americana, Fraxinus pennsylvanica* or *Populus deltoides*. Native and exotic herbaceous species are present in the understory with sparse to moderate cover. Herbaceous species include *Achillea millefolium, Artemisia ludoviciana, Bromus inermis, Bromus tectorum, Cirsium arvense,*

Galium boreale, Glycyrrhiza lepidota, Pascopyrum smithii, and *Poa pratensis*. Woody vines sometimes occur, most commonly *Parthenocissus vitacea*. *Symphoricarpos occidentalis* shrublands often have a significant component of exotic species, especially where grazing has been intense (Hansen and Hoffman 1988, Jones and Walford 1995). *Bromus inermis, Cirsium arvense*, and *Poa pratensis* are the most abundant of these exotics. Overgrazing of prairies can lead to the expansion of degraded forms of this alliance.

Dynamics: *Symphoricarpos occidentalis* shrublands often have a significant component of exotic species, especially where grazing has been intense (Hansen and Hoffman 1988, Jones and Walford 1995). *Bromus inermis, Cirsium arvense*, and *Poa pratensis* are the most abundant of these exotics. Overgrazing of prairies can lead to the expansion of degraded forms of this alliance. Hansen et al. (1988) consider the presence of *Symphoricarpos occidentalis* to indicate a grazing induced community type. In Colorado and Wyoming, the presence of *Symphoricarpos occidentalis* seems to indicate a lack of grazing. There is a dramatic fence-line contrast between grazed and ungrazed areas along small creeks in the Pawnee National Grassland. On the grazed side of the fence, *Symphoricarpos occidentalis* is widely spaced and nearly hidden by the tall *Thinopyrum intermedium*. While on the ungrazed side of the fence, *Symphoricarpos occidentalis* and *Prunus virginiana* grow in thick, impenetrable stands (Kittel et al. 1996).

ALLIANCE SOURCES

Authors: M.S. REID, West **Identifier:** A.961

References: Christy 1973, Clark 1977b, Clark et al. 1980, Faber-Langendoen et al. 1996, Hansen and Hoffman 1988, Hansen et al. 1984, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, Johnston 1987, Jones and Walford 1995, Kittel et al. 1994, Kittel et al. 1996, Kittel et al. 1999a, Meyer 1985, Welsh et al. 1987

SYMPHORICARPOS OCCIDENTALIS SHRUBLAND

Western Snowberry Shrubland

ELEMENT CONCEPT

Environment: This community is found in mesic swales, depressions, ravines and floodplains. Some examples of this community experience intermittent and brief flooding. The soils are fertile and well-drained to imperfectly drained silts and loams. The upper soil horizon is usually deep, although a thin layer of sand may be present if the site has been recently flooded (Jones and Walford 1995).

Vegetation: Throughout its range this community is dominated by shrubs approximately 1 m tall. Shrub cover is typically greater than 50%, and in places it can approach 100%. These shrubs form dense clumps that exclude most other species. *Symphoricarpos occidentalis* is the most common shrub, but *Rhus aromatica* (or *Rhus trilobata*) and *Prunus virginiana* can be locally abundant and can grow to 2-3 m in places. *Toxicodendron rydbergii* may also be present. Herbaceous species and smaller shrubs are most abundant at the edges of this community and in gaps between the clumps of taller shrubs where the shading is less complete. *Rosa woodsii* is a typical smaller shrub. Common graminoids include *Pascopyrum smithii* and *Poa pratensis*. *Achillea millefolium, Artemisia ludoviciana, Galium boreale*, and *Solidago* spp. are common forbs of this community. Woody vines sometimes occur, including *Parthenocissus vitacea*.

Dynamics: Stands may occasionally be flooded (Jones and Walford 1995). *Symphoricarpos occidentalis* seems to thrive in disturbed areas (Hansen and Hoffman 1988), especially those subject to disturbance by fire and cattle grazing.

Similar Associations:

- Fraxinus pennsylvanica - Ulmus americana / Prunus virginiana Woodland (CEGL000643)--related in terms of habitat; floristically distinct.

GRank & Reasons: G4G5 (96-02-01). This type is common throughout the northern Great Plains. Historically, it may never have been very extensive. It has been observed to grow out from forest or woodland edges and shade out the grasses. It is tolerant of both grazing and fire (Hansen and Hoffman 1988), and is under no threat from human activities. In some cases, heavily grazed pastures may favor this types. Many examples are somewhat weedy; thus the type is not demonstrably secure.

Comments: This type often occurs in heavily disturbed areas in conjunction with exotic species such as *Poa pratensis* and *Cirsium arvense*. Because it occurs in mesic swales, depressions, ravine bottoms and floodplains, some stands are occasionally flooded whereas others are just very moist. Thus it tends to fall on both sides of the upland/wetland division.

ELEMENT DISTRIBUTION

Range: This western snowberry shrubland is found in the western tallgrass and northern Great Plains of the United States and Canada.
Nations: CA US
States/Provinces: CO:S3, IA?, MB?, MT:S4S5, ND:S4?, NE:S4, SD:SU, SK:S?, WY:SR

ELEMENT SOURCES

Authors: J. Drake, WCS **Confidence:** 3 **Identifier:** CEGL001131
References: Bourgeron and Engelking 1994, Christy 1973, Clark 1977b, Clark et al. 1980, Driscoll et al. 1984, Hansen and Hoffman 1988, Hansen et al. 1984, Hansen et al. 1991, Hansen et al. 1995, Johnston 1987, Jones 1992b, Jones and Walford 1995, Kittel et al. 1994, Kittel et al. 1999a, McAdams et al. 1998, Meyer 1985, Steinauer and Rolfsmeier 2000

SALIX LUTEA SEASONALLY FLOODED SHRUBLAND ALLIANCE

Yellow Willow Seasonally Flooded Shrubland Alliance

ALLIANCE CONCEPT

Environment: Communities within this alliance occur on alluvial terraces adjacent to mountain rivers and streams. They occupy broad floodplains (0-6% slope), stream and river edges, ditches, seeps, and moist alluvial terraces. Stands are associated with beaver ponds or lakes. Elevations range from 1100-3600 m. The soils are typically peaty Histosols. Soils texture ranges from sandy clay loam to silt. These soils are saturated early in spring and often remain moist throughout the growing season. Adjacent upland communities include *Pinus contorta* and *Populus tremuloides*.
Vegetation: Vegetation types within this alliance are characterized as cold-deciduous seasonally flooded shrublands. The tall-shrub canopy is continuous and dominated by *Salix lutea* with varying amounts of *Salix exigua, Salix bebbiana* and *Salix boothii*. The short-shrub layer cover is typically 25% or greater and consist of *Ribes aureum, Ribes inerme*, and *Rosa woodsii*. The graminoid layer ranges from sparse to dense percent cover. Major herbaceous species include *Calamagrostis canadensis, Carex utriculata, Calamagrostis stricta*, and *Carex microptera*.
Dynamics: If browsing pressure is heavy, willow coverages will decrease, resulting in more open communities. Grazing pressure by livestock will cause a decrease in the more desirable grasses with a corresponding increase in weedy species such as *Phleum pratense, Poa pratensis*, and *Agrostis stolonifera*.

ALLIANCE SOURCES

Authors: D. CULVER, West **Identifier:** A.1007
References: Dorn 1997, Evenden 1990, Great Plains Flora Association 1986, Hansen et al. 1991, Hansen et al. 1995, Kagan 1997, Kartesz 1999, Kearney and Peebles 1969, Manning and Padgett 1995, Sawyer and Keeler-Wolf 1995

SALIX LUTEA / CAREX UTRICULATA SHRUBLAND

Yellow Willow / Beaked Sedge Shrubland

ELEMENT CONCEPT

GRank & Reasons: G4 (96-02-01).

ELEMENT DISTRIBUTION

Nations: US
States/Provinces: CA:S?, MT:S4, NV:S?, OR:S2

ELEMENT SOURCES

Authors: WCS **Confidence:** 2 **Identifier:** CEGL001220
References: Bourgeron and Engelking 1994, Driscoll et al. 1984, Evenden 1990, Hansen et al. 1991, Hansen et al. 1995, Manning and Padgett 1995

SARCOBATUS VERMICULATUS INTERMITTENTLY FLOODED SHRUBLAND ALLIANCE

Black Greasewood Intermittently Flooded Shrubland Alliance

ALLIANCE CONCEPT

Environment: Shrublands included in this alliance occur on lowland sites in plains, mountain valleys and intermountain basins throughout the arid and semi-arid western United States. Elevations range from 100-2400 m. Summers are hot. Winters are generally cold, but are mild in subtropical regions. Precipitation varies with geography but is generally low and infrequent. Sites are generally flat, poorly drained and intermittently flooded with a shallow or perched water table often within 1 m depth (West 1983b). Substrates are generally shallow, calcareous, fine-textured soils (clays to silt-loams), derived from alluvium. Soils are alkaline and typically moderately saline (West 1983b).

Adjacent upland vegetation depends on geography. In the Great Plains, it is likely shortgrass or midgrass prairie. In the Great Basin and central Wyoming, upland vegetation is typically *Artemisia* spp.- or *Grayia spinosa*-dominated shrublands. In the Mojave and other warm desert sites, *Larrea tridentata, Grayia spinosa*, or *Atriplex* spp. dominate the upland sites. In the California Central Valley adjacent upland vegetation is dominated by *Atriplex* spp. with annual grasses. Lowland vegetation is typically sparser stands of *Sarcobatus vermiculatus* or stands of species more tolerant of saline soils or poor soil aeration such as *Distichlis spicata, Allenrolfea occidentalis* or *Suaeda moquinii* (Franklin and Dyrness 1973, Young et al. 1986).

Vegetation: This widespread alliance includes shrublands from alkali flats around playas and floodplains along stream channels that dissect much of the arid and semi-arid western U.S. Stands have a moderately dense to dense woody layer (20-60% cover) dominated or codominated by the deciduous, facultative halophytic shrub *Sarcobatus vermiculatus*. Other shrubby codominants include *Picrothamnus desertorum (= Artemisia spinescens), Artemisia tridentata, Atriplex confertifolia, Atriplex gardneri, Chrysothamnus* spp. or *Grayia spinosa*. In more saline environments, *Nitrophila occidentalis* and *Suaeda moquinii* may be present. Herbaceous layers range from absent to a moderately dense canopy of medium-tall to short bunch grasses or sod grasses (0-25% cover). If the herbaceous layer is present, perennial grasses such as the strongly rhizomatous *Distichlis spicata* and *Pascopyrum smithii*, or the perennial bunch grasses *Elymus elymoides, Hordeum jubatum, Leymus cinereus*, and *Achnatherum hymenoides (= Oryzopsis hymenoides)* will dominate. Perennial forbs are typically sparse and often include *Grindelia squarrosa, Iva axillaris*, and *Sphaeralcea coccinea*. Annual grasses, especially the exotic *Bromus japonicus, Bromus rubens*, and *Bromus tectorum*, may be present to abundant. Forbs are common on disturbed weedy sites. Weedy annual forbs may include the exotics *Descurainia* spp., *Helianthus annuus, Halogeton glomeratus, Lactuca serriola*, and *Lepidium perfoliatum*.

Dynamics: *Sarcobatus vermiculatus*, like many facultative halophytes, is tolerant of alkaline and saline soil conditions that allow the species to occur in sites with less interspecific competition (Ungar et al. 1969, Branson et al. 1976). The shrub also occurs on extremely arid non-saline sites. *Sarcobatus vermiculatus* is often found on sites with high water tables that are intermittently flooded. Hansen et al. (1995) reported that it can tolerate saturated soil conditions for up to 40 days. *Sarcobatus vermiculatus*-dominated vegetation can occur as a narrow band along a channel, or in a mosaic of communities where composition and density of the shrub and understory species vary with depth to water table, salinity and alkalinity, soil texture, and past land use or disturbance. Hanson (1929) described stands in south-central Colorado and found that pure stands of *Sarcobatus vermiculatus* and *Distichlis spicata* are more common on strongly saline/alkaline sites with fine-textured soil and shallow water tables, whereas stands with mixed shrubs such as *Chrysothamnus* or *Artemisia* are more common on drier, coarser textured, low-alkaline sites. Sporobolus airoides is found on dry, strongly alkaline sites, and *Pascopyrum smithii* is most common on less alkaline, moist, sites in low lying areas.

Sarcobatus vermiculatus is not ordinarily browsed, but Daubenmire (1970) found that under heavy stocking rates, the shrubs will develop a compact canopy. Hansen et al. (1995) also reported browsing damage with heavy spring and summer grazing, but noted that *Sarcobatus vermiculatus* is moderately poisonous to livestock especially in the fall, and supplemental feed is recommended to avoid livestock loss. Hanson (1929) states that *Sarcobatus vermiculatus* can form an important part of winter forage for sheep. Fire will topkill *Sarcobatus vermiculatus*, but the shrub will promptly resprout from the root crown (Daubenmire 1970).

NRCS range sites for the eastern plains of Colorado do not describe this alliance on good condition sites. Several range sites (Salt flat #33, Saline overflow #37) list *Sarcobatus vermiculatus* as present in low abundance in good condition stands but describe it as increasing with overgrazing. The NRCS range sites also describe *Bouteloua gracilis* increasing with overgrazing. Stands dominated by *Sarcobatus vermiculatus* with an understory dominated by *Bouteloua gracilis* been observed in eastern Colorado (S. Kettler pers. obs.).

ALLIANCE SOURCES

Authors: K. SCHULZ, JT, West **Identifier:** A.1046

References: Barbour and Major 1977, Blackburn et al. 1969b, Blackburn et al. 1969c, Blackburn et al. 1969d, Blackburn et al. 1971, Branson and Owen 1970, Branson et al. 1976, Brotherson et al. 1986, Brown 1982, Bundy et al. 1996, Chappell et al. 1997, Copeland 1979, Copeland and Greene 1982, Dastrup 1963, Daubenmire 1970, DeVelice and Lesica 1993, DeVelice et al. 1991, DeVelice et al. 1995, Dick-Peddie 1993, Fenemore 1970, Francis 1986, Franklin and Dyrness 1973, Graham 1937, Hamner 1964, Hansen et al. 1995, Hanson 1929, Holland 1986b, Johnston 1987, Lesica and DeVelice 1992, Medicine Bow Mine Application n.d., Mueggler and Stewart 1980, Sawyer and Keeler-Wolf 1995, Sweetwater Uranium Project 1978, Terwilliger and Smith 1978, Tweit and Houston 1980, Ungar et al. 1969, West 1983b, Young et al. 1986

SARCOBATUS VERMICULATUS / DISTICHLIS SPICATA SHRUBLAND

Black Greasewood / Saltgrass Shrubland

ELEMENT CONCEPT

Environment: This shrubland occupies alkaline flatlands and valley bottoms. These areas are usually closed basins. Elevation ranges from approximately 600-2300 m. It forms expansive shrublands on broad floodplains along large rivers and streams, and forms an outer ring around playas above the *Distichlis spicata*-dominated center. Flooding is generally intermittent. Substrates are deep, alkaline, saline and generally fine-textured soils with a perennial high water table. However, in southern Colorado's San Luis valley, stands grow between salt flat depressions (playas) on sandy hummocks approximately 1.2 m above the lakebed. Cryptogamic crusts are important on some sites.

Vegetation: The vegetation is characterized by a fairly open to moderate shrub canopy (18-60% cover) dominated by *Sarcobatus vermiculatus* with an herbaceous layer dominated by the rhizomatous graminoid *Distichlis spicata* (10-80% cover). Associated shrubs and dwarf-shrubs may include *Ericameria nauseosa, Gutierrezia sarothrae*, and *Tetradymia canescens*. *Sporobolus airoides* may codominate the graminoid layer, and *Hordeum jubatum* is common in disturbed stands. *Juncus balticus* and *Leymus cinereus* are also present in some stands. The forb layer is generally sparse and composed of species such as *Iva axillaris* and *Ipomopsis* spp. Introduced species such as *Bromus tectorum, Lepidium latifolium, Lepidium perfoliatum*, and *Bassia hyssopifolia* may be present to abundant in disturbed stands.

[From CCA: The stand described by Baker (1982b) for the Piceance Basin had patches of *Sarcobatus vermiculatus* alternating with wide expanses of *Distichlis spicata (= var. stricta)*. A few species of annuals also were present but could not be identified. Cover of *Sarcobatus* in this stand was not high.

Data from Costello (1944b) for the San Juan Valley show dominance of *Sarcobatus*, with >60% cover, and *Chrysothamnus* spp. are associated. The understory consists primarily of *Distichlis spicata* and *Sporobolus airoides*, with *Bouteloua gracilis, Iva axillaris*, and *Muhlenbergia richardsonis (= Muhlenbergia squarrosa)* commonly present. Costello (1944b) also reported on *Sarcobatus*-dominated stands in western Colorado and Wyoming with several associated shrub species, including *Artemisia tridentata, Atriplex gardneri, Atriplex confertifolia*, and *Kochia americana*. Herbaceous species include *Elymus lanceolatus (= Elytrigia dasystachya), Salsola* spp., and *Sporobolus airoides*.

Baker (1982b) reports that many *Sarcobatus*-dominated communities are in the literature for Colorado, with understories of exotic annual weeds. His stand was one of only a few stands from western Colorado that still contains a native perennial grass understory.

Hanson (1929) reports that the appearance of greasewood stands varies greatly with depth to water table and salt concentration in the soil. It can form almost pure, tall stands, or in places be much more open with shrubs and grasses associated.]

Dynamics: *Sarcobatus vermiculatus* and *Distichlis spicata*, like many facultative halophytes, are tolerant of alkaline and saline soil conditions that allow the species to occur in sites with less interspecific competition (Ungar et al. 1969, Branson et al. 1976). *Sarcobatus vermiculatus* is often found on sites with high water tables that are intermittently flooded. Hansen et al. (1995) reported that it can tolerate saturated soil conditions for up to 40 days. *Sarcobatus vermiculatus*-dominated vegetation can occur as a narrow band along a stream, a broad floodplain shrubland, or as a mosaic of communities where composition and density of the shrub and understory species vary with depth to water table, salinity and alkalinity, soil texture, and past land use or disturbance. This shrubland may occur as a band of abrupt concentric rings of vegetation around a salt flat or depression. This visible zonation is caused by the change in dominant species and their relative tolerances to soil salinity and depth to groundwater.

The warm-season grass *Distichlis spicata* is rhizomatous, tolerant of moderate grazing, and its roots resist trampling. Although relatively unpalatable, it can provide valuable winter forage for livestock, if needed. When grazed, *Distichlis spicata* generally increases because of reduced competition from other less grazing-tolerant species. If grazed heavily, *Distichlis spicata* will decline and may be replaced by less desirable warm-season grasses such as tumblegrass, *Schedonnardus paniculatus*, or *Hordeum jubatum* (Costello 1944b, Jones and Walford 1995). Weeds are generally not a problem because few grow well in saline soils. However, severely disturbed sites are susceptible to invasion by introduced species such as *Bromus tectorum, Lepidium latifolium, Lepidium perfoliatum*, and *Bassia hyssopifolia* (Franklin and Dyrness 1973).

Anything that raises the water table of a closed basin will result in an increase in this type, due to the resulting alkalinity of the soils. Grazing of domestic livestock decreases *Distichlis* and results in its replacement by annual weedy plants such as *Bromus tectorum, Chorispora* spp., and *Lepidium* spp. (Baker 1982b).

Similar Associations:

- Sarcobatus vermiculatus Shrubland (CEGL001357)--similar but no herbaceous layer.
- Sarcobatus vermiculatus / Ericameria nauseosa Shrubland (CEGL001362)--also occurs on playa in NV.
- Sarcobatus vermiculatus / Leymus cinereus Shrubland (CEGL001366)--occurs in similar habitats those not as saline.
- Sarcobatus vermiculatus / Sporobolus airoides Sparse Vegetation (CEGL001368)
- Sarcobatus vermiculatus / Elymus elymoides Shrubland (CEGL001372)
- Sarcobatus vermiculatus / Distichlis spicata - (Puccinellia nuttalliana) Shrub Herbaceous Vegetation (CEGL002146)--similar but known from the northern Great Plains and not flooded.

GRank & Reasons: G4 (96-02-01).

ELEMENT DISTRIBUTION

Range: This shrubland association occurs throughout much of the interior West from western Montana to Washington, south to Nevada, Utah and Colorado.

Nations: US

States/Provinces: CO:S1, ID:S1, MT:S2, NV?, OR:S4, UT:S?, WA:S2?, WY:S?

ELEMENT SOURCES

Authors: M.S. Reid, mod. K. Schulz, WCS **Confidence:** 1 **Identifier:** CEGL001363

References: Baker 1982b, Bourgeron and Engelking 1994, Branson et al. 1976, Costello 1944b, Crawford 2001, Daubenmire 1970, Driscoll et al. 1984, Franklin and Dyrness 1973, Hansen et al. 1995, Hanson 1929, Jones and Walford 1995, Kittel et al. 1999a, Mueggler and Stewart 1980, Ungar et al. 1969

SARCOBATUS VERMICULATUS / LEYMUS CINEREUS SHRUBLAND

Black Greasewood / Great Basin Lyme Grass Shrubland

ELEMENT CONCEPT

Summary: This shrubland is found in Montana and Oregon, and possibly Washington, California and Nevada. This type occurred historically in Idaho, but appears to be eliminated from that state. Stands often are found in a relatively narrow band on floodplains and toeslopes above drainages in semi-arid environments. The association has also been observed around lakes and playas in north-central Montana. Substrates are poorly drained, alkaline soils that are often saline. This vegetation has a moderately dense short-shrub canopy (25-50% cover) that is dominated by *Sarcobatus vermiculatus*. Other shrubs and dwarf-shrubs include *Chrysothamnus viscidiflorus, Artemisia frigida* and *Gutierrezia sarothrae*. The moderately dense herbaceous layer (20-50% cover) is dominated by perennial graminoids. *Pascopyrum smithii* and *Leymus cinereus*, the diagnostic grass, codominate with *Pseudoroegneria spicata, Koeleria macrantha, Carex filifolia*, and the introduced grass *Poa pratensis*. Scattered forbs include *Symphyotrichum chilense (= Aster chilensis), Comandra umbellata, Iva axillaris, Tragopogon dubius*, and *Sphaeralcea coccinea*. The cactus *Opuntia polyacantha* is typically present.

GRank & Reasons: G3 (99-12-01). The current areal extent of this shrubland is not certain, but it thought to be very small. Stands are found in Montana and Oregon. More survey is needed to determine if this association occurs in Washington, California, Nevada, or Idaho. This shrubland is restricted to a relatively narrow band on floodplains and toeslopes above drainages in semiarid environments. Much of the historic range of this association has been convert to cropland. Improper grazing by livestock can totally eliminate *Leymus cinereus* from the stands, and favors the introduced grass *Poa pratensis*. Suppression of natural processes may alter the hydrologic regimes that support this vegetation.

ELEMENT DISTRIBUTION

Range: This association is found in western Montana and Oregon, and may occur in Washington, California, Nevada and Idaho.
Nations: US
States/Provinces: CA?, ID:S2, MT:S2S3, NV?, OR:S2, WA:S1

ELEMENT SOURCES

Authors: K.A. Schulz, WCS **Confidence:** 1 **Identifier:** CEGL001366
References: Bourgeron and Engelking 1994, Driscoll et al. 1984, Mueggler and Stewart 1980, Sawyer and Keeler-Wolf 1995, Tweit and Houston 1980

V. HERBACEOUS VEGETATION

BROMUS INERMIS SEMI-NATURAL HERBACEOUS ALLIANCE

Smooth Brome Semi-natural Herbaceous Alliance

ALLIANCE CONCEPT

Environment: This introduced-species grassland alliance occurs widely throughout the northern Great Plains of the United States, and perhaps more widely in the Midwest and Canada. It likely occurs throughout much of the Rocky Mountains and Intermountain West. In semi-arid environments, it is restricted to relatively mesic conditions such as in riparian areas or forest openings at montane elevations. Stands can occur in a wide variety of human-disturbed habitats, including highway rights-of-way, jeep trails, etc. *Bromus inermis* is also widely planted for cover, pasture, and hay, and has escaped into a variety of habitats.
Vegetation: This alliance is characterized by a moderately dense to dense layer of medium-tall (0.5-1 m) perennial graminoids. The dominant grass is *Bromus inermis*, a naturalized species from Eurasia. Other weedy species may occur as well, but native species are generally less than 10% cover. Native species may include mixed-grass prairie grasses, such as *Pascopyrum smithii* and *Hesperostipa comata (= Stipa comata)*, as well as others. Where native species are conspicuous enough to identify the native plant association that could occupy the site, the stand should be typed as such.

