
Platte River Wet Meadows

A Primer on their Flora, Fauna, Hydrology,
Management, and Restoration

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The Platte River Whooping Crane Maintenance Trust, Inc. *is a non-profit organization dedicated to the conservation of migratory bird habitat along Nebraska's Platte River. The Trust's mission is to protect and maintain the physical, hydrological, and biological integrity of the Big Bend area of the river so that it continues to function as a life support system for the Whooping Crane and other migratory birds. The Trust acquires land and water rights, manages and protects habitat, and conducts research related to migratory birds and their habitat needs.*

PLATTE RIVER WET MEADOWS

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Platte River Wet Meadows

What are They?

Introduction

This Handbook is designed to provide a broad introduction to the natural history and ecological functioning of wet meadows along the Platte River in Central Nebraska. The information presented here is based on observations, research studies, and data collected by the Trust, University researchers, and others during the past 10 to 15 years. Although this is not a comprehensive scientific treatment, the information presented here will hopefully highlight the major features and characteristics of meadows, and provide an appreciation for the complexity of this ecosystem.

Wet meadows have long been recognized as an important habitat component on the Platte (USFWS 1981, Currier et al. 1985), but a clear, universally accepted, definition of wet meadows has not emerged. The goal in this publication is to describe their characteristic flora and fauna, and some of the ecological functions of wet meadows. One difficulty in defining wet meadows is their dynamic nature, seasonal variability, and the variety of topographic and hydrologic situations in which they occur. A further complication is their wide geographical distribution over more than 200 miles of the North Platte and Platte River valleys. In this report, we define wet meadows as a complex of grassland and wetland areas in central and western Nebraska within close proximity to the Platte River channel and with a hydrologic connection to river flows. By this definition, wet meadows are confined to the river floodplain, and for the most part, are located within 1 to 2 miles of the channel. They generally have pooled or ponded standing water during a portion of the year (primarily spring and early summer) and are hydrologically interconnected with the river through a common groundwater table and on occasion by surface water overflow (see Plate I).



Currier et al. (1985) described more than 21,000 acres of wet meadow on the Central Platte and nearly 11,000 acres of wet meadow on the North Platte in high crane use areas along the river. Under the Currier et al. (1995) classification, mesic or moist prairies, sedge meadows, emergent cattail and bulrush marshes, wetland swales, ponds, and sloughs, and lowland savannas (mix of grassland and open tree and shrub growth) were all included in the wet meadow category. Although wet meadows are generally flat to gently sloping as a result of their alluvial floodplain nature, they do have a gently rolling or "corrugated" surface topography that includes lowland sloughs and swales as well as sand ridges and upland grasslands. The common thread in the classification, however, is the presence of scattered wetlands with high groundwater, poor drainage, and nutrient rich soils, within a larger matrix of lowland to upland prairie. In other words, wet meadows and their characteristic organisms, seem to be defined by the shape, size, extent, and characteristics of their component wetlands.

A dynamic interaction exists among the main channels, side channels, backwaters, and wet meadows of the Platte River. The high groundwater levels characteristic of wet meadows are hydrologically linked to channel flows. Short-term high "pulse" flows and flood flows recharge meadows by elevating groundwater levels and creating overbank flooding. Such events are instrumental in redistributing nutrients, seeds, and organisms between the river system and isolated wetlands and wet meadows.

Few habitats have the diversity of life found in the complex of wetland swells and rolling grasslands that form the wet meadows. Although dominated by prairie grasses, sedges, and marsh emergents, wet meadows support more than 200 species of wetland and grassland plants. Woodland and shrubs provide another component of wet meadows, but they are generally confined to the perimeter. The variety of plants and microhabitats in the meadows provides habitat for a wide diversity of organisms from birds and amphibians to earthworms, snails, and insects. The seeds, tubers, insects, ground beetles, spiders, insect larvae, and other organisms found in wet meadows form the bulk of the production at the base of the food chain. This food base provides an important source of direct forage for migratory birds, but also sustains mice, rodents, snakes, and other organisms upon which harriers and hawks feed, and on which coyotes, skunks, badgers, and other predator species at the top of the food chain rely for their food.

Since the late 1800s, an estimated 75-80% of the wet meadows along the Platte have disappeared from the landscape (Currier et al. 1985, Sidle et al. 1989). As settlement expanded onto the central plains, many meadows were ditched and drained to allow conversion to cropland. Intensive grazing and haying has also changed the character of many of the remaining sites by reducing the stature of the vegetation, eliminating sensitive species, and allowing invasion and expansion of weedy and introduced plants such as bluegrass (*Poa pratensis*) and smooth brome (*Bromus inermis*). Water development in the Platte River Basin and reductions of about two-thirds of the peak and mean annual flows in the stream (Williams 1978, U.S. Geological Survey 1983, Butler 1994) have undoubtedly affected the hydrology of wet meadows as well. As a result of areal reductions and changes in hydrology, (including groundwater declines), wet meadows are thought to be one of the most limiting habitat components in the Big Bend Reach of the Platte (Currier et al. 1985, Sidle et al. 1989).

In recent years, the Platte River Trust and other conservation groups have acquired and protected a number of wet meadows, and have begun restorations on other sites. Grazing and haying rotations, prescribed burning, reductions in stocking rates, and reseeding have been used to enhance and restore much of this habitat. The Trust has also experimented with windmills, low-head sills and dams, and the re-shaping of ground surface topography, as ways to enhance wet meadow hydrology. Although these land management techniques have made substantial improvements in the diversity and standing crop of wet meadows, important questions remain about the relationship between vegetation, soils, and hydrology, and the water regime that is necessary to manage and maintain wet meadows.

Wet Meadow Flora

A Diverse Mix of Lowland and Prairie Species

Along a Wetland Gradient

The vegetation in wet meadows includes wetland species (e.g., sedges, bulrushes, smartweeds) on lowland sites, mid- to tallgrass prairie species (e.g., big bluestem, little bluestem, indiagrass, switchgrass, goldenrod, ironweed) over most of the area, and shortgrass prairie species (e.g., sideoats grama, blue grama, purple poppy mallow, coneflower) on more elevated ridges (see Plates II, III, IV, V, and Appendix A). Although wet meadows are generally dominated by herbaceous plants, shrub, woodland, and savanna communities are also associated with these areas. Russian olive (*Eleagnus angustifolia*), mulberry (*Morus rubra*), Siberian elm (*Ulmus pumila*), buffalo berry (*Shepherdia argentea*), eastern red cedar (*Juniperus virginiana*), wild plum (*Prunus americana*), and false indigo (*Amorpha fruticosa*) are woody species commonly found at the periphery of wet meadows and on some wet meadow-woodland-shrub complexes.

Standing-water wetland sites are often dominated by water sedge (*Carex aquatilis*), 3-square (*Scirpus americanus*), spikerush (*Eleocharis macrostachya*), bluejoint (*Calamagrostis inexpansa*), cutgrass (*Leersia virginica*) and smartweeds (*Polygonum* spp.) (Plate IV). A number of forbs with relatively low cover values are also characteristic of moderately wet sites. These include fog fruit (*Phyla lanceolata*), ironweed (*Vernonia fasciculata*), and blue vervain (*Verbena hastata*) (Plate II). On drier, but moist sites, a number of grasses such as switchgrass (*Panicum virgatum*), cordgrass (*Spartina pectinata*), and wheatgrass (*Agropyron* spp.) are often quite common. These species are often accompanied by wild licorice (*Glycyrrhiza lepidota*), dogbane (*Apocynum sibiricum*), Canada goldenrod (*Solidago canadensis*), Maximillian and sawtooth sunflowers (*Helianthus maximilliana* and *H. grosseserratus*) and white sweet clover (*Melilotus albus*). The latter plants appear to define the boundary between moderately wet and moderately dry sites (hydrologic break between sloughs and ridges). White sweet clover is often associated with past disturbance (e.g., overgrazed or tilled sites) and can persist for a decade or more after a disturbance.

Mesic to moderately dry sites are characterized by smooth brome (*Bromus inermis*), and big bluestem (*Andropogon gerardii*). These species are quite widely distributed, but they drop-off sharply on both the very wet and the very dry sites in the meadows. Blue grama (*Bouteloua gracilis*), field sandbur (*Cenchrus longispinus*), and purple poppy mallow (*Callirhoe involucrata*), are characteristic species for dry sites located primarily on high sand ridges in the meadows. Disturbance species including bluegrass (*Poa pratensis*), common ragweed (*Ambrosia artemisiifolia*), marsh elder (*Iva annua*), and foxtail barley (*Hordeum jubatum*) are also common in wet meadows. These species are opportunistic colonizers that take advantage of openings in the vegetative cover. Such openings can be the result of grazing, cattle hoof action, or mudflats created by long-term ponding of water on a meadow site.

Cranes and Waterfowl

Wet Meadows Provide Important Feeding and Resting Sites

A Spring Phenomenon

Wet meadows play an important role in providing feeding and nesting habitat for large flocks of spring-migrating birds including sandhill cranes, waterfowl, and shore and other aquatic birds. The Platte River is a significant staging area for spring migrating sandhill cranes and waterfowl. Nearly one-half million sandhill cranes and 7 to 9 million ducks and geese migrate to the Platte River Valley each spring. At night the cranes and waterfowl roost and rest on channels of the Platte, but during daytime hours, these species feed in adjacent cornfields and wetland meadows.

Nearly 100,000 cranes and waterfowl can be seen gathering mid-day in wet meadows of a 1,000 acres or more. Although both cranes and waterfowl obtain most of their nourishment from corn fields, they spend about 50% of their time in wet meadows. They are often seen probing and feeding for earthworms, snails, insect larvae, and plant tubers along the edges of sloughs, swales, and ponds in the wet meadows. In just a few days of probing in the soil for fleshy tubers, tender plant shoots, insects and earthworms, several thousand cranes can rake an area of a meadow clean. Emergent plants are uprooted and searched for insects and grubs, and cow chips are turned and examined for insect larvae or undigested bits of seeds and grains. The meadows provide a source of invertebrate foods and animal protein that is essential for successful egg laying and reproduction. Although corn provides the bulk of the diet, these essential amino acids are only available from wet meadows and other grasslands and haylands.

In addition to feeding, the wet meadows also provide an important area for waterfowl and cranes to rest. They will preen, dance, and lounge in the meadows in mid-day after feeding in other areas. Cranes spend time in the meadows reinitiating their pair bonds by dancing and calling in unison. Although waterfowl are normally present on the meadows before the cranes arrive in early spring, a few remain late into the migration season, and may even nest if water conditions in the meadows are adequate. In all, the spring migration on the Platte and in the congregations of birds in the wet meadows is a great spectacle not to be missed.

Nesting Birds and Other Migrants

Some Stay, Others Visit While Passing Through!

Common Species

Wet meadows host a diverse bird community (Table 1). The combination of wet soils and associated vegetation hosts a multitude of invertebrates and other organisms that provide an important food source for birds. Vegetation stature is also a key component in providing both roosting and nesting cover. Over 120 species have been recorded utilizing this habitat type. That is nearly 30% of the bird species recorded for the entire state of Nebraska. Sixty-five species (52%) are neotropical migrants (a species that winters south of Mexico and nests in North America). This group of birds has shown a general decline in populations and is of increasing concern to the conservation community as habitat losses continue both on their wintering and nesting grounds.

Table 1. List of the most common nesting and migratory birds that use wet meadows.

