photo by D.S. Wovcha MN DNR

Sherburne County, MN

General Description

Floodplain Forest (FF) communities are present on occasionally or annually flooded sites along streams and rivers. FF communities are dominated by deciduous trees tolerant of saturated soils, prolonged inundation, and frequent erosion and deposition of sediment. Active floodplains, which are inundated most years, have forests dominated by silver maple mixed with green ash and some American elm, cottonwood, hackberry, black willow, peach-leaved willow, red willow, and river birch. Sites such as river or stream terraces that flood less frequently or severely support mixed stands of American elm, box elder, silver maple, green ash, hackberry, cottonwood, basswood, black ash, red elm, and swamp white oak. The understories of FF communities characteristically are open, with few shrubs or saplings. Ground-layer cover is highly variable, ranging from areas of bare silt or sand to dense patches of wood nettle *(Laportea canadensis)* or impatiens *(Impatiens capensis* or *I. pallida).* Woody vines are important in FF communities in the Eastern Broadleaf Forest (EBF) Province, with wild grape (*Vitis riparia*), Virginia creeper *(Parthenocissus* spp.), moonseed (*Menispermum canadense*), and greenbrier (*Smilax tamnoides*) the most common species. Pools or mucky depressions in old channels are often present on actively flooded sites. FF communities are associated with streams and rivers throughout the EBF Province and are extensive along the Mississippi, Minnesota, and St. Croix rivers, contributing significantly to the native habitat available to plants and animals in the province.

In general, the flooding that occurs along streams and rivers is fed by water flowing over the ground surface (surface flow) as well as by water that enters stream and river beds as groundwater (base flow). Much of the surface flow reaches streams or rivers over frozen or saturated ground in the spring, initiating flooding in the lower reaches of watersheds. After spring flooding, base flow maintains river levels as well as stable, high water tables on river terraces and floodplains. Flooding imposes several physical challenges on plants in FF communities, including inundation, erosion, sedimentation, and severe scarring of tree trunks by flood-transported ice and debris. Flooding also results in chemical and physiological stresses, especially lack of the oxygen necessary for plant metabolism and for decomposition of litter. Although the annual pattern of flooding is predictable, the timing, duration, and energy vary from year to year. Flooding during the growing season due to unusually heavy rains is highly unpredictable and the most destructive to plants, which are far less tolerant of inundation when leafed out than when dormant or not fully developed. Flooding causes fairly constant shifting of sediment and features such as point-bars, meander scrolls, levees, and backwaters that influence the distribution of understory plants in FF communities.

Plant Adaptations

Among forested native plant community systems, the FF System is unique in its development around an annual disturbance regime. Each episode of flooding causes the death of many understory plants and leaves behind exposed mineral substrates with abundant moisture and nutrients for plant regeneration. The characteristic plants of FF communities have various adaptations and strategies for withstanding inundation and sedimentation. Because new habitat is created after each flood event, floodplain plants tend to be good at colonizing new or recently exposed habitats. Most are extremely mobile during some part of their life cycle, often using flowing water to disperse to new sites. Many are capable of extreme dominance, creating nearly pure colonies to the exclusion of other plants. The characteristic woody species of FF communities have morphological or physiological adaptations for supplying oxygen to tissues below the water or to roots in saturated soils. Some species simply avoid damage from inundation by being dormant or present as seeds or propagules during seasonal flood periods.

The dominant trees on regularly and severely flooded sites—including silver maple, American elm, cottonwood, green ash, and black ash—are among the most flood-tolerant tree species in Minnesota. Numerous indices and rankings have been published concerning the relative and absolute ability of trees to survive flooding. Such rankings vary regionally across North America and are confounded by dormancy and age of individual trees, with all trees surviving better when dormant, and middle-aged trees more resistant than younger or older trees. Among species in Minnesota, silver maple, green ash, cottonwood, and black willow appear to be tolerant even of the prolonged flooding that occurs annually in the bottomlands of large rivers in southern Minnesota, such as the Mississippi and the Minnesota. Hackberry, bur oak, swamp white oak, American elm, river birch, and box elder are tolerant of moderate flooding. The tolerance of black ash is less understood. Black ash occurs commonly with flood-tolerant trees on regularly flooded stretches of rivers in northern Minnesota but rarely occurs on such sites in southern Minnesota (see ***Floristic Regions,*** below).