ALLIANCE SOURCES

Authors: D. FABER-LANGENDOEN, MOD., Midwest **Identifier:** A.3561
References:

BROMUS INERMIS - (PASCOPYRUM SMITHII) SEMI-NATURAL HERBACEOUS VEGETATION

Smooth Brome - (Western Wheatgrass) Semi-natural Herbaceous Vegetation

ELEMENT CONCEPT

Environment: This smooth brome grassland type occurs widely throughout the northern Great Plains and on relatively mesic sites in the semi-arid interior western United States, and perhaps more widely in the midwestern U.S. and Canada. Stands can occur in a wide variety of human-disturbed habitats, including highway rights-of-way, jeep trails, etc. The type is also widely planted for revegetating disturbed land, pasture, and hay fields, and has escaped into a variety of habitats including prairie, riparian grasslands, and mesic mountain meadows. In Montana, this community is found on elevation ranges from 1100-2050 m (3590-6700 feet) with best examples occurring on mesic alluvial terraces (Hansen et al. 1995). This grass grows best on moist, well-drained, finer-textured loam and clay loams, not heavy clays or sand, and does not tolerate prolonged flooding (Hansen et al. 1995).
Vegetation: This association is dominated by medium-tall (0.5-1 m) graminoids. The dominant grass is *Bromus inermis*, a naturalized species from Eurasia, that forms moderately dense to dense stands that often develop into monocultures. Other weedy species such as *Cirsium arvense* may occur as well, but native species are generally less than 10% cover. Native species may include mixed-grass prairie and montane meadow grasses, such as *Pascopyrum smithii, Deschampsia caespitosa*, and *Hesperostipa comata (= Stipa comata)* and sparse, scattered mesic shrubs such as *Symphoricarpos* spp. as well as many others. However, the native species are not conspicuous enough to identify the native plant association that could occupy the site or the stand would be typed as such.
Dynamics: *Bromus inermis* is a strongly rhizomatous, cool-season grass that grows 0.5-1 (1.5) m tall (Cronquist et al. 1977). It is a highly competitive, sod-forming grass with a dense fibrous root and rhizome system. The extensive

rhizome system allows it to rapidly spread and makes it able to tolerate heavy grazing by livestock (Hansen et al 1995). Although this grass grows best on moist alluvial sites, it does not tolerate prolonged flooding (Hansen et al. 1995). It also has good drought resistance, which allows it to persist in semi-arid regions (Cronquist et al. 1977). Flooding of infested riparian areas has been used to restore native riparian or wetland species in degraded (de-watered) sites (Hansen et al. 1995). *Bromus inermis* is also fire-adapted and will vigorously sprout after most burns (Hansen et al. 1995). However, this cool-season grass is not tolerant of hot, late-spring burns, which is during its active growing period (Hansen et al. 1995). This may be an effective control measure where native vegetation is dominated by warm-season grasses.

Similar Associations:

GRank & Reasons: GW (99-06-17). This is a naturalized type from Europe and Asia, widely planted for cover, pasture, and hay, and has escaped into a variety of habitats.

Comments: Where native species are conspicuous enough to identify the native plant association that could occupy the site, the stand should be typed as such. *Bromus inermis* occurs widely throughout the midwestern and western U.S., and perhaps this association should be broadened to include almost any stand dominated almost exclusively by *Bromus inermis*.

ELEMENT DISTRIBUTION

Range: This type occurs widely throughout the northern Great Plains and in relatively mesic sites in Utah and Wyoming, and perhaps more widely in the midwestern U.S. and Canada as well as the western United States where *Bromus inermis* has escaped from revegetation and forage plantings.

Nations: US

ELEMENT SOURCES

Authors: D. Faber-Langendoen, mod. K.A. Schulz, MCS **Confidence:** 3 **Identifier:** CEGL005264

References: Cronquist et al. 1977, Hansen et al. 1995

DISTICHLIS SPICATA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE

Saltgrass Intermittently Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Grasslands in this western alliance occur in lowland habitats such as playas, swales and terraces along washes that are intermittently flooded. The flooding is usually the result of highly localized thunderstorms which can flood one basin and leave the next dry. The unpredictable nature of the flooding is the key environmental factor separating this alliance from similar alliances with more predictable flooding regimes. Climate is semi-arid to arid. Soil texture ranges from clay loam to sandy clay (Johnston 1987, Redmann 1972). These soils are deep, saline and alkaline. They generally have an impermeable layer and therefore are poorly drained. When the soil is dry, the surface usually has salt accumulations.

Vegetation: Vegetation included in this alliance occurs in lowland sites throughout much of the semi-arid and arid western U.S. This is an intermittently flooded grassland of playas and intermittent and ephemeral streams. Cover is sparse to dense and is dominated by *Distichlis spicata*, occurring in nearly pure stands. Stands have higher diversity and cover during wet years and near boundaries with other vegetation types. Higher soil salinity favors *Distichlis spicata* over less salt-tolerant species. However, very high salinity will dwarf the *Distichlis spicata* and reduce cover. Generally, vegetation height and cover, and species diversity tend to vary inversely with salinity (Ungar 1967, Steinauer 1989). Associated species may be restricted by the level of salinity in the soil. Those from higher soil salinity sites may include the graminoid *Puccinellia nuttalliana* and the forbs *Salicornia rubra, Triglochin maritima*, and *Suaeda calceoliformis (= Suaeda depressa)*. Species from lower salinity sites include the graminoids *Hordeum jubatum, Pascopyrum smithii, Sporobolus airoides, Carex filifolia*, and *Juncus balticus*, and the forbs *Helianthus* spp. and Asteraceae spp. (Ungar 1974). Forb cover is generally low. Shrubs are rare, but may include scattered *Atriplex canescens* and *Sarcobatus vermiculatus*.

Dynamics: The intermittent flooding regime combined with high evaporation rate in these dry climates causes accumulations of soluble salts in the soil. Total vegetation cover (density and height), species composition, and soil salinity depend on the amount and timing of precipitation and flooding. Growth-inhibiting salt concentrations are diluted when the soil is saturated allowing the growth of less salt-tolerant species and more robust growth of *Distichlis spicata*. As the saturated soils dry, the salt concentrates until it precipitates on the soil surface (Dodd and Coupland 1966, Ungar 1968). This osmotic stress of growing in alkaline and saline soils is compensated by the accumulation of proline by some halophytic species including *Distichlis spicata*. This aids the plants' water uptake

by increasing the osmotic potential of the plant (Shupe et al. 1986). Vegetation forms zones at some saline sites, where species abundance is stratified by salt tolerance (Shupe et al. 1986, Ungar et al. 1969). In playas, the soil salinity at field capacity generally increases from the edge to the center allowing for several different vegetation stands to co-occur (Ungar 1967, 1970, Ungar et al. 1969). Microtopography can also affect vegetation structure. Where soil accumulates to form hummocks, less salt- and alkali-tolerant plants can occur (Ungar 1972, Johnson 1987).

Distichlis spicata is rhizomatous and is tolerant of moderate grazing and its roots resist trampling. Although relatively unpalatable, it can provide valuable winter forage for livestock if needed. If grazed heavily, *Distichlis spicata* will decline and may be replaced by less desirable warm-season grasses such as tumblegrass, *Schedonnardus paniculatus* (Costello 1944b). Weeds are generally not a problem because few grow well in saline soils.

ALLIANCE SOURCES

Authors: K. SCHULZ, West **Identifier:** A.1332

References: Baker 1984a, Beatley 1976, Brotherson 1987, Bunin 1985, Copeland 1979, Costello 1944b, Crouch 1961a, Daniels 1911, Daubenmire 1970, Franklin and Dyrness 1973, Graham 1937, Griffiths 1902, Hansen et al. 1991, Hansen et al. 1995, Henrickson 1974, Hyder et al. 1966, Johnston 1987, Jones and Walford 1995, Kittel and Lederer 1993, Kittel et al. 1994, Klipple and Costello 1960, Osborn 1974, Ralston 1969, Ramaley 1942, Redmann 1972, Rogers 1953, Saul 1974, Shanks 1977, Shupe et al. 1986, Soil Conservation Service 1978, Soil Conservation Service n.d., Stearns-Roger Inc. 1978, Steinauer 1989, Tuhy and Jensen 1982, Ungar 1967, Ungar 1968, Ungar 1970, Ungar 1972, Ungar 1974b, Ungar 1974c, Ungar et al. 1969, Vestal 1914, Weaver and Albertson 1956

DISTICHLIS SPICATA HERBACEOUS VEGETATION

Saltgrass Herbaceous Vegetation

ELEMENT CONCEPT

Environment: These grasslands occur in the semi-arid and arid western North America from southern Saskatchewan to Mexico. Elevation ranges from 1000-2300 m. Stands are found in lowland habitats such as playas, swales and terraces along washes that are typically intermittently flooded. The flooding is usually the result of highly localized thunderstorms which can flood one basin and leave the next dry. However, this association may also occur in other flood regimes (temporarily, seasonally, and semipermanently). Soil texture ranges from clay loam to sandy clay (Johnston 1987). These soils are often deep, saline and alkaline. They generally have an impermeable layer and therefore are poorly drained. When the soil is dry, the surface usually has salt accumulations. Salinity is likely more important than flooding as an environmental factor.

Vegetation: Vegetation included in this association occurs in lowland sites throughout much of the semi-arid and arid western U.S. This is an intermittently flooded grassland of playas and intermittent and ephemeral streams. Cover is sparse to dense and is dominated by *Distichlis spicata*, occurring in nearly pure stands. Stands have higher diversity and cover during wet years and near boundaries with other vegetation types. Higher soil salinity favors *Distichlis spicata* over less salt-tolerant species. However, very high salinity will dwarf the *Distichlis spicata* and reduce cover. Generally, vegetation height and cover and species diversity tend to vary inversely with salinity on the plains, but may increase on very saline sites (Brotherson 1987). Minor cover of associated graminoids may include *Muhlenbergia asperifolia, Hordeum jubatum, Pascopyrum smithii, Sporobolus airoides, Carex filifolia, Eleocharis palustris, Puccinellia nuttalliana*, and *Juncus balticus*. Associated forbs, such as *Iva axillaris, Helianthus* spp. and Asteraceae spp. (from lower salinity sites), *Salicornia rubra, Triglochin maritima*, and *Suaeda* spp., may also be present. Shrubs are rare, but scattered *Atriplex canescens* and *Sarcobatus vermiculatus* may be present. Introduced species are present in some stands and may include *Elymus repens, Lepidium latifolium, Lepidium perfoliatum, Bassia scoparia (= Kochia scoparia)*, and occasionally *Tamarix* spp.

Dynamics: The intermittent flooding regime combined with the high evaporation rate in these dry climates causes accumulations of soluble salts in the soil. Total vegetation cover (density and height), species composition, and soil salinity depend on the amount and timing of precipitation and flooding. Growth-inhibiting salt concentrations are diluted when the soil is saturated allowing the growth of less salt-tolerant species and more robust growth of *Distichlis spicata*. As the saturated soils dry, the salt concentrates until it precipitates on the soil surface (Dodd and Coupland 1966, Ungar 1968). This osmotic stress of growing in alkaline and saline soils is compensated by the

accumulation of proline by some halophytic species including *Distichlis spicata*. This aids the plants' water uptake by increasing the osmotic potential of the plant (Shupe et al. 1986). Vegetation forms zones at some saline sites, where species abundance is stratified by salt tolerance (Shupe et al. 1986, Ungar et al. 1969). In playas, the soil salinity at field capacity generally increases from the edge to the center allowing for several different vegetation stands to co-occur (Ungar 1967, 1970, Ungar et al. 1969). Microtopography can also affect vegetation structure. Where soil accumulates to form hummocks, less salt- and alkali-tolerant plants can occur (Ungar 1972, Johnston 1987).

Brotherson (1987) studied species in a saline meadow adjacent to the Great Salt Lake in Utah and found 5 vegetation zones all with *Distichlis spicata* present. The meadow sloped down and away from the shoreline for the first 4 zones, then up for the last. Soil pH and soluble salts levels followed the slope pattern with the lowest zone (4) having lower pH and salt concentrations and the highest cover of *Distichlis spicata* (99%) almost exclusively. The other higher salt zones were codominated by other species such as *Suaeda calceoliformis, Puccinellia nuttalliana, Salicornia rubra, Triglochin maritima, Glaux maritima*, or *Eleocharis palustris*. Zone 5 was dominated by *Eleocharis palustris* and had additional moisture from a nearby seep. The salts were concentrated in the higher elevation zones because of evaporation of the salt-laden water that was leached from the lower lying areas.

The warm-season grass *Distichlis spicata* is rhizomatous, tolerant of moderate grazing, and its roots resist trampling. Although relatively unpalatable, it can provide valuable winter forage for livestock, if needed. When grazed, *Distichlis spicata* generally increases because of reduced competition from other less grazing-tolerant species. If grazed heavily, *Distichlis spicata* will decline and may be replaced by less desirable warm-season grasses such as tumblegrass, *Schedonnardus paniculatus*, or *Hordeum jubatum* (Costello 1944b, Jones and Walford 1995). Weeds are generally not a problem because few grow well in saline soils. However, severely disturbed sites are susceptible to invasion by introduced species such as *Bromus tectorum, Lepidium latifolium, Lepidium perfoliatum*, and *Bassia hyssopifolia* (Franklin and Dyrness 1973).

Similar Associations:

- Leymus cinereus - Distichlis spicata Herbaceous Vegetation (CEGL001481)
- Pascopyrum smithii - Distichlis spicata Herbaceous Vegetation (CEGL001580)
- Sporobolus airoides - Distichlis spicata Herbaceous Vegetation (CEGL001687)
- Distichlis spicata Mixed Herb Herbaceous Vegetation (CEGL001771)
- Distichlis spicata - Lepidium perfoliatum Herbaceous Vegetation (CEGL001772)
- Distichlis spicata - (Scirpus nevadensis) Herbaceous Vegetation (CEGL001773)
- Eleocharis palustris - Distichlis spicata Herbaceous Vegetation (CEGL001834)
- Distichlis spicata - Hordeum jubatum - (Poa arida, Iva annua) Herbaceous Vegetation (CEGL002031)--currently described only from the Great Plains.
- Polygonum spp. - Echinochloa spp. - Distichlis spicata Playa Lake Herbaceous Vegetation (CEGL002039)
- Distichlis spicata - (Hordeum jubatum, Poa arida, Sporobolus airoides) Herbaceous Vegetation (CEGL002042)--currently described only from the Great Plains.
- Distichlis spicata - Schoenoplectus maritimus - Salicornia rubra Herbaceous Vegetation (CEGL002043)--currently described only from the Great Plains.
- Distichlis spicata - Hordeum jubatum - Puccinellia nuttalliana - Suaeda calceoliformis Herbaceous Vegetation (CEGL002273)--currently described only from the Great Plains.
- Distichlis spicata - Spartina spp. Herbaceous Vegetation (CEGL002275)--currently described only from the Great Plains.
- Distichlis spicata - Hordeum jubatum - Puccinellia nuttalliana - Plantago maritima Herbaceous Vegetation (CEGL002551)--currently described only from the Great Plains.

GRank & Reasons: G5 (96-02-01).

Comments: This graminoid association is characteristically dominated by *Distichlis spicata*. Closely related communities include *Pascopyrum smithii - Distichlis spicata* Herbaceous Vegetation (CEGL001580), *Sporobolus airoides - Distichlis spicata* Herbaceous Vegetation (CEGL001687), and several others.

ELEMENT DISTRIBUTION

Range: This grassland association occurs in low areas in semi-arid and arid western North America from southern Saskatchewan to Mexico.

Nations: CA MX? US

States/Provinces: AZ:S3, CA:S3, CO:S3, ID:S4, MT:S4, NM:S4, NV:S?, OR:S4, SK:S?, UT:S3S5, WA:S1?, WY:S3

ELEMENT SOURCES

Authors: K.A. Schulz, WCS **Confidence:** 2 **Identifier:** CEGL001770

References: Baker 1984a, Beatley 1976, Bourgeron and Engelking 1994, Brotherson 1987, Bunin 1985, Costello 1944b, Crouch 1961a, Daniels 1911, Daubenmire 1970, Dodd and Coupland 1966, Driscoll et al. 1984, Franklin and Dyrness 1973, Graham 1937, Hansen et al. 1991, Hansen et al. 1995, Hyder et al. 1966, Johnston 1987, Jones and Walford 1995, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1999a, Klipple and Costello 1960, Muldavin et al. 2000a, Osborn 1974, Ralston 1969, Ramaley 1942, Rogers 1953, Sawyer and Keeler-Wolf 1995, Shanks 1977, Shupe et al. 1986, Soil Conservation Service 1978, Stearns-Roger Inc. 1978, Tuhy and Jensen 1982, Ungar 1967, Ungar 1968, Ungar 1970, Ungar et al. 1969, Vestal 1914, Weaver and Albertson 1956

PUCCINELLIA NUTTALLIANA INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE

Nuttall's Alkali Grass Intermittently Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Plant associations within this alliance are found in saline flats at lower to moderate elevations in the western United States. This alliance is known from salt flats in a large, high-elevation (2900 m) park in the Colorado Rocky Mountains, and possibly basins (1500 m) in Nevada and South Dakota. Typically the climate is cool, the growing season short. Ungar (1974) reports that the precipitation in the Colorado location is about 27 cm annually, with 75% occurring during the growing season. Topography is generally flat with poor drainage. Soil moisture is augmented in some areas by groundwater. There is a small microtopography of hummocks which affects the water relations and therefore species composition. The soils are moist, saline and alkaline, derived from calcareous shales. The rain- and groundwater-saturated soils usually dry out during the growing season. Communities form a ring just above the succulent plant associations associated with playas, salt flats, and saline lakes. They exist in saline soils that range from 1.2 to 4.1% soluble salts (Ungar 1970, Brotherson and Field 1987). The pH levels are commonly very alkaline, up to 8.5 (Brotherson and Field 1987).

Vegetation: *Puccinellia nuttalliana* dominates the graminoid stratum with up to 65% cover. *Distichlis spicata* or *Hordeum jubatum* often codominate the graminoid layer. The forb layer is relatively sparse, typically only 30%. It can be composed of *Salicornia rubra* or *Triglochin maritima* (Ungar 1974). *Puccinellia nuttalliana* can also occur as an understory plant for *Chrysothamnus albidus* (Young et al. 1986).

Dynamics: Plant communities within this alliance form a distinct pattern, a 'ring', according to soil pH and salinity concentrations. Brotherson and Field (1987) state that saline concentrations decrease as plants move downslope. They attribute this decrease to two factors. First, water will drain from the high to low point, and the increased moisture in the soil will increase the leaching effect on salts. Second, as soil dries, moisture together with its dissolved salts is drawn from the deeper soils. As a result of this 'wicking action,' water evaporating from the soil surface leaves increased concentrations of dissolved salt in the upper horizon (Waisel 1972 as cited in Brotherson 1974). Consequently, salinity increases along the ridge and decreases in the depression. *Puccinellia nuttalliana* can tolerate the very alkaline (pH 8.5) soils that are found above the high water mark from the intermittent flooding. The highest pH levels are not found at the bottom of the ring, but along the rim, with an average pH level of 8.7 (Brotherson and Field 1987).

ALLIANCE SOURCES

Authors: D. CULVER, West **Identifier:** A.1335

References: Brotherson and Field 1987, Cronquist et al. 1977, Reid et al. 1994, Ungar 1970, Ungar 1972, Ungar 1974c, Young et al. 1986

PUCCINELLIA NUTTALLIANA HERBACEOUS VEGETATION

Nuttall's Alkali Grass Herbaceous Vegetation

ELEMENT CONCEPT

Summary: This wetland association is described from a high-elevation (2900 m) park in central Colorado and in southwestern and central Montana, but likely occurs elsewhere across the western and northern Great Plains and the western U.S. and Canada. While the dominant species occurs over a broad geographic range, it has quite specific habitat needs requiring moist soils of intermediate salinity in seasonally wet meadow habitats. Site topography is generally flat with poor drainage. In South Park, Colorado, there is often a small microtopography of hummocks

which affects the water relations and therefore species composition. The soils are moist, saline and alkaline, derived from calcareous shales. The snow/rain- and groundwater-saturated soils usually dry out during the growing season. Communities form a ring just above the succulent plant associations associated with playas, salt flats and saline lakes, or may occur as patches along intermittent drainages. They exist in saline soils that range from 0.7-1% total salts. The pH levels are commonly very alkaline. The wetland vegetation is characterized by the dominance of *Puccinellia nuttalliana* in the graminoid layer. *Distichlis spicata* or *Hordeum jubatum* may codominate is some stands. The forb layer is relatively sparse and is often composed of *Salicornia rubra* or *Triglochin maritima*. Diagnostic of this herbaceous wetland association is the dominance of *Puccinellia nuttalliana*.
GRank & Reasons: G3? (97-11-14). This type occurs over a broad geographic range, but has quite specific habitat needs. The association requires moist soils of intermediate salinity in seasonally wet meadow habitats of South Park, Colorado (Ungar 1974c). Cooper et al. (1999) suggest this type is quite common in the state of Colorado, occurring in a diversity of habitats. Occurrences are primarily small, however, and often impacted by livestock grazing in that state (Sanderson pers. comm. 1997). Stands of this association have been noted by researchers in the eastern (Nebraska) and northern plains regions to Saskatchewan and through the intermountain region to Utah and California (Ungar 1974c). Saline wetlands which support the association have been impacted by water diversion, livestock grazing, and land conversion in many places. Saline wetland associations of the Great Plains are considered especially vulnerable to habitat fragmentation and loss (Gersib and Steinauer 1991).

ELEMENT DISTRIBUTION

Range: This association occurs on moist soils of intermediate salinity in seasonally wet meadow habitats of South Park, Colorado (Ungar 1974c). Possible stands of this association have been noted by researchers in the eastern (Nebraska) and northern plains regions to Saskatchewan and through the intermountain region to Utah and California (Ungar 1974c).
Nations: CA? US
States/Provinces: CO:S1?, MT:S?, NV?, SD?, SK?, UT?

