FP Forested Rich Peatland System

photo by Norm Aaseng, MN DNR

Roseau 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 (LMF) Province and extend across the northern half of the Eastern Broadleaf Forest (EBF) Province. They reach their western limit in the Tallgrass Aspen Parklands (TAP) Province, where they are uncommon, and along the border of the northern part of the EBF Province with the Prairie Parkland (PPA) Province, where they are extremely rare. In the PPA and TAP provinces, high rates of evapotranspiration—caused by warmer climate and relatively low precipitation—combined with historical prevalence of fires limit peat development and restrict FP communities to wetlands fed by upwelling groundwater.

Peatland Formation

Most of Minnesota's peatlands began to form following climate cooling and increased precipitation about 5,000 to 6,000 years ago; peatland development in western Minnesota in the TAP and PPA provinces is much more recent, beginning around 3,000 years ago. Cooler, wetter climates led to stabilization of 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 0.4–0.8mm 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 increasingly dependent on external inputs of essential minerals from precipitation, surface runoff from adjacent uplands, and groundwater-derived subsurface flow. Groundwater supplies to peatlands can have high concentrations of minerals in settings where groundwater has percolated through calcareous substrates; high rates of evaporation also concentrate minerals at the peat surface in peatlands in the TAP and PPA provinces. As a result, both FP and Open Rich Peatland (OP) communities can

have surface water with relatively high concentrations of minerals such as calcium and magnesium. The precipitation, surface runoff, and groundwater that feed peatlands, however, usually have only very low concentrations of the essential nutrients nitrogen and phosphorus.

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 sufficiently dry and aerated 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; in addition, relatively dry hummocks in FP communities provide areas of suitable habitat for forb species not present in OP communities. 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 balsam fir, and ericaceous shrubs, such as Labrador tea *(Ledum groenlandicum)* and bog rosemary *(Andromeda glaucophylla)*, 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 FP communities, such as pitcher plant *(Sarracenia purpurea),* 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 FPw Region, are represented in the TAP Province. The FPs Region barely extends into the PPA Province, with a few isolated occurrences in the CGP. (See *Field Guide to the Native Plant Communities of Minnesota: The Eastern Broadleaf Forest Province* [Minnesota Department of Natural Resources 2005] for a description of how the FPs Region differs from the FPn Region.)

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 Northern Cedar Swamp (FPn63) occurs in the TAP Province, in well-protected areas that rarely burn. The FPw Region is represented by one native plant community class, Northwestern Rich Conifer Swamp (FPw63). FPw63 is limited in distribution to the TAP Province and the western portion of the MOP in the LMF Province. FPw63 is associated with areas of groundwater seepage and is confined to sites that offer some protection from fires but that probably burn occasionally.

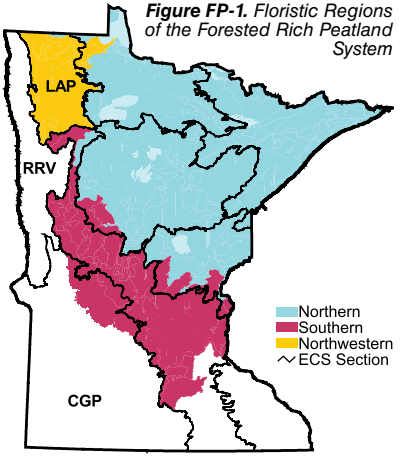

Figure FP-1. *Floristic Regions of the Forested Rich Peatland System*

Differences in species composition between FPn and FPw communities are presented in Table FP-1 and Table FP-2. Species with greater affinity for FPn communities include ericaceous shrubs such as creeping snowberry *(Gaultheria hispidula)* and leatherleaf *(Chamaedaphne calyculata)*, orchids such as stemless lady's slipper *(Cypripedium acaule)* and heart-leaved twayblade *(Listera cordata)*, and insectivorous plants such as round-leaved sundew *(Drosera rotundifolia)* and pitcher plant. It is likely that the diminished presence in the FPw Region of species common in the FPn Region is related to more frequent drought, with prolonged drawdown of the water table; low snow cover, resulting in desiccation of evergreen shrubs during the winter; and more frequent fire. Species with greater affinity for FPw communities include species typical of shallow peat, wet mineral soil, or even upland habitats.