In addition to surviving inundation, floodplain trees share other characteristics that are presumed adaptive for life along rivers. All are capable of rapid growth, and most are adept colonizers of newly exposed or deposited sediments. All of the typical tree species of FF communities can replace damaged stems by sprouting from the base of the stem, and some are capable of sending up new suckers from rootlike rhizomes. Multiple-stemmed old trees are common in FF communities as a result of resprouting from repeatedly damaged main trunks. In addition, all species are extremely resistant to the physical battering caused by spring ice floes and other flood-carried debris. Ice-scarred or beaver-chewed trunks are sometimes present in FF communities with little more than a few inches of intact cambium supporting a full, live crown, indicating the degree to which these species have adapted to physical disturbances associated with floodplain sites.

Trees limited to upland habitats generally have seeds with mechanisms that delay germination until the next advantageous growing period, usually the spring following the development of the seed. In floodplain settings, the dominant species tend to have seeds that can germinate immediately when shed from the tree. Most often, germination occurs early in the growing season after floodwaters have receded, leaving exposed mineral-soil seedbeds. The contrast in seed germination patterns of characteristically floodplain versus characteristically upland species of the maple, oak, birch, and ash genera is illustrative. The floodplain species, such as silver maple, swamp white oak, bur oak, river birch, and green ash, have little or no dormancy. The upland species, such as sugar maple, northern red oak, paper birch, yellow birch, and black ash, exhibit strong seed dormancy. Presumably these differences are an adaptation involving the synchronization of seed dispersal and germination with the different annual periods during which seedbeds are exposed in floodplain and upland sites. In general, the seeds of floodplain tree species tend to survive well in pools but can die within hours if desiccated. This is true of seeds of silver maple, cottonwood, American elm, black willow, and river birch. Carpets of germinating tree seedlings of up to a million per acre are a common feature of floodplains by late summer and fall where these species are dominant in the tree canopy. Interestingly, this strategy of immediate seed germination is not reflected in the herbaceous species characteristic of FF communities, which include many short-lived plants that successfully regenerate from banks of dormant seeds.

In spite of the large number of new seedlings that can be present, saplings are uncommon in the understory in most floodplain forests. The cover of saplings and older seedlings in FF communities is the lowest of the forested plant community systems in Minnesota. Within the FF System, the cover of saplings and older seedlings is lower in FF communities on active floodplain sites than in those on higher terraces or less actively flooded sites. On active floodplains, extensive recruitment of silver maple saplings into the tree canopy seems to occur most often when silver maple has become established within thickets of sandbar willow *(Salix exigua)* or cottonwood. This may be because these stands of silver maple are established as initial components of willow thickets on aggrading floodplain sites and never relinquish dominance to other tree species. Silver maple, green ash, black ash, and American elm are typically present at low abundance at all heights beneath the canopy of mature silver maple–dominated floodplain forests, yet less than 5% of the FF samples on active floodplain sites (i.e., Northern Floodplain Forests or Southern Floodplain Forests) used in developing this classification have structure and composition that suggests the replacement of a silver maple canopy by any of these tree species, including silver maple itself. This contrasts with FF communities on terraces and other infrequently flooded sites (i.e., Northern Terrace Forests or Southern Terrace Forests), where replacement of silver maple by more shade-tolerant trees such as green ash, black ash, and American elm seems common. Better drainage and less intense flooding appear to favor these species over silver maple in the long term on such sites.

