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General Description

Wet Meadow/Carr (WM) communities are graminoid- or shrub-dominated wetlands that are subjected to moderate inundation by standing water following spring thaw and heavy rains and to periodic drawdowns during the summer. The dominant graminoids are broad-leaved species such as lake sedge (*Carex lacustris*), tussock sedge (*C. stricta*), bluejoint (*Calamagrostis canadensis*), and Sartwell's sedge (*Carex sartwellii*). Shrubs, especially willows (*Salix* spp.) and dogwoods (*Cornus* spp.), are often dominant on sites that are not inundated by water throughout the summer and not exposed frequently to fire. Peak water levels are high and persistent enough to prevent trees from becoming established. However, there may be little or no standing water present during much of the growing season. As a result, the substrate surface alternates between aerobic and anaerobic conditions. Any organic matter that accumulates over time is usually oxidized during periodic drawdowns and may even burn during severe droughts. Soils range from mineral soils to muck and peat. Silt from flooding sometimes is intermixed with organic matter in muck or peat soils, especially in riverine settings. Although organic matter can accumulate over time in WM communities, they are not "peat-accumulating" communities, because periodic oxidation from drought and fire limits net peat accumulation to depths less than 12in (30cm). WM communities can be present on deeper peat formed previously on the site by a peat-producing community—such as an Open Rich Peatland—that was flooded by beaver or human activity and converted to a WM community. Deep peat may also be present in some WM communities because of debris that has been transported into the wetland, forming sedimentary peat. Because surface water is derived from runoff, stream flow, or groundwater, it is circumneutral (pH 6.0–8.0) and has high mineral and nutrient content. WM communities are present statewide and occur throughout the Prairie Parkland (PPA) and Tallgrass Aspen Parklands (TAP) provinces in wetland basins, along streams and drainageways, on seepage slopes, and as semi-floating mats along sheltered lake shorelines. Native wet meadows have become uncommon across much of the PPA and TAP provinces. Most of the loss has been from drainage and cultivation of wetland basins, but even meadows that have been spared are commonly dominated by non-native species such as reed canary grass (*Phalaris arundinacea*), which displace native species in meadows subjected to heavy grazing or inflows of nutrient-rich, silt-laden runoff from agricultural land.



Plant Adaptations

The characteristic plants of WM communities have adaptations that allow them to survive waterlogged conditions, although they are generally intolerant of prolonged inundation or high (> 20in [50cm]) water levels. Like many wetland plants, they have stems, leaves, and roots that contain intercellular air spaces (aerenchyma) that store oxygen and transport it from above-water structures to roots during waterlogged periods. In addition, some sedges and grasses (e.g., tussock sedge [*Carex stricta*] and bluejoint) form dense tussocks that elevate rootlets above the water surface. These tussock-forming species account for the hummocky topography characteristic of WM communities. Other species, such as willows, develop roots from stems or root collars (adventitious roots) that provide access to oxygen when other roots are submerged. Plants in WM communities must also minimize desiccation during periods of drawdown; this is accomplished by development of roots that extend deeply into permanently wet or moist substrates and by hard-walled cells (sclerenchyma) on outer surfaces of roots and rhizomes that reduce water loss. Although floating-leaved and submerged aquatic species may temporarily invade WM communities during periods of high water, these species lack adaptations to prevent desiccation and do not persist during periods of low water.

Because minerals and nutrients are plentiful in WM communities, growth of vegetation is typically luxuriant. The characteristic sedges are wide-leaved, strongly rhizomatous species, such as lake sedge (*Carex lacustris*), tussock sedge (*C. stricta*), slough sedge (*C. atherodes*), and beaked sedge (*C. utriculata*), that can form dense monotypic stands and produce dense thatch. In many wet meadows, regular oscillations in water level and thick thatch limit plant diversity by reducing habitats available for forb species. WM communities dominated by tussock-forming species, such as tussock sedge (*C. stricta*), usually have higher vascular species diversity, with forbs growing between tussocks and on the exposed roots of uprooted tussocks.

The exotic species reed canary grass (*Phalaris arundinacea*), an aggressive invader of fertile wetland habitats, is problematic at many sites where WM communities occur. Invasion by reed canary grass is promoted by disturbance and altering of water-table levels. Reed canary grass spreads rapidly by rhizomes, begins growing very early in spring, is tolerant of a wide range of water levels as well as dry conditions, and benefits from nitrates in agricultural runoff. Consequently, once established at a site, it often rapidly displaces native species from WM communities.

