OP Open Rich Peatland System

photo by B.A. Coffin MN DNR

Winter Road Lake Peatland, Lake of the Woods 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 ericaceous species such as leatherleaf *(Chamaedaphne calyculata)* and bog rosemary *(Andromeda glaucophylla)*, along with bog birch *(Betula pumila)*. Mosses are common in OP communities, with *Sphagnum* species characteristic on hummocks and brown mosses characteristic in wet hollows. OP communities are widespread in the Laurentian Mixed Forest (LMF) Province, where cool climate, abundant precipitation, and the presence of poorly drained basins and glacial lake plains provide suitable conditions for peat development. They are particularly prominent in MOP and in the Tamarack Lowlands Subsection in MDL. OP communities also occur locally south of the LMF Province in settings where groundwater discharge is sufficient to offset higher rates of evapotranspiration caused by warmer temperatures.

Peat Characteristics and Hydrology

(For a discussion of general peatland formation in Minnesota, see Peatland Formation under the Forested Rich Peatland System on page LMF-FP1.) The peat in OP communities is moderately decomposed (hemic) and formed from graminoids and brown mosses. OP communities occur in peatland settings influenced by inputs of groundwater. Concentrations of minerals such as calcium are often abundant in groundwater that has percolated through till and can reach very high levels in areas with calcareous till deposits, which are typical in the western part of the LMF Province. Therefore, OP communities often have high concentrations of minerals (and high species diversity) in comparison with Acid Peatland (AP) communities. OP communities, however, are 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. 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 formerly occupied by peat-forming communities. Differences in species composition and vegetation, however, distinguish OP and WM communities even when deep peat is present in WM communities. OP communities (with the exception of Northern Shrub Shore Fens [OPn81]) are usually dominated by fine-leaved graminoids, mosses, or ericaceous shrubs such as leatherleaf, while WM communities are dominated by broad-leaved graminoids, lack significant moss cover, and lack ericaceous shrubs.

Plant Adaptations

The plants characteristic of OP communities are adapted to full sunlight, sustained water levels, low nutrient levels, and high mineral levels. This environment is well suited to dominance by sun-loving herbaceous species, brown mosses, and minerotrophic *Sphagnum* species. The lack of shade from trees and shrubs favors dominance in the ground layer by shade-intolerant species, especially graminoids (in comparison with FP communities, which have more abundant forbs and shrubs in the understory). 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 water-logged periods. Other plants, such as bog birch *(Betula pumila),* grow on aerated hummocks, or in the case of tufted bulrush *(Scirpus cespitosus)* 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 <1/3 inch (3mm) wide), with species such as fen wire grass *(Carex lasiocarpa),* candle-lantern sedge *(C. limosa),* creeping sedge *(C. chordorrhiza),* and white beak rush *(Rhynchospora alba)* most common. OP communities are also characterized by insectivorous plants, including pitcher plant *(Sarracenia purpurea),* sundews *(Drosera* spp.), and bladderworts *(Utricularia* spp.), that supplement their intake of both nitrogen and phosphorus by capturing and digesting insects. Although nutrients are low in OP communities, concentrations of minerals such as calcium can be very high near groundwater discharge points, particularly in the western parts of the LMF Province where peatlands are underlain by calcareous glacial deposits. Plants that thrive in areas of calcareous groundwater discharge include tufted bulrush, Kalm's lobelia *(Lobelia kalmii),* and grass of Parnassus *(Parnassia* spp.), along with the rare species twig rush *(Cladium mariscoides)* 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). All of the OP communities in the LMF Province are in the OPn Region, with the exception of the Salol Peatland in Roseau County along the western border of MOP. Communities in the OPp Region are at the western climatic limit in Minnesota of peatland formation and are subject to fires and water stress during periods of drought. Therefore, they lack some of the characteristic OP species less tolerant of drought, including ericaceous shrubs, such as leatherleaf, bog rosemary, and small cranberry *(Vaccinium oxycoccos);* insectivorous plants such as pitcher

plant, sundews, and bladderworts; and ferns and fern allies such as crested fern *(Dryopteris cristata)* and water horsetail *(Equisetum fluviatile),* all of which are typically present in communities in the OPn Region. On the other hand, OPp communities have species common in the drier and more fire-prone landscapes of western Minnesota that are not present in the OPn Region. Examples of these species are grass-leaved goldenrod *(Euthamia graminifolia),* Buxbaum's sedge *(Carex buxbaumii),* and narrow reedgrass *(Calamagrostis stricta)*.