ELEMENT SOURCES

Authors: D. Sarr, WCS **Confidence:** 2 **Identifier:** CEGL001799
References: Bourgeron and Engelking 1994, Cooper et al. 1999, Dodd and Coupland 1966, Driscoll et al. 1984, Gersib and Steinauer 1991, Ungar 1970, Ungar 1972, Ungar 1974c, Young et al. 1986

HORDEUM JUBATUM TEMPORARILY FLOODED HERBACEOUS ALLIANCE

Foxtail Barley Temporarily Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Stands included in this alliance have been reported from lowlands across the northern Great Plains, in intermountain parks in Colorado and northeastern Utah. The climate is semi-arid continental with mean annual precipitation of 25-48 cm. Elevation generally ranges from 750-1600 m, and up to 2600 m in South Park, Colorado. The topography is flat and the soils are often briefly flooded or saturated in the spring (Redmann 1972). It is also found in the drawdown zone of ponds with moderately saline water (Hansen et al. 1995). Soils are clay loam to clay and poor to very poorly drained. Soil salinity is somewhat variable. Wilson (1967) found *Hordeum jubatum* grew best in non-saline soils in laboratory conditions. In the field with competition, this grass grew best in moderately saline conditions (up to 0.7% salinity). The soil surface may be covered with white salt crusts with moderately to strongly saline soils (Barnes 1978, Wilson 1967, Ungar 1969, Hansen et al. 1995). Adjacent wetter sites are often open water, while surrounding uplands can be dominated by a variety of grasslands or shrublands.
Vegetation: Grasslands included in this alliance are found in lowland sites in the northern and western Great Plains. The vegetation is a sparse to dense layer of short and medium-tall graminoids dominated by the cool-season, short-lived, perennial bunchgrass *Hordeum jubatum*. It often occurs in nearly pure stands. Ungar (1969) described one stand that was dominated by *Hordeum jubatum* in the spring and early summer, then became dominated by *Iva annua* in the late summer. Total vegetation cover is usually high, but can range from 20% to nearly 100% (Barnes 1978, Hansen et al. 1995). Shrubs are often absent and forbs are present, but not usually abundant. Species diversity is typically low. Other species include *Chenopodium* spp., *Distichlis spicata, Eleocharis* spp., *Elymus trachycaulus, Iva annua, Pascopyrum smithii, Poa arida, Poa compressa, Puccinellia nuttalliana, Rumex crispus, Salicornia rubra*, and *Schoenoplectus maritimus (= Scirpus paludosus)*.
Dynamics: *Hordeum jubatum* is a common, short-lived pioneer species of mesic prairie habitats where permanent grass cover has been destroyed (Dodd and Coupland 1966). It may represent a seral stage that will be taken over by

more permanent grasses (Hansen et al. 1995). It is moderately salt-tolerant and can densely colonize areas disturbed by flooding along drainages, around playas and more permanent ponds. *Hordeum jubatum* is moderately tolerant of salinity. Often on playas, these grasslands occupy a zone of intermediate salinity between halophytic vegetation dominated by *Distichlis spicata, Puccinellia nuttalliana*, or *Salicornia rubra*, and non-saline, mesic prairie vegetation dominated by *Pascopyrum smithii, Poa* spp. or *Elymus* spp. Total vegetation cover (density and height), species composition and soil salinity depend on the amount and timing of precipitation and flooding. Growth-inhibiting salt concentrations are diluted when the soil is saturated, allowing the growth of less salt-tolerant species and more robust growth (Ungar 1967).

ALLIANCE SOURCES

Authors: K. SCHULZ, West **Identifier:** A.1358

References: Baker 1984a, Barnes and Tieszen 1978, Bunin 1985, Dodd and Coupland 1966, Faber-Langendoen et al. 1996, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, Redmann 1972, Reid 1974, Ungar 1967, Ungar et al. 1969, Vestal 1914

HORDEUM JUBATUM HERBACEOUS VEGETATION

Foxtail Barley Herbaceous Vegetation

ELEMENT CONCEPT

Environment: This association has been reported from lowlands across the northern Great Plains, in intermountain parks in Colorado and northeastern Utah. The climate is semi-arid continental with mean annual precipitation of 25-48 cm. Elevation generally ranges from 750-1600 m, and up to 2600 m in South Park, Colorado. Stands are located in lowlands with moderately to strongly saline soils (Barnes and Tieszen 1978). The topography is flat, and the soils are often flooded or saturated in the spring (Redmann 1972). *Hordeum jubatum* is often found dominating disturbed areas such as roadsides and over-grazed bottomland.

Vegetation: The typically dense vegetation is dominated by short and medium-tall graminoids with a total vegetation cover of nearly 100%, but may occur in sparser stands (25-30% cover) (Barnes and Tieszen 1978, Von Loh 2000). Shrubs are usually absent. *Hordeum jubatum* dominates the community. Other common species in this community are *Elymus trachycaulus, Distichlis spicata, Pascopyrum smithii, Poa arida, Poa compressa, Rumex crispus, Ambrosia tomentosa*, and *Malvella leprosa*. Introduced species may be common in some stands including *Bassia scoparia (= Kochia scoparia), Sonchus arvensis*, and *Lepidium latifolium*.

Dynamics: Total vegetation cover (density and height), species composition, and soil salinity depend on the amount and timing of precipitation and flooding. Growth-inhibiting salt concentrations are diluted when the soil is saturated, allowing the growth of less salt-tolerant species and more robust growth (Ungar 1967). *Hordeum jubatum* will replace *Distichlis spicata* in those communities when heavily grazed (Jones and Walford 1995).

Similar Associations:

- Distichlis spicata - Hordeum jubatum - Puccinellia nuttalliana - Suaeda calceoliformis Herbaceous Vegetation (CEGL002273)
- Pascopyrum smithii - Hordeum jubatum Herbaceous Vegetation (CEGL001582)
- Distichlis spicata - Hordeum jubatum - (Poa arida, Iva annua) Herbaceous Vegetation (CEGL002031)
- Distichlis spicata - (Hordeum jubatum, Poa arida, Sporobolus airoides) Herbaceous Vegetation (CEGL002042)
- Distichlis spicata - Hordeum jubatum - Puccinellia nuttalliana - Plantago maritima Herbaceous Vegetation (CEGL002551)
- Schoenoplectus robustus - Juncus gerardii - Hordeum jubatum - Atriplex patula Herbaceous Vegetation (CEGL006234)

GRank & Reasons: G4 (96-02-01).

Comments: This type is poorly defined. This abstract is based on two descriptions of *Hordeum jubatum*-dominated stands which are assumed to be examples of this community. These stands may be variants of *Distichlis spicata - Hordeum jubatum - Puccinellia nuttalliana - Suaeda calceoliformis* Herbaceous Vegetation (CEGL002273) and *Pascopyrum smithii - Hordeum jubatum* Herbaceous Vegetation (CEGL001582). The relationship between *Hordeum jubatum* Herbaceous Vegetation (CEGL001798) and these types is unclear. Both communities usually contain *Hordeum jubatum* and *Distichlis spicata* or *Pascopyrum smithii* in varying amounts. The presence of

Puccinellia nuttalliana or *Suaeda calceoliformis* may be distinguishing factors. They appear to be more characteristic of strongly saline areas while *Hordeum jubatum* can dominate on less saline sites (Redmann 1972). Classification problems may arise on intermediate sites when *Hordeum jubatum* is the dominant species and *Distichlis spicata, Pascopyrum smithii, Puccinellia nuttalliana*, and *Suaeda calceoliformis* are present in more than minor amounts.

ELEMENT DISTRIBUTION

Range: This foxtail barley community type is found in the northern and central Great Plains of the United States and Canada, ranging from Colorado to Saskatchewan. It is also described from Utah and may occur elsewhere in the interior West.
Nations: CA US
States/Provinces: CO:S3?, MT:S4, ND:S?, SD?, SK:S?, UT:S?

ELEMENT SOURCES

Authors: J. Drake, mod. K. Schulz, WCS **Confidence:** 3 **Identifier:** CEGL001798
References: Baker 1984a, Barnes and Tieszen 1978, Bourgeron and Engelking 1994, Bunin 1985, Driscoll et al. 1984, Hansen et al. 1991, Hansen et al. 1995, Jones and Walford 1995, Redmann 1972, Reid 1974, Ungar 1967, Vestal 1914, Von Loh 2000

PASCOPYRUM SMITHII TEMPORARILY FLOODED HERBACEOUS ALLIANCE

Western Wheatgrass Temporarily Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: This northwestern Great Plains alliance occurs at low to moderate elevations, from about 760 m to over 1100 m. Climate is temperate continental, semi-arid to subhumid. Precipitation often occurs during the winter and spring as snow or rain, and during the summer as thunderstorms. Stands are found in playas and on stream terraces that are temporarily flooded for part of the growing season. Sites are flat to gently sloping on any aspect. Substrates are moderately saline, often poorly drained, ranging in soil texture from clay and silty clay to silty loam and sandy loam with a clay subsoil (Hanson and Whitman 1938, Johnston 1987, Jones and Walford 1995). In Wyoming playas, stands are found on clay and clay loam soils (Jones and Walford 1995). In playas, this clay or clay loam subsoil impedes infiltration and allows for mesic moisture regimes. Johnston (1987) reports alkaline pH's ranging from 7.2-8.3, and acid pH's ranging from 5.8-6.5, but his source for this information is unclear. Much of the ground is bare (to 75% in some stands).

Adjacent vegetation is upland mid- or shortgrass prairie often dominated by *Schizachyrium scoparium, Hesperostipa comata, Bouteloua gracilis* or *Pascopyrum smithii*.

Vegetation: Grasslands in this alliance is found along intermittent and ephemeral streams and playas in the northern Great Plains. Stands are dominated by sparse to dense cover of graminoids, up to 1 m tall, although most of the vegetation is 0.6 m tall or shorter. The depth to the clay layer affects the height and amount of vegetation, i.e., the deeper the clay layer the denser the vegetation (Hirsch 1985). The herbaceous layer is dominated or codominated by *Pascopyrum smithii* with *Distichlis spicata, Hordeum jubatum, Eleocharis acicularis* or *Eleocharis palustris* often codominating. Other common graminoids include *Bouteloua gracilis, Juncus balticus, Koeleria macrantha, Hesperostipa comata (= Stipa comata)*, and *Carex duriuscula (= Carex eleocharis)*. Forbs that may be present include *Iva annua, Helianthus petiolaris, Plantago patagonica*, and Asteraceae spp. Woody plants are rare. Some stands may have scattered woody species such as the dwarf-shrubs *Gutierrezia sarothrae* or *Artemisia frigida*, or the shrubs *Artemisia cana* or *Symphoricarpos occidentalis*. The temporary flooding regime combined with high evaporation rates in these dry climates causes accumulations of soluble salts in the soil. Total vegetation cover (density and height), species composition, and soil salinity depend on the amount and timing of precipitation and flooding. In playas, growth-inhibiting salt concentrations are diluted when the soil is saturated allowing the growth of less salt-tolerant species such as *Pascopyrum smithii*. As the saturated soils dry, the salt concentrates until it precipitates on the soil surface (Dodd and Coupland 1966). Vegetation forms zones at some saline sites, where species abundances are stratified by salt tolerance. In playas, the soil salinity at field capacity generally increases from the edge to the center allowing for several different vegetation stands to co-occur (Ungar 1967, 1969, 1970). Also within a vegetation type more mesic or salt-tolerant species such *Eleocharis acicularis, Eleocharis palustris, Juncus balticus*, and *Alopecurus* spp. will be more common at lower topographic levels where flooding is more frequent, than the dry-mesic species such as *Pascopyrum smithii*.

Pascopyrum smithii is rhizomatous and is tolerant of moderate grazing. If severely over-grazed, *Pascopyrum smithii* will decline and may be replaced by less desirable warm-season grasses and exotic species such as *Poa pratensis*.

Dynamics: The temporary flooding regime combined with high evaporation rates in these dry climates causes accumulations of soluble salts in the soil. Total vegetation cover (density and height), species composition, and soil salinity depend on the amount and timing of precipitation and flooding. In playas, growth-inhibiting salt concentrations are diluted when the soil is saturated allowing the growth of less salt-tolerant species such as *Pascopyrum smithii*. As the saturated soils dry, the salt concentrates until it precipitates on the soil surface (Dodd and Coupland 1966). Vegetation forms zones at some saline sites, where species abundance is stratified by salt tolerance. In playas, the soil salinity at field capacity generally increases from the edge to the center allowing for several different vegetation stands to co-occur (Ungar 1967, 1969, 1970). Also within a vegetation type more mesic or salt-tolerant species such *Eleocharis acicularis, Eleocharis palustris, Juncus balticus*, and *Alopecurus* spp. will be more common at lower topographic levels where flooding is more frequent, than the dry-mesic species such as *Pascopyrum smithii*. *Pascopyrum smithii* is rhizomatous and is tolerant of moderate grazing. If severely over-grazed, *Pascopyrum smithii* will decline and may be replaced by less desirable warm season grasses and exotic species such as *Poa pratensis*.

ALLIANCE SOURCES

Authors: MCS, MOD. M.S. REID/K. SC, West **Identifier:** A.1354

References: BLM 1979b, Britton 1979, Caballo Rojo Mine Application n.d., Culver et al. 1996, Diamond 1993, Dodd and Coupland 1966, Faber-Langendoen et al. 1996, Hanson and Whitman 1938, Harner-White Consultants n.d., Hirsch 1985, Hoagland 1998a, Holpp 1977, Johnston 1987, Jones and Walford 1995, Medicine Bow Mine Application n.d., Mine Reclamation Consultants 1977, NVS Corporation n.d., Stoecker-Keammerer Consultants n.d.(a), Stoecker-Keammerer Consultants n.d.(c), Ungar 1967, Ungar 1970, Western Resources Development Corporation n.d. (b), Western Resources Development Corporation n.d. (c)

PANICUM VIRGATUM - (PASCOPYRUM SMITHII) HERBACEOUS VEGETATION

Switchgrass - (Western Wheatgrass) Herbaceous Vegetation

ELEMENT CONCEPT

Environment: Switchgrass is a common component of many wetlands and mesic sites, but becomes dominant in wetter parts of drainages and wetland basins (Von Loh et al. 1999).

Vegetation: In Badlands National Park, South Dakota, the switchgrass grassland type provides dense ground cover, typically between 50-80%. *Panicum virgatum* is the dominant species in more mesic areas. *Pascopyrum smithii* is more abundant on elevated sites within the drainages and basins, and *Schizachyrium scoparium* is the dominant species along the upper margin of the type. Where this type is found in drainages, the distribution often becomes 'patchy' and *Calamovilfa longifolia* replaces *Schizachyrium scoparium* on the upper type margin. Commonly associated species include *Glycyrrhiza lepidota, Symphyotrichum ericoides (= Aster ericoides)*, and occasionally *Populus deltoides*.

GRank & Reasons: G2Q (96-02-01).

Comments: The concept of this type is still under review, as well as its alliance placement. There is no documentation for this type at the Montana Natural Heritage Program (S.V. Cooper pers. comm.) *Panicum virgatum* does occur in southern Montana, but it seems unlikely that it would ever be a community dominant over any appreciable area. In addition, this type currently is defined to include stands from Badlands National Park, but there is minimal similarity between these and observed stands in Montana. This type may not be valid. The other candidate alliance is the *Panicum virgatum* Temporarily Flooded Herbaceous Alliance (A.1343), which is currently reported only from the southern United States.

ELEMENT DISTRIBUTION

Range: This moist switchgrass type occurs in the northern Great Plains of the United States. It has been reported from eastern Wyoming, eastern Montana and western South Dakota, but its range is not well understood.

Nations: US

States/Provinces: MT:S2Q, SD:S?

ELEMENT SOURCES

Authors: P. Lesica and D. Faber-Langendoen, WCS **Confidence:** 3 **Identifier:** CEGL001484

References: Bourgeron and Engelking 1994, Driscoll et al. 1984, MTNHP n.d., Von Loh et al. 1999

PASCOPYRUM SMITHII - DISTICHLIS SPICATA HERBACEOUS VEGETATION
Western Wheatgrass - Saltgrass Herbaceous Vegetation

ELEMENT CONCEPT

Environment: This community is found in depressions and on stream terraces, including ephemeral streams. Stands contain moderately saline silt loam and sandy loam soils, sometimes with a clay subsoil (Hanson and Whitman 1938, Johnston 1987, Steinauer and Rolfsmeier 2000). Hirsch (1985) found the clay layer to be 0-25 cm below the surface. The soils are wet for part of the year and may flood periodically.

Vegetation: The vegetation is dominated by graminoids, which may be as tall as 1 m, but typically are less than 0.6 m. The depth to the clay layer affects the height and amount of vegetation, and the deeper the clay layer is buried, the taller the vegetation (Hirsch 1985). The dominants are *Pascopyrum smithii* and *Distichlis spicata*. Other common graminoids include *Bouteloua gracilis, Koeleria macrantha, Hesperostipa comata (= Stipa comata), Hordeum jubatum*, and *Carex duriuscula (= Carex eleocharis)*. Forbs that may be present are *Iva annua, Helianthus petiolaris, Plantago patagonica, Gutierrezia sarothrae*, and members of the Asteraceae (including *Symphyotrichum falcatum (= Aster falcatus)*). Woody plants are rare. In Wyoming, some stands may have scattered *Artemisia frigida* or *Artemisia cana ssp. cana*. In Nebraska stands may have scattered *Populus deltoides*. There, alkaline indicators, such as *Muhlenbergia asperifolia* and *Sporobolus airoides*, may also be present. Exotic species, principally *Atriplex micrantha (= Atriplex heterosperma)* and *Cirsium arvense*, are ubiquitous and may contribute substantial cover in many stands (Steinauer and Rolfsmeier 2000).

Similar Associations:

- Pascopyrum smithii - Hordeum jubatum Herbaceous Vegetation (CEGL001582)--is found further east; however, the floristic and environmental differences between these communities appear to be slight. Further review has to be completed to determine if there are enough differences to maintain the separate communities.
- Distichlis spicata - (Hordeum jubatum, Poa arida, Sporobolus airoides) Herbaceous Vegetation (CEGL002042)
- Sporobolus airoides Northern Plains Herbaceous Vegetation (CEGL002274)

GRank & Reasons: G4 (96-02-01). The G4 rank is based on a large geographic range and rather general environmental requirements. In light of the ubiquity of exotic plants in this type and the large proportion of stands in Nebraska (and perhaps elsewhere) that have been heavily disturbed by livestock (Steinauer and Rolfsmeier 2000), the rank probably should be reviewed.

Comments: This type is somewhat complex, with *Pascopyrum smithii* more important in less saline/alkaline areas, and *Distichlis spicata* and other alkaline indicators present in more alkaline areas. As such this type tends to share similarities to *Distichlis spicata - (Hordeum jubatum, Poa arida, Sporobolus airoides*) Herbaceous Vegetation (CEGL002042), which, in Nebraska, is called `western alkaline meadows' (Steinauer and Rolfsmeier 2000).

ELEMENT DISTRIBUTION

Range: This western wheatgrass saline prairie type is found in the northern Great Plains of the United States, extending from perhaps Montana south to Nebraska.

Nations: US

States/Provinces: MT?, ND:S?, NE:S3, SD:S?, WY:S3S4

ELEMENT SOURCES

Authors: J. Drake, mod. D. Faber-Langendoen, WCS **Confidence:** 2 **Identifier:** CEGL001580

References: Bourgeron and Engelking 1994, Driscoll et al. 1984, Hanson and Whitman 1938, Harner-White Consultants n.d., Hirsch 1985, Johnston 1987, Jones 1992b, NVS Corporation n.d., Steinauer and Rolfsmeier 2000, Stoecker-Keammerer Consultants n.d.(a), Stoecker-Keammerer Consultants n.d.(c), Western Resources Development Corporation n.d. (b), Western Resources Development Corporation n.d. (c)

PASCOPYRUM SMITHII - ELEOCHARIS SPP. HERBACEOUS VEGETATION
Western Wheatgrass - Spikerush species Herbaceous Vegetation

ELEMENT CONCEPT

Summary: This association includes stands of herbaceous vegetation growing in periodically inundated, small playas on the northern Great Plains. The sites supporting this association are closed basins (playas) of <1 ha with fine-textured soils that impede drainage; consequently the playas are flooded periodically. The small basins supporting this association have standing water during 'the wet seasons,' presumably meaning mainly in the spring and also after heavy summer rains. *Pascopyrum smithii* and *Eleocharis* spp. (*Eleocharis acicularis* or *Eleocharis*

palustris or both) dominate the vegetation, and *Hordeum brachyantherum, Juncus balticus*, and *Alopecurus* spp. often are present. Stands of this type typically include two zones, resulting from differences in the period of inundation. The lowest part of the stand, which is inundated most often and for the longest time, is dominated by *Eleocharis acicularis*, and may contain *Hordeum brachyantherum, Juncus balticus*, and *Alopecurus aequalis* or *Alopecurus carolinianus*, and bare soil accounts for about 75% of the ground surface; the higher part of the stand is dominated by *Pascopyrum smithii* and may contain substantial amounts of *Carex douglasii* and *Vulpia octoflora (= Festuca octoflora)*. The species common in the surrounding vegetation are absent from stands of this type, or contribute little cover.

Vegetation: This type includes low herbaceous vegetation growing in closed basins. *Pascopyrum smithii* and *Eleocharis acicularis* generally dominate, and the plants common in the surrounding steppe generally are absent or contribute very little cover. Stands of this type typically include two zones, resulting from differences in the period of inundation. The following information is from two stands surveyed by Jones (1997): the lowest part of the stand, which is inundated most often and for the longest time, is dominated by *Eleocharis acicularis* and may contain *Hordeum brachyantherum, Juncus balticus*, and *Alopecurus aequalis* or *Alopecurus carolinianus*, and bare soil accounts for about 75% of the ground surface; the higher part of the stand is dominated by *Pascopyrum smithii* and may contain substantial amounts of *Carex douglasii* and *Vulpia octoflora (= Festuca octoflora)*. According to Thilenius et al. (1995), *Hordeum jubatum* occurs on the margins of the stands.

Similar Associations:

- Pascopyrum smithii - Hordeum jubatum Herbaceous Vegetation (CEGL001582)--stands are dominated or codominated by *Pascopyrum smithii*, but *Eleocharis acicularis* is absent and *Hordeum jubatum* is a major species. Stands occur in playas where the subsoils contain higher concentrations of sodium (Paris and Paris 1974, Bergman and Marcus 1976). Holpp (1977) described vegetation from 10 playas in Campbell County, Wyoming, that seems very similar to the playas containing this association. His stands generally were dominated by *Pascopyrum smithii* and contained some wetland species (*Juncus balticus, Alopecurus carolinianus*), but they showed no consistency in species composition and none contained *Eleocharis acicularis*.

GRank & Reasons: G1 (98-11-30). This association has been described from a small area (ca. 250 square miles) in northeastern Wyoming, mainly on the divide between the Belle Fourche River drainage and the Cheyenne River drainage. The range of the type may extend into eastern Montana and western South Dakota, but further inventory and classification work are needed to confirm this. The area covered by stands of this association is estimated to be <100 acres because the playas are each 2 acres or smaller, and less than 50 occur in northeastern Wyoming where the association is best known. Enough additional stands may exist in other Northern Great Plains states (eastern Montana and the western Dakotas) to increase the estimated area to 100-1000 acres. The rank has been changed from G2G3 to G1 to reflect the very limited known distribution, the small number of stands, and the small proportion of stands that are undisturbed.

Comments: Species composition varies among stands of this type depending on the degree of inundation, but the degree of variation is unknown. More stand data might indicate that this association and *Pascopyrum smithii - Hordeum jubatum* Herbaceous Vegetation (CEGL001582) should be combined as it also occupies small playas.

ELEMENT DISTRIBUTION

Range: This association has been described from a small area (ca. 250 square miles) in northeastern Wyoming, mainly on the divide between the Belle Fourche River drainage and the Cheyenne River drainage. Two stands apparently have been described from the area of the Montana - South Dakota border as well (Hansen and Hoffman 1988, Table A-5, stands 61 and 136), suggesting that the range of the type may extend into eastern Montana and western South Dakota.