Floristic Regions

Based on general differences in species composition, WM communities in Minnesota are grouped into three floristic regions: the Northern Floristic (WMn) Region, the Southern Floristic (WMs) Region, and the Prairie Floristic (WMP) Region (Fig. WM-1). All three floristic regions are represented in the PPA and TAP provinces.

WMn communities are most common in the Eastern Broadleaf Forest (EBF) and Laurentian Mixed Forest provinces, both of which are characterized by regular, relatively high amounts of precipitation and low evapotranspiration rates. WMn communities occur throughout the TAP Province but are uncommon in the PPA Province, reaching the western limit of their range in the eastern part of the province. In the TAP Province, WMn communities often have shrub cover > 25% and are often associated with fen communities of the Open Rich Peatland (OP) System. In the PPA Province, WMn communities typically have shrub cover < 5% and appear to be associated with marshes and open-water basins where water levels are relatively stable.

WMs communities are present in both the EBF and TAP provinces but are most common in the PPA Province, where precipitation is sporadic and evapotranspiration rates are relatively high. Here, they are associated with areas of groundwater seepage or other



wetland settings, such as the margins of marshes, that rarely experience prolonged dry periods. Because of frequent fire in the PPA Province, shrub cover is typically low or is limited to the most protected sites.

Wmp communities are confined to the TAP and PPA provinces and appear to be associated with shallow basins that do not receive large quantities of surface runoff from the surrounding area and are at least somewhat open to down-gradient drainage. The water table remains close to the surface for much of the growing season but drops somewhat by late summer most years. Shrubs are scarce or absent because of frequent fire.

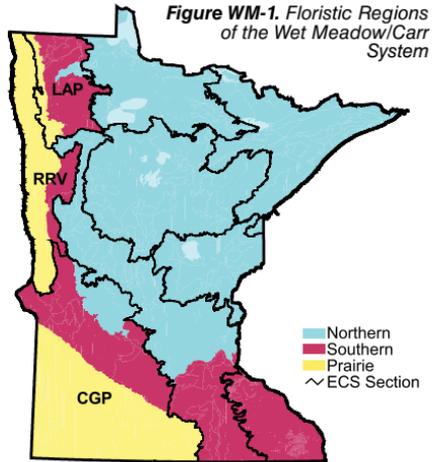


Figure WM-1. Floristic Regions of the Wet Meadow/Carr System

Species that help to differentiate the WMn, WMs, and Wmp regions are presented in Table WM-1. WMn communities are more likely to have species characteristic of FP and OP communities and species with a distinctly northern geographic distribution. WMs communities can have species of Wet Forest (WF) as well as Wetland Prairie (WP)

Table WM-1. Plant species useful for differentiating the Northern, Southern, and Prairie Floristic Regions of the Wet Meadow/Carr 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 (%)			
			WMn	Wms	Wmp	
Northern Floristic Region	Tree	Paper birch	8	-	-	
		Red maple	5	-	-	
	Shrub	Speckled alder	<i>Alnus incana</i>	24	-	-
		Red raspberry	<i>Rubus idaeus</i>	13	3	-
		Bog willow	<i>Salix pedicellaris</i>	9	-	-
		Balsam willow	<i>Salix pyrifolia</i>	7	-	-
		Leatherleaf	<i>Chamaedaphne calyculata</i>	7	-	-
		Steeplebush	<i>Spiraea tomentosa</i>	5	-	-
	Forb	Marsh skullcap	<i>Scutellaria galericulata</i>	53	26	-
		Three-cleft & Small bedstraw	<i>Galium trifidum</i> & <i>G. tinctorium</i>	46	9	-
		Bulb-bearing water hemlock	<i>Cicuta bulbifera</i>	46	13	-
		Marsh cinquefoil	<i>Potentilla palustris</i>	39	3	-
		Arrow-leaved tearthumb	<i>Polygonum sagittatum</i>	27	3	-
		Marsh St. John's wort	<i>Triadenum fraseri</i>	23	-	-
		Sensitive fern	<i>Onoclea sensibilis</i>	20	11	-
		Long-leaved chickweed	<i>Stellaria longifolia</i>	13	4	-
		White violets*	<i>Viola blanda</i> or <i>V. macloskeyi</i>	13	-	-
		Mad dog skullcap	<i>Scutellaria lateriflora</i>	13	-	-
		Rough cinquefoil	<i>Potentilla norvegica</i>	11	2	-
		Yellow loosestrife	<i>Lysimachia terrestris</i>	10	-	-
Wild calla	<i>Calla palustris</i>	10	-	-		
Dotted smartweed	<i>Polygonum punctatum</i>	7	-	-		
Intermediate bladderwort	<i>Utricularia intermedia</i>	5	-	-		
Sweet-scented bedstraw	<i>Galium triflorum</i>	5	-	-		

