FP Forested Rich Peatland System

photo by E.R. Rowe MN DNR

Becker County, MN

General Description

Forested Rich Peatland (FP) communities are conifer- or tall shrub–dominated wetlands on deep (>15in [40cm]), actively forming peat. They are characterized by mossy ground layers, often with abundant shrubs and forbs. FP communities are widespread in the Laurentian Mixed Forest Province but extend only into the northern half of the Eastern Broadleaf (EBF) Province. The warmer climate of the EBF Province, less abundant precipitation, and absence of poorly drained glacial lake plains limit peat development relative to the northern part of Minnesota, making FP communities much less common.

Peatland Formation

Most of Minnesota's peatlands began to form following climate cooling and increased precipitation about 5,000 to 6,000 years ago. Change in climate stabilized seasonal water levels in many basins and on large, flat, poorly drained landscapes such as glacial lake plains, causing saturation of soils and oxygen deficiency (anaerobic conditions). The anaerobic conditions, along with lower temperatures, inhibit plant decomposition and result in accumulation of peat. Peat accumulation rates in Minnesota are variable but generally range from 0.4 to 0.8mm per year (or 1.5–3in [4–8cm] per century). Once peat accumulates to a depth of 12–15in (30–40cm), the nutrients available to plants fall sharply because plants are no longer rooted in mineral soil. In addition to isolating plants from mineral soil, peat adsorbs and holds nutrients, which combined with low levels of microbial activity in anaerobic environments, limits nutrient recycling. With accumulation of peat, plants become dependent on inputs of essential nutrients from hydrologic processes such as precipitation, surface runoff from adjacent uplands, and groundwater-derived subsurface flow. (In some instances, low-nutrient environments can develop on thinner peat deposits, either in shallow basins with small watersheds or in landscapes with nutrient-poor sandy soils.) These sources usually supply very low concentrations of the essential nutrients nitrogen and phosphorus. However, concentrations of minerals are often high in groundwater that has percolated through till. Therefore, peatlands influenced by inputs of groundwater (including FP and Open Rich Peatland [OP] communities) can have relatively high concentrations of minerals such as calcium and magnesium.

The peat in FP communities is moderately decomposed (hemic) and formed from woody plant debris. The water table is typically below the peat surface and drops regularly and predictably during the summer. At high water levels, pools may form on the peat surface, but undulating microtopography and low hummocks at the bases of trees provide substrates that remain dry and aerated enough to support trees and shrubs. The presence of trees and shrubs in turn favors herbaceous species in the ground layer that are tolerant of at least moderate levels of shade. In contrast, OP communities have water-table levels that remain near the surface throughout the growing season, preventing establishment of significant tree cover and leaving the ground exposed to full sunlight. As a result, FP communities typically are richer in forb species than OP communities because forbs tend to be more competitive than graminoids in low-light environments. Another prominent feature of FP communities is the presence of feathermosses and other brown mosses, which are adapted to high mineral content, low nutrients, and sustained moisture. Brown mosses typically dominate the moss layer, with patches of minerotrophic *Sphagnum*.

Plant Adaptations

The environment in FP communities is well suited to dominance by herbaceous vascular plants, brown mosses, minerotrophic *Sphagnum*, and tree and shrub species that can survive periods of inundation or saturated substrates. Many of the plant species in FP communities have structures that allow them to survive waterlogged conditions for short periods. For example, speckled alder (*Alnus incana*) has adventitious roots that provide access to oxygen during high water levels. Other plants grow on aerated substrates on tree bases and moss hummocks elevated above the water table.

As in other peatland systems, plants of FP communities are adapted to low-nutrient environments. Evergreen species, including black spruce and ericaceous shrubs such as bog rosemary *(Andromeda glaucophylla)*, Labrador tea *(Ledum groenlandicum)*, and bog laurel *(Kalmia polifolia)*, conserve nutrients by retaining their leaves from year to year. Deciduous tree species, which lose nutrients when leaves are shed each year, are nearly absent from FP communities. The thickened outer leaf membranes characteristic of ericaceous shrubs and other species such as bog birch *(Betula pumila)* and the presence of chemical compounds in leaves help to reduce herbivory. The low palatability of leaves also retards breakdown of litter by decomposing organisms and contributes to peat accumulation. Some species in the community, such as pitcher plant *(Sarracenia purpurea)* and sundews *(Drosera* spp.), supplement their intake of the important nutrients, nitrogen and phosphorus, with structures that trap and digest insects.

Floristic Regions

Based on general differences in species composition, FP communities in Minnesota are grouped into three floristic regions: the Northern Floristic (FPn) Region, the Southern Floristic (FPs) Region, and the Northwestern Floristic (FPw) Region (Fig. FP-1). Two of these floristic regions, the FPn Region and the FPs Region, are represented in the EBF Province. Differences in species composition between FPn and FPs communities are presented in Tables FP-1 and FP-2.