Nations: US

ELEMENT SOURCES

Authors: G.P. Jones, WCS **Confidence:** 2 **Identifier:** CEGL001581

References: BLM 1979b, Bergman and Marcus 1976, Bourgeron and Engelking 1994, Caballo Rojo Mine Application n.d., Driscoll et al. 1984, Hansen and Hoffman 1988, Hansen et al. 1984, Holpp 1977, Jones 1997, Mine Reclamation Consultants 1977, Paris and Paris 1974, Soil Conservation Service 1986, Thilenius et al. 1995, Western Resources Development Corporation n.d. (c)

PASCOPYRUM SMITHII - HORDEUM JUBATUM HERBACEOUS VEGETATION
Western Wheatgrass - Foxtail Barley Herbaceous Vegetation

ELEMENT CONCEPT

Environment: Stands of this association occupy temporarily flooded sites (playas and stock ponds) with deep, poorly drained, clayey, alkaline-saline soils. This type occurs on drawdown zones around reservoirs in eastern Montana (S. Cooper, MTNHP, pers. comm. 1998).
Vegetation: Grasses contribute most of the cover in this association, although forbs and scattered shrubs may be present. *Pascopyrum smithii* or *Elymus lanceolatus* dominate, and *Hordeum jubatum* contributes substantial cover. Other species may be present but contribute little cover. Stands in south-central Wyoming contain scattered *Atriplex gardneri* from the surrounding vegetation (Medicine Bow Mine, no date).
Similar Associations:

- Sporobolus airoides Northern Plains Herbaceous Vegetation (CEGL002274)
- Pascopyrum smithii - Eleocharis spp. Herbaceous Vegetation (CEGL001581)
- Hordeum jubatum Herbaceous Vegetation (CEGL001798)

GRank & Reasons: G4 (96-02-01). The G4 rank is based on a fairly broad geographic range.
Comments: Stands apparently occupy soils with higher sodium concentrations than do stands of the similar *Pascopyrum smithii - Eleocharis* spp. Herbaceous Vegetation (CEGL001581) (Bergman and Marcus 1976), or playas where the surface dries and the water table drops more quickly (BLM 1974). This association has not been described well. Further analysis of existing information and additional inventory will be helpful in determining the range of variation in stands of this type and how this type differs from other vegetation types of temporarily flooded sites.

ELEMENT DISTRIBUTION

Range: This wheatgrass saline prairie type is found in the northern Great Plains of the United States and adjacent Canada, extending from Colorado north to Montana and possibly Saskatchewan.
Nations: CA? US
States/Provinces: CO?, MT?, ND:S?, NE?, SK?, WY:S3?

ELEMENT SOURCES

Authors: WCS **Confidence:** 2 **Identifier:** CEGL001582
References: BLM 1979b, Bergman and Marcus 1976, Bourgeron and Engelking 1994, Driscoll et al. 1984, Medicine Bow Mine Application n.d.

SPARTINA PECTINATA TEMPORARILY FLOODED HERBACEOUS ALLIANCE
Prairie Cordgrass Temporarily Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: This is a wide-ranging alliance found on scattered low-elevation sites of the central and northeastern United States, and portions of the Intermountain West. The elevation range is from near sea level in the East and Upper Midwest to over 1500 m in east-central Colorado. Locations supporting this alliance are moist, poorly drained, sometimes alkaline areas along ephemeral, intermittent or perennial streams, and overflow areas of large river floodplains. Weaver (1965) reported that historically, large stands of *Spartina pectinata* occurred on mud flats of the Missouri River. This alliance can also be found in swales, meadows, and on the margins of marshes, ponds or lakes. Sites are generally level to gently sloping. Jones and Walford (1995) found stands along highly meandering, narrow (<12.5 m wide) floodplains, and often the channel was deeply entrenched. The water table is typically high, within 1 m of the surface; the sites are typically flooded for part of the winter and spring. Soils are fine-textured, ranging from clays to silt-loam (Weaver 1960, Steinauer 1989), and may be slightly to moderately alkaline (Ungar 1974, Hansen et al. 1995, Jones and Walford 1995). Soil water movement is rapid enough to preclude the accumulation of salts in the surface horizon. In the east, stands can experience droughty conditions in the summer and fall (Comer et al. 1995), while in the southern and central portion of this alliance's range they can remain saturated for much of the growing season (Kuchler 1974).
Vegetation: This alliance is found primarily in central North America. The vegetation of this alliance is characterized by dense stands of graminoids 1-2 m tall with scattered to very infrequent woody plants. In some stands, *Spartina pectinata* can form virtual monocultures, as a result of growth from vigorous rhizomes (Johnson and Knapp 1995, Hansen et al. 1995). The most abundant species are *Spartina pectinata, Calamagrostis canadensis,*

Carex aquatilis, Carex atherodes, Carex pellita (= Carex lanuginosa), Carex nebrascensis, and *Carex sartwellii*. Other common graminoids include *Andropogon gerardii, Muhlenbergia richardsonis, Panicum virgatum, Poa palustris* (in the western part of this alliance's range), and *Sorghastrum nutans*. Forbs can be abundant and include *Symphyotrichum ericoides (= Aster ericoides), Symphyotrichum novae-angliae (= Aster novae-angliae), Glycyrrhiza lepidota, Helianthus grosseserratus, Lythrum alatum, Pycnanthemum virginianum*, and *Thalictrum dasycarpum*. Shrubs and small trees are infrequent in the south and west but are often present in the north and east (MNNHP 1993, Chapman 1984). Among these *Cornus* spp., *Fraxinus pennsylvanica, Amorpha fruticosa*, and *Salix* spp. are typical.

Dynamics: *Spartina pectinata* is an early colonizer of suitable habitat and is tolerant of sediment deposition (Hansen et al. 1995, Weaver 1965). On the South Platte River floodplain it appears to be an early colonizer of the fresh sediments laid down by the 1995 flood.

Stands of *Spartina pectinata* have high production rates, however the rough-edged leaves make for poor forage quality, and it is not readily eaten by livestock or wildlife. Its tall height and thick growth provide shade and cover for wildlife and certain bird species (Hansen et al. 1988a).

ALLIANCE SOURCES

Authors: D.J. ALLARD 94, MOD. M.S., JT, Midwest **Identifier:** A.1347

References: Chapman 1984, Comer et al. 1995b, Cooper 1988, Culwell and Scow 1982, DeSelm 1989, Evans 1989a, Evans 1989b, Evans 1991, Faber-Langendoen et al. 1996, Hansen and Hoffman 1988, Hansen et al. 1988a, Hansen et al. 1989, Hansen et al. 1991, Hansen et al. 1995, Hoagland 1998a, Johnson and Knapp 1995, Johnston 1987, Jones and Walford 1995, Kittel et al. 1996, Kittel et al. 1999a, Kuchler 1974, MNNHP 1993, Sawyer and Keeler-Wolf 1995, Steinauer 1989, Ungar 1974c, Weaver 1960, Weaver 1965

SPARTINA PECTINATA - CAREX SPP. HERBACEOUS VEGETATION

Prairie Cordgrass - Sedge species Herbaceous Vegetation

ELEMENT CONCEPT

Environment: At Wind Cave National Park in South Dakota, stands occur in drainage bottoms where the soil is wet for at least part of the growing season (H. Marriott pers. comm. 1999). At Theodore Roosevelt and Badlands national parks, stands occur in poorly drained depressions within floodplains of major rivers.

Vegetation: At Wind Cave National Park in South Dakota, this type has dense herbaceous cover, greater than 75%. Species dominance is patchy within stands, with various graminoids locally abundant, often to the exclusion of other species. In the single sampled stand, *Spartina pectinata, Carex nebrascensis*, and *Eleocharis palustris* were locally dominant. *Epilobium ciliatum* was common in shallow water (H. Marriott pers. comm. 1999). At Theodore Roosevelt National Park in North Dakota *Spartina pectinata* is the dominant species. Species richness is generally low. *Hordeum jubatum* and *Pascopyrum smithii* are the most prominent secondary species (J. Butler pers. comm. 1999).

At Badlands National Park in South Dakota, prairie cordgrass stands are small, but dense. Aerial cover of the entire herbaceous layer is typically estimated at 75-100%. *Spartina pectinata* is the dominant species. The stands occupy moist soils and occur adjacent to spikerush *Eleocharis palustris, Polygonum amphibium, Typha angustifolia, Typha latifolia*, and *Schoenoplectus pungens (= Scirpus pungens)* stands; the latter stands occupy saturated to inundated soils. Adjacent uplands are typically vegetated by *Pascopyrum smithii*.

Dynamics: Sites may occasionally flood from rivers or ponding up of depressions.

Similar Associations:

- Panicum virgatum - (Pascopyrum smithii) Herbaceous Vegetation (CEGL001484)
- Spartina pectinata - Schoenoplectus pungens Herbaceous Vegetation (CEGL001478)--This association may simply need to be split between a *Schoenoplectus pungens* association and a *Spartina pectinata* association.
- Spartina pectinata - Calamagrostis stricta - Carex spp. Herbaceous Vegetation (CEGL002027)--This is the northern tallgrass region equivalent.

GRank & Reasons: G3? (99-09-28). This type has a relatively restricted distribution, and occurs in somewhat specialized wetland habitats in an arid climate. In addition, many such wetland sites are subject to heavy grazing pressure by cattle, which favor these moist locations. No element occurrences have been documented for this type, but at least several stands occur within three national parks in the western Dakotas.

Comments: It is possible that *Panicum virgatum - (Pascopyrum smithii)* Herbaceous Vegetation (CEGL001484) could be considered a variant of this type. This type is restricted to the Great Plains ecoregions and is not found in

the tallgrass prairie regions of the Midwest, where *Spartina pectinata - Calamagrostis stricta - Carex* spp. Herbaceous Vegetation (CEGL002027) is found.

ELEMENT DISTRIBUTION

Range: This cordgrass wet prairie type is found in the northwestern Great Plains of the United States, particularly in the western Dakotas and eastern Montana.
Nations: US
States/Provinces: MT:S3, ND:S?, SD:S?

ELEMENT SOURCES

Authors: D. Faber-Langendoen, WCS **Confidence:** 2 **Identifier:** CEGL001477
References: Bourgeron and Engelking 1994, Culwell and Scow 1982, Driscoll et al. 1984

SPARTINA PECTINATA - SCHOENOPLECTUS PUNGENS HERBACEOUS VEGETATION
Prairie Cordgrass - Threesquare Herbaceous Vegetation

ELEMENT CONCEPT

Environment: This community is usually found as narrow bands along the margins of low-gradient or standing open water and in depressions where the soil is saturated or flooded for short periods during the growing season (Jones and Walford 1995). Soils are fine-textured and often have a high organic content.
Vegetation: This community is dominated by tall graminoids approximately 1-2 m tall. Vegetation cover is usually high. *Spartina pectinata* is dominant and can form near monocultures. *Schoenoplectus pungens (= Scirpus pungens), Poa pratensis, Carex praegracilis*, and *Carex nebrascensis* are all common constituents of the herbaceous stratum (Jones 1992b). Shrubs and trees are not abundant, but *Salix* spp. can be found in many stands.
GRank & Reasons: G3? (00-11-29). The wetland vegetation included in this association occurs in stream channels and on low terraces on the Great Plains of eastern Montana and northeastern Wyoming. The validity of this association has not been demonstrated by analysis of data or descriptions from stands of *Spartina pectinata* vegetation, so the syntaxonomy of the association is questionable and the rank must be considered inexact.
Comments: A number of wetland and riparian studies have produced data on stands of vegetation dominated by *Spartina pectinata* with *Schoenoplectus pungens* present in many of those stands. The presence of substantial amounts of *Schoenoplectus pungens*, to the point that it codominates with *Spartina pectinata*, seems to have prompted the naming of this *Spartina pectinata - Schoenoplectus pungens* Herbaceous Vegetation (CEGL001478). However, there seems to have been no thorough comparison of these *Spartina pectinata - Schoenoplectus pungens* stands to other *Spartina pectinata* stands with little or no *Schoenoplectus pungens*, so the relationship of this association to others is unclear.

ELEMENT DISTRIBUTION

Range: Stands from southeastern Montana and northeastern Wyoming seem to belong to this association, but whether stands from other areas also belong to it is unknown.
Nations: US
States/Provinces: MT:S3, WY:S2S3

ELEMENT SOURCES

Authors: J. Drake, WCS **Confidence:** 3 **Identifier:** CEGL001478
References: Bourgeron and Engelking 1994, Culwell and Scow 1982, Driscoll et al. 1984, Hansen et al. 1995, Jones 1992b, Jones and Walford 1995, Vanderhorst et al. 1998

SPARTINA PECTINATA WESTERN HERBACEOUS VEGETATION
Prairie Cordgrass Western Herbaceous Vegetation

ELEMENT CONCEPT

Summary: In Colorado, this is a tallgrass meadow comprised entirely of *Spartina pectinata*. Stands occurs in small swales on the plains as well as on floodplains of larger rivers. Stands of this grass have been included in other tallgrass prairie plant associations. On large river floodplains, this type occurs as distinct patches and is distinguished from adjacent riparian types by micro-topography and degree of soil saturation. Weaver (1965) reports

that historically, large stands of *Spartina pectinata* occurred on mud flats of the Missouri River. Large stands have been observed south of Denver, now threatened by housing and golf course developments (Steve Kettler pers. comm.).

Additional information on stands outside of Colorado will be included later.

Similar Associations:

- Spartina pectinata - Carex spp. Herbaceous Vegetation (CEGL001477)

GRank & Reasons: G3? (96-02-01).

Comments: Compare this association with *Spartina pectinata - Carex* spp. Herbaceous Vegetation (CEGL001477).

ELEMENT DISTRIBUTION

Nations: US

States/Provinces: CO:S1, MT:S3?, WA:S1, WY:S?

ELEMENT SOURCES

Authors: WCS **Confidence:** 2 **Identifier:** CEGL001476

References: Bourgeron and Engelking 1994, Driscoll et al. 1984, Evans 1989a, Hansen and Hoffman 1988, Hansen et al. 1989, Hansen et al. 1991, Hansen et al. 1995, Kittel et al. 1996, Weaver 1965

CAREX AQUATILIS SEASONALLY FLOODED HERBACEOUS ALLIANCE

Aquatic Sedge Seasonally Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Vegetation types within this common, widespread alliance occur as large meadows in high montane valleys or as narrow strips bordering ponds and streams at lower elevations. Elevations range from near sea level in California to 3500 m in Colorado. Stands occur in a variety of landforms, but the largest expanses occur in broad, low-gradient valleys where large snowmelt-fed swales and slopes dominate the landscape. Stands also occur in fine sediments at the margins of lakes, silted-in beaver ponds, or depressions left by migrating stream channels. Looman (1981a, 1982) found *Carex aquatilis*-dominated stands in the northern Great Plains on mostly mineral soils in fresh or slightly saline shallow marshes.

Soils are typically Histosols. Mollisols are less frequently associated with this alliance. Soil texture varies from clay to sandy loam. Water tables are at or near the soil surface throughout the year. Soil pH ranges from 6.0-7.0 (Hansen et al. 1995).

Vegetation in the alliance usually occurs in a mosaic of riparian plant associations, such as *Salix planifolia, Salix wolfii*, and *Salix monticola - Salix geyeriana* shrublands and *Carex utriculata* wetlands in adjacent standing water. *Abies lasiocarpa - Picea engelmannii* forests and alpine fell-fields occur on adjacent hillslopes at higher elevations (Kittel et al. 1999).

Vegetation: Vegetation types within this alliance are classified as seasonally flooded temperate grasslands. Vegetation types are characterized by a dense, rhizomatous meadow of *Carex aquatilis* (50-80%), usually accompanied a few other graminoids species such as *Calamagrostis canadensis* or *Deschampsia caespitosa*. *Carex utriculata* is often present with 10-30% cover. A few forbs are commonly present, with percent cover ranging from 10-25%. Forb species include *Pedicularis groenlandica, Caltha leptosepala, Symphyotrichum foliaceum (= Aster foliaceus), Urtica dioica*, and *Epilobium ciliatum*. The fern layer is typically dominated by *Equisetum variegatum* with percent cover up to 40%. Willow carrs are often adjacent. A few scattered willows occur within the *Carex aquatilis* stand, such as *Salix monticola, Salix drummondiana, Salix geyeriana*, and *Salix planifolia*. In the subalpine stands *Abies lasiocarpa* and *Picea engelmannii* occur with up to 10% cover (Kittel et al. 1999, Hansen et al. 1995).

Dynamics: Presence of *Carex utriculata* may indicate the site has progressed from the more wet *Carex utriculata* type to the current more mesic conditions, and may become dominated by *Salix planifolia* or *Salix wolfii* (Youngblood et al. 1985b). Wilson (1969) reports that *Carex aquatilis* associations trap sediment from overbank flows which forms a clay pan, eventually raising the water table. This process drives retrogressive succession and a plant association dominated by *Carex utriculata* often takes over on these sites (Wilson 1969).

ALLIANCE SOURCES

Authors: D. CULVER, West **Identifier:** A.1404

References: Andrews 1983, Baker 1983a, Baker 1983c, Baker 1984a, Baker and Kennedy 1985, Bierly 1972, Briggs and MacMahon 1983, Bunin 1975c, Cox 1933, Cronquist et al. 1977, Faber-Langendoen et al. 1996, Giese 1975, Hall 1971, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, Hermann 1970, Hess 1981, Hess and Wasser 1982, Hickman 1993, Johnson 1932a, Johnson 1932b, Johnson 1936, Johnson 1939, Johnston 1987, Kartesz

1999, Kearney and Peebles 1969, Kettler and McMullen 1996, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1995, Kittel et al. 1996, Kittel et al. 1999a, Komarkova 1976, Komarkova 1986, Kovalchik 1987, Kovalchik 1993, Langenheim 1962, Lewis 1970, Looman 1981a, Looman 1982, Mattson 1984, Mutel 1976, Norton et al. 1981, Padgett and Manning 1988, Padgett et al. 1988b, Padgett et al. 1989, Ramaley 1919a, Ramaley 1920, Robbins 1918, Sanderson and Kettler 1996, Terwilliger et al. 1979a, Tuhy 1981, Tuhy and Jensen 1982, Wilson 1969, Youngblood et al. 1985a, Youngblood et al. 1985b

CAREX AQUATILIS HERBACEOUS VEGETATION
Aquatic Sedge Herbaceous Vegetation

ELEMENT CONCEPT

Environment: This plant association occurs in a variety of valley types, but the largest expanses occur in broad, low-gradient valleys where large snowmelt-fed swales and slopes dominate the landscape. It can also grow in fine sediments at the margins of lakes and beaver ponds. Presence of at least 25% cover of *Carex aquatilis* typically indicates wet soils with high organic matter or histic epipedons.

Vegetation: This plant association is characterized by a dense rhizomatous meadow of *Carex aquatilis* (10-80% cover), usually accompanied by a few other graminoids species such as *Calamagrostis canadensis* (1-40%) or *Deschampsia caespitosa* (1-16%). *Eleocharis quinqueflora* can be abundant on organic substrates (1-49% cover) at high elevations. *Carex utriculata* (1-20% cover) may be present. When present, *Carex utriculata* is usually not more than one-third the cover of *Carex aquatilis* cover. If it is more than that, the stand may be classified as *Carex aquatilis* - *Carex utriculata* Herbaceous Vegetation (CEGL001803) or *Carex utriculata* Herbaceous Vegetation (CEGL001562). Forbs are often present, although sometimes inconspicuous (generally <10%, but can be as high as 40%). Species include *Epilobium* spp., *Pedicularis groenlandica, Caltha leptosepala, Cardamine cordifolia*, and *Mertensia ciliata*.

Dynamics: Overgrazing by livestock can dry the site, increase non-native grass cover, and reduce the vigor of root structure. The wet and often saturated soils of this plant association are also vulnerable to compaction by livestock and heavy equipment. In order to maintain productivity and vigor of the plants and prevent damage to the soils, livestock grazing should be deferred until soils dry (Hansen et al. 1995).

Deferred and rest rotation grazing systems are recommended for maintaining the vigor and productivity of this plant association. Rest periods are recommended in order to provide time for plant establishment. Late summer and fall grazing is not recommended because if there are adjacent willows, they are vulnerable to pruning damage due to limited regrowth before the end of the growing season (Hansen et al. 1995, Kovalchik and Elmore 1992).

Beaver activity in the vicinity of this plant association is important for maintaining the health of the riparian ecosystem. Beaver dams aid in controlling channel downcutting, streambank erosion, and downstream movement of sediment. Beaver dams raise the water table and provide water for hydrophytic plants including willows and sedges. The trapping of sediment behind beaver dams, along with plant reproduction, raises the channel bed and creates a wetland environment. Land managers should consider maintaining beaver activity in an area versus their removal (Hansen et al. 1995).

Burning of this plant association temporarily increases the productivity of *Carex utriculata* and *Carex aquatilis*. However, livestock grazing needs to be eliminated for the year prior to burning and for at least 2-3 years after burning. This is necessary in order to keep livestock from damaging young, palatable regrowth and to allow for root reserve build up. Prescribed burning is also an effective method of rejuvenating decadent clumps of willows. The willow species in this plant association vigorously sprout following quick, hot fires. Slow-burning fires can actually damage the plants (Hansen et al. 1995).

Presence of *Carex utriculata* may indicate the site has progressed from the more wet *Carex utriculata* community to the current less mesic conditions, and may become dominated by *Salix planifolia* or *Salix wolfii* (Youngblood et al. 1985a). Wilson (1969) reports that *Carex aquatilis* associations trap sediment from overbank flows which forms a clay pan, eventually raising the water table. This process drives retrogressive succession, and a plant association dominated by *Carex utriculata* takes over on these sites (Wilson 1969).

GRank & Reasons: G5 (96-02-01).

Comments: *Carex aquatilis* Herbaceous Vegetation (CEGL001802) is distinguished from *Carex aquatilis* - *Carex utriculata* Herbaceous Vegetation (CEGL001803) and *Carex aquatilis* - *Pedicularis groenlandica* Herbaceous

Vegetation (CEGL001804) by the dominance of *Carex aquatilis*. If *Carex utriculata* is present, it is no more than 1/3 of the total cover.

ELEMENT DISTRIBUTION

Range: This association is common and located throughout the western U.S. and Canada.
Nations: US
States/Provinces: AZ?, CA:S3, CO:S4, ID:S4, MT:S4, NM:S4, NV:S?, OR:S4, UT:S3?, WA:S3, WY:S3

ELEMENT SOURCES

Authors: G. Kittel, WCS **Confidence:** 1 **Identifier:** CEGL001802
References: Baker 1983c, Baker 1984a, Baker and Kennedy 1985, Bierly 1972, Bourgeron and Engelking 1994, Briggs and MacMahon 1983, Bunin 1975c, Cox 1933, Crowe and Clausnitzer 1997, Driscoll et al. 1984, Giese 1975, Hall 1971, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, Hess and Wasser 1982, Johnson 1932a, Johnson 1932b, Johnson 1936, Johnson 1939, Kettler and McMullen 1996, Kittel and Lederer 1993, Kittel et al. 1995, Kittel et al. 1996, Komarkova 1976, Kovalchik 1993, Kovalchik and Elmore 1992, Lewis 1970, Manning and Padgett 1995, Mattson 1984, Norton et al. 1981, Padgett and Manning 1988, Padgett et al. 1988b, Padgett et al. 1989, Ramaley 1919a, Ramaley 1920, Robbins 1918, Sanderson and Kettler 1996, Terwilliger et al. 1979a, Tuhy 1981, Tuhy and Jensen 1982, Wilson 1969, Youngblood et al. 1985a, Youngblood et al. 1985b

CAREX ATHERODES SEASONALLY FLOODED HERBACEOUS ALLIANCE

Awned Sedge Seasonally Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Stands of this alliance occur on lowland sites that have standing water for several weeks each year. These sites are typically in depressions or basins but can be along streams and rivers (MNNHP 1993). The water may be fresh to mildly saline. Soils can be mineral but mucks often form through the buildup of organic material (Looman 1982).
Vegetation: This alliance, found in the northern Great Plains typically forms a central core of a wetland or bands along more permanent water (Stewart and Kantrud 1971). Vegetation cover is usually high but can vary in wet or dry years. Dominant species are herbaceous and typically between 0.5 and 1 m tall. Forb diversity is moderate to high. *Carex atherodes* can either form almost monotypic stands or be the dominant species (Walker and Coupland 1970). Common associated species include *Alisma triviale, Eleocharis palustris, Glyceria grandis* (in drier stands), *Mentha arvensis, Phalaris arundinacea, Polygonum amphibium, Schoenoplectus fluviatilis (= Scirpus fluviatilis), Scolochloa festucacea* (especially on mildly saline sites), *Sium suave*, and *Sparganium eurycarpum*. Shrubs, including *Salix* spp., can invade stands of this alliance, especially in the eastern portions of its range.