The herbaceous plants characteristic of FF communities have a wide variety of strategies for dealing with inundation and sedimentation. Perennial herbs, especially grasses, sedges, nettles, and some ferns, often form much larger monotypic colonies on floodplains than observed in other habitats. Their roots and rhizomes form dense, thick mats that presumably confer some protection from erosion. Other herbaceous plants can survive floods as seeds or vegetative propagules. Nearly 10% of the plants recorded in FF plots in Minnesota are annuals or biennials, the highest proportion recorded for any system with persistent vegetation in this classification. Beggarticks *(Bidens* spp.), cleavers *(Galium aparine),* clearweeds *(Pilea* spp.), kidney-leaved buttercup *(Ranunculus abortivus),* stickseeds *(Hackelia* spp.), and dotted smartweed *(Polygonum punctatum)* are the most frequent annual or biennial plants in FF communities. Some herbs, including bulb-bearing water hemlock (*Cicuta bulbifera),* knotty rush *(Juncus nodosus),* and river bulrush *(Scirpus fluviatilis)*, are capable of vegetative reproduction via bulblets, tubers, or corms that detach from the parent plant, float downstream, and root when they become stranded on land. Yet other species, such as creeping lovegrass (*Eragrostis hypnoides),* grow prostrate on mudflats, rooting at every node and producing small plants that if detached, are capable of colonizing new sites. Others, such as dark green bulrush *(Scirpus atrovirens),* are capable of producing roots and leafy tufts when their stems bend and touch the water. Still others, including water parsnip *(Sium suave)* and water smartweed *(Polygonum amphibium),* produce aquatic leaves when submerged and normal leaves upon emergence, with some individuals having both leaf types. Many herbaceous species, as well as some trees, can develop adventitious roots, which form when the plant is in standing water or its stem is partially buried by sediment. Individuals with this adaptation, when present on sites where sediment has accumulated over several years, often have successive whorls of adventitious roots that correspond to successive soil-surface levels.

The most prominent stress on plants in FF communities is lack of oxygen needed for respiration. During the flood stage, anoxia affects the portions of woody plants that are normally aboveground, in addition to plant roots, and flooding severely constrains the connections of cells in plant stems and roots with the atmosphere. Within hours of the onset of flooding, actively growing tissues can deplete their supply of oxygen, while concentrations of the gaseous by-products of respiration begin to increase. The buildup of ethylene, in particular, provides a chemical signal that alters hormone levels and causes plants to respond to the stress of flooding. Numerous physiological and morphological changes happen in flood-stressed plants, but in general activities associated with photosynthesis and resource acquisition shut down. Wilted leaves, yellow leaves, and leaf fall are obvious symptoms of flood-stressed trees. Less obvious are the construction of special gas-conducting cells (or aerenchyma), the production of lenticels on stems, and the formation of adventitious roots that can serve to reconnect submerged tissues with the atmosphere. Trees that survive floods and subsequently maintain these gas-conducting tissues are in a sense pre-adapted to flooding in the future, a strategy not available to herbaceous plants. Another strategy for woody plants is dormancy during the typical period of annual flooding. Woody vegetation is less susceptible to death from anoxia when plants are dormant because of low respiration rates in inactive tissues. This may be one reason why leaves are slow to emerge in the spring in characteristic FF species, and why the perennial understory vegetation in FF communities develops much later than in surrounding terrestrial forests.

Floodplains and river terraces have persistently high water tables. This property is shared with Wet Forest (WF) and Wet Meadow/Carr (WM) communities, which commonly have some surface drainage features (such as rivulets) that are smaller or more intermittent than those characteristic of streams or rivers. High water tables cause deep soil layers to be continuously saturated, anaerobic, and chemically reducing, presenting many of the same obstacles for plant growth as flooding. Rooting in these layers is limited to plants that can supply oxygen to their roots through specialized gas-conducting cells. In addition, saturated soil conditions cause the mobilization of ions such as manganese and formation of by-products from anaerobic decomposition that can be toxic to plants. Roots in this environment often exude oxygen into the soil to create a small but effective oxidized zone (called a rhizosphere) that diminishes the uptake of toxic ions or compounds.

Nutrient Cycling

The processing of organic matter and release of essential nutrients is quite different in FF communities than in upland forests and in peatlands. In comparison with other forest systems, the plants of FF communities produce much more organic matter, which is augmented by deposition of organic litter washed from uplands into streams and rivers. The residence time of organic matter on floodplains is exceedingly short in comparison with that of peat in wetland forests or leaf litter in upland forests. The bulk of the fine organic matter deposited on floodplains is processed by invertebrates and other decomposers in a single season. A substantial amount of processing happens in backwaters and pools, where aquatic invertebrates reduce leaves to particles that can remain in suspension or to compounds soluble in water. Another fraction is incorporated into the mineral soil, mostly by earthworms. The soils of floodplains have about twice the incorporated organic matter (2-6%) of upland forest soils, while unprocessed organic material on the soil surface is likely to be washed away by subsequent floods. At the same time, substantial amounts of organic matter can be deposited by floodwater on sites that previously had none. Therefore, FF communities, unlike upland forests or peatlands, have no persistent bank or reserve of dead organic matter.

