photo by R. P. Dana, MN DNR

Ulen Wildlife Management Area, Kittson County, MN

General Description

Wetland Prairie (WP) communities are herbaceous plant communities dominated by graminoid species with a forb component that can approach codominance with the graminoids. The tall grasses big bluestem *(Andropogon gerardii)* and prairie cordgrass *(Spartina pectinata)* are the most important graminoids. The most common associates are Indian grass *(Sorghastrum nutans)* and switchgrass *(Panicum virgatum)*, also tall grasses, and mat muhly grass *(Muhlenbergia richardsonis)*, a short-stature species. Sedges *(Carex* spp.) are common in WP communities but are typically a subordinate component; woolly sedge (*Carex pellita*) and Buxbaum's sedge (*C. buxbaumii*) are the most important. Shrubs are often present, usually sparse in southern Minnesota but becoming abundant northward. These include prairie rose *(Rosa arkansana)*, a low semi-shrub, and taller shrubs such as red-osier dogwood *(Cornus sericea)* and several willows *(Salix* spp.). Bog birch (*Betula glandulifera*) and shrubby cinquefoil (*Potentilla fruticosa*) are common in the far north. The main vegetation layer is usually less than 40in (1m) high, although some forbs and the flowering stalks of many of the grasses rise well above this height as the season progresses.

The herbaceous dominance of WP communities is closely tied to the frequent occurrence of fire. In circumstances where fire frequency or intensity is reduced, shrubs and suckers of quaking aspen and balsam poplar can increase in abundance, forming wet brush-prairie communities. These wet brush-prairies may appear more like brushland or shrubland than prairie, but herbaceous prairie plants remain a major component of the vegetation. The shrub layer is patchy and usually less than 5ft (1.5m) tall. In the absence of fire, wet brush-prairies rapidly succeed to woodlands. Today, most wet brush-prairies occur in the Tallgrass Aspen Parklands (TAP) Province of northwestern Minnesota.

WP communities almost always occur in association with Upland Prairie (UP) communities, most frequently as inclusions in landscapes dominated by the latter. Historically, they were common in the Prairie Parkland (PPA) Province, occurring in slight depressions and along drains. Marshes and meadows in the province typically had a fringe of wet prairie. In the hummocky morainic areas along the north and east

boundaries of the CGP in the Coteau Moraines Subsection, WP communities were irregularly scattered in the prairie landscape. They were similarly scattered in the broad central zone of the Minnesota River Prairie Subsection, but there were also more extensive occurrences in low-relief areas that had been the beds of shallow, short-lived glacial lakes. Shallow stream valleys tributary to the Minnesota River, many of which followed old meltwater channels, were additional sites for WP communities. In the Inner Coteau Subsection, where closed depressions are uncommon, WP communities were concentrated along valleys. The most extensive occurrences of WP communities were probably in the broad, nearly flat lake plain of Glacial Lake Agassiz, which dominates the RRV. WP communities may have comprised more of the prairie landscape here than UP communities. Along the east margin of the lake plain, WP communities dominated long, linear zones behind the beach ridges formed at different stages of the lake's history. The TAP Province, a ground moraine reworked by wave action during a period when it was a shallow-water part of Glacial Lake Agassiz, is almost as topographically smooth as the deep-water lake plain in the RRV, and WP communities were often quite extensive. A broad band of prominent beach ridges arcs through the province, and WP communities were similarly disposed within it as in the interbeach zone on the east side of the RRV. In the TAP Province, communities of the WP System were frequently associated with communities of the Open Rich Peatland (OP) System. Very little native wetland prairie remains today in either province; drainage and cultivation, succession to woodland and forest, and urban and suburban development have destroyed more than 99% of the wetland prairies present in the PPA Province before Euro-American settlement. A greater fraction has been spared from cultivation in the TAP Province, where some substantial areas remain.

Natural History

Frequent fire (with return intervals less than 10 years) is critical for the occurrence of wetland prairies. The association, noted above, of wetland prairies with larger upland prairies is explained by their dependence on proximity to upland prairies for a fire regime adequate to establish and maintain them, as their limited size and the increased influence of wet conditions reduce the likelihood of ignition and spread within them.

Fire frequency is responsive to climate and to landscape properties. The most important factors are the frequency and intensity of drying events that create flammable conditions, and the absence of topographic and water features that impede the spread of fire. Vegetation itself may facilitate or impede the spread of fire: deciduous forests are much more resistant to fire than grasslands, which burn readily. The size of a fire-prone landscape is also an important influence on the fire-return interval at points within it, as ignition events generally increase with area, as does the average extent of individual fires. In the PPA Province, the combination of a relatively dry climate and a topographically subdued landscape with few lakes resulted in the strong dominance of the entire province by prairie communities. Increasingly moist climatic conditions eastward in Minnesota, together with rougher topography and much higher density of lakes, dramatically altered the fire environment in most of the Eastern Broadleaf Forest Province, resulting in dominance by woodland and forest communities. The importance (noted above) of brush-prairies in the TAP Province probably involves cooler, moister soil conditions in the spring when dead vegetation is most flammable. The longer duration of snow cover and cooler average temperatures presumably afford some protection to the root crowns of woody plants during the spring fire season, and the wet soils might even still be frozen when many fires occur in the province.