<i>Nesting Species (at Crane Meadows)</i>	<i>Winter Resident</i>	<i>Endangered Species</i>	<i>Spring Migrant</i>	<i>Fall Migrant</i>
Least Bittern	Raptors	Bald Eagle	Waterfowl	Waterfowl
Wood Duck		Peregrine Falcon	Wading birds	Raptors
Mallard		Whooping Crane	Raptors	Shorebirds
N. Pintail		Eskimo Curlew	Shorebirds	Passerines
Blue-winged Teal			Passerines	
Ring-necked Pheasant			Sandhill Crane	
N. Bobwhite			Sprague's Pipit	
Virginia Rail				
Sora				
Killdeer				
Upland Sandpiper				
Common Snipe				
Wilson's Phalarope				
Mourning Dove				
E. Kingbird				
Sedge Wren				
Common Yellowthroat				
Dickcissel				
Grasshopper Sparrow				
Henslow's Sparrow				
Swamp Sparrow				
Bobolink				
Red-winged Blackbird				
E. Meadowlark				
W. Meadowlark				
Yellow-headed Blackbird				
Brown-headed Cowbird				

There are 27 species that potentially nest on Mormon Island Crane Meadows based on 15 years of breeding bird censuses (Table 1, Platte V). Of these, about 11 species occur regularly as nesters and are representative of the species nesting within wet meadow habitat in general. Bobolinks and Eastern Meadowlarks are found only on this habitat type and are excellent indicator species for wet meadows. Varying numbers and diversity of birds occur seasonally as well. The huge concentration of Sandhill Cranes in spring is perhaps the most conspicuous and best known phenomenon. Spring migration hosts large numbers of waterfowl as well, particularly Canada Geese, Greater White-fronted Geese, Mallards, and Northern Pintails. In addition, a variety of shorebirds such as Lesser and Greater Yellowlegs, Pectoral Sandpipers, and Least Sandpipers pause briefly as they prepare themselves for their flight to their northern nesting grounds in the arctic. Several species of raptors (hawks and owls) winter on these sites where they feed on small mammals and small birds. Rough-legged Hawks, Northern Harriers, and Short-eared Owls are a few of the species that may be found during winter. Four federally endangered species frequent wet meadows during migration and, in the case of Bald Eagles, during winter. Perhaps the best known of these is the Whooping Crane which feeds in the meadows and croplands and roost on the nearby river channel.

Wet Meadow Size and Bird Use

One of the interesting questions facing the conservation community is to decipher what habitat or mix of habitat components is necessary to provide for the needs of migratory birds. Basic research about habitat characteristics and habitat use helps provide such answers. Some of the results of a recent study conducted by researchers from the University of Nebraska is illustrated in Figure 1. The majority of meadowlark and grasshopper sparrows are found on relatively small grassland areas of 40 acres or less. In contrast, bobolinks and upland sandpipers tend to prefer much larger areas of 150 acres or more. One possibility for this diverse habitat selection is that larger areas tend to be more heterogeneous or patchy, and may provide a better chance for bobolinks and upland sandpipers to find the particular habitat component they require. In any case, these requirements are an important consideration in trying to manage wet meadows for the diverse species that use them.

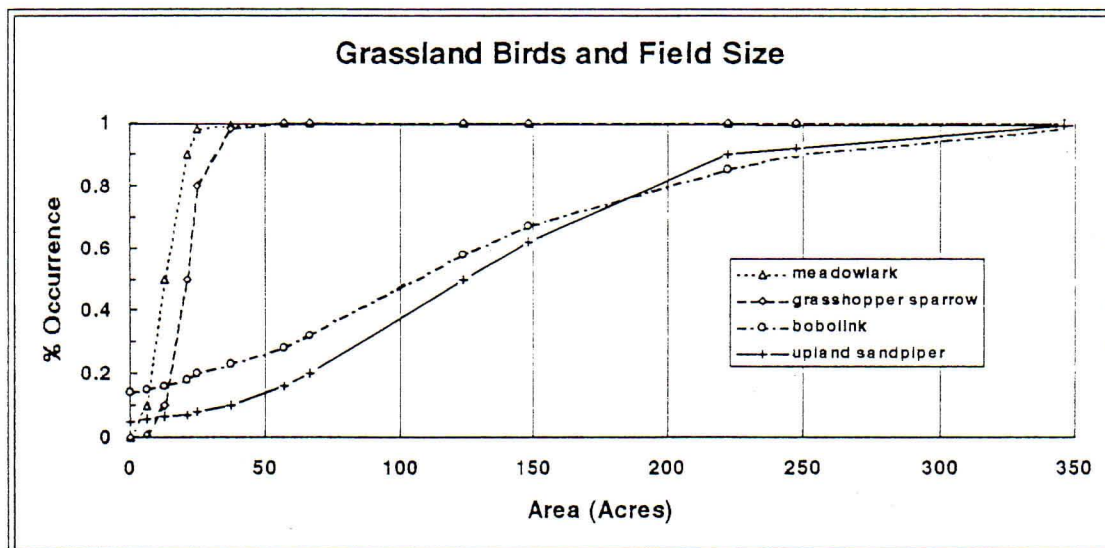


Figure 1. Variable habitat requirements of wet meadow birds. Meadowlarks and grasshopper sparrows tolerate smaller fields, while bobolinks and upland sandpipers prefer large grassland tracts (based on unpublished data from C. Helzer, University of Nebraska, Lincoln).

Sedge Wren, A Species with a Unique Tie to Wet Meadows

This poorly known species depends upon the Platte River wet meadows for a reliable and regular breeding area, while faced with the loss of its habitat elsewhere (Bedell 1993). The marginally wet habitat required by Sedge Wrens throughout its range is typically unreliable and even ephemeral in its existence. In response, sedge wrens are opportunistic and do not necessarily use the same site every year to breed. In contrast, the number of sedge wrens using the Platte River wet meadows appears to be fairly constant, suggesting that the Platte River wet meadows provide a relatively stable habitat to breed.

Sedge wrens have a very unusual, and probably unique, timing for breeding. After raising a first brood of nestlings elsewhere in the spring, like most birds, they shift to the Platte River wet meadows in late July into early August to raise a second brood. Most of their eggs for this second brood are laid by the second week of August. They build their nests primarily along the margins of the sloughs, avoiding the slightly higher ground between the sloughs. The nest is a well-concealed ball of live and dead grass cleverly interwoven low into the stems of surrounding grasses with a small entrance hole to one side. The male also builds from 5 to 13 dummy nests in its territory. These nests may be used for roosting or possibly as decoys for predators. The brood nest is lined by the female with soft materials including feathers and cottonwood seeds. Although sedge wrens will nest in grazed grasslands, the taller ungrazed grasslands are much preferred.

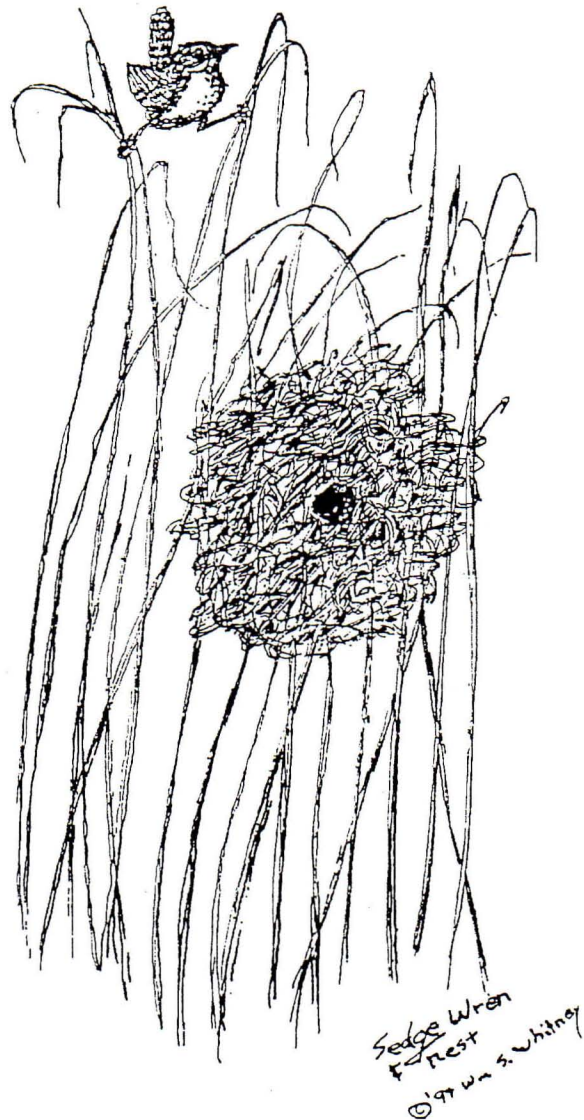


Figure 2. A sedge wren and its unusual nest constructed from dead grass interwoven into the stems of the surrounding grasses (Drawing by W.S. Whitney, Prairie Planes Resource Institute, Aurora, NE).

Other Wet Meadow Fauna

Other Animals Live Here Too!

Insects of the Wet Meadows

Wet meadows in the Platte River Valley host more than 40 butterfly species. In their larval stage, these species provide important forage for a number of migratory birds. Because larvae often feed on specific plants, a high diversity of flowering forbs is desirable in meadows.

Table 2. Common butterflies on wet meadows and moist grasslands in the Platte River Valley (unpublished data from Eric Volden, Crane Meadows Nature Center, Wood River, Nebraska).

Butterfly Species	Year				Total
	1993	1994	1995	1996	
Regal Fritillary	364	321	1196	1422	3303
Common Wood Nymph	463	459	1011	1161	3094
Orange Sulphur	387	1083	195	144	1809
Spring Azure	72	9	0	636	717
Common Checkered Skipper	35	315	205	89	644
Eastern Tailed Blue	254	97	43	195	589
Cabbage White	74	184	14	46	318
Monarch	32	63	24	178	297
Clouded Sulphur	30	125	50	54	259
Pearl Crescent	41	56	3	16	116
Silver-bordered Fritillary	14	48	4	17	83

Regal Fritillary, A Butterfly That Depends on Wet Meadows

The Regal Fritillary butterfly (*Speyeria idalia*, Platte III) is one example of a species that depends upon the complex interactions of the biological environment and its supporting hydrology (Nagel 1992). This candidate for listing as a federally endangered species is rare or uncommon in Nebraska, except in the native Platte River wet meadows. These meadows support the only known larval food for the Regal Fritillary, the blue prairie violet (*Viola pratincola*). Blue prairie violets are also strongly associated with the high water tables in these wet meadows, and are sensitive to human disturbance. In the wet meadows where management has benefited these violets, the Regal Fritillary populations appear to be increasing.

The adult butterflies begin emerging by mid June, and a few can still be found in September. The maximum recorded longevity for an adult butterfly is 49 days, but the average life-span for an adult is much less (Nagel 1992). Adults prefer to feed on the nectar from milkweeds, and they occur most often where the land management practices provide minimal disturbance (Figure 3). With the proper management (both

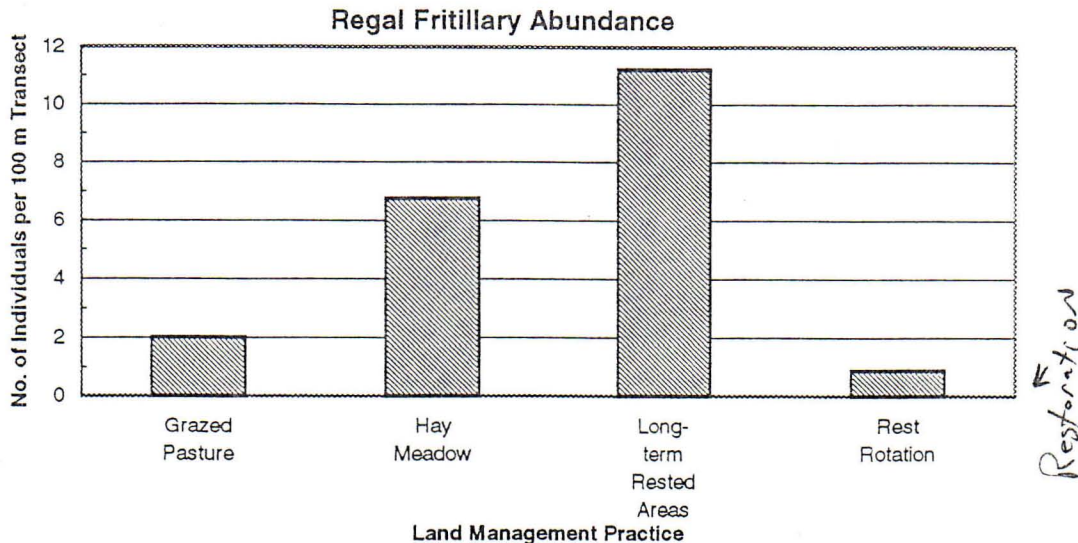


Figure 3. Mean abundance (numbers of individuals per 100 m transect) of Regal Fritillaries in wet meadow and mesic grasslands near the Platte River. Numbers of butterflies tend to be associated with the abundance of mid-summer flowering plants such as prairie clovers (*Petalostemon purpureus*, *P. candidus*). Data from Kent Pfeiffer, The Nature Conservancy, Platte/Rainwater Basin Office, Aurora, Nebraska.

hydrologic and land use), the critical plant species required by the Regal Fritillary should continue to thrive in the Platte River Valley, and so should the Regal Fritillary.