*Big-leaf white or Northern white violet

Table WM-1. continued on next page



Table WM-1. continued

		Common Name	Scientific Name	frequency (%)		
				WMn	Wms	WMp
Northern Floristic Region	Fern	Northern marsh fern	<i>Thelypteris palustris</i>	42	22	-
		Crested fern	<i>Dryopteris cristata</i>	25	4	-
		Spinulose shield fern	<i>Dryopteris carthusiana</i>	6	-	-
	Graminoid	Lake sedge	<i>Carex lacustris</i>	72	32	-
		Beaked sedge	<i>Carex utriculata</i>	33	11	-
		Woolgrass	<i>Scirpus cyperinus</i>	23	2	-
		Silvery sedge	<i>Carex canescens</i>	6	-	-
		Creeping sedge	<i>Carex chordorrhiza</i>	5	-	-
		Three-way sedge	<i>Dulichium arundinaceum</i>	5	-	-
Southern Floristic Region	Tree	Box elder	<i>Acer negundo</i>	1	10	-
	Shrub	Poison ivy	<i>Toxicodendron rydbergii</i>	-	7	-
		Silky dogwood	<i>Cornus amomum</i>	1	5	-
	Vine	Wild grape	<i>Vitis riparia</i>	-	5	-
	Forb	Virginia mountain mint	<i>Pycnanthemum virginianum</i>	-	21	15
		Swamp thistle	<i>Cirsium muticum</i>	4	18	-
		Willow-herbs*	<i>Epilobium</i> spp.	9	15	-
		White turtlehead	<i>Chelone glabra</i>	4	14	-
		Clearweed	<i>Pilea</i> spp.	8	14	-
		Starry false Solomon's seal	<i>Smilacina stellata</i>	-	10	4
		Spring cress	<i>Cardamine bulbosa</i>	-	9	-
		Swamp saxifrage	<i>Saxifraga pensylvanica</i>	1	8	-
		Bottle gentian	<i>Gentiana andrewsii</i>	-	5	-
	Graminoid	Whitetop	<i>Scolochloa festucacea</i>	-	14	-
		Awl-fruited sedge	<i>Carex stipata</i>	6	11	-
		Rice cut grass	<i>Leersia oryzoides</i>	4	10	-
		Common reed grass	<i>Phragmites australis</i>	6	10	-
		Hairy-fruited sedge	<i>Carex trichocarpa</i>	-	5	-
		Crested sedge	<i>Carex cristatella</i>	1	5	-
	Prairie Floristic Region	Shrub	Shrubby cinquefoil	<i>Potentilla fruticosa</i>	-	-
Wood's rose			<i>Rosa woodsii</i>	-	-	8
Forb		Rough bugleweed	<i>Lycopus asper</i>	3	24	58
		Sunflowers**	<i>Helianthus</i> spp.	-	26	42
		Spotted water hemlock	<i>Cicuta maculata</i>	2	18	42
		Stemless blue violets***	<i>Viola</i> spp.	2	23	38
		Clasping dogbane	<i>Apocynum sibiricum</i>	-	8	38
		Prairie loosestrife	<i>Lysimachia quadriflora</i>	-	4	38
		Grass-leaved goldenrod	<i>Euthamia graminifolia</i>	2	4	31
		Silverweed	<i>Potentilla anserina</i>	-	-	31
		Autumn sneezeweed	<i>Helenium autumnale</i>	-	8	19
		Golden & False golden ragwort	<i>Senecio aureus</i> & <i>S. pseudoaureus</i>	-	5	15
		Golden alexanders	<i>Zizia aurea</i>	-	4	15
		Maximilian's sunflower	<i>Helianthus maximiliani</i>	-	2	12
		Seaside arrowgrass	<i>Triglochin maritima</i>	-	2	12
		Veiny pea	<i>Lathyrus venosus</i>	-	-	12
		Kalm's lobelia	<i>Lobelia kalmii</i>	-	-	12
		Riddell's goldenrod	<i>Solidago riddellii</i>	-	-	8
		Common false Solomon's seal	<i>Smilacina racemosa</i>	-	-	8
		Obtuse bedstraw	<i>Galium obtusum</i>	-	-	8