Table FP-1*. Plant species useful for differentiating the Northern from the Northwestern Floristic Region of the Forested Rich Peatland System. (Species frequencies in this table are based on all samples across the range of each floristic region in Minnesota.)*

				frequency (%)	
		Common Name	***Scientific Name***	**FPn**	**FPw**
Northern Floristic Region	**Tree**	White cedar (C)	*Thuja occidentalis*	44	4
		Balsam fir (C)	*Abies balsamea*	30	4
		Red maple (U)	*Acer rubrum*	40	-
		Mountain ashes (U)	*Sorbus* spp.	17	-
	Tall Shrub	Fly honeysuckle	*Lonicera canadensis*	22	-
		Bog willow	*Salix pedicellaris*	21	-
		Round-leaved dogwood	*Cornus rugosa*	10	-
	Low Shrub	Creeping snowberry	*Gaultheria hispidula*	53	8
		Lowbush blueberry	*Vaccinium angustifolium*	32	4
		Leatherleaf	*Chamaedaphne calyculata*	32	-
		Bog laurel	*Kalmia polifolia*	12	-
	Forb	Stemless lady's slipper	*Cypripedium acaule*	20	-
		Arrow-leaved tearthumb	*Polygonum sagittatum*	15	-
		One-flowered pyrola	*Moneses uniflora*	14	-
		Round-leaved sundew	*Drosera rotundifolia*	12	-
		Heart-leaved twayblade	*Listera cordata*	12	-
		Early coralroot	*Corallorhiza trifida*	10	-
		Small northern bog orchid	*Platanthera obtusata*	10	-
		Lesser rattlesnake plantain	*Goodyera repens*	10	-

Table FP-1 *continued on next page*

Table FP-1. continued

Northern Floristic Region	Forb	Bluebead lily	*Clintonia borealis*	32	4
		Wild calla	*Calla palustris*	24	4
		Pitcher plant	*Sarracenia purpurea*	18	4
	Fern	Cinnamon fern	*Osmunda cinnamomea*	24	-
		Bristly clubmoss	*Lycopodium annotinum*	10	-
	Graminoid	Three-fruited bog sedge	*Carex trisperma*	46	4
		Poor sedge	*Carex paupercula*	42	4
		Creeping sedge	*Carex chordorrhiza*	10	-

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

Table FP-2. *Plant species useful for differentiating the Northwestern from the Northern Floristic Region of the Forested Rich Peatland 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 (%) FPn	FPw
Northwestern Floristic Region	Tree	American elm (U)	*Ulmus americana*	4	46
		Bur oak (C)	*Quercus macrocarpa*	4	21
		Balsam poplar (C)	*Populus balsamifera*	1	17
		Box elder (C)	*Acer negundo*	-	13
	Tall Shrub	Chokecherry	*Prunus virginiana*	5	33
		Highbush cranberry	*Viburnum trilobum*	3	29
		Shrubby cinquefoil	*Potentilla fruticosa*	1	29
		Wild black currant	*Ribes americanum*	4	17
	Low Shrub	Poison ivy	*Toxicodendron rydbergii*	4	33
	Vine	Wild honeysuckle	*Lonicera dioica*	-	29
	Forb	Spotted Joe pye weed	*Eupatorium maculatum*	19	75
		Alpine enchanter's nightshade	*Circaea alpina*	7	38
		Swamp thistle	*Cirsium muticum*	2	33
		Starry false Solomon's seal	*Smilacina stellata*	1	33
		Side-flowering aster	*Aster lateriflorus*	2	29
		Tall meadow-rue	*Thalictrum dasycarpum*	2	29
		Arrow-leaved sweet coltsfoot	*Petasites sagittatus*	5	21
		Wood strawberry	*Fragaria vesca*	2	21
		Cut-leaved bugleweed	*Lycopus americanus*	1	21
		Fireweed	*Epilobium angustifolium*	3	17
		Canada goldenrod	*Solidago canadensis*	2	13
		Elliptic shinleaf	*Pyrola elliptica*	1	13
	Graminoid	Fringed brome	*Bromus ciliatus*	6	58
		Common reed grass	*Phragmites australis*	3	21
		Prairie sedge	*Carex prairea*	3	17
		Fowl bluegrass	*Poa palustris*	3	13
		Golden-fruited sedge	*Carex aurea*	2	13

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

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 for their removal by *Sphagnum*.

photo by E.R. Rowe, MN DNR

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