Mammals of the Wet Meadows

Thirty-six species of mammals occur in the wet meadows (Appendix A). Small mammal populations appear to be cyclic and vary widely in numbers annually. The most abundant mammal is the meadow vole (*Microtus pennsylvanicus*) followed closely by the white-footed mouse (*Peromyscus leucopus*). Small mammals provide a prey base for the raptors which winter in the area. Raptor numbers are tied directly with small mammal abundance. White-tailed deer (*Odocoileus virginianus*) is the most conspicuous and abundant large mammal. The central Platte River environs does not attract large numbers of mule deer (*O. hemionus*) although they commonly occur outside of the river valley. Dramatic fluctuations of black-tailed jackrabbit (*Lepus californicus*) numbers occur from year to year also. During years of abundance, they can easily be seen huddled in clumps of grass in early spring. In other years, finding any at all is nearly impossible. Coyotes (*Canis latrans*) out compete red fox (*Vulpes vulpes*) where their ranges overlap. Opossums (*Didelphis virginiana*), raccoons (*Procyon lotor*), and striped skunks (*Mephitis mephitis*) routinely scavenge the meadows, seeking nests and young of birds or any other offering they can find. Fossorial (burrowing) species such as black-tailed prairie dogs (*Cynomys ludovicianus*) and ground squirrels in general, are present in small numbers. High groundwater levels limit their distribution.

Amphibians and Reptiles of the Wet Meadows

The diversity of amphibians and reptiles in the Great Plains is comparatively low and rapidly decreases as you travel north from Texas to North Dakota. Likewise, the herpetofauna of wet meadow habitat in Nebraska is not as diverse as other parts of the state. Of the 12 species known to occur in wet meadows, only 2 were

considered abundant and even those have populations which fluctuate widely from year to year (see Appendix). High water tables and severe winters are thought to be the primary factors limiting populations. No salamanders or turtles occur here. Tremendous numbers of tadpoles are evident in the ephemeral pools found in the meadows. Mortality is extremely high especially as the pools dry. Tadpoles succumb to exposure or fall prey to other organisms such as snakes and birds.

Fish of the Wet Meadows

Surprising as it may seem, fish utilize the small sloughs in the wet meadows for cover, feeding, spawning, and as nursery areas for small fish. Table 3 lists the fish species that have been observed in wet-meadow sloughs. Populations of these fish fluctuate wildly as water levels in the river change. When water levels are high and there is a connection with side and main channels of the river, fish are able to find their way to wet meadows where they may spawn or rear young. As water levels decline, these fish may often follow the flow back to the main channels of the river. However if water levels fall too fast, fish can become trapped in the disjunct sloughs, and often die as a result of these areas drying-up (Platte III).

Table 3. List of fish species collected in the wet-meadow sloughs at Mormon Island and Wild Rose Ranch from 1992-96 (unpublished data from B. Goldowitz, Platte River Whooping Crane Trust).

<i>Common Name</i>	<i>Scientific Name</i>
Shortnose gar	<i>Lepisosteus platostomus</i>
Central stoneroller	<i>Campostoma anomalum</i>
Red shiner	<i>Cyprinella lutrensis</i>
Common carp	<i>Cyprinus carpio</i>
Brassy minnow	<i>Hybognathus hankinsoni</i>
Bigmouth shiner	<i>Notropis dorsalis</i>
Fathead minnow	<i>Pimephales promelas</i>
Creek chub	<i>Semotilus atromaculatus</i>
Plains topminnow	<i>Fundulus sciadicus</i>
Plains killifish	<i>Fundulus zebrinus</i>
Western mosquitofish	<i>Gambusia affinis</i>
Green sunfish	<i>Lepomis cyanellus</i>
Bluegill	<i>Lepomis macrochirus</i>
Largemouth bass	<i>Micropterus salmoides</i>

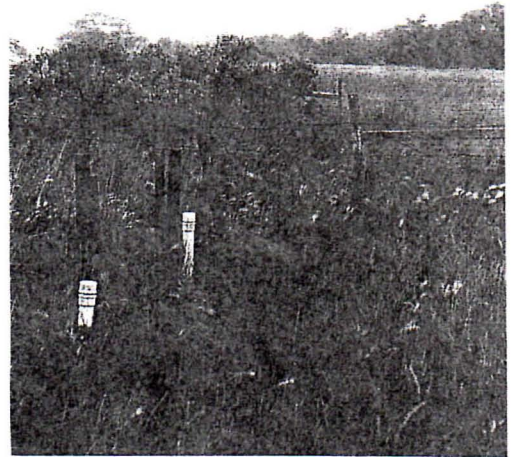
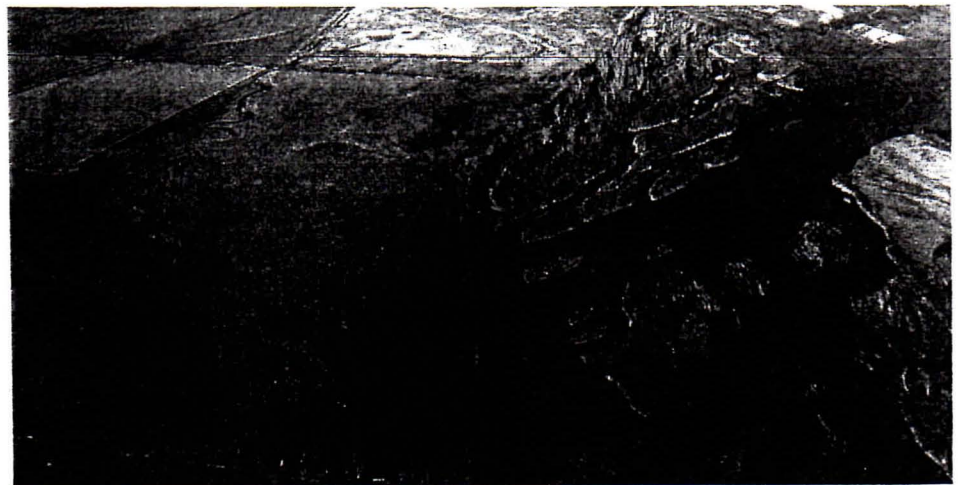


Plate I. Clockwise from top left: river overflow on the west tip of Mormon Island Crane Meadows near Grand Island; well network used in groundwater monitoring; flood flow in a wet meadow slough; interconnectivity between river flows and wetland hydrology; aerial view of saturated sloughs, pools, and potholes in April.



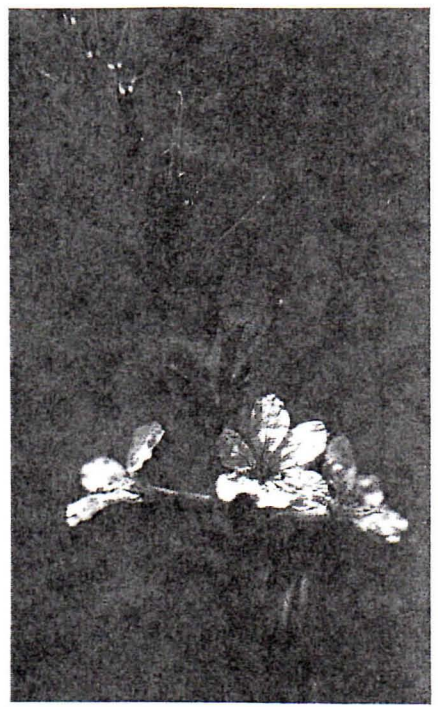
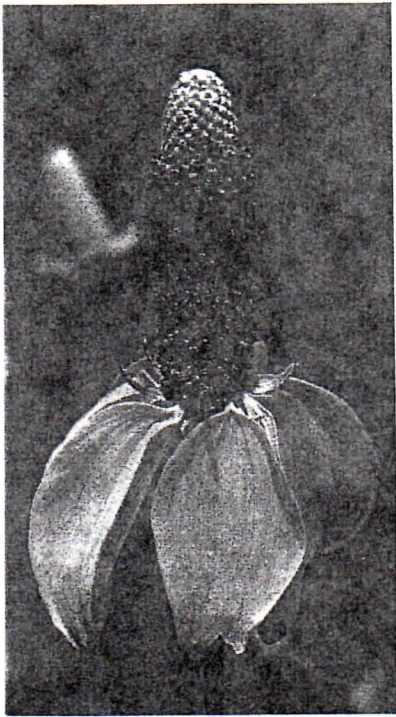


Plate II. Clockwise from top left: coneflower (*Ratibida columnifera*); field mint (*Mentha arvensis*); meadow loosestrife (*Lythrum alatum*); western ironweed (*Vernonia fasciculata*); federally listed (threatened) western prairie-fringed orchid (*Platanthera leucophaea*).



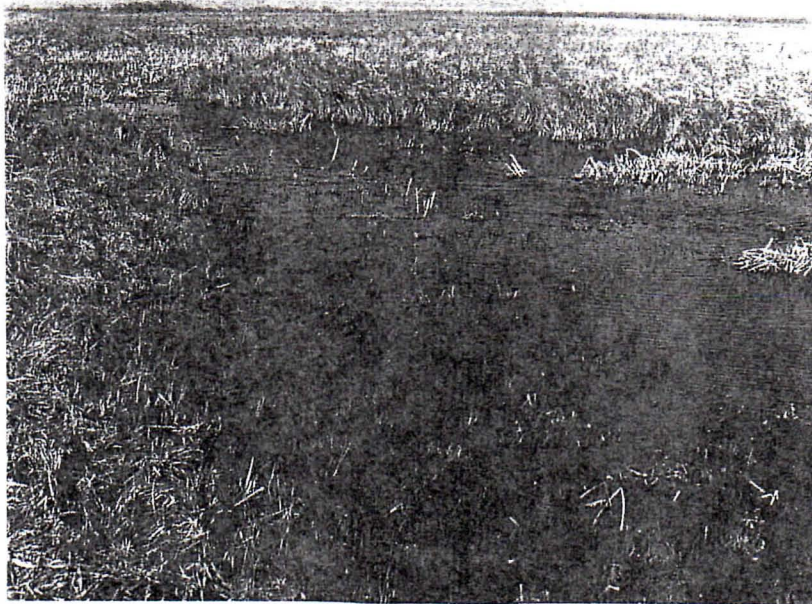


Plate III. Clockwise from top left: wet meadow slough in early spring; regal fritillary butterfly on marsh milkweed (*Asclepias incarnata*); mid-summer dry-out of a wetland slough; blue cardinal flower (*Lobelia siphilitica*); sloughs and potholes on a meadow with heavy organic soils (cranes can be seen feeding on the slough edge).





Plate IV. Clockwise from top left: summer bloom of thickspike gayfeather (*Liatris pycnostachya*); burreed (*Sparganium eurycarpum*); wet meadow slough dominated by smartweed (*Polygonum nutans*) and 3-square (*Scirpus americanus*); sandhill cranes feeding in a wet meadow.





Plate V. Clockwise from top left: golden grasses in fall; tufted loosestrife in a sedge meadow (*Lysimachia thrysiflora*); spring prescribed burn; soft stem bulrush (*Scirpus validus*) and willow (*Salix exigua*) in a wetland slough. Center: summer nesting upland sandpiper.