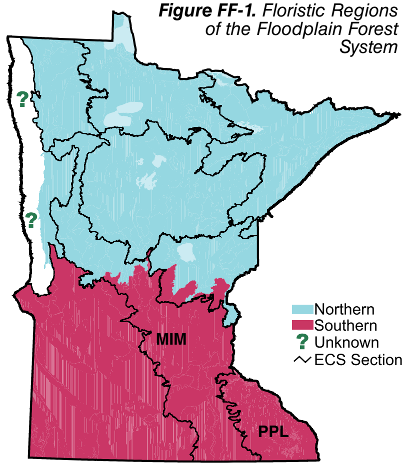
The mineralization of nitrogen—that is, the process by which microorganisms convert nitrogen-containing organic matter to inorganic compounds and simple organic compounds that plants can use—is of particular interest to forest ecologists because plant growth in most temperate forests is limited by the availability of nitrogen. Knowledge of nitrogen mineralization rates is also important for commercial forest management because mineralization rates are predictive of yield and can be reduced without proper management practices. In the FF System, the rate at which nitrogen mineralization occurs, the seasonal timing of mineralization, and the prevalent form of nitrogen available to plants are all quite specific compared with other forested ecological systems described in this field guide. Because FF communities are open systems at the scale normally used in studying forest dynamics, the common notion of nutrient cycling in forests is not completely applicable. Rather, it is more useful to think about fluxes and seasonal pulses of water, organic matter, and nutrients in FF communities. Instead of cycling within the community, the organic matter mineralized in floodplain forests may well have been produced elsewhere, while the nitrogen released may be taken up by plants at other sites. In all other forested systems in Minnesota, the primary pool of nitrogen is organic matter, living and dead. In FF communities, the primary pool is nitrates dissolved in water and in the tissues of live trees. Unfortunately, both the runoff and groundwater affecting FF communities in Minnesota has been greatly enriched in nitrates over the past 100 to 150 years from human activities, especially the burning of fossil fuels and use of industrial fertilizers. In watersheds with extensive human development, the natural behavior of nitrogen is unknown as is the effect of nitrogen enrichment on floodplain plant communities. It is known that contemporary FF communities serve the important role of nitrogen sinks by helping to immobilize nitrogen or return it to the atmosphere. In specific, when nitrate-laden groundwater enters organic-rich river backwaters, under the anaerobic conditions present in the backwaters the nitrates are converted by microbes to gaseous nitrogen or nitrous oxides that reenter the atmosphere. This process of denitrification is much more prevalent in FF communities than in other forested wetland systems in Minnesota. In addition, some floodplain trees are known to sequester large amounts of nitrogen, often far more than needed for growth and survival. If these trees remain intact after death, either submerged in the river (where they can remain for hundreds of years) or buried in sediments (for up to thousands of years), the nitrogen taken up by the living tree is effectively immobilized. This immobilization can help to lessen the effects of nitrates as pollutants downstream and ultimately in oceans (such as the Gulf of Mexico).

Floristic Regions

Based on geographic variation in species composition or flora, FF communities in Minnesota are divided into two floristic regions: the Northern Floristic (FFn) Region and the Southern Floristic (FFs) Region (Fig. FF-1). Both of these floristic regions are represented in the EBF Province. The FFn Region is present from Todd County to the north and west; the FFs Region is present south and east from Todd County. Because the land in the northern and western part of the EBF Province is rugged and forms the topographic high point of the region, catchments of rivers in the FFn Region are small, and few rivers become large enough to form extensive terraces or floodplains. Therefore, FFn communities are rare in the province. In contrast, in the FFs Region there are many large rivers with extensive bottomland forests that provide large areas of natural habitat in a landscape that is mostly farmland and urban land.