ALLIANCE SOURCES

Authors: MCS, Midwest **Identifier:** A.1396
References: Brotherson 1969, Dix and Smeins 1967, Faber-Langendoen et al. 1996, Looman 1982, MNNHP 1993, Stewart and Kantrud 1971, Walker and Coupland 1970

CAREX ATHERODES HERBACEOUS VEGETATION

Awned Sedge Herbaceous Vegetation

ELEMENT CONCEPT

Environment: This community is found on lowland sites that have standing water for several weeks each year. These sites are typically in depressions or basins but can be along streams and rivers (MNNHP 1993). The water may be fresh or mildly saline. Soils can be mineral but mucks often form through the buildup of organic material (Looman 1982).
Vegetation: Vegetation cover is usually high but can vary in wet or dry years. Dominant species are herbaceous and typically between 0.5 and 1 m tall. Forb diversity is moderate to high (MNNHP 1993). *Carex atherodes* can form almost monotypic stands or it may be dominant. Common associated species are *Alisma triviale, Symphyotrichum lanceolatum (= Aster lanceolatus), Eleocharis palustris, Glyceria grandis* (in drier stands), *Mentha arvensis, Phalaris arundinacea, Polygonum amphibium, Scolochloa festucacea* (especially on mildly saline stands), *Sium suave*, and *Sparganium eurycarpum*. Shrubs, including *Salix* spp., can invade this community, especially in the

eastern portions of its range. *Beckmannia syzigachne* often is an indicator of disturbance (Walker and Coupland 1970).
Dynamics: Fire may have been important to prevent the invasion of this community by woody species, especially in the eastern part of its range (MNNHP 1993).
Similar Associations:
- Scolochloa festucacea Herbaceous Vegetation (CEGL002260)

GRank & Reasons: G3G5 (98-06-22).
Comments: See Dix and Smeins (1967) for a discussion of the hydrology of this type, which borders on temporarily vs. seasonally flooded. See also Stewart and Kantrud (1972, including photos on pp. 34-35). Brotherson (1969) performed an ordination of pothole and drainage communities on a prairie in northwestern Iowa and found a community with 55% cover by *Carex atherodes*. The only other species with more than 4% cover was *Polygonum amphibium*, at 30%. *Schoenoplectus fluviatilis (= Scirpus fluviatilis), Calamagrostis canadensis, Carex lasiocarpa, Spartina pectinata*, and *Carex aquatilis* all had between 1 and 3% cover. This community occurred as a narrow band around potholes or sometimes in wide patches.
The relationship of this community and *Scolochloa festucacea* Herbaceous Vegetation needs to better defined. *Carex atherodes* tends to be on non-saline sites while *Scolochloa festucacea* tends to do better on mildly to moderately saline sites (Walker and Coupland 1970). However, the two can co-occur or codominate on mildly saline sites. *Carex atherodes* tends to occur on drier sites (Smith 1973).

ELEMENT DISTRIBUTION

Range: This awned sedge wet meadow occurs in the northern tallgrass prairie region of the United States and Canada, from Minnesota and Iowa, north and west into the Dakotas, Manitoba and perhaps other provinces.
Nations: CA US
States/Provinces: IA:S?, MB:S2, MN:S?, ND:S?, SD:S?

ELEMENT SOURCES

Authors: J. Drake, mod. D. Faber-Langendoen, MCS **Confidence:** 2 **Identifier:** CEGL002220
References: Brotherson 1969, Dix and Smeins 1967, Looman 1982, MNNHP 1993, Smith 1973, Stewart and Kantrud 1971, Stewart and Kantrud 1972, Walker and Coupland 1970

CAREX NEBRASCENSIS SEASONALLY FLOODED HERBACEOUS ALLIANCE

Nebraska Sedge Seasonally Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Vegetation types within this alliance occur on saturated soils of flat floodplains bordering ponds or pools adjacent to stream channels. Stands also occur on flat marshy areas surrounding springs or wet meadows. Elevations range from sea level in California to 2400 m in Colorado.

The alluvial soils are heavy clays and silty clay loams with high organic matter content. Soils are alkaline in some sites. Anoxic conditions often occur within 20 cm of the surface either in the form of a gleyed layer or abundant mottling. Soils often remain saturated throughout the summer, but water tables occasionally drop below 1 m of the soil surface by the end of the growing season. *Carex nebrascensis* typically occurs on sites where water flows over the surface but does not pond (Ratliff and Westfall 1988).

Adjacent riparian vegetation includes *Populus angustifolia* and *Populus balsamifera ssp. trichocarpa* forests, *Salix exigua, Salix lucida*, and *Salix boothii* shrublands, and *Carex praegracilis, Carex utriculata*, and *Schoenoplectus tabernaemontani* meadows. *Pinus edulis - Juniperus* spp. and *Quercus gambelii* woodlands, *Sarcobatus vermiculatus* and *Artemisia tridentata* shrublands, and *Bouteloua gracilis* shortgrass prairies occur on adjacent hillslopes.
Vegetation: Vegetation types within this alliance are classified as seasonally flooded temperate or subpolar grasslands. This alliance is dominated by 30-98% cover of *Carex nebrascensis*. Other graminoids include *Eleocharis palustris, Carex praegracilis, Catabrosa aquatica, Calamagrostis stricta, Triglochin maritima*, and *Schoenoplectus pungens (= Scirpus pungens)*. Forb cover is generally low.
Dynamics: In Montana, the *Carex nebrascensis* type is considered a grazing-disclimax. Under season-long grazing, *Carex nebrascensis* increases in abundance, replacing former dominant species (Hansen et al. 1995). However, under extreme grazing conditions and a resulting drop in the water table, *Juncus balticus* or *Poa pratensis* can eventually replace *Carex nebrascensis*. In Nevada, sites dominated by *Carex nebrascensis* are considered the

Potential Natural Community (Manning and Padgett 1995), which appears to be the case in undisturbed stands in Colorado.

Unlike other moisture-loving species of sedges, *Carex nebrascensis* readily tolerates dry air and intense insolation, so long as its roots are wet (Cronquist et al. 1977).

ALLIANCE SOURCES

Authors: D. CULVER, West **Identifier:** A.1417

References: Baker 1982b, Cooper and Cottrell 1990, Cronquist et al. 1977, Durkin et al. 1994b, Durkin et al. 1995, Hall 1973, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, Hermann 1970, Johnston 1987, Jones and Walford 1995, Kearney and Peebles 1969, Kittel et al. 1994, Kittel et al. 1996, Kittel et al. 1999a, Kovalchik 1987, Manning and Padgett 1995, Martin and Hutchins 1980, Mutz and Queiroz 1983, Padgett and Manning 1988, Padgett et al. 1988b, Padgett et al. 1989, Ratliff and Westfall 1988, Youngblood et al. 1985a, Youngblood et al. 1985b

CAREX NEBRASCENSIS HERBACEOUS VEGETATION

Nebraska Sedge Herbaceous Vegetation

ELEMENT CONCEPT

Environment: This wetland plant association occurs on the western Great Plains and throughout much of the western U.S. Elevation ranges from 1000-2800 m (3300-9200 feet). Stands form open meadows that occur along the margins of streambanks, flat floodplains, and lakes often forming a band along the alluvial terrace. Stands have also been sampled from marshy areas surrounding springs and below seeps on lower hillslopes. This association is often found on well-developed soil, but occurs on a wide variety of soil types ranging from saturated organics to Mollisols to Entisols. Soils tend to be fine-textured alluvium, ranging from sandy, silty loam, clay loam, or clay to organic and are typically gleyed and mottled near the surface because of the high water table most of the growing season.

Vegetation: These wetlands are characterized by a moderately dense to dense perennial graminoid layer dominated or codominated by *Carex nebrascensis* (25-99% cover), that generally forms small- to medium-sized meadows. Stands often are nearly pure *Carex nebrascensis*, but a variety of other graminoid species may be present such as *Carex praegracilis, Calamagrostis stricta, Calamagrostis canadensis, Deschampsia caespitosa, Eleocharis palustris, Glyceria striata, Juncus balticus, Schoenoplectus pungens (= Scirpus pungens)*, or *Triglochin maritima*. Forb cover is generally low, but can be high in moist locations. Common forbs include *Eurybia integrifolia (= Aster integrifolius), Geum macrophyllum, Mentha arvensis, Mimulus glabratus, Heracleum maximum*, and *Ranunculus cymbalaria*. Introduced species *Poa pratensis, Poa palustris, Cirsium arvense*, and *Melilotus officinalis* may also be common.

In Nebraska, common species include *Agrostis stolonifera, Carex hystericina, Carex pellita (= Carex lanuginosa), Eleocharis erythropoda, Equisetum* spp., *Juncus balticus, Schoenoplectus pungens (= Scirpus pungens)*, and *Triglochin* spp. (Steinauer and Rolfsmeier 2000).

Dynamics: In Montana, the *Carex nebrascensis* Community Type is considered a grazing-disclimax. Under season-long grazing, *Carex nebrascensis* increases in abundance, replacing former dominant species (Hansen et al. 1995). However, under extreme grazing conditions and a resulting drop in the water table, *Juncus balticus* or *Poa pratensis* can eventually replace *Carex nebrascensis*. In Nevada, sites dominated by *Carex nebrascensis* are considered the Potential Natural Community (Manning and Padgett 1995), which appears to be the case in undisturbed stands in Colorado.

GRank & Reasons: G4 (96-02-01). This type is widely distributed, but many examples have been heavily grazed by cattle, lowering their floristic quality.

Comments: In the Black Hills, classification of stands was problematic due to identification problems with *Carex nebrascensis* and *Carex aquatilis*. The two are difficult to distinguish based on available keys and written descriptions (Marriott and Faber-Langendoen 2000).

ELEMENT DISTRIBUTION

Range: This sedge meadow type is widely distributed from the western Great Plains into the western mountains of the United States, ranging from South Dakota and Montana to possibly as far west as Washington, south to California and east to New Mexico.

Nations: US

States/Provinces: AZ:S2, CA:S3, CO:S3, ID:S3, MT:S4, NE:S2, NM?, NV:SR, OR:S3?, SD:S?, UT:S3?, WA?, WY:S3

ELEMENT SOURCES

Authors: J. Drake, mod. D. Faber-Langendoen, mod. K.A. Schulz, WCS **Confidence:** 1 **Identifier:** CEGL001813

References: Baker 1982b, Bourgeron and Engelking 1994, Cooper and Cottrell 1990, Driscoll et al. 1984, Hall 1973, Hall and Hansen 1997, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, Jones 1992b, Jones and Walford 1995, Kittel et al. 1994, Kittel et al. 1996, Kittel et al. 1999a, Kovalchik 1987, Manning and Padgett 1995, Marriott and Faber-Langendoen 2000, Mutz and Queiroz 1983, Padgett et al. 1988b, Padgett et al. 1989, Steinauer and Rolfsmeier 2000, Youngblood et al. 1985a, Youngblood et al. 1985b

CAREX PELLITA SEASONALLY FLOODED HERBACEOUS ALLIANCE

Woolly Sedge Seasonally Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Vegetation types within this alliance occur in wet meadows, basins, and sometimes shallow water. They are found from the plains (<300 m) and lowlands (1050 m) to moderate (2700 m) elevations in the mountains in low-gradient (1-2% slope), trough-shaped, moderately wide valleys with gentle to moderately steep sideslopes. Stands occur in depressions and swales at the saturated edge of stream channels or in standing water. Soils are variable, but most commonly mineral with large amounts of organic matter or more rarely, with thick accumulations of partially decomposed sedges. Stands are poorly drained, and water may persist on the soil surface through the summer. Streambanks have alluvial soils composed of sand, silt, and clay deposits. These stands are often flooded during spring runoff, and water levels normally remain in the rooting zone throughout the growing season (Hansen et al. 1988a). Mottling often occurs throughout the profile.

Adjacent vegetation along foothill streams includes *Salix amygdaloides, Populus balsamifera ssp. trichocarpa*, and *Populus angustifolia* woodlands. *Populus deltoides* woodlands occur along streams on the eastern Great Plains. Adjacent communities at higher elevations are typically *Artemisia* spp. shrublands or *Pinus contorta* forests.

Vegetation: This grassland alliance is characterized by a nearly monotypic stand of 40-90% cover of *Carex pellita (= Carex lanuginosa)*. Other graminoid cover is minor (0-20%), but includes *Carex microptera, Phalaris arundinacea, Calamagrostis stricta, Carex nebrascensis, Juncus balticus, Scirpus microcarpus, Schoenoplectus acutus (= Scirpus acutus)*, and *Schoenoplectus pungens (= Scirpus pungens)*. Scattered forbs include 0-40% cover of *Geum macrophyllum, Mentha arvensis, Prunella vulgaris*, and *Potentilla gracilis*. In the plains, the most abundant species are *Calamagrostis stricta, Carex pellita, Carex sartwellii, Anemone canadensis, Apocynum cannabinum, Symphyotrichum lanceolatum (= Aster lanceolatus), Eleocharis compressa, Juncus balticus, Phalaris arundinacea, Polygonum amphibium*, and *Schoenoplectus americanus (= Scirpus americanus)*. *Carex buxbaumii* can be common (Nelson et al. 1981, Dix and Smeins 1967).

Dynamics: The *Carex pellita* plant association appears to be a fairly stable community due to the dominant species' rhizomatous roots (Padgett et al. 1989). In Montana, the *Carex pellita* plant association can include communities dominated by *Carex lasiocarpa*. With season-long grazing, *Carex pellita* decreases in abundance, shifting dominance towards *Poa pratensis*. In Colorado, stands of *Carex pellita* that occur on streambanks with a consistent water table depth and heavy, cohesive clay soils, appear stable as long as the water table remains constant.

ALLIANCE SOURCES

Authors: D. CULVER, MOD. D. FABER-, West **Identifier:** A.1414

References: Cronquist et al. 1977, Dix and Smeins 1967, Drake and Faber-Langendoen 1997, Hansen et al. 1988a, Hansen et al. 1988b, Hermann 1970, Hickman 1993, Kittel et al. 1995, Kovalchik 1987, Nelson et al. 1981, Padgett et al. 1988b, Padgett et al. 1989

CAREX PELLITA HERBACEOUS VEGETATION

Woolly Sedge Herbaceous Vegetation

ELEMENT CONCEPT

Summary: This plant association occurs along stream channels, and in depressions and swales along floodplains at low to moderate elevations in the western U.S. from Washington to Montana south to Oregon, Utah, and Colorado. It also has been reported from British Columbia, Canada. These wetlands form small to medium-sized meadows. *Carex pellita (= Carex lanuginosa)*, a distinctive wetland-indicator species, clearly dominates stands with 30-80%

cover. Low species diversity, with few associates having high constancy, is characteristic. *Deschampsia caespitosa, Carex microptera, Carex nebrascensis, Carex simulata, Carex praegracilis, Elymus glaucus, Juncus balticus, Schoenoplectus pungens (= Scirpus pungens), Equisetum arvense*, and *Equisetum hyemale* are sometimes present with low cover. On the eastern plains of Colorado, it can occur under a canopy of cottonwood trees, forming *Populus deltoides / Carex pellita* Woodland (CEGL002649).

Similar Associations:

- Populus deltoides / Carex pellita Woodland (CEGL002649)

GRank & Reasons: G3 (00-10-17). This association has been documented in small stands throughout much of the western United States and Canada. High-quality stands are uncommon due to improper grazing by livestock, hydrologic alterations, and ground-disturbing activities. The diagnostic species in this association is very palatable to livestock when young. Stands may be dry at the surface as early as July allowing season-long livestock utilization. Overuse by livestock can result in introduction of non-native species such as *Poa pratensis* and *Taraxacum officinale* or an increase in less palatable species such as *Carex nebrascensis* and *Juncus balticus*. Overuse by livestock can also result in stream downcutting that may permanently change the site potential from a wet to a dry meadow. *Phalaris arundinacea*, an additional non-native species, may become established due to alteration of hydrology or sediment inputs. Meadows that support stands of *Carex pellita* are often used for hay pasture and may be drained, ditched and flood irrigated, or seeded with pasture grasses to increase hay production.

Comments: This plant association has been described in recent classifications throughout its range (Kovalchik 1987, Padgett et al. 1989, Evenden 1990, Crowe and Clausnitzer 1997, Manning and Padgett 1995, Kittel et al. 1999a). Hansen et al. (1995) included all combinations of *Carex pellita (= Carex lanuginosa), Carex lasiocarpa*, and *Carex buxbaumii* in the *Carex lasiocarpa* habitat type. There may be some similarities between sites supporting *Carex pellita, Carex lasiocarpa*, and *Carex buxbaumii* plant associations. However, *Carex pellita* stands typically occur on mineral soils in seasonally saturated floodplains along runoff-dominated stream channels or headwater basins, while *Carex lasiocarpa* and *Carex buxbaumii* occur on organic soils in association with semipermanently saturated spring-fed or groundwater-driven wetlands. From a biodiversity conservation standpoint, the three associations should be recognized as distinct types. Identification of this association is complicated when shrubs are present and when *Carex pellita* is not clearly dominant.

ELEMENT DISTRIBUTION

Range: This plant association is a minor type in Colorado, Utah, Idaho, Montana, Washington, Oregon, and British Columbia, Canada. *Carex pellita* is a common sedge that occurs throughout the northern and western United States. It is likely that this or a closely related association occurs in Wyoming, California, and New Mexico.

Nations: CA US

States/Provinces: BC:S2Q, CO:S3, ID:S2, MT?, OR:S5Q, UT:S2S3, WA:S1Q

ELEMENT SOURCES

Authors: M. Jankovsky-Jones, WCS **Confidence:** 1 **Identifier:** CEGL001809

References: Bourgeron and Engelking 1994, Crowe and Clausnitzer 1997, Driscoll et al. 1984, Evenden 1990, Hansen et al. 1988b, Hansen et al. 1995, Kittel et al. 1995, Kittel et al. 1999a, Kovalchik 1987, Manning and Padgett 1995, Padgett et al. 1988b, Padgett et al. 1989

CAREX PRAEGRACILIS SEASONALLY FLOODED HERBACEOUS ALLIANCE

Clustered Field Sedge Seasonally Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Vegetation types within this alliance occur in wet meadows and moist swales and adjacent to seeps, springs, and stream channels in the mountains and shortgrass prairie. Elevations range from 1300-2400 m. Sites range from wet meadows that are often alkaline to peat-accumulating fens. The majority of the sites are relatively flat (1-4% slope).

Soils are variable. Some sites have fairly deep soils that range from heavy clays to sandy clay loams with mottling. Sites near seeps or springs have peaty soils, up to 60 cm deep. Surface water is typically present for extended periods well into the growing season. The water table is usually near the soil surface. Adjacent vegetation includes patches of *Carex nebrascensis* and *Pascopyrum smithii* on the prairie and *Salix* spp. shrublands in the mountains.

Vegetation: Vegetation types within this alliance are classified as seasonally flooded temperate or subpolar grasslands. *Carex praegracilis* dominates the graminoid stratum with up to 100% cover. Stands on drier sites form

narrow bands with 25-30% cover. (Kittel et al. 1999). Other graminoid species include *Calamagrostis stricta, Carex aquatilis, Carex simulata, Carex utriculata, Deschampsia caespitosa, Eleocharis palustris*, and *Juncus balticus*. The forb stratum is present with up to 30% cover; species include *Cicuta douglasii* and *Senecio hydrophilus*.

ALLIANCE SOURCES

Authors: D. CULVER, West **Identifier:** A.1419
References: Brotherson and Barnes 1984, Cronquist et al. 1977, Culver and Sanderson 1997, Durkin et al. 1994b, Hansen et al. 1988b, Hermann 1970, Jones and Walford 1995, Kittel et al. 1997, Kittel et al. 1999a

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CAREX PRAEGRACILIS HERBACEOUS VEGETATION
Clustered Field Sedge Herbaceous Vegetation

ELEMENT CONCEPT

Summary: This plant association forms meadows in swales and along stream channels in the prairies of several western states (Montana, Idaho, Wyoming, Colorado) on both sides of the Continental Divide. In Montana it is found at elevations as low as 2000 feet. The association occurs along small, shallow streams, usually no more than 2-5 m (7-17 feet) wide, with little sinuosity, low gradient and little to no floodplain development. Soils are deep, ranging from heavy clays to sandy clay loams. Often the only vegetation type along small streams, it completely covers the ground in narrow bands following the streambed and dominated by *Carex praegracilis* (20-40% cover), *Eleocharis palustris*, and *Equisetum laevigatum*. Alternatively, it can occur in patches within a mosaic of monotypic stands of wet meadow graminoid species including *Juncus balticus, Carex nebrascensis, Carex pellita (= Carex lanuginosa)*, and *Schoenoplectus pungens (= Scirpus pungens)*. No shrubs or trees are present.
Similar Associations:
- Carex praegracilis - Carex aquatilis Herbaceous Vegetation (CEGL001821)

GRank & Reasons: G3G4 (01-02-05). This association is known from several western states, although few stands have been well-documented. Stands are small meadows in Colorado (1-20 acres), but it is known to form large meadows in southwestern Montana. Occurrences on federal lands are often in a degraded condition. The highest conditions exist on unprotected private lands. Soil compaction and compositional shifts from grazing and heavy recreational use are the greatest threats. The global rank was changed from G2 to G3G4 to reflect the wide distribution of the type as well as its apparent abundance in several states (Montana and Wyoming).
Comments: This association is known from several western states (MT, ID, WY, CO), although few stands have been well-documented. This type needs to be compared with *Carex praegracilis* - *Carex aquatilis* Herbaceous Vegetation (CEGL001821), as they are probably the same type.

ELEMENT DISTRIBUTION

Range: The plant association occurs in appropriate habitat across the Rocky Mountain and northern Great Basin states.
Nations: US
States/Provinces: CO:S2, ID:S2, MT:S3S4, WY:S3S4

ELEMENT SOURCES

Authors: R.J. Rondeau, mod. M.S. Reid, WCS **Confidence:** 2 **Identifier:** CEGL002660
References: Culver and Sanderson 1997, Hansen et al. 1995, Jones and Walford 1995, Kittel et al. 1997, Kittel et al. 1999a

ELEOCHARIS PALUSTRIS SEASONALLY FLOODED HERBACEOUS ALLIANCE
Marsh Spikerush Seasonally Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Plant associations included in this alliance are conspicuous, common emergent associations that occur in shallow, mostly still water throughout the western United States. Elevation ranges from sea level in California to 3050 m in Colorado. Stands occur on a variety of landforms including lake margins, stream terraces, floodplains, gravel bars, and wet basins (cienegas). Stands occur on sites that are flat, 1% slope with all aspects (Crowe and Clausnitzer 1997). Soils vary from Histosols to Entisols. High-elevation stands consistently occur on organic (highly sapric) soils, or on a thick organic horizon that overlays fine to coarse alluvial material. Lower elevation stands occur on fresh alluvial deposits of fine-textured loamy sands, clays, and sandy clays (Kittel et al.

1999). Soil reaction is often alkaline (Hansen et al. 1988). All sites are saturated throughout much of the growing season. Oregon stands are located on soils derived from volcanic (andesite, basalt) or sedimentary parent materials (Crowe and Clausnitzer 1997).

At higher elevation, *Carex aquatilis* or *Carex utriculata* meadows and *Salix wolfii* or *Salix planifolia* shrublands occur within the riparian mosaic. At lower elevation, *Schoenoplectus pungens* often occurs within the stream channel while wet meadow prairies of *Panicum virgatum* and *Sorghastrum nutans* occupy the immediate streambanks and low floodplains.