In plant community composition and ecosystem function, the FPn Region is the most varied of the three floristic regions in the FP System. It is represented by seven native plant community classes, although only two occur in the EBF Province. These two classes, Northern Rich Tamarack Swamp (Western Basin) (FPn82) and Northern Rich Alder Swamp (FPn73), form in basins underlain by fine-textured substrates with relatively low hydraulic conductivity. These communities are influenced primarily by stagnant groundwater and are common where irregular topography allows the development of poorly drained, isolated depressions. They form in peat-filled depressions and on floating

mats adjacent to lakes, ponds, or rivers. Species characteristic of FPn communities relative to FPs communities include white cedar, three-fruited bog sedge *(Carex trisperma),* and ericaceous shrubs such as creeping snowberry *(Gaultheria hispidula)* and leatherleaf *(Chamaedaphne calyculata).*

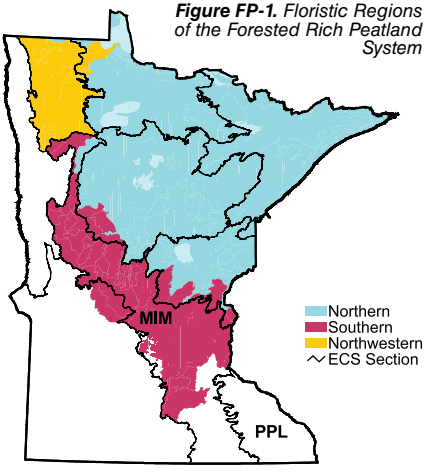

Figure FP-1. *Floristic Regions of the Forested Rich Peatland System*

The FPs Region is represented by one native plant community class, Southern Rich Conifer Swamp (FPs63). FPs communities in Minnesota are at the edge of the range of climate suitable for peat-forming vegetation. Because of a relatively warm climate and severe periodic droughts that cause drawdown of the water table and loss of peat in many basins, FPs communities are restricted to basins fed by groundwater flow that maintains sufficiently saturated conditions to promote peat development. They are most common on glacial moraines and outwash plains and appear to be associated with areas underlain by sandy substrates. It is likely that frequent drought and prolonged drawdown of the water table, along with more frequent fire, reduce the presence in FPs communities of some of the species characteristic in FPn communities. The scarcity or lack of ericaceous shrubs in FPs relative to FPn communities may be related to minimal snow cover in the FPs Region, resulting in desiccation of these plants during winter. Species characteristic of the FPs Region relative to the FPn Region include American and red elm, box elder, poison ivy *(Toxicodendron rydbergii)*, and vines such as Virginia creeper (*Parthenocissus* spp.), wild grape *(Vitis riparia)*, and wild honeysuckle *(Lonicera dioica)*.

Succession

FP communities can develop from Wet Forest communities if conditions become suitable for accumulation of organic matter (peat), and rooting contact with mineral soil is reduced. These conditions typically occur in settings where the water table becomes elevated or stabilized so that the ground surface is continuously saturated. As peat accumulates, and the peat surface and water table rise, rates of water flow and inputs of minerals to the peat surface are gradually reduced, and the community is transformed into a Forested Rich Peatland. Conditions then become suitable for invasion of the site by minerotrophic *Sphagnum* species, which absorb and retain minerals—particularly calcium—and release hydrogen ions, increasing the acidity of surface waters. As acidity increases, more acid-tolerant *Sphagnum* species become established at the site, and pH gradually falls. At pH 5.5 the water chemistry reaches a critical buffering point. It is no longer buffered by bicarbonates but by humic acids, and the community becomes an Acid Peatland (AP). The higher parts of hummocks quickly become more boglike, and minerotrophic *Sphagnum* species in hollows are replaced by oligotrophic species. The transformation of an FP community to an AP community can be stopped or slowed if groundwater or surface water inputs to the site increase and supply enough minerals to compensate their removal by *Sphagnum*.

It is possible to have characteristics of both AP and FP communities in the same peatland when peatlands have well-developed hummock and hollow topography. Originally, both hummocks and hollows in rich peatland communities have similar water chemistry, but as peat accumulates and the surface becomes more isolated from mineral-rich water,

Table FP-1. *Plants useful for differentiating the Northern from the Southern Floristic Region of the Forested Rich Peatland System.*