*American, Purple-leaved, or Northern willow-herb (*Epilobium ciliatum*, *E. coloratum*, or *E. glandulosum*)

**Sunflowers (*Helianthus giganteus*, *H. grosseserratus*, or *H. nuttallii*)

***Stemless blue violets (*Viola nephrophylla* and similar *Viola* spp.)

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Table WM-1. continued

	Common Name	Scientific Name	frequency (%)			
			WMn	Wms	Wmp	
Prairie Floristic Region	Graminoid	Prairie cordgrass	-	21	85	
		Narrow reedgrass	<i>Calamagrostis stricta</i>	4	14	81
		Woolly sedge	<i>Carex pellita</i>	-	22	69
		Sartwell's sedge	<i>Carex sartwellii</i>	2	13	69
		Baltic rush	<i>Juncus arcticus</i>	-	2	62
		Dark green or Pale bulrush	<i>Scirpus atrovirens</i> or <i>S. pallidus</i>	1	13	35
		Buxbaum's sedge	<i>Carex buxbaumii</i>	3	8	35
		Flattened spikerush	<i>Eleocharis compressa</i>	-	-	31
		Foxtail barley	<i>Hordeum jubatum</i>	-	-	23
		Rigid sedge	<i>Carex tetanica</i>	-	-	15
		Very slender sedge	<i>Carex praegracilis</i>	-	-	12
		Sweet grass	<i>Hierochloa odorata</i>	-	-	12
		Dudley's rush	<i>Juncus dudleyi</i>	-	-	8
		Mat muhly grass	<i>Muhlenbergia richardsonis</i>	-	-	8
		Switchgrass	<i>Panicum virgatum</i>	-	-	8

communities. Wmp communities have species that have affinity for WP communities or very rich fens (i.e., Prairie Extremely Rich Fens [OPp93]) and very few, if any, species typical of forested wetland communities.

Recent plot data collected for WMs and Wmp communities show a much greater geographical overlap between the two floristic regions than was previously thought, and future analysis may indicate that they should be combined into a single floristic region.

Variation within Floristic Regions

Currently, only one native plant community class is recognized in the WMn Region, Northern Wet Meadow/Carr (WMn82). Future collection and analysis of environmental data along with vegetation data will likely lead to delineation of several WMn classes based on average or maximum water depth or length of inundation. There are two native plant community classes in the WMs Region: Southern Seepage Meadow/Carr (Wms83) and Southern Basin Wet Meadow/Carr (Wms92). Wms83 develops in settings fed by groundwater and is characterized by a relatively constant water supply. Wms92 occurs in settings where water is supplied by precipitation and surface runoff and is characterized by distinct wet and dry cycles. There is only one class in the Wmp floristic region, Prairie Wet Meadow/Carr (Wmp73). Wmp73 occurs in basins where water is supplied by precipitation or possibly groundwater but the seasonal change in water level is not great.

Succession

WM communities can develop from WF communities in areas flooded by beaver activity, or from FP communities following catastrophic fires during severe droughts. WM communities can also develop from Marsh (MR) communities where siltation, accumulation of sedimentary peat, development of floating root mats, or lowering of water tables—commonly following artificial drainage or disintegration of beaver dams or other natural or artificial dams—effectively lowers the water level in relation to the substrate surface; this promotes invasion and dominance by bluejoint and sedges (*Carex* spp.) over emergent aquatic plants such as cattails (*Typha* spp.) and bulrushes (*Scirpus* spp.). Lowered water tables in MR communities often result in more rapid invasion by reed canary grass than by native sedges and grasses. In the TAP Province, WM communities can be invaded by peat-producing bryophytes (particularly *Sphagnum*), causing decline in nutrient levels and replacement of the dominant broad-leaved sedge species by fine-leaved sedges, leading to conversion to OP communities. WM communities can also succeed to MR communities following hydrological changes that result in raising of the water table.