Vegetation: Plant associations within this alliance are classified as seasonally flooded, temperate or subpolar grasslands. *Eleocharis palustris*, a facultative wetland species, dominates the graminoid stratum. Cover ranges from sparse to quite dense (10-80%). *Eleocharis palustris* plant associations occur within a wide elevational range, and the species composition can be quite variable. In the Great Plains stands, co-occurring species often include *Phalaris arundinacea (= Phalaroides arundinacea), Juncus balticus, Carex praegracilis, Schoenoplectus pungens (= Scirpus pungens), Panicum virgatum, Carex pellita (= Carex lanuginosa), Spartina pectinata*, and *Schoenoplectus americanus (= Scirpus americanus)*. Forb cover can also include *Sparganium angustifolium, Lemna* spp., and *Potamogeton* spp. (Kittel et al. 1999). *Distichlis spicata* and *Muhlenbergia asperifolia* codominate the graminoid layer in cienegas (Arizona and New Mexico). Forb cover is composed of *Berula erecta* and *Rorippa nasturtium-aquaticum*, especially in stands with deep water (Cross 1991).

At higher, montane elevations other graminoids present include *Carex aquatilis, Carex utriculata, Carex buxbaumii, Eleocharis rostellata*, and *Deschampsia caespitosa*. Forb cover is typically low, but can be up to 25% in some stands. Common forb species include *Pedicularis groenlandica, Rhodiola integrifolia*, and *Caltha leptosepala* (Hansen et al. 1995, Kittel et al. 1999).

Crowe and Clausnitzer (1997) state that *Eleocharis palustris* is an aggressive species, typically excluding other species from establishing. In the Oregon stands, associated forbs include *Mentha arvensis, Rumex crispus, Iris missouriensis*, and *Ranunculus cymbalaria*.

Dynamics: At lower elevations *Eleocharis palustris* plant associations occur well within the active channel and are inundated annually. These early seral communities colonize backwater eddies and shallow edges of slow moving reaches of small and larger rivers. The stands are probably ephemeral, as the eddies and river edges are scoured out each year during high spring flows (Kittel et al. 1999). These communities have also been described as early seral stages by Padgett et al. (1989). Padgett et al. (1989) describe light colored soils for the sites, indicating an early phase of soil development. Kovalchik (1987) reports that the lower elevation plant associations within this alliance frequently form seral communities in ponded sites between stream rehabilitation structures such as loose rock check dams.

In the montane zone, associations within this alliance occur in ponded sites on faster moving streams. If siltation occurs, sites may become dominated by *Carex utriculata*. At higher elevations, the associations appear to be stable. Stands occur near seeps on soils with deep organic layers, often sapric, and are saturated throughout the growing season.

Crowe and Clausnitzer (1997) state that *Eleocharis palustris* is of little to no forage value to livestock and wild ungulates. On seasonally drier sites, ungulate trampling may cause this species to increase (Snyder 1992 as cited in Crowe and Clausnitzer 1997). However, this species does provide seed forage and cover to ducks and geese (Kovalchik 1987).

ALLIANCE SOURCES

Authors: D. CULVER, West **Identifier:** A.1422

References: Baker 1983c, Baker and Kennedy 1985, Brotherson 1987, Brotherson and Barnes 1984, Brown 1982, Bunin 1985, Cronquist et al. 1977, Cross 1991, Crowe and Clausnitzer 1997, Durkin et al. 1995, Ellis et al. 1979, Flowers 1962, Hall and Hansen 1997, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, Hendrickson and Minckley 1984, Johnston 1987, Kartesz 1994a, Kettler and McMullen 1996, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1999a, Kovalchik 1987, Kovalchik 1993, Manning and Padgett 1995, Muldavin et al. 2000a, Mutel 1973, Mutel and Marr 1973, Padgett et al. 1988b, Padgett et al. 1989, Ramaley 1919a, Ramaley 1942, Reid et al. 1994, Sawyer and Keeler-Wolf 1995, Shupe et al. 1986, Stearns-Roger Inc. 1978, Stewart 1940, Sturges 1968, Youngblood et al. 1985a

ELEOCHARIS PALUSTRIS HERBACEOUS VEGETATION
Marsh Spikerush Herbaceous Vegetation

ELEMENT CONCEPT

Environment: This wetland occurs across the central and northwestern Great Plains and western United States. Elevations range from near sea level to 3050 m (in Colorado). In eastern Washington and Idaho it occurs in valleys and canyon bottoms with low-gradient streams, sloughs, and along the margins of ponds and lakes (Kovalchik 1993). In northwest Nebraska and southwest South Dakota, this community occurs in small depressions in intermittent streambeds and depression ponds that flood early in the season and dry out by summer. Soils are silty clay formed from weathered siltstone and shale (Steinauer and Rolfsmeier 2000). In southwestern South Dakota, the type occupies depression ponds in prairies (H. Marriott pers. comm. 1999). In Utah stands are described from small playas on floodplain terraces of a large river (Von Loh 2000).

In Colorado this community type occurs on the bottom of ephemeral ponds or playas (Baker and Kennedy 1985), or is associated with small to moderate-sized ponds or the edges of larger lakes and reservoirs (Bunin 1985, Padgett et al. 1989). The sites are generally only seasonally flooded, but remain moist throughout the year (Bunin 1985, Padgett et al. 1989). Elevations range from 1525-2750 m (5000-9020 feet).

The soils of Baker and Kennedy's (1985) stands were derived from Quaternary alluvium, with a heavy clay content and an average pH of 7.8, slightly alkaline. The soils reported by Padgett et al. (1989) were mineral soils with fine-loamy to fine particle sizes or organic. They are commonly ponded throughout the growing season and have developed from pond siltation. Hansen et al. (1988a) indicate that *Eleocharis palustris* is alkaline-tolerant.

Vegetation: This wetland association is dominated by submersed and emergent rooted vegetation under 1 m tall and occurs across the northwestern Great Plains and western U.S. within a wide elevational range. The species composition can be quite variable, but this community is easy to recognized by the bright green, nearly pure stands of *Eleocharis palustris*. Vegetation cover can be sparse to dense (10-90%), but *Eleocharis palustris* is the dominant species, and the only species with 100% constancy. Other species, when present, can contribute as much as 40% cover, but never exceed that of the *Eleocharis palustris* cover. Some of this variation is described from Colorado (Kittel et al. 1999, Baker and Kennedy 1985). Co-occurring species in low-elevation stands on the western slope can include *Phalaris arundinacea (= Phalaroides arundinacea), Juncus balticus, Hordeum jubatum, Pascopyrum smithii, Schoenoplectus americanus (= Scirpus americanus), Sparganium angustifolium*, species of *Lemna* and *Potamogeton*, as well as the introduced *Melilotus officinalis* and *Bromus inermis*. On the eastern plains of Colorado co-occurring species can include *Leersia oryzoides, Schoenoplectus pungens (= Scirpus pungens), Panicum virgatum, Carex pellita (= Carex lanuginosa)*, and *Spartina pectinata*. At montane elevations, other graminoids, such as *Carex aquatilis, Carex utriculata*, and *Deschampsia caespitosa* are present. Forb cover is typically low, but can be occasionally abundant (30%) in some stands. Forb species include *Pedicularis groenlandica, Rhodiola integrifolia*, and *Caltha leptosepala*.

In stands from eastern Washington, associates include *Carex utriculata, Cicuta douglasii*, and species of *Glyceria* and *Potamogeton*. In northwestern Nebraska, stands are dominated *Eleocharis acicularis* and *Eleocharis palustris* which commonly cover the bottoms of the pools and emerge above the water as the pools dry out. Ephemeral submersed aquatics, such as *Callitriche palustris (= Callitriche verna), Potamogeton diversifolius* and *Marsilea vestita*, may be present. As the pools dry out in mid-summer, ephemeral annual forbs, such as *Limosella aquatica* and *Plagiobothrys scouleri*, may appear. By late summer *Amaranthus californicus* and *Gnaphalium palustre* may dominate in the lowest parts of the depression (Steinauer and Rolfsmeier 2000). In southwestern South Dakota, vegetation is composed of nearly homogeneous stands of *Eleocharis palustris*. Other emergents, such as *Polygonum amphibium, Marsilea vestita*, and *Eleocharis ovata*, are occasionally found. Herbaceous cover is greater than 75% except in areas of deeper open water where floating and submerged aquatic plants occur, including *Bacopa rotundifolia* and *Heteranthera limosa* (H. Marriott pers. comm. 1999). In lower elevation Utah stands *Glaux maritima, Distichlis spicata*, and *Juncus balticus* were important associates (Brotherson and Barnes 1984).

Few stand data are available for Colorado examples. Generally, it appears that this community is dominated by *Eleocharis palustris*, forming a scattered to dense overstory, often with few associated species. Commonly associated graminoids include *Hordeum jubatum* and *Pascopyrum smithii*. Forbs present may include *Atriplex argentea, Polygonum aviculare*, and *Rorippa sinuata* (Baker and Kennedy 1985). The higher elevation stands may include a slightly different suite of species, but no stand data are available. Ramaley (1942) described a *Distichlis spicata*-dominated salt meadow on a lakeshore in the San Luis Valley which was ringed by *Eleocharis palustris*. Communities in Utah include *Eleocharis acicularis* and *Alopecurus aequalis* as likely associates (Padgett et al. 1989).

Dynamics: The hydrological regime is critically important to this association. Most stands are seasonally to permanently flooded, although some in the Great Plains occur under intermittently to temporarily flooded conditions.

Baker and Kennedy (1985) suggest that domestic livestock grazing may tend to result in increases in *Hordeum jubatum, Bassia scoparia*, and *Polygonum aviculare*. However, Hansen et al. (1988a) suggest that palatability of *Eleocharis palustris* is low for both domestic and wild animals, but that heavy grazing may increase this rhizomatous species and spread it onto adjacent sites. Trampling damage may occur to this type when animals heavily use the sites supporting it, particularly during drought years (Hansen et al. 1988a). Water level fluctuations over a year of greater than 1 m will not support this type (Hansen et al. 1988a).

Similar Associations:

- Eleocharis palustris - Distichlis spicata Herbaceous Vegetation (CEGL001834)
- Eleocharis palustris - Juncus balticus Herbaceous Vegetation (CEGL001835)
- Eleocharis palustris - (Eleocharis compressa) - Leptochloa fusca ssp. fascicularis Herbaceous Vegetation (CEGL002259)

GRank & Reasons: G5 (96-02-01).

ELEMENT DISTRIBUTION

Range: This spikerush wet meadow community is found in the central Great Plains of the United States and Canada and in the western United States.

Nations: CA US

States/Provinces: BC:S4, CA?, CO:S4, ID:S3, MT:S5, NE:S?, NV:SR, OR:S5, SD:S?, SK:S?, UT:S3?, WA:S3?, WY:S3

ELEMENT SOURCES

Authors: D. Faber-Langendoen, mod. K. Schulz, mod. M.S. Reid, WCS **Confidence:** 1 **Identifier:** CEGL001833

References: Baker 1983c, Baker and Kennedy 1985, Billings 1945, Bourgeron and Engelking 1994, Brotherson and Barnes 1984, Bunin 1985, Driscoll et al. 1984, Ellis et al. 1979, Flowers 1962, Hall and Hansen 1997, Hansen et al. 1988a, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, Kettler and McMullen 1996, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1999a, Kovalchik 1987, Kovalchik 1993, Mutel 1973, Mutel and Marr 1973, Padgett et al. 1988b, Padgett et al. 1989, Penfound 1953, Ramaley 1919a, Ramaley 1942, Stearns-Roger Inc. 1978, Steinauer and Rolfsmeier 2000, Stewart 1940, Von Loh 2000, Youngblood et al. 1985a

JUNCUS BALTICUS SEASONALLY FLOODED HERBACEOUS ALLIANCE

Baltic Rush Seasonally Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Plant associations within this alliance are widely distributed in wet, often alkaline places, from the plains to mountains. Elevation ranges from sea level in California to 3500 m in Colorado. Montane plant associations can occur on alluvial terraces, floodplains, overflow channels, seeps, meadows, and near springs. Sites are typically gentle (1-3%) slope on all aspects. Barbour and Major (1977) state that *Juncus balticus* occurs in northern California coastal salt marshes.

Soils are mineral with dark surface horizons containing large amounts of well-decomposed organic matter (Tuhy and Jensen 1982). Soils are Mollisols, or rarely Entisols. Soil texture ranges from silt to sandy loam. Water tables are often at or near the soil surface in early summer, but may drop below 50 cm by late August. Soil reaction ranges from neutral to mildly alkaline (pH 7.0-8.0) (Hansen et al. 1995).

Salix exigua shrublands, *Distichlis spicata* marshes, or *Carex* spp. meadows occur in adjacent wet riparian areas. *Sarcobatus vermiculatus* and *Artemisia tridentata* shrublands occur on drier alluvial terraces and adjacent hillslopes. *Abies lasiocarpa - Picea engelmannii, Pseudotsuga menziesii*, and *Populus tremuloides* forests, *Pinus edulis - Juniperus* spp. woodlands, and *Ericameria nauseosa* shrublands occur on adjacent hillslopes.

Vegetation: Plant associations within this alliance are classified as seasonally flooded, temperate or subpolar grasslands. They are dominated by a thick stand of 10-98% cover of *Juncus balticus*, a facultative wetland species. Other graminoid cover is minor, but can include *Carex pellita (= Carex lanuginosa), Carex aquatilis, Carex canescens, Leymus cinereus, Deschampsia caespitosa, Hordeum jubatum*, or *Sporobolus airoides*. Forb cover is typically minor and may include *Achillea millefolium, Iris missouriensis*, or *Geum macrophyllum*. The plant association from California is composed of *Distichlis spicata, Carex lyngbyei, Carex obnupta*, and *Schoenoplectus*

robustus (= Scirpus robustus). Occasionally, a few tree or shrub seedlings are present including *Populus angustifolia, Dasiphora fruticosa ssp. floribunda (= Pentaphylloides floribunda)*, and *Salix exigua*. Stands often contain adventive species, e.g., *Poa pratensis* and *Phleum pratense*.
Dynamics: In low-disturbance areas, the *Juncus balticus* stands of this alliance appear to be a stable, late seral communities. They occupy frequently inundated swales and wet, low- to mid-elevation sites (Kittel and Lederer 1993). However, in some areas, stands of this alliance may be considered to be grazing-induced (Padgett et al. 1989). *Juncus balticus* is considered an increaser due to its low forage value and high tolerance to grazing (USFS 1937 as cited in Kittel et al. 1999, Hansen et al. 1995). It usually increases in abundance on sites formerly dominated by *Deschampsia caespitosa* or *Calamagrostis canadensis*. Nearly pure stands of *Juncus balticus* indicate that the site may have been heavily grazed in the past (Hansen et al. 1995).

ALLIANCE SOURCES

Authors: ECS 96, MOD. D. CULVER, MP, West **Identifier:** A.1374
References: Barbour and Major 1977, Blackburn et al. 1971, Brooks and Clemants 2000, Brotherson and Barnes 1984, Brown 1982, Bunin 1985, Crowe and Clausnitzer 1997, Flowers 1962, Grossman et al. 1994, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, Hess 1981, Johnston 1987, Jones and Walford 1995, Kartesz 1994a, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1999a, Komarkova 1986, Kovalchik 1987, Kunze 1994, Manning 1988, Manning and Padgett 1995, Mutel 1973, Mutz and Graham 1982, Olson and Gerhart 1982, Padgett 1982, Padgett et al. 1989, Rawinski 1992, Rector 1979, Richard et al. 1996, Roberts et al. 1992, Sawyer and Keeler-Wolf 1995, Shupe et al. 1986, Sneddon et al. 1996, Stewart 1940, Tuhy and Jensen 1982, Wasser and Hess 1982, Youngblood et al. 1985a

JUNCUS BALTICUS HERBACEOUS VEGETATION

Baltic Rush Herbaceous Vegetation

ELEMENT CONCEPT

Environment: This widespread herbaceous wetland community is found throughout western North America. Elevation ranges from 1420-3500 m. Stands usually occur as small, dense patches on flat to gently sloping sites near seeps and streams. Stream channels are highly variable in size and type ranging from narrow to moderately wide, and deeply entrenched to very sinuous (Kittel et al. 1999). Soils are also variable and range from alluvial sandy and well-drained, to poorly drained silty clay loam, to organic; however, soils tend to be finer-textured, alkaline and may be saline (Brotherson and Barnes 1984, Kittel et al. 1999, Padgett et al. 1989). Cobbles and gravel are common on many sites, and gleyed and mottled horizons are often present because of flooding or high water tables (Kittel et al. 1999).
Vegetation: This association is characterized by a low (<50 cm), dense graminoid layer dominated by the rhizomatous perennial *Juncus balticus*. Minor cover of *Carex* species, including *Carex aquatilis, Carex praegracilis, Carex nebrascensis* or *Carex utriculata*, is often present. Other common graminoids include *Deschampsia caespitosa, Distichlis spicata, Glyceria striata, Hordeum jubatum, Muhlenbergia asperifolia, Phleum alpinum*, and *Sporobolus airoides*. Forb cover is generally low, but may include *Caltha leptosepala, Glaux maritima, Maianthemum stellatum, Rumex aquaticus, Cirsium scariosum (= Cirsium tioganum), Achillea millefolium, Potentilla plattensis, Polygonum bistortoides, Dodecatheon pulchellum*, and *Iris missouriensis*. Shrubs are not common, however occasional *Salix* spp. may occur. Some stands may be codominated by the introduced perennial sod grasses *Poa pratensis* or *Agrostis stolonifera*. Other introduced species, such as *Taraxacum officinale, Trifolium* spp., *Cirsium arvense, Lactuca serriola, Phleum pratense*, and *Thinopyrum intermedium*, may occur in disturbed stands.
Dynamics: This association is considered by some to be a grazing-induced community because *Juncus balticus* is tolerant of grazing (low palatability when mature) and increases with grazing disturbance (Hansen et al. 1995, Padgett et al. 1989). Nearly pure stands of *Juncus balticus* may indicate that the site was heavily grazed in the past (Hansen et al. 1995). However, this association also occurs as a stable, late-seral community in areas with low disturbance (Kittel and Lederer 1993).
Similar Associations:
- Eleocharis palustris - Juncus balticus Herbaceous Vegetation (CEGL001835)
- Juncus balticus - Carex rossii Herbaceous Vegetation (CEGL001839)

GRank & Reasons: G5 (96-02-01).
Comments: This association is often considered to be a grazing-induced community since it increases with grazing disturbance.

ELEMENT DISTRIBUTION

Range: This Baltic rush wet meadow community is found widely throughout the western United States, ranging from South Dakota and Montana west to Washington, south to possibly California, and east to New Mexico.
Nations: CA US
States/Provinces: BC:S3, CA?, CO:S5, ID:S5, MT:S5, NM:S4, NV:S?, OR:S5, SD:S?, UT:S3S4, WA:S3S4, WY:S3

ELEMENT SOURCES

Authors: J. Drake, mod. D. Faber-Langendoen, mod. K. Schulz, WCS **Confidence:** 1 **Identifier:** CEGL001838
References: Baker 1984a, Bourgeron and Engelking 1994, Brotherson and Barnes 1984, Bunin 1985, Cowardin et al. 1979, Driscoll et al. 1984, Faber-Langendoen 2001, Flowers 1962, Hall and Hansen 1997, Hansen et al. 1988b, Hansen et al. 1991, Hansen et al. 1995, Hess 1981, Johnston 1987, Jones and Walford 1995, Kartesz 1994a, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1999a, Komarkova 1986, Manning 1988, Muldavin et al. 2000a, Mutel 1973, Mutz and Graham 1982, Olson and Gerhart 1982, Padgett 1982, Padgett et al. 1989, Rector 1979, Richard et al. 1996, Shupe et al. 1986, Stewart 1940, Tuhy and Jensen 1982, Wasser and Hess 1982, Youngblood et al. 1985a

SPARTINA GRACILIS SEASONALLY FLOODED HERBACEOUS ALLIANCE

Alkali Cordgrass Seasonally Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: This alliance is found on scattered low-elevation sites of the northern and western Great Plains, and in northern portions of the Intermountain West. Elevations range from 716 m in Montana to over 2200 m in south-central Colorado. Locations supporting this alliance are moist, poorly drained, often alkaline areas along ephemeral, intermittent or perennial streams, as well as swales, meadows, and the margins of marshes and ponds. Jones and Walford (1995) report that stands occur along low-gradient, small, meandering creeks. Kittel et al. (1999) found stands on moist sandy overflow channels and backwater areas of large rivers on the eastern plains of Colorado. The water table is typically high, within 1 m of the surface, but the sites are not permanently flooded. Soils are fine-textured, and range from clays to silt-loam, and usually slightly to moderately alkaline (Ungar 1974, Hansen et al. 1995). Soil water movement is rapid enough to preclude the accumulation of salts in the surface horizon.
Vegetation: This lower elevation alliance is dominated by tall perennial graminoids. *Spartina gracilis* is usually the dominant, although cover may be moderate (30-60%). Vigorous growth from rhizomes allows this species to sometimes form pure stands. Other graminoids present, and occasionally codominant, can include *Schoenoplectus pungens (= Scirpus pungens), Juncus balticus*, and *Pascopyrum smithii*. Forb species present tend to be weedy, such as *Grindelia squarrosa, Glycyrrhiza lepidota*, and *Xanthium strumarium*. These forbs can be somewhat abundant in disturbed locations, but otherwise are found in small amounts.

Adjacent riparian vegetation can include *Ribes* spp., *Chrysothamnus* spp., *Artemisia cana*, or *Shepherdia argentea* shrublands on adjacent floodplains. *Eleocharis* meadows or *Scirpus* marshes can occur on adjacent wet swales, overflow channels, or closer to open water. Adjacent upland vegetation includes *Pascopyrum smithii*-dominated grasslands, *Artemisia tridentata* shrublands or *Pinus edulis* - *Juniperus monosperma* woodlands on surrounding hill slopes in Colorado.
Dynamics: *Spartina gracilis* tolerates alkaline soils to the exclusion of other species. It also tolerates burial by flood deposition and readily re-sprouts, pushing up sharp shoots (Weaver 1965). If the soil salinity drops, the community will become dominated by less alkaline-tolerant plants.

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

ALLIANCE SOURCES

Authors: M.S. REID, West **Identifier:** A.1407
References: Baker 1984b, Evans 1989b, Hansen et al. 1988b, Hansen et al. 1995, Hanson 1929, Jones and Walford 1995, Kittel et al. 1999a, Sawyer and Keeler-Wolf 1995, Ungar 1972, Ungar 1974b, Ungar 1974c, Weaver 1965

SPARTINA GRACILIS HERBACEOUS VEGETATION
Alkali Cordgrass Herbaceous Vegetation

ELEMENT CONCEPT

Summary: In Colorado, these wetland meadows have a sparse to thick herbaceous layer of grasses and grass-like plants that is dominated by *Spartina gracilis*. Few stands have been documented in Colorado, so its classification is tentative.

Information on stands that occur outside Colorado will be added later.

GRank & Reasons: GU (94-02-23).

ELEMENT DISTRIBUTION

Range:
Nations: US
States/Provinces: CA:SU, CO:SU, MT?, NV:SU, UT?, WA?, WY:S?