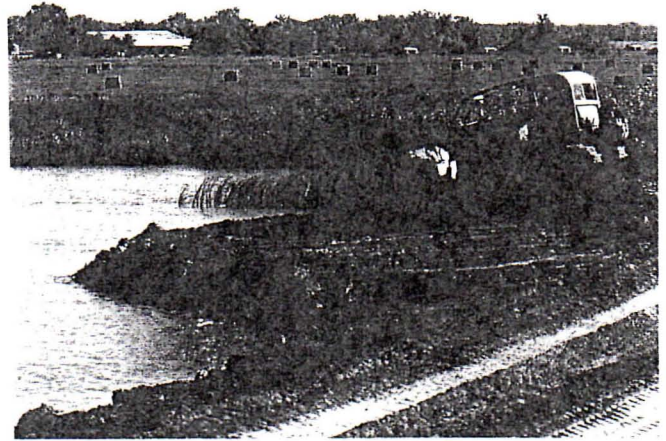


Plate VI. Clockwise from top left: false indigo (*Amorpha fruticosa*) shrub on meadow edge; restoration of shallow water wetlands on the edge of a former gravel pit; scraping to re-establish wet meadow topography and hydrology in a cropland to wet meadow restoration; grazing as a management tool for wet meadows; comparison of grazing impacts inside (right - without grazing) and outside (left - with grazing) of a study enclosure.

Wet Meadow Hydrology

What Makes a Wet Meadow Wet?

River Flow, Precipitation, and Groundwater All Play a Part

River flow is the most dominant factor affecting the water level in wet meadows along the Platte River (Figure 4, and Plate I). River flow determines the river stage (or depth), which in turn governs whether water will flow from the river to the wet meadows or vice versa (Figure 5). Like all water, groundwater flows down-gradient (or down hill). So when the river stage is higher than the wet-meadow water table, water flows from the river through the ground to the wet meadows. River water can also flow directly overland to the wet meadows when the river stage exceeds its banks (or floods).

FACTORS AFFECTING WET-MEADOW WATER LEVELS

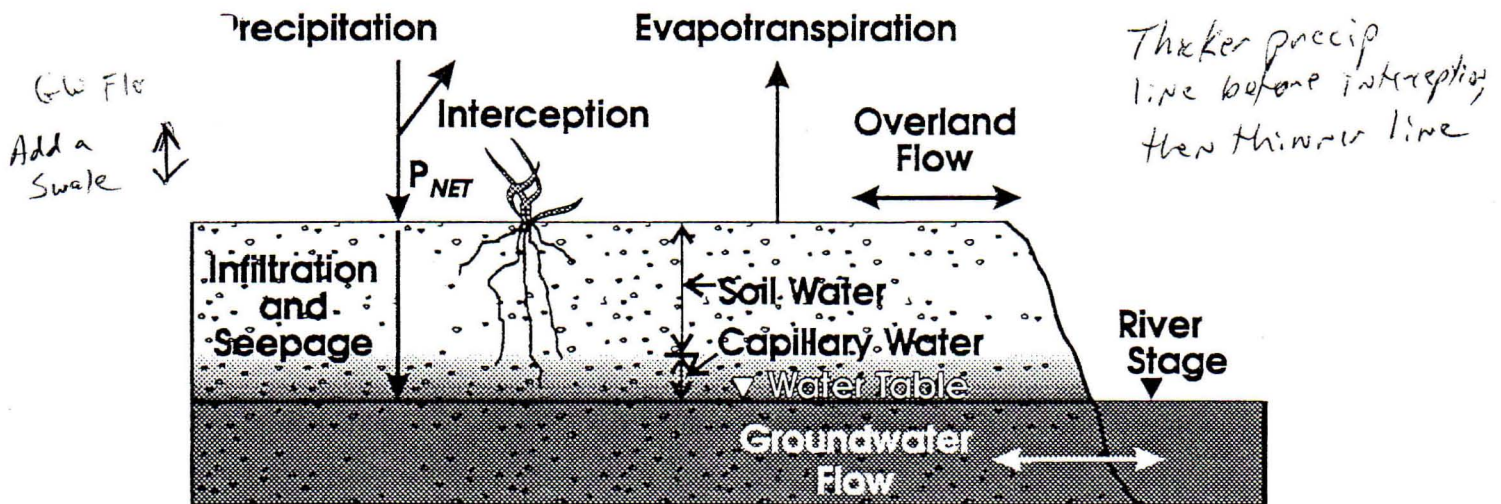


Figure 4. Schematic diagram showing the major factors that affect wet-meadow water levels. P_{NET} represents the amount of precipitation that reaches the soil surface, since some precipitation may be intercepted by the vegetation and evaporate back to the atmosphere.

In addition to the river, which provides the foundation for wet-meadow water levels, precipitation plays an important secondary role in temporarily elevating the water level and replenishing the soil water above the water table. Groundwater inflows from the surrounding watershed can also contribute to elevating the water level in those wet meadows that are located between the river and the uplands.

Lower water levels may result from: decreased river stage, evapotranspiration (the combined effect of evaporation from the soil surface and transpiration from plants), and groundwater outflows to surface water (springs) and to the surrounding aquifer. Groundwater withdrawals for irrigation may also lower water levels

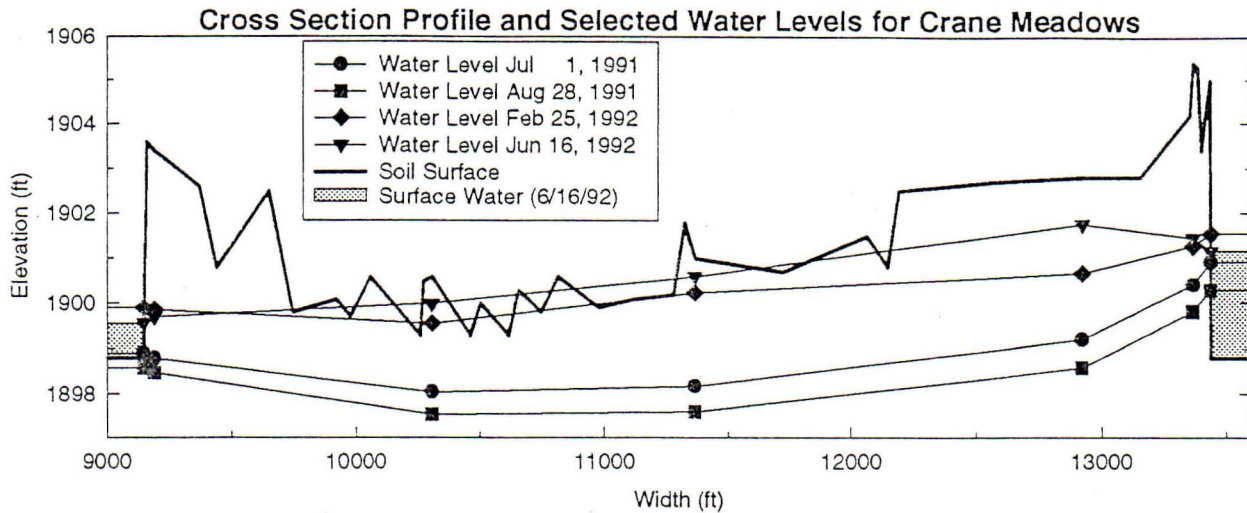


Figure 5. Cross section profile of a wet meadow showing the relationships among the river stage, water table, and soil surface. Note that some of the swales were probably filled from groundwater on the highest two dates (see Platte I for examples). Dates were selected to represent typical groundwater profiles when the lowest (August 28, 1991) and highest (June 16, 1992) periodic measurements were observed at this site from 1989-92, and the median groundwater profiles for the spring (February 25, 1992) and summer (July 1, 1991) seasons (after Wesche et al. 1994)..

locally (within a few hundred feet from the well), but the cumulative effect from groundwater withdrawals throughout the Platte River Valley on wet-meadow water levels has not been studied.

Water Levels are Dynamic

Water levels in the wet meadows are constantly adjusting to changes in river stage, precipitation,

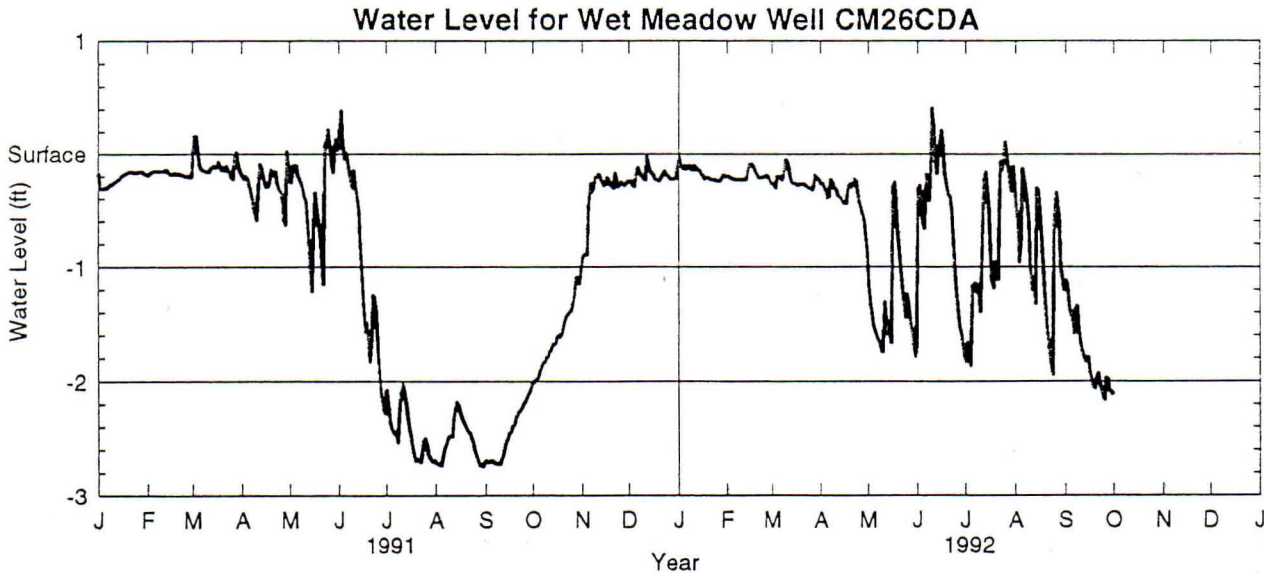


Figure 6. An example of a wet-meadow hydroperiod, showing the constantly changing water level. Note the water level was closer to the surface during the summer of 1992 compared to the summer of 1991. Data based on mean daily water levels (after Wesche et al. 1994).

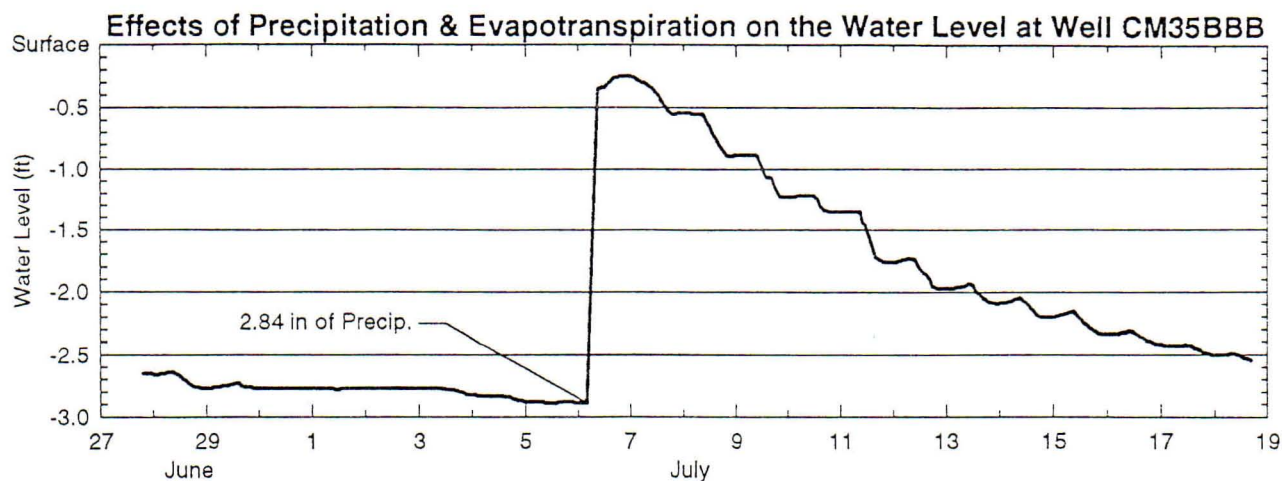


Figure 7. An example of a more detailed wet-meadow hydroperiod, showing a typical response to precipitation and evapotranspiration. Note the rapid response to precipitation, and that evapotranspiration causes the water level to decline only during daylight hours. The elevated water level from precipitation typically lasts from 7 to 14 days. Data based on instantaneous recordings (after Wesche et al. 1994).

evapotranspiration, and a host of other factors (Figure 6 and Figure 7). As a consequence, it's important to make daily, and sometimes nearly continuous, observations to truly represent water level changes through time. Water levels tend to be highest in the late winter through early spring, and lowest in September, although summer thunderstorms may temporarily elevate the water level above springtime levels. This pattern of these water-level changes through time is called the *hydroperiod*, and tends to be different for each wet-meadow plant community (Platte III).

