OP Open Rich Peatland System

photo by R.P. Dana MN DNR

Kittson County, MN

General Description

Open Rich Peatland (OP) communities are graminoid- or low shrub–dominated wetlands on actively forming deep (> 16in [40cm]) peat. The dominant graminoids most often are fine-leaved sedges *(Carex* spp.); shrubs, when present, typically include willows (especially sage-leaved willow *[Salix candida]* and bog willow *[S. pedicellaris]*), bog birch *(Betula pumila)*, or shrubby cinquefoil *(Potentilla fruticosa)*. Moss cover is variable in OP communities, but brown mosses may be abundant, particularly in the Tallgrass Aspen Parklands (TAP) Province. OP communities are widespread in the Laurentian Mixed Forest (LMF) Province, where a cool climate, abundant precipitation, and the presence of poorly drained basins and glacial lake plains provide suitable conditions for peat development. OP communities are also common in the TAP Province, which also has a cool climate and poorly drained lake plains, although amounts of precipitation are lower than in the LMF Province. In the Prairie Parkland (PPA) Province, where peatlands are at the southern and western limits of their range, OP communities are generally confined to floating mats in small watersheds or to settings where groundwater discharge is sufficient to offset higher rates of evapotranspiration caused by warmer temperatures; the relatively cold temperatures of groundwater also inhibit decomposition of plant litter and promote peat accumulation in these settings.

Peat Characteristics and Hydrology

(For a discussion of general peatland formation in Minnesota, see Peatland Formation under the Forested Rich Peatland System on page PPA/TAP-FP1.) The peat in OP communities is moderately decomposed (hemic) and formed predominantly from graminoids and brown mosses. OP communities occur in peatland settings influenced by inputs of groundwater. In the TAP and PPA provinces, the groundwater percolates through calcareous till and lacustrine deposits and therefore has high concentrations of minerals such as calcium. High rates of evaporation in these two provinces further concentrate minerals at the peat surface. Although OP communities in the TAP and PPA provinces may have relatively high concentrations of calcium or other minerals—especially in comparison with OP communities farther east in Minnesota—OP communities as a whole are generally not rich in nutrients, especially nitrogen and phosphorus.

The water inputs to OP communities come primarily from regional or local groundwater. These supplies are steady and maintain fairly constant water levels near the peat surface, in contrast to Forested Rich Peatland (FP) and Wet Meadow/Carr (WM) communities, in which the peat surface is not continuously saturated. The continuous saturation of peat substrates in OP communities creates anaerobic conditions that prevent establishment of trees and tall shrubs. As a result, OP communities lack the shaded habitats and shade-tolerant plant species characteristic in the understories of FP communities. OP communities have much smaller seasonal water-level oscillations than WM communities, providing conditions more favorable for formation and accumulation of peat. WM communities can be present on relatively deep sedimentary peat deposits or on deep peat on sites previously occupied by peat-forming communities. Even when WM communities are present on relatively deep peat, they are distinguishable from OP communities by their species composition and vegetation: OP communities are usually dominated by fine-leaved graminoids, mosses, or ericaceous shrubs such as large cranberry *(Vaccinium macrocarpon),* while WM communities are dominated by broad-leaved graminoids and lack significant moss cover and ericaceous shrubs.

Plant Adaptations

The plants characteristic of OP communities are adapted to full sunlight (because of absence of significant shade from trees and shrubs), sustained water levels, low nutrient levels, and high mineral levels. The lack of shade from trees and tall shrubs favors dominance in the ground layer by shade-intolerant species, especially graminoids; OP communities tend to have only sparse cover of forbs. Like many wetland plants, the characteristic species in OP communities, such as sedges *(Carex* spp.) and buckbean *(Menyanthes trifoliata)*, have stems, leaves, and roots with intercellular air spaces (aerenchyma) that store oxygen and transport it from above-water structures to roots during waterlogged periods. Other plants, such as tufted bulrush *(Scirpus cespitosus)*, sterile sedge *(Carex sterilis)*, and prairie sedge *(Carex prairea)* form hummocks that elevate the plant above persistently anaerobic peat surfaces. Generally, desiccation is not a problem for plants in OP communities because the plant-rooting zone is almost always wet and remains moist even during periods of drought when the water table drops below the peat surface.

As in other peatland systems, plants in OP communities are visibly affected by low-nutrient conditions and often have adaptations enabling them to exist on the limited nutrients in substrates and surface water. Particularly evident are reduced growth forms. Many of the characteristic shrubs and graminoids are very short. The dominant graminoids tend to have very narrow leaves (typically < 1/4 inch [6mm] wide), with species such as fen wiregrass sedge *(Carex lasiocarpa),* sterile sedge *(C. sterilis),* and narrow reedgrass *(Calamagrostis stricta)* most common. Although nutrients are low in OP communities, concentrations of minerals such as calcium can be very high near groundwater discharge points, particularly where peatlands are underlain by calcareous glacial deposits. Plants that thrive in areas of calcareous groundwater discharge include Kalm's lobelia *(Lobelia kalmii),* marsh arrowgrass *(Triglochin palustris)*, and grass-of-Parnassus *(Parnassia* spp.), along with the rare species twig rush *(Cladium mariscoides)*, sterile sedge *(Carex sterilis)*, and hair-like beak rush *(Rhynchospora capillacea)*.