ELEMENT SOURCES

Authors: WCS **Confidence:** 3 **Identifier:** CEGL001588
References: Baker 1984b, Bourgeron and Engelking 1994, Driscoll et al. 1984, Hanson 1929, Sawyer and Keeler-Wolf 1995, Ungar 1972, Ungar 1974c

SCHOENOPLECTUS ACUTUS - (SCHOENOPLECTUS TABERNAEMONTANI) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE
Hardstem Bulrush - (Softstem Bulrush) Semipermanently Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: This relatively widespread alliance occurs on pond and lake margins, and in backwater areas. It also occupies basins where the water table may remain relatively high, but can drop below the soil surface late in the growing season. Elevations range from sea level in coastal areas to 2025 m in Montana. Stands of this alliance are flooded for most or all of the growing season. Stands can have water from 0 (exposed soil) to approximately 1.5 m deep, but usually are less than 1 m (Tolstead 1942, Steinauer 1989). Within a stand, water levels can vary by up to 1 m during the year (Tolstead 1942). The water can be fresh to mildly saline throughout most of this alliance's range (Stewart and Kantrud 1971), however, in the Nebraska Sandhills some stands occur in moderately alkaline water (Steinauer 1989). Across the range of this alliance, soils are deep, poorly drained muck, peat, or mineral. Adjacent wetter sites are typically dominated by *Typha latifolia*, while drier sites support herbaceous communities dominated by *Carex* spp., *Poa pratensis* or other grasses.
Vegetation: This alliance is found in the midwestern and western United States and central Canada. Vegetation is characterized by medium to tall graminoids which typically range from 1 to over 2 m (Weaver 1960). The vegetation is moderately dense to dense. Some stands are heavily dominated by one or two *Schoenoplectus* species while others have several graminoids common throughout the stand. The most abundant species are typically *Schoenoplectus acutus (= Scirpus acutus), Schoenoplectus fluviatilis (= Scirpus fluviatilis)*, and *Schoenoplectus tabernaemontani (= Scirpus tabernaemontani)*. Species composition and abundance can vary from year-to-year depending mostly on water level fluctuations. In most years, typical species include *Lemna* spp., *Phragmites australis, Schoenoplectus americanus (= Scirpus americanus)* (in alkaline stands), *Triglochin maritima* (in alkaline stands), *Typha latifolia*, and *Utricularia macrorhiza*. *Potamogeton* spp. often occur in the deeper parts of stands of this alliance and where emergent species are not densely packed. Shrubs, such as *Salix* spp., are not common, but may become established in shallow water areas. During droughts, species more tolerant of low water, such as *Polygonum amphibium*, may invade and alter the species composition of stands of this alliance.
Dynamics: *Schoenoplectus acutus* and *Schoenoplectus tabernaemontani* are early colonizers of suitable habitats (Hansen et al. 1995), and are able to persist under wet conditions. *Schoenoplectus* spp. stands are generally considered permanent wetland communities. They will remain in place unless the hydrologic regime is severely altered. If water levels have fallen, stands of this alliance can burn in either late fall or early spring. Stands of *Schoenoplectus* are important to wildlife species, especially birds, by providing cover and nesting habitat.

ALLIANCE SOURCES

Authors: MCS, MOD. M.S. REID, MP, Midwest **Identifier:** A.1443

References: Christy et al. 1998, Faber-Langendoen et al. 1996, Faber-Langendoen et al. 1997, Fike 1999, Hansen et al. 1991, Hansen et al. 1995, Kunze 1994, Smith 1991, Steinauer 1989, Stewart and Kantrud 1971, Tolstead 1942, Weaver 1960

SCHOENOPLECTUS ACUTUS HERBACEOUS VEGETATION
Hardstem Bulrush Herbaceous Vegetation

ELEMENT CONCEPT

Environment: This association is a common emergent herbaceous wetland found mostly in the interior western U.S. Elevations range from near sea level to 2030 m. Stands occur along low-gradient, meandering, usually perennial streams, river floodplain basins and around the margins of ponds and shallow lakes especially in backwater areas. Some sites are flooded most of the year with about 1 m of fresh to somewhat saline or alkaline water. Other sites, however, dry up enough in late summer to where the water table drops below the ground surface, though the soils are still partially saturated. Soils are generally deep, organic, alkaline, poorly drained and fine-textured, but range in soil textures from sand to clay to organic muck. The soils may be normal or saline.
Vegetation: This wetland association is characterized by a dense tall herbaceous vegetation layer 1-3 m tall that is dominated by *Schoenoplectus acutus (= Scirpus acutus)*, often occurring as a near monoculture. Associated species include low cover of *Mentha arvensis, Polygonum amphibium, Sagittaria latifolia*, and species of *Carex, Eleocharis, Rumex*, and *Typha*. Early in the growing season or at the more permanently flooded sites, aquatic species such as *Potamogeton* spp. and *Lemna minor* may be present to abundant. Stands of this association contain no tree or shrub layer, but a few sites have been invaded by the introduced shrub *Tamarix* spp.
Dynamics:
Similar Associations:
- Schoenoplectus acutus - Typha latifolia - (Schoenoplectus tabernaemontani) Sandhills Herbaceous Vegetation (CEGL002030)
- Schoenoplectus acutus - (Schoenoplectus fluviatilis) Freshwater Herbaceous Vegetation (CEGL002225)
- Typha spp. - Schoenoplectus acutus - Mixed Herbs Midwest Herbaceous Vegetation (CEGL002229)

GRank & Reasons: G5 (96-02-01).
Comments: This association appears to be somewhat variable in flood regime. It is flooded less time than some of the other *Schoenoplectus acutus* associations in this semipermanently flooded alliance with some stands included in this association occurring in a seasonally flooded hydrologic regime. However, stands described by Kunze (1994) from western Washington were permanently flooded with shallow water (about 1 m deep). Additional research is needed to determine if the different hydrological regimes indicate a need to split out new associations.

ELEMENT DISTRIBUTION

Range: This association is a common emergent wetland found mostly in the interior western U.S. from Washington to Montana south to California, Nevada and Utah.
Nations: US
States/Provinces: CA:S3?, ID:S4, MT:S5, NV:S?, OR:S5, UT:S?, WA:S4

ELEMENT SOURCES

Authors: K.A. Schulz, WCS **Confidence:** 1 **Identifier:** CEGL001840
References: Bourgeron and Engelking 1994, Bundy et al. 1996, Dethier 1990, Driscoll et al. 1984, Evans 1989a, Hansen et al. 1991, Hansen et al. 1995, Kunze 1994

SCHOENOPLECTUS PUNGENS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE
Threesquare Semipermanently Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Plant associations within this alliance occur in saline meadows, depressions, playas, and river valleys in the western United States. Elevations range from 750-1380 m. Sites are located in wet areas such as along smaller streams and the edges of marshes, ponds, and playas (Hansen et al. 1995, Bundy et al. 1996, Jones and

Walford 1995, Walford 1996). Although these sites are often subjected to inundation (up to 1.5 m) in the early season, they are generally free of standing water by midsummer. Groundwater levels are often at or near ground surface (Brotherson and Barnes 1984). Soils are typically Entisols or Mollisols. Soil texture ranges from clay loam to sandy loam, and the soils are commonly poorly drained. Soil reaction is typically alkaline (pH 8.5) (Steinauer 1989, Hansen et al. 1995).

Adjacent wetter communities are usually dominated by *Eleocharis palustris*. *Typha latifolia* or *Schoenoplectus acutus* can dominate the open water. In Nevada, adjacent communities are dominated by *Sarcobatus vermiculatus*.

Vegetation: Plant associations within this alliance are classified as semipermanently flooded temperate or subpolar grasslands. *Schoenoplectus pungens (= Scirpus pungens)* dominates the graminoid layer, forming dense stands. Other common herbaceous associates include *Suaeda calceoliformis, Spartina pectinata, Muhlenbergia asperifolia, Distichlis spicata*, and *Ruppia maritima*. *Chenopodium incanum*, *Monolepis nuttalliana*, and *Picradeniopsis oppositifolia* are sometimes abundant on less saline portions of the alliance. In eastern Wyoming, *Hordeum jubatum* and *Hordeum jubatum ssp. intermedium (= Hordeum caespitosum)* are present in most stands in small amounts (Jones and Walford 1995).

Dynamics: Hansen et al. (1995) state that *Schoenoplectus pungens* is an early colonizer of suitable habitats and able to persist under wet conditions. It is tolerant of alkaline conditions, but does not require it (Cronquist et al. 1977). Because of the wet soil conditions and aggressive growth of *Schoenoplectus pungens*, other species can be precluded from the sites. Disturbance can cause the establishment of increaser species such as *Juncus balticus* and *Hordeum jubatum*. Lowering the water table may dry the site and result in a decrease of *Schoenoplectus pungens*. An increase in salinity may increase alkaline-tolerant species.

ALLIANCE SOURCES

Authors: D. CULVER, West **Identifier:** A.1433

References: Brotherson and Barnes 1984, Bundy et al. 1996, Cronquist et al. 1977, Faber-Langendoen et al. 1996, Hansen et al. 1991, Hansen et al. 1995, Jones and Walford 1995, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1999a, Lesica 1989, Steinauer 1989, Walford 1996

SCHOENOPLECTUS PUNGENS HERBACEOUS VEGETATION

Threesquare Herbaceous Vegetation

ELEMENT CONCEPT

Environment: Stands of this widespread association are found throughout much of the western U.S. in appropriate wetland habitat. Elevations range from 1000-2400 m. Stands occur along low-gradient, meandering, usually perennial streams, around the margins of ponds and marshes, in low-lying swales, and abandoned or overflow channels where the soils remain saturated. (Hansen et al. 1995, Kittel et al. 1999, Jones and Walford 1995, Walford 1996). It also occurs on silt and sand bars within the active channel. Soils are generally derived from alluvium and are fine-textured, black, alkaline, organic anoxic with gleying. Soils range from normal to saline with pH ranging from 7.4-9.1.

Vegetation: This widespread wetland association is characterized by a dense, 0.3- to 0.6-m tall herbaceous vegetation layer that is dominated by *Schoenoplectus pungens (= Scirpus pungens)*. Associated species include *Schoenoplectus maritimus (= Scirpus maritimus), Spartina gracilis, Hordeum jubatum, Pascopyrum smithii, Juncus balticus, Eleocharis palustris, Lemna minor, Sagittaria latifolia*, and *Typha* spp. Stands of this association contain no tree or shrub layer, but a few scattered trees and shrubs may be present, most commonly *Populus deltoides, Salix amygdaloides, Salix exigua, Symphoricarpos occidentalis*, or *Sarcobatus vermiculatus*.

Dynamics: Stands of this association are flooded in the spring (Larson 1993).

Similar Associations:

- Schoenoplectus americanus Western Herbaceous Vegetation (CEGL001841)--stands are dominated by *Schoenoplectus americanus* instead of *Schoenoplectus pungens*.
- Spartina pectinata - Schoenoplectus pungens Herbaceous Vegetation (CEGL001478)--should probably be split into a *Spartina* type and a *Schoenoplectus pungens* type.

GRank & Reasons: G3G4 (98-04-09).

Comments: Muldavin et al. (2000a) described 5 *Schoenoplectus pungens (= Scirpus pungens)* community types from New Mexico. Most are codominated with an associated species listed in the vegetation description, e.g., *Eleocharis palustris, Distichlis spicata, Paspalum distichum*, and *Equisetum laevigatum*, with one being a *Schoenoplectus pungens* Monotype Community Type reported from the Gila River basin. Muldavin et al.'s (2000a)

concept of this community type states that it can be dominated by *Schoenoplectus pungens (= Scirpus pungens)* or *Schoenoplectus americanus (= Scirpus americanus, = Scirpus olneyi)*. Hansen et al. (1995) also include *Schoenoplectus americanus* in their *Scirpus pungens* Habitat Type. This association needs further review to clarify whether to include stands where *Schoenoplectus pungens* is not the dominant species.

ELEMENT DISTRIBUTION

Range: This community is found in the western United States in the intermountain basins, as well as in western parts of the Great Plains, from Montana south to Colorado, and west into Nevada, Utah, and Wyoming.
Nations: US
States/Provinces: CO:S3, KS:S?, MT:S3, ND:S?, NM:S?, NV:S?, SD:S?, UT:S2S4, WY:S?

ELEMENT SOURCES

Authors: G.P. Jones, mod. K. Schulz, WCS **Confidence:** 2 **Identifier:** CEGL001587
References: Bourgeron and Engelking 1994, Brotherson and Barnes 1984, Bundy et al. 1996, Driscoll et al. 1984, Gleason and Cronquist 1991, Great Plains Flora Association 1986, Hansen et al. 1991, Hansen et al. 1995, Jones and Walford 1995, Kittel and Lederer 1993, Kittel et al. 1994, Kittel et al. 1999a, Larson 1993, Lauver et al. 1999, MTNHP 1988, Muldavin et al. 2000a, Walford 1996

TYPHA (ANGUSTIFOLIA, LATIFOLIA) - (SCHOENOPLECTUS SPP.) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE

(Narrowleaf Cattail, Broadleaf Cattail) - (Clubrush species) Semipermanently Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: This alliance is found most commonly along lake or pond margins, slow-moving ditches, in shallow basins, adjacent to stream or river channels in wet mud, oxbows, and occasionally in river backwaters. Elevations range from near sea level to around 2000 m in Colorado. Sites where this alliance occurs are typically semipermanently flooded, inundated with 30-100 cm of water throughout the year. Lacustrine cattail marshes typically have a muck-bottom zone bordering the shoreline, where cattails are rooted in the bottom substrate, and a floating mat zone, where the roots grow suspended in a buoyant peaty mat. *Typha angustifolia* can grow in deeper water compared to *Typha latifolia*, although both species reach maximum growth at a water depth of 50 cm (Grace and Wetzel 1981). Soils are characterized by accumulations of organic matter over deposits of fine silt and clay (Hansen et al. 1995), or loams, sandy loams, or coarse sand (Jones and Walford 1995, Bundy et al. 1996). *Typha* often occurs in pure stands, and can colonize areas recently exposed by either natural or human causes.

Adjacent herbaceous wetland vegetation types can be dominated by species of *Scirpus* and/or *Schoenoplectus, Carex*, or *Eleocharis*. Riparian shrublands or forests include those dominated by species of *Salix, Fraxinus*, or *Populus*.

Vegetation: This alliance, is found at low to moderate elevations in virtually every state in the United States and probably most Canadian provinces. It contains stands dominated by *Typha angustifolia* and/or *Typha latifolia*, either alone or in combination with other tall emergent marsh species. Associated species vary widely; in the central and western United States, they include many sedges such as *Carex aquatilis, Carex rostrata, Carex pellita (= Carex lanuginosa)*, and bulrushes such as *Schoenoplectus americanus (= Scirpus americanus), Schoenoplectus acutus (= Scirpus acutus), Schoenoplectus tabernaemontani (= Scirpus tabernaemontani)*, and *Schoenoplectus heterochaetus (= Scirpus heterochaetus)*. Other graminoids can include *Juncus* spp., *Eleocharis* spp., or *Glyceria* spp. In the central and eastern parts of its range, broad-leaved herbs such as *Thelypteris palustris, Asclepias incarnata, Impatiens capensis, Sagittaria latifolia, Scutellaria lateriflora, Sparganium eurycarpum, Hibiscus moscheutos*, and *Verbena hastata*, may be present. In the west, forbs may include *Mentha arvensis, Polygonum amphibium, Epilobium ciliatum* and many others. Floating aquatics such as *Lemna minor* may predominate in deeper zones (Anderson 1982, MNNHP 1993, Hansen et al. 1995).

Dynamics: *Typha angustifolia* occupies inundated and disturbed grounds and can tolerate deeper water and higher alkalinity levels than *Typha latifolia* (Great Plains Flora Association 1986). *Typha* species are prolific seed producers, spreading rapidly to become the early colonizers of wet mineral soil and will persist under wet conditions (Hansen et al. 1995). Roots and lower stems are well-adapted to prolonged submergence, but periods of draw-down are required for seed germination to occur (Hansen et al. 1995). These are important wetland communities for many species of birds and waterfowl. Hansen et al. (1995) report that in Montana heavy livestock use may convert stands to *Carex nebrascensis*-dominated communities.

ALLIANCE SOURCES

Authors: MCS, MOD. M.S. REID, MP, Midwest **Identifier:** A.1436

References: Anderson 1982, Apfelbaum 1985, Bundy et al. 1996, Bunin 1985, Christy 1973, Eggers and Reed 1987, Faber-Langendoen et al. 1996, Fike 1999, Foti 1994b, Foti et al. 1994, Grace and Wetzel 1981, Great Plains Flora Association 1986, Hansen et al. 1991, Hansen et al. 1995, Hoagland 1998a, Hoagland 2000, Jones and Walford 1995, Kittel et al. 1996, Kittel et al. 1999a, Komarkova 1976, Komarkova 1986, Kovalchik 1993, Lindauer 1978, Lindauer and Christy 1972, MNNHP 1993, Masek 1979, McEachern 1979, Mitsch and Gosselink 1993, Mohlenbrock 1959, Muldavin et al. 1993b, Muldavin et al. 2000a, Padgett et al. 1989, Sawyer and Keeler-Wolf 1995, Segadas-Vianna 1951, Simkins 1931, Smith 1991, TNC 1995b, Tolstead 1942, Wharton 1978, Youngblood et al. 1985a

TYPHA LATIFOLIA WESTERN HERBACEOUS VEGETATION

Broadleaf Cattail Western Herbaceous Vegetation

ELEMENT CONCEPT

Environment: This widespread community is found along streams, rivers, canals, and the banks of ponds and lakes. Elevations range from near sea level to 2000 m. Sites are nearly level. The soil is saturated or flooded for much of the year from freshwater sources such as springs or streams. The alluvial soils have variable textures ranging from sand to clay and usually with a high organic content.

Vegetation: This community is dominated by hydrophytic macrophytes, especially *Typha latifolia*, which grow from approximately 2-3 m tall. *Typha latifolia* often forms dense, near-monotypic stands (70-98% cover), almost to the exclusion of other species. Other species typical of wetlands may be found in lesser amounts in this community; among these are shallower water emergents such as *Carex* spp., *Eleocharis macrostachya, Eleocharis palustris, Glyceria* spp., *Juncus balticus, Juncus torreyi, Mentha arvensis, Schoenoplectus acutus*, and *Veronica* spp. In deeper water, *Lemna minor, Potamogeton* spp., *Sagittaria* spp., *Azolla filiculoides*, and other aquatics may be present in trace amounts. Trace amounts of grasses like *Agrostis stolonifera, Beckmannia syzigachne, Hordeum jubatum, Muhlenbergia asperifolia*, and *Phalaris arundinacea* may also be present.

Dynamics: This association is dependent on flooding and high water tables from flowing freshwater sources, such as streams and seeps, and does not grow well in alkaline or stagnant water (Von Loh 2000). Disturbance greatly increases the total number of species present (Hansen et al. 1995). *Typha* spp. produce abundant wind-dispersed seeds that allow them to colonize wet bare soil sites quickly and to survive under wet conditions (Muldavin et al. 1999, Hansen et al. 1995).

Similar Associations:

- Schoenoplectus acutus - Typha latifolia - (Schoenoplectus tabernaemontani) Sandhills Herbaceous Vegetation (CEGL002030)--occurs in Great Plains, but is codominated by *Schoenoplectus* spp.
- Typha (angustifolia, domingensis, latifolia) - Schoenoplectus americanus Herbaceous Vegetation (CEGL002032)--occurs in Great Plains, but is codominated by *Schoenoplectus* spp.
- Typha latifolia - Equisetum hyemale - Carex (hystericina, pellita) Seep Herbaceous Vegetation (CEGL002033)--occurs in Great Plains, but is codominated by *Equisetum* and *Schoenoplectus* spp.
- Typha latifolia Southern Herbaceous Vegetation (CEGL004150)--occurs in the southern Great Plains and is very similar, but has not been reported further west than Arkansas, Oklahoma and Texas; further review is need to clarify differences.

GRank & Reasons: G5 (94-02-23).

Comments: This community is a common element found in many wetland systems, but has received little attention. Consequently, the diagnostic features and species of this community are not well known. Some ecologists (Hansen et al. 1995, Kittel et al. 1999) have include *Typha angustifolia* as a codominant in this association. More classification work is needed to clarify the concept of this association.

ELEMENT DISTRIBUTION

Range: *Typha latifolia* Herbaceous Vegetation is widely distributed, occurring across the western United States and western Great Plains.

Nations: CA US

States/Provinces: AZ:S3, BC:S5, CA:S3, CO:S3, ID:S4, MT:S5, NM:S5, NV:S?, OR:S5, UT:S2S4, WA:S5, WY:S?

ELEMENT SOURCES

Authors: J. Drake, mod. K. Schulz, WCS **Confidence:** 2 **Identifier:** CEGL002010
References: Baker 1984a, Bourgeron and Engelking 1994, Bundy et al. 1996, Bunin 1985, Christy 1973, Crowe and Clausnitzer 1997, Dethier 1990, Driscoll et al. 1984, Hansen et al. 1991, Hansen et al. 1995, Holland 1986b, Johnston 1987, Jones and Walford 1995, Kittel et al. 1996, Kittel et al. 1999a, Kovalchik 1993, Kunze 1994, Lindauer 1978, Lindauer and Christy 1972, Masek 1979, McEachern 1979, Muldavin et al. 1993b, Padgett et al. 1989, Ramaley 1939b, Titus et al. 1996, Tolstead 1942, Von Loh 2000, Youngblood et al. 1985a

SARCOBATUS VERMICULATUS INTERMITTENTLY FLOODED SHRUB HERBACEOUS ALLIANCE

Black Greasewood Intermittently Flooded Shrub Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Shrublands included in this alliance occur on lowland sites in the northwestern Great Plains and central Wyoming. Precipitation varies with geography but ranges from 25-35 cm. Elevations range from 655-2400 m. Stands occur on flat to gently sloping alluvial fans, terraces, lakebeds, and floodplains (Mueggler and Stewart 1978, Hansen and Hoffman 1988). Dodd and Coupland (1966) found *Sarcobatus vermiculatus* in association with *Pascopyrum smithii* only on the most arid parts of southwest Saskatchewan. Sites are poorly drained and intermittently flooded with a shallow or perched water table often within 1 m depth (Hansen et al. 1995). Substrates are generally shallow, fine-textured soils (clays to silt-loams), derived from alluvium, although coarse soils are possible (Hirsch 1985, USFS 1992, Jones and Walford 1995, Thilenius et al. 1995) Soils are alkaline or saline, although not strongly saline because salt crusts do not generally form (Thilenius et al. 1995)

Adjacent upland vegetation varies with geography. In the Great Plains, it is likely short- or midgrass prairie and in central Wyoming it is typically shrublands dominated by *Artemisia tridentata*.

Vegetation: Vegetation included in this alliance is found on intermittently flooded lowland sites such as stream terraces, swales, playas and gently sloping alluvial fans in the northern Great Plains and Rocky Mountain foothills. The vegetation typically has moderate to dense cover (Jones and Walford 1995, Thilenius et al. 1995, Walford 1996) dominated by the cool-season mid grasses. The herbaceous cover is sparse beneath the shrubs and moderate to dense between them. The dominant species are typically 0.5-1 m tall. The most abundant species is *Pascopyrum smithii*, usually accompanied by *Bouteloua gracilis, Hesperostipa comata (= Stipa comata)* and the exotics *Bromus japonicus* and *Bromus tectorum*. Medium-tall (0.5-1.5 m) shrubs are scattered throughout; their total canopy is 10-25%. The shrub layer is dominated by *Sarcobatus vermiculatus*, with *Atriplex confertifolia*, *Artemisia tridentata*, and *Chrysothamnus viscidiflorus* in smaller amounts. *Symphoricarpos occidentalis* and *Rhus aromatica* are sometimes found in more mesic microhabitats within this community (Hirsch 1985). Few forbs are found in this community. *Achillea millefolium* and *Opuntia polyacantha* are the only species with high constancy. Overall species diversity in this community is low (Hansen and Hoffman 1988).