The boundary between the floristic regions depicted in Fig. FF-1 is based on regional differences in the assemblages of plants that occur on floodplains and river terraces.

Figure FF-1. *Floristic Regions of the Floodplain Forest System*



There are several physical differences between river valleys in the FFn and FFs regions that may act independently or in concert to account for variation in species composition. These include differences in physiography, landscape maturity, bedrock geology, and flooding regime. The physiographic differences between river valleys in the FFn and FFs regions are marked. In general, the major river valleys in the FFs Region are wide (up to several miles), deep (with local relief of 100 to 600 feet), rock walled, and have broad alluvial bottoms made up of diverse alluvial landforms such as fans, deltas, meander scrolls, levees, backwater lakes, and terraces. River valleys in the FFn Region are narrow (only hundreds of feet wide), shallow (less than 100 feet deep), cut in glacial drift, and have minimal deposits of alluvium and variation in landform. These valleys tend to lie on extremely flat glacial lake plains and outwash trains; because these settings are so flat, rivers in the FFn Region have little fall or erosive power, causing them to wind and to have poorly developed alluvial features and tributaries. This is especially true of northern rivers within the Mississippi and Red River drainages. River valleys in the FFn Region that are within the Lake Superior drainage, however, share some features with rivers in the FFs Region.

Differences in the maturity of landscapes in the FFs and FFn regions are related to differences between the two regions in history of deglaciation. The rivers in the FFs Region have been developing drainages and eroding lands within their watersheds for a much longer period than rivers in the FFn Region. This is particularly true of the Cannon, Zumbro, Whitewater, and Root rivers in the PPL but applies also to tributaries of the lower St. Croix and Minnesota rivers as they traverse the MIM. When the glaciers were melting most rapidly in Minnesota about 12,000–15,000 years ago, vast amounts of meltwater were coursing through the largely ice-free FFs Region, cutting deeply into the bedrock that now forms the valley walls of the Minnesota, lower St. Croix, and lower Mississippi rivers. From these deep gorges, high-gradient streams eroded headward into the adjacent lands, creating a geologically mature and dissected landscape with many streams, innumerable drains, and steep side-slopes. Later, when the volume and energy of glacial meltwater feeding rivers in the FFs Region waned, the lower energy streams deposited large quantities of suspended particles, filling their valleys with alluvium. Eventually, deposition of glacial sediment subsided and rivers and streams in the FFs Region began incising the alluvium in their valleys, often leaving several sets of abandoned terraces along valley walls as the streams eroded downward toward the major rivers. Ongoing sheet erosion of the steep side-slopes typical in the FFs Region has delivered fine soil particles (especially silt) to the terraces and active floodplains of streams and rivers, so bottomlands in the region tend to be composed of fine-textured alluvial deposits that retain nutrients more effectively than coarse-textured deposits such as sand or gravel. The mature, deeply incised drainages of the FFs Region also are characterized by relatively high inputs of organic matter and nutrients from terrestrial sources to river bottomlands.

At the time the river valleys of the FFs Region were being incised by glacial meltwater, most of the FFn Region was covered by glacial ice or glacial lakes and the general courses of the rivers that now drain the FFn Region had not been established. Even after the ice covering the surface of the FFn Region melted, large areas of ice remained buried beneath glacial deposits. This led to repeated abandonment of newly forming river channels as ice-cored lands collapsed to reveal new, lower river outlets. Overall, therefore, the channels of rivers in the FFn Region became established much more recently than those in the FFs Region and their drainages have developed over a much shorter period. The northern rivers and their tributaries are more likely than rivers in the FFs Region to have sandy, rather than silty, alluvial bottomlands. They are also much less incised in the landscape than rivers in the FFs Region and tend to have lower inputs of organic matter and nutrients from surrounding uplands.

Because of differences in sediment texture and inputs of nutrients to the bottomlands of rivers in the FFs and FFn regions, FFs communities are characterized by plants more demanding of nutrients. Natural differences in nutrient richness between FFs and FFn communities have been clouded, however, by changes in the landscape caused by agricultural activity. The climate of the FFs Region is more suitable for agriculture than that of the FFn Region. As a result, agricultural activity is more widespread in the FFs Region and in particular, poor agricultural practices (combined with logging) at the height of Euro-American settlement caused massive erosion and delivery of fine sediments to stream and river bottomlands. Widespread use of commercial fertilizers has also contributed to nutrient loading of FFs communities, possibly to the point of nitrogen satiation (see above).