Experiments to Enhance Wet Meadow Hydrology

The hydrology of Platte River wet meadows has changed since the turn of the century when water was first impounded by reservoirs to support our society's needs. In general, the cumulative effect of these projects has been to decrease peak springtime water levels and to intermittently raise minimum summertime water levels. To counter some of the effects of these changes, several small-scale projects to enhancement wet meadows have been tried. These projects include pumping or diverting surface water onto the wet meadows (Currier 1995), lowering the land surface by dredging or scraping (Currier 1995, see also Plate VI), and artificially raising the river stage by constructing temporary dams across the river channel (Currier 1995, Currier and Goldowitz 1995). All these projects met with limited or no success, and would be too expensive or impossible to implement on a large-scale. Managing river flows still remains the best solution to enhance wet meadow hydrology on a large-scale, or on an ecosystem basis.

Wet Meadow Soils

More Than Just Dirt!

General Description

Wet meadow soils developed on alluvium deposited over the years by floods from the Platte River. They are composed of moderately permeable silty or loamy soils that overlay highly permeable deep deposits of sand and gravel (Figure 8). Although water can move fairly rapidly through these soils, they tend to be somewhat poorly drained due to their proximity to the shallow water table. Soil depths range from very shallow in the wettest meadows to relatively deep in the drier meadows (Figure 9). Topography ranges from nearly flat to complex networks of swales and ridges that vary up to 10 ft in elevation over fairly short distances (Platte I).

Several soil types occur within the wet meadows, often occurring in complex patterns with each other (Yost et al. 1962, Buller et al. 1974, Brown et al. 1978). The main soil types, ranging from approximate lowest to highest in elevation, are: Barney, Platte, Gothenburg, Alda, Leshara, Wann, and Sarpy. These soils all have fairly similar properties, and differ chiefly in their soil texture (silty or loamy), soil depth, and water-table depth.

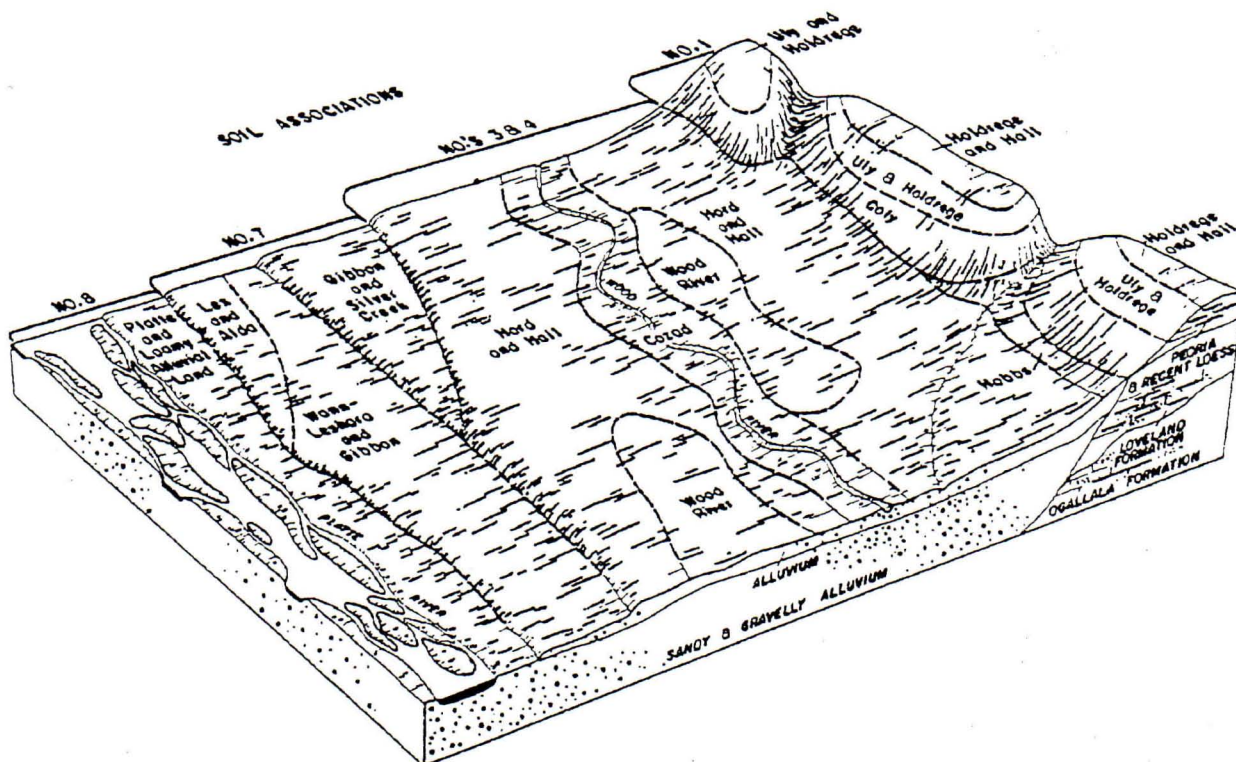


Figure 8. Relationship of Platte River wet-meadow soils (Soil Associations 7 & 8) to those of the adjacent uplands and the underlying sandy gravel (from Buller et al. 1974).

The Barney and Platte are shallow soils, with water levels ranging from above the surface in the early spring to 3 to 5 feet below the surface by late summer. The Alda and Wann are moderately deep to deep soils, with water tables ranging from 2 to 6 feet below the surface. The Sarpy soils occur on low sand ridges formed from fine, wind-blown sand, and have 6 to 12 foot water tables. The Leshara and Gothenburg differ from the other riverine soils by being more closely associated with prairies.

Drainage Patterns and Soils

Wet meadow soils appear to be associated with two distinct types of wet meadow drainage patterns. The most prevalent drainage pattern consists of a series of interconnecting channels and swales, with the density of channels and swales ranging from very complex (Plate I upper left) to fairly simplistic (Plate I center left). Soils associated with this pattern are dominated by the Platte, Wann, Alda, Barney and Sarpy. The second drainage pattern is dominated by potholes that typically pond water on the land surface and have no clear drainage sloughs (Plate I center left, Plate III center). Pothole soils are dominated by Leshara and Gothenburg.

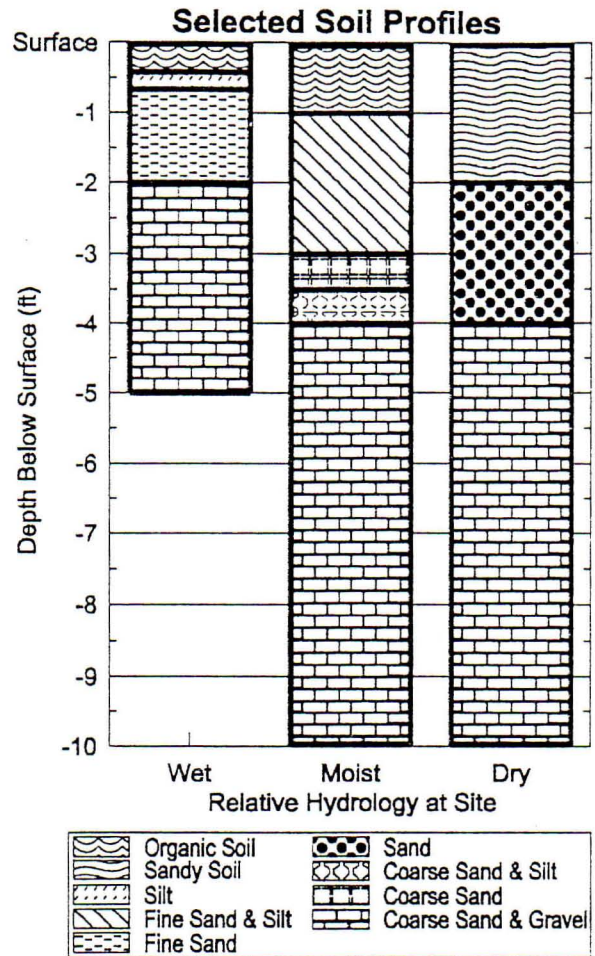


Figure 9. Example of three soil profiles, showing the variability in topsoil depth and soil texture distribution.

Chapter
8

Wet Meadow Management

It's Learning Process

Based on Experience

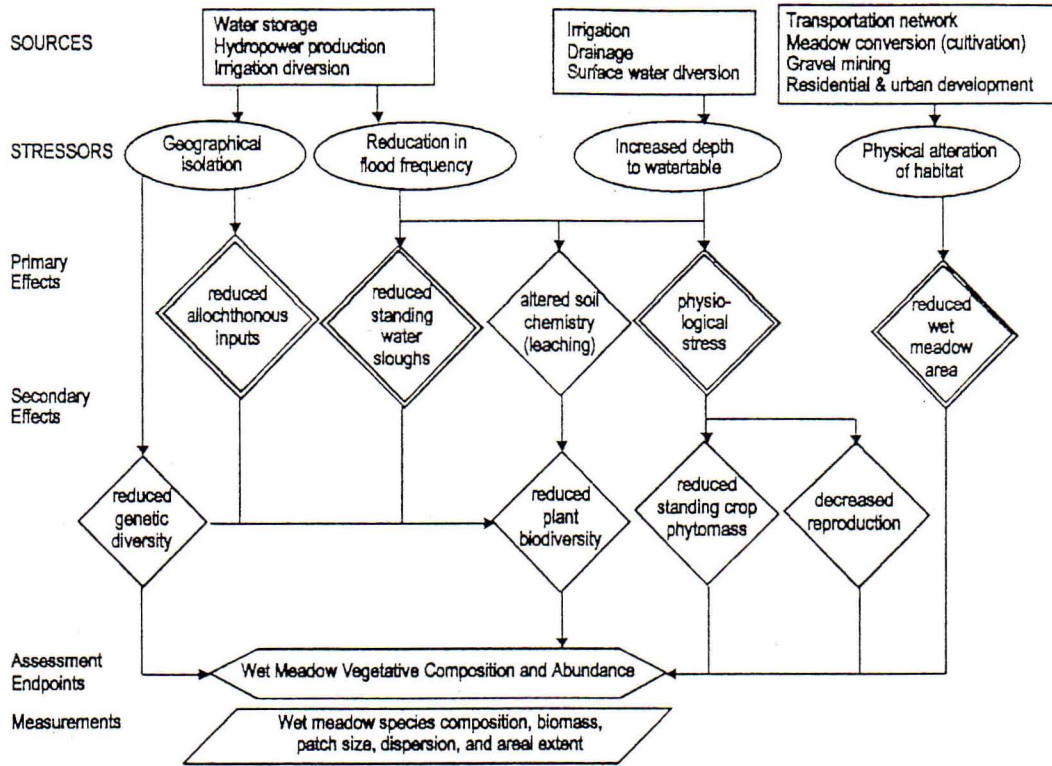
Over the past 100 years, many wet meadow areas have been drained by ditching and leveling, and converted to cropland. Although topsoils on wet meadow sites are usually shallow and sandy, and have poor water retention capabilities, they can produce excellent crops if irrigation is used to maintain moisture in the soil profile. An estimated 74-80% of the wet meadows in the Platte River Valley have been converted (Sidle et al. 1989). As a result, wet meadows are now one of the most limiting habitat types in the Platte River Valley.