WP communities were historically subject to grazing and browsing by large mammals, primarily bison and elk. The role these animal activities played in shaping WP communities is unclear, but they probably influenced relative abundances of plant species through their effects on regeneration and competitive interactions. These animals are major dispersers of seeds and are especially important for dispersals of more than a few

meters. Mechanical disturbance of the soil by their hooves is critical for the regeneration of many short-lived plant species that are part of WP communities. Reduction in the height and density of the canopy of tall grasses by grazing allows shorter plant species to persist in the community. Grazing also stimulates recruitment of new individuals of longer-lived plant species and affects competitive interactions among them. Large grazers can produce greater disturbance in WP communities than in UP communities, as wet soils are vulnerable to greater mechanical disturbance by the hooves of these heavy animals than are drier soils. However, bison and elk may have avoided wetland prairies when soils were soft, as there would have been ample upland prairie available. On the other hand, during drier periods, wetland prairies provided superior forage and were probably preferentially grazed.

Grazing and fire apparently interacted in a way that helped distribute their effects evenly throughout prairies and provided periods of respite from both disturbances. New plant growth following fire is more palatable and nutritious than older growth, so grazing animals tended to follow fires. Areas neglected by grazers accumulated greater fuel loads and therefore burned more readily than grazed areas. Thus, in the past, a cycle of burning, followed by grazing, abandonment by grazers, and, after fuel buildup, burning again, characterized the WP system. WP communities are readily degraded by repeated season-long grazing; conversely, prolonged absence of grazing, even with periodic fire, will probably result in greater dominance by taller species, as described above. Therefore, the movement of herds to new areas seeking the superior forage of recently burned prairie was likely important in maintaining the full component of species in wetland prairie communities. It is not known whether the long-term absence of grazing will result in the disappearance of species from WP communities.

Soil-moisture conditions in WP communities are intermediate between those in UP and Wet Meadow (WM) communities. WP communities typically receive surface runoff but are subjected to only brief, periodic inundation. Although the water table usually remains in the lower part of the plant rooting zone for much of the growing season, most of the rooting zone is not saturated except for brief periods during snowmelt or after heavy rains. As a result, anoxic conditions rarely persist long enough to cause mortality in plants that lack morphological adaptations for transporting oxygen to their roots. In some situations, upward seepage of groundwater is enough to keep the surface soil permanently moist but not enough to saturate it. Severe moisture stress is an infrequent experience for plants in WP communities in the PPA and TAP provinces. In the far western part of Minnesota, where evapotranspiration regularly exceeds precipitation, translocated salts concentrate at the surface in many low areas, making water uptake by plants difficult. A distinctive variant of wet prairie occupies these saline places. Plants associated with drier conditions, such as little bluestem *(Schizachyrium scoparium)* and western ragweed *(Ambrosia psilostachya)*, are often common in these sites, along with a reduced set of typical species of WP communities and some species restricted to saline conditions. Soils that support WP communities are classified as mollisols (very dark, base-rich mineral soils). Textures vary, including clays, silts, loams, and sands. At present, no floristic differences associated with these textural variations are recognized, but additional data collection and analysis may support subdivision based on this factor.

Plant Adaptations

Adaptations to frequent fire are prominent in the flora of the WP System. Plants with herbaceous life-forms, unlike woody plants, do not lose much investment when fire destroys their aboveground parts, and strongly dominate WP communities. However, shrubs are more important in WP communities than in UP communities, as greater productivity resulting from greater availability of water allows shrubs to maintain their root structure despite frequent destruction of aboveground parts. The perennating organs of most of the plants—buds, tubers, root collars, or other tissue from which

new growth originates—are generally deep enough below the soil surface to escape damage in prairie fires. This is not as true of shrubs, but moist soil conditions in WP communities provide some buffering of high temperatures at the soil surface during fires, increasing their chances for survival. In general, plants in WP communities invest heavily in belowground growth: biomass below ground in tallgrass prairies, including WP communities, is estimated to be two to four times that above ground. There are several selective forces that produce this result, but sequestering nitrogen—a limiting nutrient in tallgrass prairies—from loss in fire is probably one. Related to this is sequestration of nutrient and energy reserves to support rapid regrowth following grazing. The graminoid life-form is itself an adaptation to grazing, as the meristematic tissue from which new growth arises is at the base of the plant, where it is inaccessible to grazers and can replace lost leaf tissue simply by adding new cells to the leaf base to reelongate the blade.