Layer	Common Name	Scientific Name	frequency (%) FPn	FPs
Northern Floristic Region				
Tree	White cedar (C,U)	*Thuja Occidentalis*	48	-
	White pine (U)	*Pinus strobus*	6	-
Tall Shrub	Mountain maple	*Acer spicatum*	11	-
	Beaked hazelnut	*Corylus cornuta*	11	-
	Balsam willow	*Salix pyrifolia*	7	-
	Black chokeberry	*Aronia melanocarpa*	6	-
Low Shrub	Creeping snowberry	*Gaultheria hispidula*	54	-
	Velvet-leaved blueberry	*Vaccinium myrtilloides*	33	3
	Leatherleaf	*Chamaedaphne calyculata*	31	3
	Bog rosemary	*Andromeda glaucophylla*	26	7
	Bog laurel	*Kalmia polifolia*	12	-
	Lingonberry	*Vaccinium vitis-idaea*	9	-
Forb	Goldthread	*Coptis trifolia*	57	10
	Bluebead lily	*Clintonia borealis*	34	7
	Northern blue flag	*Iris versicolor*	28	7
	Pitcher plant	*Sarracenia purpurea*	17	-
	Heart-leaved twayblade	*Listera cordata*	12	-
	Large-leaved aster	*Aster macrophyllus*	11	-
	Lesser rattlesnake plantain	*Goodyera repens*	10	-
	Arctic raspberry	*Rubus acaulis*	10	-
	Indian pipe	*Monotropa uniflora*	9	-
	Gaywings	*Polygala paucifolia*	7	-
	Palmate sweet coltsfoot	*Petasites frigidus*	7	-
	Green-flowered pyrola	*Pyrola chlorantha*	7	-
	Rose twistedstalk	*Streptopus roseus*	6	-
Fern	Common oak fern	*Gymnocarpium dryopteris*	18	-
	Woodland horsetail	*Equisetum sylvaticum*	17	3
	Lady fern	*Athyrium filix-femina*	16	3
	Bristly clubmoss	*Lycopodium annotinum*	10	-
	Meadow horsetail	*Equisetum pratense*	8	-
	Marsh horsetail	*Equisetum palustre*	7	-
	Dwarf scouring rush	*Equisetum scirpoides*	6	-
Graminoid	Three-fruited bog sedge	*Carex trisperma*	47	7
	Drooping woodreed	*Cinna latifolia*	14	-
	Sparse-fruited sedge	*Carex tenuiflora*	12	-

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

hummocks change more quickly in water chemistry than hollows. The hummocks, which are elevated above the water table, often become lower in minerals and more acidic and support species characteristic of AP communities. The hollows, which remain in contact with mineral-rich water, have water chemistry and flora typical of FP communities. The site then is characterized by a mosaic of patches of AP and FP communities until the hollows also become dominated by acidic species of *Sphagnum*. Mosaics of FP and AP communities occur most commonly in settings where woody plants (shrubs and trees) are abundant, because these sites often are hummocky from presence of stumps,

Table FP-2 *Plants useful for differentiating the Southern from the Northern Floristic Region of the Forested Rich Peatland System.*

	Layer	Common Name	Scientific Name	frequency (%) FPn	FPs
Southern Floristic Region	Tree	American elm (C,U)	*Ulmus americana*	4	57
		Box elder (U)	*Acer negundo*	-	27
		Red elm (U)	*Ulmus rubra*	1	20
		Black cherry (U)	*Prunus serotina*	-	7
	Shrub	Poison ivy	*Toxicodendron rydbergii*	4	57
		Poison sumac	*Toxicodendron vernix*	2	13
		Bush juniper	*Juniperus communis*	1	13
		Nannyberry	*Viburnum lentago*	1	10
	Vine	Virginia creeper	*Parthenocissus* spp.	5	60
		Wild grape	*Vitis riparia*	1	40
		Wild honeysuckle	*Lonicera dioica*	-	37
	Forb	Clearweed	*Pilea* spp.	3	33
		Swamp thistle	*Cirsium muticum*	2	20
		Purple avens	*Geum rivale*	1	20
		Loesel's twayblade	*Liparis loeselii*	-	17
		Cut-leaved bugleweed	*Lycopus americanus*	1	13
		Jack-in-the-pulpit	*Arisaema triphyllum*	1	10
		Elliptic shinleaf	*Pyrola elliptica*	1	10
		Spring cress	*Cardamine bulbosa*	-	10
		American spikenard	*Aralia racemosa*	-	10
		Skunk cabbage	*Symplocarpus foetidus*	-	10
		Swamp lousewort	*Pedicularis lanceolata*	-	7
		Dotted smartweed	*Polygonum punctatum*	-	7
	Graminoid	Fringed brome	*Bromus ciliatus*	6	33
		Bristly sedge	*Carex comosa*	4	30
		Porcupine sedge	*Carex hystericina*	3	27
		Prairie sedge	*Carex prairea*	3	20
		Golden fruited sedge	*Carex aurea*	2	20

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

roots, and fallen trees. Although initially formed over woody debris or tree bases, the hummocks become amplified by growth and accumulation of moss. The settings most likely to have abundant trees and shrubs are also those with slightly larger water-table drawdowns, making the establishment of woody plants possible.