Another obvious difference between the FFs and FFn regions is in their bedrock geology. The FFs Region is underlain by sedimentary rocks largely deposited during the Paleozoic Era. These rocks form the valley walls of the larger rivers and the lower stretches of their tributaries. Aquifers in this bedrock contribute significantly to the base flow of rivers in the FFs Region and contribute groundwater that is often saturated in bicarbonates. Springs, spring runs, and seeps are common along the lower valley slopes and can provide impressive amounts of cold groundwater to bottomland forests (WF communities, in particular). The alluvial soils present in FFs communities commonly have free carbonates within the rooting zone and may have free carbonates present up to the surface in areas of upwelling groundwater. In contrast, the FFn Region is underlain by some of the oldest rocks on earth, deposited in early Precambrian times, when the core of North America was being formed largely through volcanism. These rocks may be igneous, metamorphic, or sedimentary, but all tend to be noncalcareous. Where these rocks form river valley walls, the alluvial sediments are noncalcareous. This is also true within the area of glacial drift derived from these rocks, which includes the NSU, WSU, and SSU. Elsewhere in the FFn Region, the glacial drift is thick, and the underlying bedrock has no direct influence on the chemistry of base flow waters or on the mineralogy of the alluvium.

A final generalization is that rivers within the FFs Region flood more frequently and for longer periods than rivers in the FFn Region. Several features of the landscape contribute to this. First, unlike rivers in the FFs Region, rivers in the FFn Region are at the headwaters of (three) continental drainages and therefore do not receive water from as broad an area as the rivers that pass through the FFs Region. Second, while peatlands are generally small and uncommon in the FFs Region, the catchments of FFn rivers contain many large peatlands with the capacity to store significant amounts of surface water, thereby dampening increases in river flow following periods of heavy rain. Third, much of the native vegetation in the FFs Region has been cleared for agriculture and residential and urban development, while the FFn Region has large areas of intact forest vegetation, which helps to slow runoff and remove soil water through transpiration.

Plant Indicators of FFn and FFs Communities

Plant species with high fidelity for FFn relative to FFs communities are listed in Table FF-1. The valleys of rivers in the FFn Region are narrow and shallow compared to river valleys in the FFs Region and have small and often discontinuous alluvial deposits.

Table FF-1. *Plants useful for differentiating the Northern from the Southern Floristic Region of the Floodplain Forest System.*