More than 10 years ago, the Platte River Trust and other conservation groups, began efforts to manage, maintain, and restore wetland meadows in the Big Bend reach of the Platte River as habitat for migratory birds. Our management model has been the mosaic of high quality wetlands at Mormon Island Crane Meadows, located on an island in the river just south of Grand Island, Nebraska. Mormon Island is the largest remaining contiguous grassland/wetland complex in the Big Bend reach of the river, and supports large numbers of migrating cranes, waterfowl, shorebirds, and summer nesting species. At times, 60,000 to 100,000 cranes and waterfowl can be found feeding and loafing on the meadows. Wetlands at Mormon Island are characterized by extensive surface water sloughs and a vegetation dominated by sedges and grasses found principally on lowland sites (e.g., sedges, big bluestem, blue joint, switchgrass, cordgrass) (Currier 1989).

In 1981, when the Trust acquired Mormon Island, there was intensive, season-long grazing. This management was compatible with the use of the area by spring migrating cranes and waterfowl, but it was clear that some areas were being overgrazed, and that management could be improved to benefit a broader group of migratory species (Lingle and Boner 1981). A management plan was instituted with grazing and haying rotations, prescribed burning, and a reduced stocking rate. Management was aimed at increasing plant production, maintaining a higher stature and diversity of vegetation, and promoting native species (e.g., big bluestem, indiagrass) over introduced species (e.g., bluegrass, smooth brome).

Over the years, Mormon Island has remained our wet meadow model. With management improvements, however, we are beginning to understand the breadth of plant and animal species that inhabit well managed sites (e.g., Figure 10). We are also starting to understand the full habitat needs of a wide variety of migratory birds and the food organisms upon which they depend. This is a continuing learning process in which we test and refine management techniques based on the results of past management. We recognize that this is an evolving science, and that our knowledge of sustainable wet meadow management is limited. The fundamental components of the meadows and the native plants and animals found there are fairly clear after many years of study. What remains to be answered, however, is what is the appropriate mix, abundance, and population size for these native species.

Wet Meadow Composition and Abundance - Part I



Wet Meadow Composition and Abundance - Part II

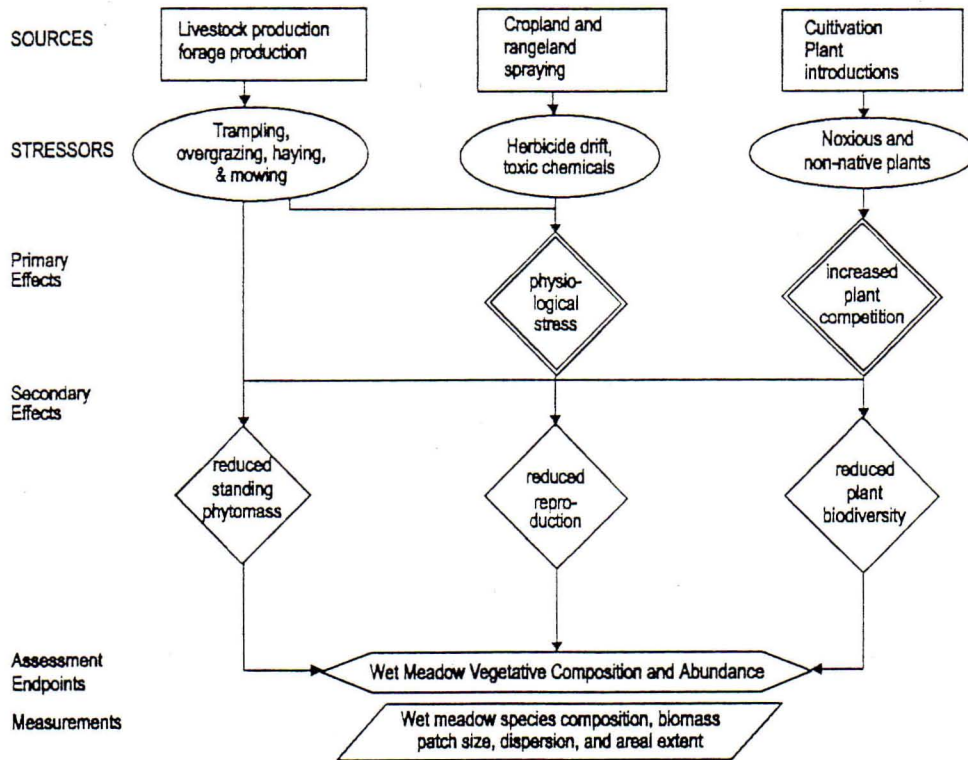


Figure 10. Multiple pathways of land management activities and their potential impacts on the areal extent and character of wet meadows (from Jelinski and Currier 1996).

Wet Meadow Restoration

A Process of Experimentation

Filling in the Pieces

Management of an existing wet meadow site, with a full complement of component species (although maybe not in the desired proportions) is a much easier task than trying to recreate wet meadow communities from scratch on altered and degraded sites. In the process of drainage and conversion to cropland, most elements of the native vegetation are irretrievably lost. Although some seeds, tubers, and other vegetative plant parts can remain dormant in the soil for many years, tillage and physical disturbance of the soil interrupts the growth and reproduction of many native species, while chemical herbicides and pesticides eliminate many others. One has only to survey an abandoned crop field to see that the majority of species present in adjacent grasslands are usually absent. Changes in drainage, depth to groundwater, structure of the soil profile, water percolation, nutrient distribution, and other physical alterations also effect the ability of species to recolonize a site. The ecological structure of native plant and animal communities may have taken thousands of years of co-evolution to achieve. Restoration attempts over the short-term, therefore, may never fully replicate native meadows. Instead, our goal should be to achieve as nearly as possible, wet meadow restorations that in appearance and in function tend to mimic native sites (see Plate VI).

Grassland management techniques used at native sites and various reseeding methods used to restore cropland areas have been fairly successful in re-establishing prairie grasses and some forbs. Plant species diversity and community development, on the other hand, have varied widely, primarily in response to the particular re-seeding and management techniques used. It remains to be seen whether these efforts will in the long-run result in functional wet meadows that emulate the hydrology of native sites and that support the full array of indigenous organisms. An initial vegetation survey indicates that on average, as many as 78% of the wetland species and 73% of the forb species found in native meadows are missing in the newly re-seeded areas. The lack of wetland species suggests that the surface and groundwater hydrology needed to sustain them may be absent. Low forb diversity is most likely due to inadequate seed sources and the limited capacity of many species to self-seed and colonize the sites. Fewer forbs were missing at the Uridil restoration site where a seed mix of over 100 species was used. The roles of landscape position, land contouring, hydrology, and management all need to be considered in attempts to restore wet meadows and re-establishing their hydrology. water management have not proved very effective.

Wet Meadow Plant and Animal Species Lists

Plant Species

List of wetland and lowland prairie species found in native wet meadows.

<u>Common Name</u>	<u>Scientific Name</u>
Slender wheatgrass	<i>Agropyron caninum</i>
Water plantain	<i>Alisma subcordatum</i>
Tooth cup	<i>Ammania coccinea</i>
Big bluestem	<i>Andropogon gerardi</i>
Dogbane	<i>Apocynum sibiricum</i>
Swamp milkweed	<i>Asclepias incarnata</i>
Panicled aster	<i>Aster simplex</i>
Northern reedgrass	<i>Calamagrostis inexpansa</i>
Water sedge	<i>Carex aquatilis</i>
Sedge	<i>Carex brevior</i>
Sedge	<i>Carex grvida</i>
Sedge	<i>Carex lanuginosa</i>
Mead's sedge	<i>Carex meadii</i>
Sedge	<i>Carex stipata</i>
Sedge	<i>Carex scoparia</i>
Fox sedge	<i>Carex vulpinoidea</i>
Barnyard grass	<i>Echinochloa crus-galli</i>
Little spikerush	<i>Eleocharis acicularis</i>
Spikerush	<i>Eleocharis macrostachya</i>
Fimbristylis	<i>Fimbristylis puberula</i>
Mannagrass	<i>Glyceria striata</i>
Sneezeweed	<i>Helenium autumnale</i>
Toad rush	<i>Juncus bufonis</i>
Baltic rush	<i>Juncus balticus</i>
Dudley rush	<i>Juncus dudleyi</i>
Torrey's rush	<i>Juncus torreyi</i>
Rice cut-grass	<i>Leersia virginica</i>
Blue lobelia	<i>Lobelia siphilitica</i>
Pale-spike lobelia	<i>Lobelia spicata</i>
American bugleweed	<i>Lycopus americanus</i>
Horehound	<i>Lycopus asper</i>
Tufted loosestrife	<i>Lysimachia thrysiflora</i>
Fringed loosestrife	<i>Lysimachia ciliata</i>
Winged lythrum	<i>Lythrum dacotanum</i>
Field mint	<i>Mentha arvensis</i>
Monkeyflower	<i>Mimulus glabratus</i>
Switchgrass	<i>Panicum virgatum</i>
Reed canary grass	<i>Phalaris arundinaceae</i>

Plant Species Continued:Common Name

Fog fruit
 Water pepper
 Pale smartweed
 Water smartweed
 Lady's thumb
 Arrowhead
 Three-square
 Green bulrush
 Big river bulrush
 Softstem bulrush
 Skullcap
 Water parsnip
 Canada goldenrod
 Indiangrass
 Cordgrass
 Burreed
 Wedgegrass
 American germander
 Hybrid cattail
 Blue vervain
 Western ironweed
 Blue prairie violet

Scientific Name

Phyla lanceolata
Polygonum hydropiper
Polygonum lapathifolium
Polygonum nutans
Polygonum persicaria
Sagittaria latifolia
Scirpus pungens
Scirpus atrovirens
Scirpus fluviatilis
Scirpus validus
Scutellaria lateriflora
Sium sauve
Solidago canadensis
Sorghastrum avenaceum
Spartina pectinata
Sparganium eurycarpum
Spenopholis obtusata
Teucrium canadense
Typha x glauca
Verbena hastata
Vernonia fasciculata
Viola pratincola

Butterfly Species

List of butterflies that occur in Platte River wet meadows and adjacent open woodland and shrub/savanna habitats.

<u>Common Name</u>	<u>Scientific Name</u>
Giant Swallowtail	<i>Papilio cresphontes</i>
Eastern Tiger Swallowtail	<i>Papilio glaucus</i>
Black Swallowtail	<i>Papilio polyxenes</i>
Orange Sulphur	<i>Colias eurytheme</i>
Clouded (common) Sulphur	<i>Colias philodice</i>
Olympia Marble	<i>Eucholoe olympia</i>
Little Yellow	<i>Eureme lise</i>
Mexican Sulphur	<i>Eureme mexicanum</i>
Dainty Sulphur	<i>Nathalis iole</i>
Cabbage White	<i>Pieris rapae</i>
Cloudless Sulphur	<i>Phoebis sennae</i>
Checker White	<i>Pontia protodice</i>
Gray Copper	<i>Lycaena dione</i>
Bronze Copper	<i>Lycaena hylus</i>
Acadian Hairstreak	<i>Satyrium acadica</i>
Olive Hairstreak	<i>Callophrus gryneus</i>
Gray Hairstreak	<i>Strymon melinus</i>
Spring Azure	<i>Celestrina ladon</i>
Eastern Tailed Blue	<i>Everes comyntas</i>
Reakirt's Blue	<i>Hemiargus isola</i>
Marine Blue	<i>Leptotes marina</i>
Melissa Blue	<i>Lycaeides melissa</i>
American Snout	<i>Libytheana carinenta</i>
Goatweed Butterfly	<i>Ansea andria</i>
Hackberry Emperor	<i>Asterocampa celtis</i>
Silver-bordered Fritillary	<i>Boloria selene</i>
Gorgone Checkerspot	<i>Chlosyne gorgone</i>
Silvery Checkerspot	<i>Chlosyne nycteis</i>
Variiegated Fritillary	<i>Euptoieta claudia</i>
Common Buckeye	<i>Junonia coenia</i>
Viceroy	<i>Limenitis archippus</i>
Red-spotted Purple	<i>Limenitis arthemis</i>
Mourning Cloak	<i>Nymphalis antiopa</i>
Pearl Crescent	<i>Phyciodes tharos</i>
Eastern Comma	<i>Polygonia comma</i>
Question Mark	<i>Polygonia interrogationis</i>
Regal Fritillary	<i>Speyeria idalia</i>
Great Spangled Fritillary	<i>Speyeria cybele</i>
Red Admiral	<i>Vanessa atalanta</i>
Painted Lady	<i>Vanessa cardui</i>
American Lady	<i>Vanessa virginiensis</i>
Common Wood Nymph	<i>Cercyonis pegala</i>
Little Wood Satyr	<i>Megisto cymela</i>
Monarch	<i>Danaus plexippus</i>
Silver-spotted Skipper	<i>Epargyreus clarus</i>
Common Sootywing	<i>Pholisora catullus</i>
Common Checkered Skipper	<i>Pyrgus communis</i>

Butterfly Species Continued:Common Name

Common Roadside Skipper
 Least Skipper
 Sachem
 Arogas Skipper
 Delaware Skipper
 Two-spotted Skipper
 Dun Skipper
 Fiery Skipper
 Eufala Skipper
 Hobomok Skipper
 Crossline Skipper
 Peck's Skipper
 Tawny-edged Skipper
 Northern Broken Dash
 Skipper Species

Scientific Name

Amblyscirtes vialia
Ancyloxypha numitor
Atalopedes campestris
Atrytone aroges
Atrytone logen
Euphyes bimecula
Euphyes vestris
Hyephiia phyleus
Lerodea eufala
Poanes hobomok
Polites origines
Polites peckius
Polites themistocles
Wallengrenia egeremet
Hesperiidae spp.