Floristic Regions

Based on geographic variation in species composition, OP communities in Minnesota are grouped into two floristic regions: the Northern Floristic (OPn) Region and the Prairie Floristic (OPp) Region (Fig. OP-1). Communities from both floristic regions are present in the PPA Province, while only communities from the OPp Region are present in the TAP Province. The OPn Region is characterized by a cool, moist climate well suited for peatland development; communities in the OPp Region are at the western climatic limit of peatland formation in Minnesota and are subject to fires and water stress

during periods of drought. Differences between the two regions in climate and fire regime are reflected in differences in species composition between the regions. OPn communities are characterized by species that are relatively intolerant of drought, including ericaceous shrubs such as leatherleaf *(Chamaedaphne calyculata)*, bog rosemary *(Andromeda glaucophylla)*, and small cranberry *(Vaccinium oxycoccos)*; insectivorous plants such as pitcher plant *(Sarracenia purpurea)*, sundews *(Drosera* spp.), and bladderworts *(Utricularia* spp.); and ferns and fern allies such as crested fern *(Dryopteris cristata)* and water horsetail *(Equisetum fluviatile)* (Table OP-1). OPp communities, in comparison, have

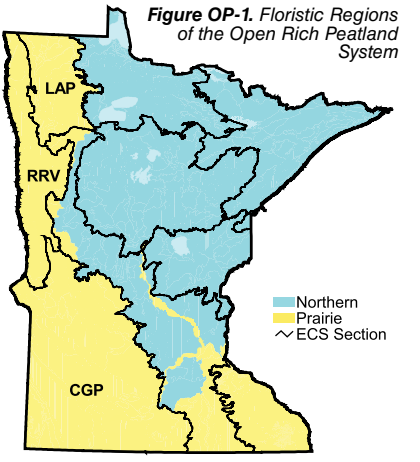

Figure OP-1. *Floristic Regions of the Open Rich Peatland System*

Table OP-1 *Plants useful for differentiating the Northern from the Prairie Floristic Region of the Open Rich Peatland System. (Species frequencies in this table are based on all samples across the range of each floristic region in Minnesota.)*

				frequency (%)	
	Layer	Common Name	Scientific Name	OPn	OPp
Northern Floristic Region	Tree	Tamarack (C,U)	*Larix laricina*	32	8
		Black spruce (U)	*Picea mariana*	14	2
		White cedar (U)	*Thuja occidentalis*	6	-
	Tall Shrub	Speckled alder	*Alnus incana*	27	-
		Balsam willow	*Salix pyrifolia*	18	-
	Low Shrub	Leatherleaf	*Chamaedaphne calyculata*	41	-
		Bog rosemary	*Andromeda glaucophylla*	34	-
		Small cranberry	*Vaccinium oxycoccos*	27	-
		Labrador tea	*Ledum groenlandicum*	14	-
		Large cranberry	*Vaccinium macrocarpon*	11	-
		Bog laurel	*Kalmia polifolia*	5	-
	Forb	Buckbean	*Menyanthes trifoliata*	36	5
		Round-leaved sundew	*Drosera rotundifolia*	34	-
		Intermediate bladderwort	*Utricularia intermedia*	30	3
		Pitcher plant	*Sarracenia purpurea*	29	3
		Scheuchzeria	*Scheuchzeria palustris*	16	-
		Three-leaved false Solomon's seal	*Smilacina trifolia*	12	-
		Spatulate-leaved sundew	*Drosera intermedia*	11	-
	Fern	Northern marsh fern	*Thelypteris palustris*	51	10
		Water horsetail	*Equisetum fluviatile*	34	7
		Crested fern	*Dryopteris cristata*	18	-
	Graminoid	Creeping sedge	*Carex chordorrhiza*	43	1
		Candle-lantern sedge	*Carex limosa*	32	5
		Lake sedge	*Carex lacustris*	27	5
		Beaked sedge	*Carex utriculata*	23	-
		White beak rush	*Rhynchospora alba*	19	-
		Slender cottongrass	*Eriophorum gracile*	17	1
		Bristle-stalked sedge	*Carex leptalea*	14	-
		Silvery sedge	*Carex canescens*	11	-
		Slender sedge	*Carex echinata*	11	-
		Chamisso's cottongrass	*Eriophorum chamissonis*	10	1

(C) = canopy tree (U) = understory tree

species common in the more drought- and fire-prone landscapes of western Minnesota, including grass-leaved goldenrod *(Euthamia graminifolia)*, Buxbaum's sedge *(Carex buxbaumii)*, and narrow reedgrass (Table OP-2).