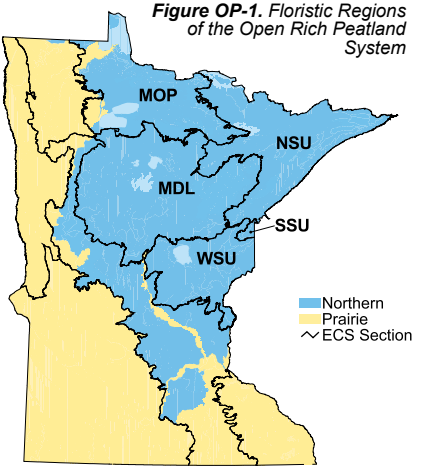

Figure OP-1. *Floristic Regions of the Open Rich Peatland System*

Variation Among Classes in the OPn Region

The plant community Classes in the OPn Region are divided into two groups based on differences in topography, substrate, and hydrology. The first group—Northern Shrub Shore Fen (OPn81) and Northern Rich Fen (Basin) (OPn92)—forms in basins underlain by fine-textured substrates with relatively low hydraulic conductivity. As a result, these peatlands are influenced primarily by stagnant (rather than flowing) groundwater. They are characterized by level or slightly concave peat surfaces and are common where irregular topography allows the development of poorly drained, isolated peat-filled depressions. They also form on floating mats adjacent to lakes, ponds, or rivers, and in lagg zones between larger peatlands and adjacent uplands. The two community Classes in this group differ from one another primarily in frequency of inundation by surface runoff or rising lake levels. Northern Shrub Shore Fens are occasionally inundated (and as a result are somewhat similar to WM communities), whereas Northern Rich Fens (Basin) are less frequently inundated.

The second group of OPn communities—Northern Extremely Rich Fen (OPn93) and Northern Rich Fen (Water Track) (OPn91)—forms on flat or slightly sloping surfaces, such as broad glacial lake plains. These communities are associated with lenses of sandy substrates that have high hydraulic conductivity. Because of the porosity of the subterranean sands, these peatlands are influenced by inputs of groundwater that create surface water flow and the formation of water tracks on the peatland surface. The elongated water tracks slope gently in the direction of drainage and sometimes form characteristic ribbed fen patterns visible on aerial photos. The water track communities differ from one another in mineral concentrations and pH. Northern Extremely Rich Fens are fed by highly calcareous groundwater and have characteristic calciphilic plants, whereas Northern Rich Fens (Water Track) have circumneutral water chemistry and lack calciphilic species.

Succession

OP communities can develop from WM communities if conditions become suitable for accumulation of organic matter and rooting contact with mineral soil is reduced. 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. Once *Sphagnum* is present, it further reduces available minerals by absorbing them—particularly calcium—and replacing them with hydrogen ions, causing the peat surface to become increasingly acidic. The site then becomes suitable for more acid-tolerant *Sphagnum* species, and pH continues to fall. Below pH 5.5, the water chemistry

changes from a bicarbonate buffered system to a humic acid buffered system. Subsequent production of humic acids by peat decomposition and living *Sphagnum* accelerates the acidification process. The higher parts of hummocks rapidly become more acidic and bog-like, while hollows usually retain more minerotrophic water chemistry and brown mosses. Eventually, the brown moss species in the hollows are replaced by oligotrophic *Sphagnum* species, completing transformation of the OP community to an Acid Peatland (AP) community. However, if inputs of minerals via groundwater or other sources are sufficient to compensate their removal by *Sphagnum*, succession to AP communities may be stopped or slowed. In comparison with OP communities, AP communities have very little contact with groundwater, have *Sphagnum* in hollows as well as on hummocks, and lack rich minerotrophic species (see table below for an explanation of minerotrophic versus bog species).

Vascular plant species that occur in bog Native Plant Communty Classes.

Because only those species listed below can persist in the ombrotrophic conditions of bogs, the occurrence of any other species can be considered an indicator of minerotrophic conditions. However, some seedlings, particularly tree species, can germinate in bogs but are short-lived and should not be considered as minerotrophic indicators.

	Common Name	Scientific Name	Northern Spruce Bog APn80 Frequency(%)	Northern Open Bog APn90 Frequency(%)
Tree	Tamarack	*Larix laricina*	51	62
	Black spruce	*Picea mariana*	100	82
	Jack pine	*Pinus banksiana*	4	6
Low Shrub	Bog rosemary	*Andromeda glaucophylla*	49	74
	Leatherleaf	*Chamaedaphne calyculata*	87	94
	Creeping snowberry	*Gaultheria hispidula*	44	–
	Bog laurel	*Kalmia polifolia*	91	94
	Labrador tea	*Ledum groenlandicum*	99	74
	Lowbush blueberry	*Vaccinium angustifolium*	45	12
	Velvet-leaved blueberry	*Vaccinium myrtilloides*	29	9
	Small cranberry	*Vaccinium oxycoccus*	95	94
	Lingonberry	*Vaccinium vitis-idaea*	31	–
	Dwarf misletoe	*Arceuthobium pusillum*	1	–
Forb	Stemless lady's slipper	*Cypripedium acaule*	19	–
	Round-leaved sundew	*Drosera rotundifolia*	38	35
	Heart-leaved twayblade	*Listera cordata*	3	–
	Indian pipe	*Monotropa uniflora*	28	–
	Pitcher plant	*Sarracenia purpurea*	29	59
	Three-leaved false Solomon's seal	*Smilacina trifolia*	86	18