Butterfly Species Continued:**Amphibian and Reptile Species**

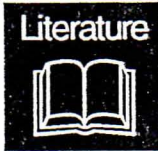
List of amphibians and reptiles that occur in Platte River wet meadows.

<u>Common Name</u>	<u>Scientific Name</u>	<u>Status</u>
Frogs and Toads (Order Anura)		
Great Plains Toad	<i>Bufo cognatus</i>	Common
Rocky Mountain Toad	<i>Bufo woodhousii</i>	Abundant
Western Striped Chorus Frog	<i>Pseudacris triseriata</i>	Abundant
Plains Leopard Frog	<i>Rana blairi</i>	Common
Northern Leopard Frog	<i>Rana pipiens</i>	Uncommon
Plains Spadefoot Toad	<i>Spea bombifrons</i>	Common
Lizards (Order Squamata)		
Prairie Skink	<i>Eumeces septentrionalis</i>	Common
Snakes (Order Serpentes)		
Blue or Green Racer	<i>Coluber constrictor</i>	Rare
Smooth Green Snake	<i>Opheodryhs vernalis</i>	Rare
Bull Snake	<i>Pituophis catenifer</i>	Uncommon
Plains Gartersnake	<i>Thamnophis radix</i>	Common
Red-sided Gartersnake	<i>Thamnophis sirtalis</i>	Common

Mammal Species

List of mammal that occur in Platte River wet meadows.

<u>Common Name</u>	<u>Scientific Name</u>	<u>Status</u>
Order Marsupialia		
Virginia Opossum	<i>Didelphis virginiana</i>	Common
Order Insectivora		
Masked Shrew	<i>Sorex cinereus</i>	Common
N. Short-tailed Shrew	<i>Blarina brevicauda</i>	Common
Least Shrew	<i>Cryptotis parva</i>	Uncommon
Eastern Mole	<i>Scalopus aquaticus</i>	Fairly common
Order Lagomorpha		
Eastern Cottontail	<i>Sylvilagus floridanus</i>	Abundant
Black-tailed Jackrabbit	<i>Lepus californicus</i>	Common
Order Rodentia		
Woodchuck	<i>Marmota monax</i>	Rare
Franklin's Ground Squirrel	<i>Spermophilus franklinii</i>	Uncommon
Thirteen-lined Ground Squirrel	<i>Spermophilus tridecemlineatus</i>	Abundant
Black-tailed Prairie Dog	<i>Cynomys ludovicianus</i>	Uncommon
Plains Pocket Gopher	<i>Geomys bursarius</i>	Common
Plains Pocket Mouse	<i>Perognathus flavescens</i>	Uncommon
Hispid Pocket Mouse	<i>Perognathus hispidus</i>	Uncommon
Beaver	<i>Castor canadensis</i>	Abundant
W. Harvest Mouse	<i>Reithrodontomys megalotis</i>	Common
Plains Harvest Mouse	<i>Reithrodontomys montanus</i>	Uncommon
White-footed Mouse	<i>Peromyscus leucopus</i>	Abundant
Deer Mouse	<i>Peromyscus maniculatus</i>	Abundant
N. Grasshopper Mouse	<i>Onychomys leucogaster</i>	Fairly common
Hispid Cotton Rat	<i>Sigmodon hispidus</i>	Rare
Prairie Vole	<i>Microtus ochrogaster</i>	Abundant
Meadow Vole	<i>Microtus pennsylvanicus</i>	Abundant
Southern Bog Lemming	<i>Synaptomys cooperi</i>	Rare
Meadow Jumping Mouse	<i>Zapus hudsonius</i>	Uncommon
Order Carnivora		
Coyote	<i>Canis latrans</i>	Abundant
Red Fox	<i>Vulpes vulpes</i>	Fairly common
Raccoon	<i>Procyon lotor</i>	Abundant
Long-tailed Weasel	<i>Mustela frenata</i>	Uncommon
Least Weasel	<i>Mustela nivalis</i>	Uncommon
Mink	<i>Mustela vison</i>	Common
Badger	<i>Taxidea taxus</i>	Fairly common
Striped Skunk	<i>Mephitis mephitis</i>	Abundant
Order Artiodactyla		
Mule Deer	<i>Odocoileus hemionus</i>	Common
White-tailed Deer	<i>Odocoileus virginianus</i>	Abundant
Bison	<i>Bison bison</i>	Extirpated



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Common Name	Scientific Name	Primary Habitat	Status	Native
Family Asteraceae				
Western Ragweed	<i>Ambrosia psilostachya</i>	Mesic Prairie	Abundant	Y
Field Pussytoes	<i>Antennaria neglecta</i>	Dry Sand Ridge	Common	Y
White Sagewort	<i>Artemisia ludoviciana</i>	Mesic Prairie	Common	Y
White Aster	<i>Aster ericoides</i>	Mesic Prairie	Abundant	Y
New England Aster	<i>Aster novae-angliae</i>	Mesic Prairie	Uncommon	Y
Willowleaf Aster	<i>Aster prealtus</i>	Wet Meadow	Common	Y
Panicled Aster	<i>Aster simplex</i>	Wet Meadow	Abundant	Y
Musk Thistle	<i>Carduus nutans</i>	Disturbed	Common	N
Golden Aster	<i>Chrysopsis villosa</i>	Dry Sand Ridge	Common	Y
Tall Thistle	<i>Cirsium altissimum</i>	Mesic Prairie	Common	Y
Prairie Thistle	<i>Cirsium flodmani</i>	Mesic Prairie	Common	Y
Plains Coreopsis	<i>Coreopsis tinctoria</i>	Wet Meadow	Common	Y
Hawk's-beard	<i>Crepis runcinata</i>	Wet Meadow	Uncommon	Y
Daisy Fleabane	<i>Erigeron strigosus</i>	Mesic Prairie	Common	Y
Grassleaf Goldenrod	<i>Euthamia graminifolia</i>	Wet Meadow	Common	Y
Tall Boneset	<i>Eupatorium altissimum</i>	Mesic Prairie	Common	Y
Boneset	<i>Eupatorium perfoliatum</i>	Wet Meadow	Uncommon	Y
Curly-top Gumweed	<i>Grindelia squarrosa</i>	Disturbed	Common	Y
Sneezeweed	<i>Helenium autumnale</i>	Wet Meadow	Common	Y
Sawtooth Sunflower	<i>Helianthus grosseserratus</i>	Wet Meadow	Common	Y
Maximilian Sunflower	<i>Helianthus maximiliana</i>	Mesic Prairie	Abundant	Y
Stiff Sunflower	<i>Helianthus rigidus</i>	Mesic Prairie	Uncommon	Y
Jerusalem Artichoke	<i>Helianthus tuberosus</i>	Mesic Prairie	Common	Y
False Sunflower	<i>Heliopsis helianthoides</i>	Mesic Prairie	Uncommon	Y
Annual Elder	<i>Iva annua</i>	Saline Soils	Common	Y
Thickspike Gayfeather	<i>Liatris pycnostachya</i>	Mesic Prairie	Common	Y
Dwarf Blazingstar	<i>Liatris squarrosa</i>	Dry Sand Ridge	Uncommon	Y
Prairie Coneflower	<i>Ratibida columnifera</i>	Mesic Prairie	Abundant	Y
Grayhead Coneflower	<i>Ratibida pinnata</i>	Mesic Prairie	Uncommon	Y
Black-eyed Susan	<i>Rudbeckia hirta</i>	Mesic Prairie	Abundant	Y
Prairie Ragwort	<i>Senecio plattensis</i>	Mesic Prairie	Common	Y
Rosinweed	<i>Silphium integrifolium</i>	Mesic Prairie	Rare	Y
Canada Goldenrod	<i>Solidago canadensis</i>	Wet Meadow	Abundant	Y
Late Goldenrod	<i>Solidago gigantea</i>	Wet Meadow	Common	Y
Prairie Goldenrod	<i>Solidago missouriensis</i>	Dry Sand Ridge	Common	Y
Dandelion	<i>Taraxacum officinale</i>	Disturbed	Common	N
Western Ironweed	<i>Vernonia fasciculata</i>	Wet Meadow	Common	Y
Family Mimosaceae				
Illinois Bundleflower	<i>Desmanthus illinoensis</i>	Mesic Prairie	Abundant	Y
Cat's Claw Sensitive Briar	<i>Schrankia nuttallii</i>	Dry Sand Ridge	Uncommon	Y
Family Fabaceae				
False Indigo	<i>Amorpha fruticosa</i>	Wet Meadow	Common	Y
Platte Milkvetch	<i>Astragalus plattensis</i>	Mesic Prairie	Rare	Y
White Prairie Clover	<i>Dalea candida</i>	Mesic Prairie	Common	Y
Foxtail Dalea	<i>Dalea leporina</i>	Disturbed	Uncommon	Y
Purple Prairie Clover	<i>Dalea purpurea</i>	Mesic Prairie	Abundant	Y
Hoary Tickclover	<i>Desmodium canescens</i>	Mesic Prairie	Uncommon	Y
Wild Licorice	<i>Glycyrrhiza lepidota</i>	Mesic Prairie	Common	Y
Roundhead Bushclover	<i>Lespedeza capitata</i>	Dry Sand Ridge	Uncommon	Y
Deervetch	<i>Lotus purshianus</i>	Dry Sand Ridge	Uncommon	Y
Black Medick	<i>Medicago lupulina</i>	Mesic Prairie	Common	N
White Sweet Clover	<i>Melilotus albus</i>	Disturbed	Abundant	N
Yellow Sweet Clover	<i>Melilotus officinalis</i>	Disturbed	Abundant	N
Silverleaf Scurf Pea	<i>Psoralea argophylla</i>	Dry Sand Ridge	Uncommon	Y
Alsike Clover	<i>Trifolium hybridum</i>	Wet Meadow	Common	N
Family Amaranthaceae				
Smooth Sumac	<i>Rhus glabra</i>	Mesic Prairie	Common	Y
Poison Ivy	<i>Toxicodendron radicans</i>	Anywhere	Abundant	Y
Family Apiaceae				
Wild Carrot	<i>Daucus carota</i>	Disturbed	Uncommon	N
Water Parsnip	<i>Sium suave</i>	Wet Meadow	Common	Y
Family Apocynaceae				
Prairie Dogbane	<i>Apocynum cannabinum</i>	Wet Meadow	Abundant	Y
Family Asclepiadaceae				
Swamp Milkweed	<i>Asclepias incarnata</i>	Wet Meadow	Abundant	Y
Showy Milkweed	<i>Asclepias speciosa</i>	Mesic Prairie	Abundant	Y
Family Boraginaceae				
Narrow-leaved Puccoon	<i>Lithospermum incisum</i>	Dry Sand Ridge	Common	Y
Marbleseed	<i>Onosmodium molle</i>	Dry Sand Ridge	Common	Y
Family Campanulaceae				
Cardinal Flower	<i>Lobelia cardinalis</i>	Wet Meadow	Rare	Y