Region	Group	Common Name	Scientific Name	frequency (%) FFn	FFs
Northern Floristic Region	Wet Forest Affinity	Sensitive fern	*Onoclea sensibilis*	64	11
		Sweet-scented bedstraw	*Galium triflorum*	52	11
		Bladder sedge	*Carex intumescens*	39	7
		Graceful sedge	*Carex gracillima*	33	-
		Projecting sedge	*Carex projecta*	29	-
		Field horsetail	*Equisetum arvense*	29	1
		Spinulose shield fern	*Dryopteris carthusiana*	23	1
		Meadow horsetail	*Equisetum pratense*	21	-
		Dwarf Raspberry	*Rubus pubescens*	21	-
		Lady-fern	*Athyrium angustum*	21	1
		Nodding trillium	*Trillium cernuum*	21	1
		Virgin's bower	*Clematis virginiana*	19	-
		Retrorse sedge	*Carex retrorsa*	17	-
		Brome-like sedge	*Carex bromoides*	15	-
		Lettuces	*Lactuca* spp.	15	-
		High-bush cranberry	*Viburnum trilobum*	15	-
		Winterberry	*Ilex verticillata*	13	1
		Balsam fir (U)	*Abies balsamea*	11	-
		Fringed brome	*Bromus ciliatus*	11	-
	Open Wetland Affinity	Tall meadow-rue	*Thalictrum dasycarpum*	52	3
		Northern blue Flag	*Iris versicolor*	37	1
		Spotted water-hemlock	*Cicuta maculata*	35	-
		Giant goldenrod	*Solidago gigantea*	31	1
		Canada anemone	*Anemone canadensis*	29	-
		Bluejoint	*Calamagrostis canadensis*	23	1
		Fowl bluegrass	*Poa palustris*	17	-
		Three-cleft bedstraw	*Galium trifidum*	17	-
		Spotted Joe-pye weed	*Eupatorium maculatum*	13	-
		Yellow loosestrife	*Lysimachia terrestris*	11	-
		Water-parsnip	*Sium suave*	11	-
		Dotted smartweed	*Polygonum punctatum*	11	1
	FF Affinity	Ostrich-fern	*Matteuccia struthiopteris*	58	5
		Fringed loosestrife	*Lysimachia ciliata*	39	1
		Tuckerman's sedge	*Carex tuckermanii*	27	-
		Virginia bugleweed	*Lycopus virginicus*	13	-
	Other	Canada Mayflower	*Maianthemum canadense*	41	1
		Bur oak (U)	*Quercus macrocarpa*	41	1
		Early meadow-rue	*Thalictrum dioicum*	37	5
		Nanyberry	*Viburnum lentago*	33	7
		Fringe sedge	*Carex crinita*	29	-
		Pale bellwort	*Uvularia sessifolia*	29	1
		Prickly or Smooth wild rose	*Rosa acicularis or R. blanda*	23	-
		Amercian hazelnut	*Corylus americana*	19	-
		Dewey's sedge	*Carex deweyana*	19	-
		Red baneberry	*Actea rubra*	19	1
		Hawthorn	*Crataegus spp.*	17	3
		Common strawberry	*Fragaria virginiana*	15	-
		Wood-anemone	*Anemone quinquefolia*	15	1
		Beaked hazelnut	*Corylus cornuta*	13	-
		Speckled alder	*Alnus incana*	13	-
		Red raspberry	*Rubus strigosus*	11	-
		Pennsylvania sedge	*Carex pensylvanica*	11	-
		Downy arrowwood	*Viburnum rafinesquianum*	11	-

(U) = understory tree

Because of this, FFn communities are more likely than FFs communities to be adjacent to plant communities from a variety of other systems and consequently are more likely to contain plant species characteristic of other systems. Plants characteristic of WF communities are especially common in FFn communities because WF communities are often present on river terraces cut into fresh glacial drift. Among these species are sensitive fern *(Onoclea sensibilis)*, sweet-scented bedstraw *(Galium triflorum)*, bladder sedge *(Carex intumescens)*, and graceful sedge *(Carex gracillima)* (Table FF-1). Open grassy riparian wetland areas are also much more common along rivers in the FFn Region than in the FFs Region. Therefore, plants of open wetland systems such as Open Rich Peatlands (OP), Wet Meadows/Carrs (WM), and Wet Prairies (WP) are occasional in FFn communities (Table FF-1). This is especially true where northern rivers traverse paludified lake plains and have tributaries that are lengthening headward into peatlands. Often, the lands adjacent to the tributaries and along segments of the main channels are peaty at the surface and too wet to support the growth of trees. Plants like northern blue flag *(Iris versicolor)*, fowl bluegrass *(Poa palustris)*, and yellow loosestrife *(Lysimachia terrestris)* are common in OP communities along these peaty shores as well as in nearby FFn communities. Where northern rivers and streams moderately overflow their main channel in spring, they are often bordered by WM communities. In the FFn Region such flooding is commonly caused by beavers. In modern times, dams constructed for waterfowl and wild rice management also often lead to the development of WM communities along rivers in the FFn Region. Plants such as bluejoint *(Calamagrostis canadensis)*, three-cleft bedstraw *(Galium trifidum)*, and spotted Joe pye weed *(Eupatorium maculatum)* are characteristic in both the forested and wet meadow–lined stretches of northern rivers.