Because severe water limitation is not frequent in WP communities in the PPA and TAP provinces, adaptations to cope with this are not common in plants of this system. Saline wet prairies are an exception, as the salinity of the soil water makes its uptake by plants difficult. The dominant graminoids of the WP System utilize the C_4 metabolic pathway in photosynthetic carbon fixation, a physiological mechanism that makes photosynthesis in the high-light and high-temperature summer prairie environment more efficient with respect to water use (and also nitrogen use). Although water is seldom limiting in WP communities, the dominance of C_4 grasses indicates that its efficient use is still favored. (In WM communities, in contrast, where conditions are wetter, the dominant graminoids are usually less-water-efficient C_3 sedges.) The challenge in wetter systems—that of providing oxygen to roots in water-logged soil—is also not a significant force in shaping the composition of WP communities. Consequently, most of the plants of this system have no morphological adaptations to cope with prolonged soil anoxia.

Floristic Regions

WP communities in Minnesota are grouped into two floristic regions based on differences in species composition, the Southern Floristic (WPs) Region and the Northern Floristic (WPn) Region (Figure WP-1). All WP communities in the southern part of the PPA Province (from Traverse County south) are recognized as being in the WPs Region, and all WP communities north of this in the PPA Province and the TAP Province are in the WPn Region. Differences between the floristic regions are subtle. The composition of the dominant graminoids is remarkably constant throughout the WP System, but there are some differences in the composition of forbs and less-important graminoids. In addition, shrubs are more common in WPn communities.

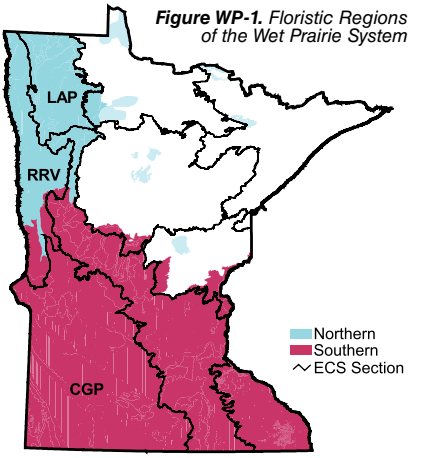

Figure WP-1. *Floristic Regions of the Wet Prairie System*

Table WP-1 lists the most geographically widespread species with at least moderately high fidelity for either the northern or the southern floristic region. Most of the species that are restricted to the WPs Region occur in only part of the region; restriction to the southeastern corner of the state is the most frequent pattern. None of the indicators for the WPs Region has high frequency for communities in that floristic region, because each of these species occurs in only part of the region, or is uncommon, or both. Low

frequency values for indicators of the WPn Region are mostly attributable to the second factor. Species that are reliably present in WP communities in one floristic region tend to be present with high frequency in communities of the other region as well. Tufted hair grass *(Deschampsia cespitosa)*, which has high frequency only in the WPn Region, is a notable exception.

Additional data and analysis may support moving the boundary between these two regions or creating different floristic regions. Another possibility is the elimination of floristic regions within the WP System. Rather than being an indication of ecologically coherent regions, it is possible that the geographic variation in species composition of WP communities is the result of independently determined range limits of some of the component species.

Table WP-1. *Plants useful for differentiating the Northern and Southern Floristic Regions of the Wetland Prairie System. (Species frequencies in this table are based on all samples across the range of each floristic region in Minnesota.)*

	Common Name	Scientific Name	frequency (%) UPn	UPs
Northern Floristic Region	Tufted hair grass	*Deschampsia cespitosa*	64	-
	Bog birch	*Betula pumila*	43	-
	White aster-like goldenrod	*Solidago ptarmicoides*	20	-
	Kalm's lobelia	*Lobelia kalmii*	20	-
	Slender willow	*Salix petiolaris*	54	10
	Bebb's willow	*Salix bebbiana*	43	10
	Seaside arrowgrass	*Triglochin maritima*	27	6
	Crawe's sedge	*Carex crawei*	12	2
Southern Floristic Region	Gray-headed coneflower	*Ratibida pinnata*	-	27
	Canada tick trefoil	*Desmodium canadense*	-	22
	Skyblue aster	*Aster oolentangiensis*	-	22
	Wild garlic	*Allium canadense*	-	16
	Cup plant	*Silphium perfoliatum*	-	12
	Tussock sedge	*Carex stricta*	1	24
	Veiny pea	*Lathyrus venosus*	1	18
	Prairie phlox	*Phlox pilosa*	4	33

photo by D.S. Wovcha, MN DNR