Family Poaceae				
Slender Wheatgrass	<i>Agropyron caninum</i>	Mesic Prairie	Abundant	Y
Tall Wheatgrass	<i>Agropyron elongatum</i>	Saline Soils	Uncommon	N
Redtop	<i>Agrostis stolonifera</i>	Mesic Prairie	Abundant	N
Shortawn Foxtail	<i>Alopecurus aequalis</i>	Wet Meadow	Rare	Y
Creeping Foxtail	<i>Alopecurus arundinaceus</i>	Wet Meadow	Uncommon	N
Big Bluestem	<i>Andropogon gerardii</i>	Mesic Prairie	Abundant	Y
Hairy Grama	<i>Bouteloua hirsuta</i>	Dry Sand Ridge	Common	Y
Smooth Brome	<i>Bromus inermis</i>	Mesic Prairie	Abundant	N
Northern Reedgrass	<i>Calamagrostis stricta</i>	Wet Meadow	Uncommon	Y
Prairie Sandreed	<i>Calamovilfa longifolia</i>	Dry Sand Ridge	Common	Y
Scribner's Panicgrass	<i>Dicanthelium oligosanthes</i>	Mesic Prairie	Common	Y
Seashore Saltgrass	<i>Distichlis spicata</i>	Saline Soils	Common	Y
Barnyardgrass	<i>Echinochloa crusgail</i>	River Channel	Common	N
Canada Wild Rye	<i>Elymus canadensis</i>	Mesic Prairie	Abundant	Y
Meadow Fescue	<i>Festuca pratensis</i>	Mesic Prairie	Common	N
Mannagrass	<i>Glyceria striata</i>	Wet Meadow	Uncommon	Y
Sweetgrass	<i>Hierochloa odorata</i>	Wet Meadow	Rare	Y
Foxtail Barley	<i>Hordeum jubatum</i>	Saline Soils	Abundant	Y
Rice Cutgrass	<i>Leersia oryzoides</i>	Wet Meadow	Common	Y
Switchgrass	<i>Panicum virgatum</i>	Wet Meadow	Abundant	Y
Reed Canarygrass	<i>Phalaris arundinacea</i>	Wet Meadow	Abundant	N
Kentucky Bluegrass	<i>Poa pratensis</i>	Mesic Prairie	Abundant	N
Little Bluestem	<i>Schizachyrium scoparium</i>	Mesic Prairie	Abundant	Y
Indiangrass	<i>Sorghastrum nutans</i>	Mesic Prairie	Abundant	Y
Prairie Cordgrass	<i>Spartina pectinata</i>	Wet Meadow	Abundant	Y
Prairie Wedgegrass	<i>Spenopholis obtusata</i>	Mesic Prairie	Common	Y
Rough Dropseed	<i>Sporobolus asper</i>	Mesic Prairie	Common	Y
Needle-and-Thread	<i>Stipa comata</i>	Dry Sand Ridge	Common	Y
Porcupinegrass	<i>Stipa spartea</i>	Mesic Prairie	Rare	Y
Family Cyperaceae				
Water Sedge	<i>Carex aquatilis</i>	Wet Meadow	Common	Y
Fescue Sedge	<i>Carex brevior</i>	Mesic Prairie	Common	Y
Broom Sedge	<i>Carex scoparia</i>	Wet Meadow	Uncommon	Y
Saw-beak Sedge	<i>Carex stipata</i>	Wet Meadow	Uncommon	Y
Fox Sedge	<i>Carex vulpinoidea</i>	Wet Meadow	Common	Y
Schweinitz Flatsedge	<i>Cyperus schweinitzii</i>	Dry Sand Ridge	Common	Y
Needle Spikesedge	<i>Eleocharis acicularis</i>	Wet Meadow	Common	Y
Spike Rush	<i>Eleocharis macrostachya</i>	Wet Meadow	Common	Y
Fimbristylis	<i>Fimbristylis puberula</i>	Wet Meadow	Uncommon	Y
Darkgreen Bulrush	<i>Scirpus atrovirens</i>	Wet Meadow	Uncommon	Y
River Bulrush	<i>Scirpus fluviatilis</i>	River Channel	Common	Y
Common Threesquare	<i>Scirpus pungens</i>	Wet Meadow	Abundant	Y
Soft-stem Bulrush	<i>Scirpus validus</i>	River Channel	Abundant	Y
Family Juncaceae				
Baltic Rush	<i>Juncus balticus</i>	Wet Meadow	Common	Y
Dudley's Rush	<i>Juncus dudleyi</i>	Wet Meadow	Common	Y
Torrey's Rush	<i>Juncus torreyi</i>	Wet Meadow	Common	Y
Family Alismataceae				
•Water Plantain	<i>Alisma subcordatum</i>	Wet Meadow	Common	Y
•Common Arrowhead	<i>Sagittaria latifolia</i>	Wet Meadow	Common	Y
Family Commelinaceae				
Long-bracted Spiderwort	<i>Tradescantia bracteata</i>	Mesic Prairie	Uncommon	Y
Family Iridaceae				
Blue-eyed Grass	<i>Sisyrinchium angustifolium</i>	Mesic Prairie	Common	Y
Family Juncaginaceae				
Arrowgrass	<i>Triglochin maritimum</i>	Wet Meadow	Rare	Y
Family Liliaceae				
Wild Onion	<i>Allium canadense</i>	Mesic Prairie	Uncommon	Y
Asparagus	<i>Asparagus officinalis</i>	Mesic Prairie	Common	N
Yellow Stargrass	<i>Hypoxis hirsuta</i>	Mesic Prairie	Common	Y
False Solomon's Seal	<i>Smilacina stellata</i>	Mesic Prairie	Uncommon	Y
Family Orchidaceae				
Prairie-fringed Orchid	<i>Platanthera praeclara</i>	Wet Meadow	Rare	Y
Nodding Ladies-tresses	<i>Spiranthes cernua</i>	Mesic Prairie	Uncommon	Y
Family Sparganiaceae				
Giant Burr-Reed	<i>Sparganium eurycarpum</i>	Wet Meadow	Common	Y
Family Typhaceae				
Common Cattail	<i>Typha x glauca</i>	Wet Meadow	Abundant	Y
Family Cupressaceae				
Red Cedar	<i>Juniperus virginiana</i>	Anywhere	Abundant	Y
Family Equisetaceae				
Scouring Rush	<i>Equisetum hyemale</i>	Mesic Prairie	Abundant	Y

Great Blue Lobelia	<i>Lobelia siphilitica</i>	Wet Meadow	Common	Y
Pale-spike Lobelia	<i>Lobelia spicata</i>	Mesic Prairie	Common	Y
Venus' Looking Glass	<i>Triodanis perfoliata</i>	River Channel	Common	Y
Family Caprifoliaceae				
Snowberry	<i>Symphoricarpos occidentalis</i>	Riparian Forest	Common	Y
Family Cornaceae				
Rough-leaved Dogwood	<i>Cornus drummondii</i>	Riparian Forest	Common	Y
Red Osier	<i>Cornus stolonifera</i>	Wet Meadow	Uncommon	Y
Family Eleagnaceae				
Russian Olive	<i>Elaeagnus angustifolia</i>	Riparian Forest	Abundant	N
Buffaloberry	<i>Shepherdia argentea</i>	Dry Sand Ridge	Uncommon	Y
Family Euphorbiaceae				
Texas Croton	<i>Croton texensis</i>	Dry Sand Ridge	Uncommon	Y
Snow-on-the-Mountain	<i>Euphorbia marginata</i>	Disturbed	Common	Y
Family Gentianaceae				
Prairie Gentian	<i>Eustoma grandiflorum</i>	Saline Soils	Common	Y
Family Lamiaceae				
American Bugleweed	<i>Lycopus americanus</i>	Wet Meadow	Common	Y
Rough Bugleweed	<i>Lycopus asper</i>	Wet Meadow	Uncommon	Y
Field Mint	<i>Mentha arvensis</i>	Wet Meadow	Common	Y
Wild Bergamot	<i>Monarda fistulosa</i>	Mesic Prairie	Uncommon	Y
Selfheal	<i>Prunella vulgaris</i>	Wet Meadow	Common	Y
Mountain Mint	<i>Pycnanthemum virginianum</i>	Mesic Prairie	Uncommon	Y
Blue Skullcap	<i>Scutellaria lateriflora</i>	Wet Meadow	Uncommon	Y
American Germander	<i>Teucrium canadense</i>	Wet Meadow	Common	Y
Family Lythraceae				
Tooth-cup	<i>Ammania coccinea</i>	Wet Meadow	Common	Y
Winged Loosestrife	<i>Lythrum alatum</i>	Wet Meadow	Common	Y
Purple Loosestrife	<i>Lythrum salicaria</i>	River Channel	Common	N
Family Malvaceae				
Pink Poppy Mallow	<i>Callirhoe alcaeoides</i>	Mesic Prairie	Common	Y
Purple Poppy Mallow	<i>Callirhoe involucrata</i>	Mesic Prairie	Common	Y
Family Onagraceae				
Serrateleaf Primrose	<i>Calylophus serrulatus</i>	Mesic Prairie	Uncommon	Y
Velvety Gaura	<i>Gaura parviflora</i>	Disturbed	Common	Y
Common Evening Primrose	<i>Oenothera biennis</i>	Disturbed	Common	Y
Family Plantaginaceae				
Alkali Plantain	<i>Plantago eriopoda</i>	Saline Soils	Uncommon	Y
Woolly Indianwheat	<i>Plantago patagonica</i>	Dry Sand Ridge	Uncommon	Y
Family Polygonaceae				
Water Smartweed	<i>Polygonum amphibium</i>	Wet Meadow	Common	Y
Pale Smartweed	<i>Polygonum lapathifolium</i>	Wet Meadow	Common	Y
Lady's Thumb	<i>Polygonum persicaria</i>	Wet Meadow	Common	Y
Smartweed	<i>Polygonum punctatum</i>	Wet Meadow	Common	Y
Curly Dock	<i>Rumex crispus</i>	Disturbed	Common	Y
Family Primulaceae				
Fringed Loosestrife	<i>Lysimachia ciliata</i>	Wet Meadow	Uncommon	Y
Tufted Loosestrife	<i>Lysimachia thyrsoiflora</i>	Wet Meadow	Rare	Y
Family Ranunculaceae				
Meadow Anemone	<i>Anemone canadensis</i>	Mesic Prairie	Common	Y
Family Rosaceae				
White Avens	<i>Geum canadense</i>	Riparian Forest	Abundant	Y
Wild Plum	<i>Prunus americana</i>	Mesic Prairie	Abundant	Y
Western Wild Rose	<i>Rosa woodsii</i>	Mesic Prairie	Abundant	Y
Family Rutaceae				
Prickly Ash	<i>Zanthoxylum americanum</i>	Riparian Forest	Common	Y
Family Salicaceae				
Cottonwood	<i>Populus deltoides</i>	Riparian Forest	Abundant	Y
Coyote Willow	<i>Salix exigua</i>	River Channel	Abundant	Y
Family Scrophulariaceae				
Slender Gerardia	<i>Agalinus tenuifolia</i>	Wet Meadow	Common	Y
Water Hyssop	<i>Bacopa rotundiflora</i>	Wet Meadow	Uncommon	Y
Monkeyflower	<i>Mimulus ringens</i>	Wet Meadow	Rare	Y
Common Mullein	<i>Verbascum thapsus</i>	Disturbed	Common	N
Family Solanaceae				
Clammy Ground Cherry	<i>Physalis heterophylla</i>	Dry Sand Ridge	Common	Y
Buffalo Bur	<i>Solanum rostratum</i>	Disturbed	Common	Y
Family Verbenaceae				
Fog Fruit	<i>Lippia lanceolata</i>	Wet Meadow	Common	Y
Blue Vervain	<i>Verbena hastata</i>	Wet Meadow	Abundant	Y
Hoary Vervain	<i>Verbena stricta</i>	Mesic Prairie	Abundant	Y
Family Violaceae				
Meadow Violet	<i>Viola pratensis</i>	Mesic Prairie	Abundant	