Table OP-2 *Plants useful for differentiating the Prairie from the Northern Floristic Region of the Open Rich Peatland System. (Species frequencies in this table are based on all samples across the range of each floristic region in Minnesota.)*

				frequency (%)	
	Layer	Common Name	Scientific Name	OPn	OPp
Prairie Floristic Region	Shrub	Sage-leaved willow	*Salix candida*	12	48
		Shrubby cinquefoil	*Potentilla fruticosa*	8	34
	Forb	Grass-leaved goldenrod	*Euthamia graminifolia*	-	43
		Kalm's lobelia	*Lobelia kalmii*	10	41
		Spotted Joe pye weed	*Eupatorium maculatum*	9	37
		Swamp lousewort	*Pedicularis lanceolata*	4	35
		Stemless blue violets	*Viola* spp.*	5	34
		Eastern panicled aster	*Aster lanceolatus*	2	33
		Swamp milkweed	*Asclepias incarnata*	3	32
		Cut-leaved bugleweed	*Lycopus americanus*	1	32
		Flat-topped aster	*Aster umbellatus*	5	31
		Sunflower	*Helianthus* spp.**	-	30
		Canada goldenrod	*Solidago canadensis*	2	26
		American grass-of-Parnassus	*Parnassia glauca*	3	23
		Rough bugleweed	*Lycopus asper*	1	22
		Swamp thistle	*Cirsium muticum*	-	22
		Northern bedstraw	*Galium boreale*	-	20
		Common mint	*Mentha arvensis*	1	18
		Lesser fringed gentian	*Gentianopsis procera*	1	18
		Riddell's goldenrod	*Solidago riddellii*	-	18
		Marsh arrowgrass	*Triglochin palustris*	-	16
		Virginia mountain mint	*Pycnanthemum virginianum*	-	13
		Prairie loosestrife	*Lysimachia quadriflora*	-	12
		Silverweed	*Potentilla anserina*	-	12
		Germander	*Teucrium canadense*	-	11
		Spotted water hemlock	*Cicuta maculata*	-	11
		Poor gerardia	*Agalinis purpurea*	-	10
	Graminoid	Narrow reedgrass	*Calamagrostis stricta*	6	78
		Buxbaum's sedge	*Carex buxbaumii*	4	51
		Tall cottongrass	*Eriophorum polystachion*	7	44
		Sterile sedge	*Carex sterilis*	1	29
		Mat muhly grass	*Muhlenbergia richardsonis*	-	28
		Rigid sedge	*Carex tetanica*	-	25
		Sartwell's sedge	*Carex sartwellii*	1	24
		Tufted hair grass	*Deschampsia cespitosa*	-	22
		Big bluestem	*Andropogon gerardii*	-	19
		Baltic rush	*Juncus arcticus*	-	14
		Woolly sedge	*Carex pellita*	-	10

**Viola nephrophylla* and similar *Viola* spp. ***Helianthus giganteus*, *H. grosseserratus*, or *H. nuttallii*

Plant Community Classes in the PPA and TAP Provinces

Three OP plant community classes are present in the PPA and TAP provinces: Northern Rich Fen (Basin) (OPn92), Prairie Extremely Rich Fen (OPp93), and Prairie Rich Fen (OPp91). OPn92 occurs only in the PPA Province, while OPp93 and OPp91 occur in both the PPA and TAP provinces. OPn92 is characterized by level or slightly concave peat surfaces and is restricted to rolling morainic landscapes in the northeastern part of the CGP in the PPA Province, where irregular topography allows the development of poorly drained, isolated depressions filled with peat or supporting floating peaty mats. Prairie Extremely Rich Fens (OPp93) develop at highly calcareous groundwater

discharge points and have characteristic calciphilic plants such as Kalm's lobelia, marsh arrowgrass, and grass-of-Parnassus *(Parnassia* spp.). Prairie Rich Fens (OPp91) occur in glacial drainageways that are influenced by lateral movement of groundwater and lack the most strongly calciphilic species present in OPp93.

Succession

OP communities can develop from WM communities if conditions become suitable for sufficient accumulation of organic matter to form peat, minimizing contact of roots with the underlying mineral soil. If peat continues to accumulate over time, the peat surface and water table become elevated, and the rate of water flow and inputs of minerals to the plant-rooting zone are gradually reduced. Conditions then become favorable for invasion by minerotrophic *Sphagnum* species; the presence of minerotrophic *Sphagnum* species causes changes to the peatland environment that can lead to invasion of the site by acidic *Sphagnum* species and eventual conversion of the OP community to an Acid Peatland (AP) community. In the TAP and PPA provinces, however, predominance of calcareous till and marginal climatic conditions limit the development of acidic *Sphagnum*; as a result, succession of OP communities to AP communities is uncommon in the TAP Province and does not occur in the PPA Province.

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