Of the northern plants in Table FF-1, only ostrich fern *(Matteuccia struthiopteris)*, fringed loosestrife *(Lysimachia ciliata)*, nannyberry *(Viburnum lentago)*, fringe sedge *(Carex crinita)*, Tuckerman's sedge *(Carex tuckermanii)*, and Virginia bugleweed *(Lycopus virginicus)* have their peak presence in FF communities. None of these plants is restricted to FFn communities, having fairly high presence in WF communities as well. Tuckerman's sedge is the best indicator of FFn communities, but it also occurs fairly often in vernal pools present within WF and MH communities. Very few of the plants listed in Table FF-1 have ranges restricted to the FFn Region. Most are widespread in both the Laurentian Mixed Forest and EBF provinces, but for some reason (probably related to duration of flooding) they do not occur on floodplains in the southern part of the state. Although balsam fir rarely occurs in the FFs Region, it is abundant only in the FFn Region and occurs infrequently along rivers there. Just five other plants listed in Table FF-1 have ranges restricted to the FFn Region. Curiously, they are all sedges and include fringe sedge, projecting sedge *(Carex projecta)*, Tuckerman's sedge, retrorse sedge *(Carex retrorsa)*, and brome-like sedge *(Carex bromoides)*.

Plant species with high fidelity for FFs relative to FFn communities are listed in Table FF-2. FFs communities have a rather large group of species that reach their peak presence in FF communities and are limited to the FFs Region, including plants such as wild grape *(Vitis riparia)*, hackberry, greenbrier *(Smilax tamnoides)*, and Virginia knotweed *(Polygonum virginianum)*. All of these plants have much higher presence in FF communities than in other systems, making them rather good indicators of the FF System as well as indicators of FFs relative to FFn communities.

The list of species that are diagnostic for FFs communities (Table FF-2) is substantially shorter than the list for FFn communities (Table FF-1). The primary reason appears to be that contemporary FFs communities occur almost exclusively next to MH communities rather than communities from a variety of systems, as is the case for FFn communities. Therefore, FFs communities tend to pick up very few species from adjacent ecological systems other than MH forests. Red elm, gregarious black snakeroot *(Sanicula gregaria)*, and bitternut hickory are among the species indicative of FFs communities

Table FF-2. *Plants useful for differentiating the Southern from the Northern Floristic Region of the Floodplain Forest System.*

Region	Affinity	Common Name	Scientific Name	frequency (%) FFn	frequency (%) FFs
Southern Floristic Region	Mesic Hardwood Forest Affinity	Red elm (U)	*Ulmus rubra*	3	23
		Gregarious black snakeroot	*Sanicula gregaria*	-	17
		Bitternut hickory (U)	*Carya cordiformis*	-	15
		Blue phlox	*Phlox divaricata*	-	13
	Floodplain Forest Affinity	Wild grape	*Vitis riparia*	15	66
		Hackberry (U)	*Celtis occidentalis*	7	58
		Green-briar	*Smilax tamnoides*	5	45
		Virginia knotweed	*Polygonum virginianum*	3	31
		Cleavers	*Galium aparine*	1	29
		Moneywort	*Lysimachia nummularia*	-	27
		Missouri gooseberry	*Ribes missouriense*	1	25
		Ambiguous sedge	*Carex amphibola*	3	21
		Swamp white oak (U)	*Quercus bicolor*	-	19
		Common Elder	*Sambucus canadensis*	-	19
		Anise-root	*Osmorhiza longistylis*	1	17
		Gray's sedge	*Carex grayi*	-	15
		Stickseeds	*Hackelia* spp.	-	15
		Green dragon	*Arisaema dracontium*	-	13
		Tall bellflower	*Campanula americana*	-	11
		Cattail sedge	*Carex typhina*	-	11
		Black willow	*Salix nigra*	1	11
		Virginia bluebells	*Mertensia virginica*	-	10
		Woodmint	*Blephilia hirsuta*	1	10
	Other	Rice cut grass	*Leersia oryzoides*	-	15

(U) = understory tree

with peak presence in forests of the MH System. Historic descriptions of the bottomlands of the Mississippi River mention marshes, meadows, and prairies being intermingled with floodplain forest communities. Records also indicate that historic floodplain forests were substantially more open than today's closed-canopy stands. Plants characteristic of marshes, meadows, and prairies are now essentially gone from river bottomlands in the FFs Region, in part because these open areas have been converted to fields, in part because the low meadows and prairies were flooded as a result of the lock and dam system on the Mississippi River, and in part because FF communities now have denser tree canopies than historic FF communities.