Dynamics: *Sarcobatus vermiculatus*, like many facultative halophytes, is tolerant of alkaline and saline soil conditions that allow it to occur in sites with less interspecific competition (Ungar et al. 1969, Bransen et al. 1976). *Sarcobatus vermiculatus* is often found on sites with high water tables that are intermittently flooded. Hansen et al. (1995) reported that it can tolerate saturated soil conditions for up to 40 days. *Sarcobatus vermiculatus* is not ordinarily browsed, but Daubenmire (1970) found that under heavy stocking rates the shrubs will develop a compact canopy. Hansen et al. (1995) also reported browsing damage with heavy spring and summer grazing, but noted that *Sarcobatus vermiculatus* is moderately poisonous to livestock especially in the fall, and supplemental feed is recommended to avoid livestock loss. Hanson (1929) states that *Sarcobatus vermiculatus* can form an important part of winter forage for sheep. Fire will topkill *Sarcobatus vermiculatus*, but the shrub will promptly resprout from the root crown (Daubenmire 1970).

ALLIANCE SOURCES

Authors: K. SCHULZ, West **Identifier:** A.1554
References: Branson et al. 1976, Brown 1971, Daubenmire 1970, Dodd and Coupland 1966, Earth Resource Technology n.d., Faber-Langendoen et al. 1996, Fisser et al. 1965, Hamner 1964, Hansen and Hoffman 1988, Hansen et al. 1988a, Hansen et al. 1995, Hanson 1929, Hirsch 1985, Johnston 1987, Jones and Walford 1995, MTNHP 1988, Mueggler and Stewart 1980, Olson and Gerhart 1982, Thilenius et al. 1995, USFS 1992, Ungar et al. 1969, Walford 1996

SARCOBATUS VERMICULATUS / PASCOPYRUM SMITHII - (ELYMUS LANCEOLATUS) SHRUB HERBACEOUS VEGETATION

Black Greasewood / Western Wheatgrass - (Streamside Wild Rye) Shrub Herbaceous Vegetation

ELEMENT CONCEPT

Environment: This community is found on flat to gently sloping alluvial fans, terraces, lakebeds, and floodplains (Mueggler and Stewart 1980, Hansen and Hoffman 1988). Dodd and Coupland (1966) found *Sarcobatus vermiculatus* in association with *Pascopyrum smithii* only on the most arid parts of southwestern Saskatchewan. The soil is usually deep clay, silty clay, sandy clay, or loam (Hirsch 1985, Jones and Walford 1995), although coarse soils are possible (USFS 1992, Thilenius et al. 1995). They are saline or alkaline, but salt crusts on the surface are absent (Thilenius et al. 1995, but see Steinauer and Rolfsmeier 2000). Parent material is usually alluvium. Flooding during the spring is possible.

Vegetation: This community has moderate to dense vegetation cover (Jones and Walford 1995, Thilenius et al. 1995). Medium-tall (0.5-1.5 m) shrubs are scattered throughout, with a total shrub canopy of 10-25% (Hansen and Hoffman 1988, USFS 1992). The shrub layer is dominated by *Sarcobatus vermiculatus*, with *Atriplex confertifolia, Atriplex canescens, Atriplex argentea, Artemisia tridentata*, and *Chrysothamnus viscidiflorus* in smaller amounts. *Symphoricarpos occidentalis* and *Rhus aromatica* are sometimes found in more mesic microhabitats within this community (Hirsch 1985). Herbaceous cover is sparse beneath the shrubs and moderate to dense in between. The dominant species are typically 0.5-1 m tall. The most abundant species is *Pascopyrum smithii*, usually accompanied by *Bouteloua gracilis, Bromus japonicus, Bromus tectorum*, and *Hesperostipa comata (= Stipa comata)*. Few forbs are found in this community. *Achillea millefolium* and *Opuntia polyacantha* are the only species with high constancy. Other species present may include *Grindelia squarrosa*. Overall species diversity in this community is low (Hansen and Hoffman 1988, Von Loh et al. 1999). In Nebraska, shrub species cover may be very low, and saline pockets may contain *Distichlis spicata* and *Sporobolus airoides*. *Astragalus bisulcatus* may be prominent (Steinauer and Rolfsmeier 2000).

Similar Associations:

- Sarcobatus vermiculatus / Elymus elymoides - Pascopyrum smithii Shrubland (CEGL001365)
- Sarcobatus vermiculatus / Distichlis spicata - (Puccinellia nuttalliana) Shrub Herbaceous Vegetation (CEGL002146)

GRank & Reasons: G4 (96-02-01).

Comments: Compare this association with *Sarcobatus vermiculatus / Elymus elymoides - Pascopyrum smithii* Shrubland (CEGL001365) from New Mexico.

See Steinauer and Rolfsmeier (2000) for a description of the stands in Nebraska. *Sarcobatus vermiculatus / Distichlis spicata - (Puccinellia nuttalliana)* Shrub Herbaceous Vegetation (CEGL002146) may be a more saline version of this type.

ELEMENT DISTRIBUTION

Range: This greasewood shrub prairie is found in saline habitats in the northwestern Great Plains of the United States and Canada, ranging from northwestern Nebraska north to the Dakotas and Saskatchewan.

Nations: CA? US

States/Provinces: MT:S4, ND:S4?, NE:S2, SD:SU, SK?, WY:S4

ELEMENT SOURCES

Authors: J. Drake, WCS **Confidence:** 1 **Identifier:** CEGL001508

References: Bourgeron and Engelking 1994, Brown 1971, Dodd and Coupland 1966, Driscoll et al. 1984, Earth Resource Technology n.d., Fisser et al. 1965, Hamner 1964, Hansen and Hoffman 1988, Hansen et al. 1984, Hirsch 1985, Johnston 1987, Jones and Walford 1995, MTNHP 1988, Mueggler and Stewart 1980, Olson and Gerhart 1982, Steinauer and Rolfsmeier 2000, Thilenius et al. 1995, USFS 1992, Von Loh et al. 1999

POTAMOGETON RICHARDSONII PERMANENTLY FLOODED HERBACEOUS ALLIANCE

Red-head Pondweed Permanently Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Associations occur in the permanently inundated, "deep water" zone of glacial ponds in gentle, rolling, glacial terrain (Faber-Langendoen et al. 1997). Water is usually 15 to >100 cm deep. Types typically occur

in fresh to moderately brackish water (Lesica 1989). The water is generally still, though it may be moving very slowly through beaver ponds. The water is typically nutrient-rich (Sanderson and Kettler 1996). The underlying parent material is mixed sedimentary (partly calcareous) glacial till. Pond bottoms are typically composed of mud, organic mud, or mud mixed with gravel and stones (Faber-Langendoen et al. 1997).
Vegetation: Plant associations within this alliance are classified as permanently flooded, temperate or subpolar, hydromorphic-rooted vegetation. All stands are dominated by aquatic macrophytes. *Potamogeton richardsonii* is the most prominent and conspicuous plant due to its broad leaves. It dominates the forb layer with up to 50% cover (Sanderson and Kettler 1996). Other aquatic associates can include *Utricularia macrorhiza (= Utricularia vulgaris), Potamogeton gramineus, Ranunculus aquatilis, Myriophyllum spicatum*, and *Polygonum amphibium* (Lesica 1989).
Dynamics: This aquatic type may provide food and habitat for waterfowl and aquatic macroinvertebrates (Sanderson and Kettler 1996).

ALLIANCE SOURCES

Authors: D. CULVER, West **Identifier:** A.1765
References: Faber-Langendoen et al. 1997, Great Plains Flora Association 1986, Hickman 1993, Lesica 1989, Lesica 1993, MTNHP n.d., Sanderson and Kettler 1996, Sawyer and Keeler-Wolf 1995, Stewart and Kantrud 1971

POTAMOGETON RICHARDSONII - MYRIOPHYLLUM SPICATUM HERBACEOUS VEGETATION
Red-head Pondweed - Eurasian Water-milfoil Herbaceous Vegetation

ELEMENT CONCEPT

Environment: This community occurs in the permanently inundated, "deep water" zone of glacial ponds in gentle, rolling, glacial terrain. Water is usually 15 to >100 cm deep. The type occurs in fresh to moderately brackish water (230-2300 ohms/cm), but is characteristic of fresh or slightly brackish water (median of 460 ohms/cm) (Lesica 1989). Ponds occur at an elevation of 4500-5000 feet. Underlying parent material is mixed sedimentary (partly calcareous) glacial till. Pond bottoms are composed of mud, organic mud, or mud mixed with gravel and stones.
Vegetation: Stands are dominated by aquatic macrophytes. *Potamogeton richardsonii* and *Myriophyllum sibiricum (= Myriophyllum exalbescens)* dominated and were both present in nearly every stand in described Montana ponds (Lesica 1989). *Stuckenia pectinata (= Potamogeton pectinatus)* was present in about 50% of sampled stands. *Utricularia macrorhiza (= Utricularia vulgaris), Potamogeton gramineus, Ranunculus aquatilis*, and *Polygonum amphibium* occurred in some ponds with fresher water. Occurrences of similar communities in North Dakota and Saskatchewan are similar in species composition, although *Potamogeton pusillus* was apparently more common in these areas.
Dynamics: There is probably little natural disturbance except inter- and intra-annual water level.
Similar Associations:
- Stuckenia pectinata - Myriophyllum spicatum Herbaceous Vegetation (CEGL002003)--occurs in the same area. It lacks broad-leaved macrophytes and is most common in somewhat more brackish water (Lesica 1989).

GRank & Reasons: G2Q (96-02-01).
Comments: Some authorities consider the native North American plants to be *Myriophyllum spicatum var. exalbescens*, while others consider them to be a distinct species, *Myriophyllum exalbescens*. Synonymous communities may have *Myriophyllum exalbescens* rather than *Myriophyllum spicatum* in the name.

Stewart and Kantrud (1972) assert that both *Potamogeton richardsonii* and *Myriophyllum spicatum* are characteristic of glacial potholes with fresh to slightly brackish water in North Dakota. Their open water community of slightly brackish ponds is dominated by *Potamogeton richardsonii, Potamogeton pusillus, Ceratophyllum demersum, Myriophyllum exalbescens (= Myriophyllum spicatum), Ranunculus aquatilis* and *Utricularia macrorhiza (= Utricularia vulgaris)* (Stewart and Kantrud 1971). Light saline ponds in southern Saskatchewan are dominated by *Myriophyllum exalbescens, Lemna trisulca, Lemna minor, Potamogeton pusillus, Potamogeton richardsonii* and *Ranunculus longirostris (= Ranunculus subrigidus)* (Walker and Coupland 1970).

ELEMENT DISTRIBUTION

Range: This type is reported from glacial ponds at the western edge of the Great Plains in north-central Montana and probably also North Dakota and Saskatchewan.
Nations: US
States/Provinces: MT:S2Q

ELEMENT SOURCES

Authors: P. Lesica, WCS **Confidence:** 3 **Identifier:** CEGL002006

References: Bourgeron and Engelking 1994, Driscoll et al. 1984, Faber-Langendoen et al. 1997, Lesica 1989, Lesica 1993, MTNHP n.d., Stewart and Kantrud 1971, Stewart and Kantrud 1972, Walker and Coupland 1970

STUCKENIA PECTINATA PERMANENTLY FLOODED HERBACEOUS ALLIANCE

Sago Pondweed Permanently Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Plant associations in this alliance occur in ponds in the midwestern and western United States. Stands are found in glacial ponds, or prairie potholes, in the northern Great Plains and in ponds and slow-moving water in Colorado. Stands are located in shallow (20 cm) to moderately deep (1 m) seasonal or permanent standing water, but with standing water present throughout the growing season. The ponds characteristically have brackish water (a relatively high ionic concentration) and bottoms composed of mud, mud mixed with gravel and, occasionally, organic matter. Parent material is often glacial till. The elevation of the plant associations ranges from 150-600 m in the Great Plains to 1200-2950 m in Montana and Colorado. Adjacent vegetation is midgrass and tallgrass prairie on the plains, and *Carex aquatilis* and *Carex utriculata* wetlands in Colorado.
Vegetation: Plant associations in this alliance occur in glacial ponds, or prairie potholes, in the northern Great Plains and in ponds and slow-moving water in Colorado. Submerged aquatic macrophytes cover at least 25% of the surface. *Stuckenia pectinata (= Potamogeton pectinatus)* is the dominant species and *Potamogeton pusillus, Zannichellia palustris, Myriophyllum spicatum, Ruppia maritima, Sparganium angustifolium*, and *Ceratophyllum demersum* are associated species. The macroalgae, *Chara* sp., is usually present.
Dynamics: The following information is based on Cooper and Severn (1992). The vegetation in this alliance occurs in relatively shallow, small- and medium-sized ponds, but not in larger lakes. The submergent vegetation requires some aerobic root respiration and mineral nutrients made available through decomposition of accumulated organic matter on the bottom of the ponds. Decomposition occurs with the occasional lowering of the water level in the ponds. *Potamogeton* species are important food for waterfowl (Weber and Wittman 1996).

ALLIANCE SOURCES

Authors: M. DAMM, West **Identifier:** A.1764
References: Cooper 1996, Cooper and Severn 1992, Cooper n.d., Faber-Langendoen et al. 1996, Faber-Langendoen et al. 1997, Hitchcock et al. 1977a, Lesica 1989, Lesica 1993, Lesica 1994, MTNHP n.d., Sanderson and Kettler 1996, Weber and Wittman 1996

STUCKENIA PECTINATA - MYRIOPHYLLUM SPICATUM HERBACEOUS VEGETATION

Sago Pondweed - Eurasian Water-milfoil Herbaceous Vegetation

ELEMENT CONCEPT

Environment: This community occurs in the permanently inundated, "deep water" zone of glacial ponds of the western Great Plains in gentle, rolling, glacial terrain. Water is usually 15-100 cm deep. The type can occur in fresh to brackish water (270-44,000 ohms/cm), but is characteristic of mildly brackish water (median of 2500 ohms/cm) (Lesica 1989). These ponds occur at an elevation of 1300-1500 m (4300-5000 feet). Underlying parent material is mixed sedimentary (partly calcareous) glacial till. Pond bottoms are composed of mud or mud mixed with gravel and stones.
Vegetation: These communities are characteristically poor in species, and canopy cover is low (<50%). Submerged aquatic macrophytes dominate the vegetation. *Stuckenia pectinata (= Potamogeton pectinatus)* was present in all stands sampled; *Myriophyllum spicatum* can be locally dominant and was present in about 50% of stands. *Ranunculus aquatilis, Utricularia macrorhiza (= Utricularia vulgaris)*, and *Potamogeton richardsonii* were occasionally present. *Chara* spp., a calciphile macroalgae, was often present (Lesica 1989, 1994; Lesica pers obs.).
Dynamics: These communities probably experience little natural disturbance except inter- and intra-annual water level fluctuations.
Similar Associations:

- Potamogeton richardsonii - Myriophyllum spicatum Herbaceous Vegetation (CEGL002006)--occurs in the same area. It has appreciable cover of the broad-leaved macrophyte *Potamogeton richardsonii* and is most abundant in water with a lower ionic content (Lesica 1989).

GRank & Reasons: G3G4 (97-11-14). More than 18 occurrences of this community type have been documented in Montana, ranging from the glacial potholes of the Ovando Valley (west-central portion) to those of Missouri

Coteau Subsection (northeastern most Montana) and including the area most intensively sampled, the prairie potholes of the Blackfeet Indian Reservation (just east of the Continental Divide, Lesica 1989); related or identical communities (supporting same dominant species) have been documented from Saskatchewan, North Dakota, and California. This is a common aquatic type of open-water portions of prairie ponds (sloughs in Canadian parlance) with slightly brackish to saline water and a variety of bottom conditions. This habitat is not unique and the dominants (indicator) species for the community type are broadly distributed, so this type can be expected to occur from at least Manitoba and Minnesota westward and south to California. This association was initially rated as rare because investigators had not previously differentiated aquatic assemblages at the community type level.
Comments: This type should be reviewed throughout the Great Plains prairie potholes region. There is disagreement over the taxonomy of *Myriophyllum*. Some authorities consider the native North American plants to be *Myriophyllum spicatum var. exalbescens*, while others consider them to be a distinct species, *Myriophyllum exalbescens*. Synonymous communities may have *Myriophyllum exalbescens* rather than *Myriophyllum spicatum* in the name.

Stewart and Kantrud (1972) report that both *Myriophyllum exalbescens (= Myriophyllum spicatum)* and *Stuckenia pectinata (= Potamogeton pectinatus)* are common in slightly or moderately brackish water of potholes in North Dakota. They describe the open-water community of moderately brackish ponds as dominated by *Zannichellia palustris* and *Stuckenia pectinata* with *Myriophyllum exalbescens* a secondary species (Stewart and Kantrud 1971). Lesica (1989, 1992) considered communities dominated by *Zannichellia palustris* distinct from those dominated by *Stuckenia pectinata*. Walker and Coupland (1970) report that lightly saline aquatic communities of southern Saskatchewan are dominated by a number of species including *Myriophyllum exalbescens*; *Stuckenia pectinata* is of secondary importance. In Saskatchewan as in North Dakota *Myriophyllum exalbescens* is dominant while *Stuckenia pectinata* is less abundant, opposite to what was found in Montana. *Myriophyllum spicatum* and *Stuckenia pectinata* are among the characteristic plants of ponds in southern California (Ferren et al. 1996). This community as described in Montana has lower species richness compared to those from other, more humid areas. Montana communities may be depauperate representations of a more widespread aquatic association of slightly to moderately saline water.

Similar communities are associated with glacial ponds in western Montana but were called the *Potamogeton pectinatus* or the *Myriophyllum spicatum* community types (Lesica 1994).

ELEMENT DISTRIBUTION

Range: This sago pondweed - water-milfoil pond community is found in glacial ponds in the northwestern Great Plains of the United States and Canada, but may range more broadly. This community was recorded for 13 of 84 ponds sampled in Glacier County, Montana. Many hundreds of ponds exist in the same general area.
Nations: CA? US
States/Provinces: CA?, MB:SU, MT:S1Q, ND:SU, ON?, SD:SU, SK:SU

ELEMENT SOURCES

Authors: P. Lesica, WCS **Confidence:** 3 **Identifier:** CEGL002003
References: Bourgeron and Engelking 1994, Cowardin et al. 1979, Driscoll et al. 1984, Ferren et al. 1996, Lesica 1989, Lesica 1992, Lesica 1993, Lesica 1994, MTNHP n.d., Stewart and Kantrud 1971, Stewart and Kantrud 1972, Walker and Coupland 1970

SALICORNIA RUBRA SEASONALLY FLOODED HERBACEOUS ALLIANCE

Red Saltwort Seasonally Flooded Herbaceous Alliance

ALLIANCE CONCEPT

Environment: Plant associations within this alliance are found in saline depressions in the western United States and northern Great Plains. Elevations range from 1500 to 2200 m. These vegetation types occur in shallow, broad depressions with poor drainage and high salt concentrations (Ungar 1970, Walker and Coupland 1970). Stands are found in exposed mud of alkali flats of saline wetland depressions during the dry or draw-down phase. Stands can also be found in the peripheral shallow-marsh zone of subsaline semipermanent ponds and lakes (Stewart and Kantrud 1971). In some areas, the major source of salinity is groundwater discharge (Dodd and Coupland 1966). These communities require moist to wet hypersaline soils which are seasonally flooded. Most soils are clay to silty loam and may have salt encrustations on the surface after drying out in mid-summer (Dodd and Coupland 1966). Ungar (1970) found the surface soil to have average salt concentrations of 4.8% and pH levels that average 8.4.

Water often collects on the surface in the spring or after heavy rains, but by mid-summer the soil can be dry to moist.
Vegetation: This alliance is found in saline depressions in the northern and western Great Plains. Total vegetation cover is sparse to moderate with exposed soil common. The harsh conditions provided by the saline soil, spring flooding, and summer drought limits the number of species capable of growing in this alliance. Stands that have more stable water tables can have moderate diversity. *Salicornia rubra*, an annual forb, dominates stands of this alliance, and often forms a monoculture on extremely alkaline mudflat areas. Dodd and Coupland (1966) found that it made up to 88-100% of the vegetative cover in stands. Other species that are often found are *Chenopodium rubrum, Distichlis spicata, Hordeum jubatum, Puccinellia nuttalliana*, and *Suaeda calceoliformis*.
Dynamics: These vegetation types have a wide distribution in the Great Plains and Rocky Mountain regions, but often occur in small stands at the bottom of hypersaline basins, having very specific habitat needs (Ungar 1974). Hypersaline wetland basins which support the alliance have been impacted by water diversion, livestock grazing, and land conversion in many places. Saline wetlands in the Great Plains and upper Midwest have been described as especially vulnerable to habitat fragmentation and loss due to increasing population and agricultural development (Gersib and Steinauer 1991). The maintenance of stands requires protection of hydrological processes such as seasonal inundation, evaporative drydown, and mineral accumulation, as well as preservation of suitable habitat.

ALLIANCE SOURCES

Authors: MCS, MOD. D. CULVER, West **Identifier:** A.1818
References: Dodd and Coupland 1966, Faber-Langendoen et al. 1996, Faber-Langendoen et al. 1997, Gersib and Steinauer 1991, Hadley and Buccos 1967, Hansen et al. 1991, Redmann 1972, Stewart and Kantrud 1971, Ungar 1970, Ungar 1972, Ungar 1974c, Walker and Coupland 1970

SALICORNIA RUBRA HERBACEOUS VEGETATION
Red Saltwort Herbaceous Vegetation

ELEMENT CONCEPT

Environment: *Salicornia rubra* is found in exposed mud of alkali flats of saline wetland depressions during the dry or drawdown phase. This community is also found in the peripheral shallow-marsh zone of subsaline semipermanent ponds and lakes (Stewart and Kantrud 1971). In some areas, the major source of salinity is groundwater discharge (Dodd and Coupland 1966). The principle salts are sulfates and chlorides of sodium and magnesium (Stewart and Kantrud 1972). Few species can tolerate the extreme salinity of these wetlands. Dodd and Coupland (1966) found *Salicornia rubra* to be the principal dominant of alkali mudflats with fine-textured soils in southern Saskatchewan.
Vegetation: *Salicornia rubra* often forms a monoculture within extremely alkaline mudflat areas. Dodd and Coupland (1966) found that it made up to 88-100% of the vegetative cover in plots. Other species include *Puccinellia nuttalliana (= Puccinellia airoides), Distichlis spicata, Hordeum jubatum, Triglochin maritima, Chenopodium rubrum*, and *Suaeda calceoliformis*.
GRank & Reasons: G2G3 (00-01-31). This type occurs over a broad geographic range and has been recorded from Nebraska, South Dakota, North Dakota, Minnesota, Montana, Colorado, and north into Saskatchewan, Canada. However, it has very specific habitat needs (Ungar 1974c), and there may be fewer than 50 occurrences rangewide. Hypersaline wetland basins which support the association have been impacted by water diversion, livestock grazing, and land conversion in many places. Saline wetlands in the Great Plains and upper Midwest have been described as especially vulnerable to habitat fragmentation and loss due to increasing population and agricultural development (Gersib and Steinauer 1991). The maintenance of stands of this association requires protection of hydrological processes such as seasonal inundation, evaporative drydown, and mineral accumulation, as well as preservation of suitable habitat.

ELEMENT DISTRIBUTION

Range: This community is associated with highly alkaline wetlands or lakes in the northern Great Plains and Great Basin of the United States and adjacent Canada, ranging from western Minnesota to Saskatchewan, south to Colorado and possibly Nevada and California.
Nations: CA US
States/Provinces: CA?, CO:S1?, MB:S?, MN:S1, MT:S2?, ND:S?, NV?, SD:S?, SK:S?

ELEMENT SOURCES

Authors: D. Lenz, WCS **Confidence:** 2 **Identifier:** CEGL001999

References: Bourgeron and Engelking 1994, Cooper 1990, Dodd and Coupland 1966, Driscoll et al. 1984, Gersib and Steinauer 1991, Greenall 1996, Hansen et al. 1991, Sarr and Sanderson 1998, Stewart and Kantrud 1971, Stewart and Kantrud 1972, Ungar 1972, Ungar 1974c

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