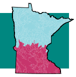

MN DNR

Lac Qui Parle County, MN

General Description

Floodplain Forest (FF) communities are present on annually or occasionally 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 in the Prairie Parkland (PPA) and Tallgrass Aspen Parklands (TAP) provinces, which are inundated most years during spring runoff, have forests dominated by trees tolerant of prolonged flooding and frequent deposition of sediment. In the CGP Section of the PPA Province, these species include silver maple, green ash, American elm, and cottonwood. Sites such as river or stream terraces that flood less frequently support mixed stands of American elm, basswood, bur oak, green ash, box elder, and, along the eastern margin of the CGP, black ash. In the RRV section of the PPA Province and in the TAP Province, forests on active floodplains and on terraces are similar to their southern counterparts, but silver maple is absent and black ash is limited to the eastern margin of this region. Statewide, the understories of FF communities are characteristically open, with few shrubs or saplings. FF communities in the PPA and TAP provinces, particularly those on higher terraces, are brushier than their counterparts in the Eastern Broadleaf Forest and Laurentian Mixed Forest provinces, primarily from presence of tree seedlings such as American elm, green ash, box elder, and, where these trees extend into the region, black ash and silver maple. Ground-layer cover is highly variable, ranging from areas of bare silt or sand to dense patches of wood nettle *(Laportea canadensis)*, ostrich fern *(Matteuccia struthiopteris*), or clearweed *(Pilea pumila* or *P. fontana).* Woody vines are important in FF communities in the PPA and TAP provinces, with wild grape (*Vitis riparia*), Virginia creeper *(Parthenocissus* spp.), and Canada moonseed *(Menispermum canadense)* occurring commonly, and greenbrier (*Smilax tamnoides*) and virgin's bower *(Clematis virginiana)* present occasionally. Pools or mucky depressions in old channels are often present on actively flooded sites and support several annual plant species not present in other forested communities in Minnesota. FF communities are associated with streams and rivers throughout the PPA and TAP provinces. In the past, FF communities were extensive along the Minnesota River and lower stretches of its tributaries. They were intermittent along the Red River and smaller streams in general, occurring only in stretches with deposits of alluvium and where the valleys offered sufficient protection from wildfires. FF communities are still common in parts of these watersheds, although significant areas have been cleared for cropland, and most sites have been affected by changes in the flooding regime caused by ditching and tiling of wetlands and conversion of native upland vegetation to cropland. FF communities on active floodplains have also experienced increased deposition of sediments from erosion of disturbed uplands.

In general, streams and rivers are 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 along the Minnesota and Red rivers. Hackberry, bur oak, American elm, 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 or in the Red River valley.

Most characteristic floodplain trees are capable of rapid growth and are adept colonizers of newly exposed or deposited sediments. Several of the typical tree species in FF communities, including silver maple, box elder, and basswood, can replace damaged stems by sprouting from the base of the stem or trunk. Multiple-stemmed old trees are common in FF communities as a result of resprouting from repeatedly damaged main trunks. In addition, most tree species are extremely resistant to the physical battering caused by spring ice floes. In the prairie regions of Minnesota, damage from large mammals appears to have been common as well. Historical accounts describe herds of bison in river valleys severely trampling small trees and rubbing the bark off larger trees.

Trees limited to upland habitats, such as sugar maple, northern red oak, paper birch, and yellow birch, 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, including silver maple, cottonwood, bur oak, American elm, green ash, black willow, and peach-leaved willow, tend to have seeds that can germinate immediately when shed from the tree or shortly thereafter. Most often, germination occurs early in the growing season after floodwaters have receded, leaving exposed mineral-soil seedbeds. 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 upland versus floodplain 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 peach-leaved willow. 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 floodplain forests statewide. 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.

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. This high presence of annual and biennial species appears related in part to the close association of FF communities with River Shore communities, in which annual and short-lived species are very common. Touch-me-not *(Impatiens* spp.), bur marigold and beggarticks *(Bidens* spp.), cleavers *(Galium aparine)*, clearweed *(Pilea* spp.), kidney-leaved buttercup *(Ranunculus abortivus)*, and stickseed *(Hackelia* spp.) 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. 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 flooding, 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.

In addition to experiencing annual or occasional flooding, floodplains and river terraces have persistently high water tables. 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 are 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 soil invertebrates. 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 in forests—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 because plant growth in most temperate forests is limited by the availability of nitrogen. Knowledge of nitrogen mineralization rates is 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 annual rate and seasonal timing of nitrogen mineralization and the prevalent form of nitrogen available to plants are quite specific compared with the 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 have been greatly enriched in nitrates over the past 100 to 150 years from human activities, especially the burning of fossil fuels and use of commercial 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. Specifically, when nitrate-laden groundwater enters organic-rich river backwaters, nitrates are converted by microbes under anaerobic conditions 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 the oceans.

Glacial History of the Red River and Minnesota River Valleys

The valleys and drainages of the two largest rivers in the prairie region of Minnesota, the Red River and the Minnesota River, have strong influence on the character and abundance of floodplain forests in the PPA and TAP provinces. The Red and the Minnesota rivers flow through markedly different valleys with very different flooding regimes and alluvial landforms. The differences in physiography of the Red River and Minnesota River drainages originate from geologic processes that occurred near the end of the last glaciation in Minnesota.

About 12,000 years ago, when Glacial Lake Agassiz was at its greatest extent and its outflow, Glacial River Warren, was cutting what is now the Minnesota River valley, the current Red River watershed was covered by the lake. During the first 700 years of the draining of Glacial Lake Agassiz, the outlet of the lake into the Glacial River Warren eroded to several successively lower positions and correspondingly lowered the elevation of the great lake. Thus, the lands of the Agassiz basin were exposed gradually; beach ridges or strand lines document at least five major episodes of drawdown from about 11,700 to 11,000 years ago. At about 11,000 years ago the outlet stabilized. The elevation of Glacial Lake Agassiz then remained about the same for at least the next 1,000 years. During this period, rivers in Minnesota that drained westward into Lake Agassiz cut through the beach ridges and eroded significant valleys in the freshly exposed sediment. Beginning about 10,000 years ago, the history of Glacial Lake Agassiz is complicated by short episodes of advance and melting of glacial ice masses, which opened drainages to the north. By about 9,500 years ago, the ice and the lake had retreated into Canada, exposing clayey, deep-water sediments in Minnesota. Because the Agassiz lake bed is incredibly flat, the Red River and most of its tributaries in Minnesota have very little fall (about 1 foot per mile) and lack the erosive power to form deep valleys. In addition, within about 1,000 years of exposure of the lake bed, Minnesota entered a period of extreme aridity that lasted until about 4,000 years ago, during which there was probably little development of valleys and drains, further slowing valley and drainage development in the flat landscape of northwestern Minnesota.

During the period of about 12,000 years ago to about 9,500 years ago, when the Red River watershed was covered by Glacial Lake Agassiz, lands in the current Minnesota River drainage were exposed to erosion. The relatively wet climate during this period and the increasing gradient of streams flowing into the deepening valley eroded by the Glacial River Warren caused early development of river valleys and delivery of alluvium to the major valleys in the Minnesota River drainage. When the northern outlets of Glacial Lake Agassiz were uncovered and the lake began to drain into Canada, the erosive and powerful flow of Glacial River Warren stopped rather abruptly. The river that succeeded Glacial River Warren, the Minnesota River, lacked the volume and energy to remove the sediment delivered by tributaries that plunge from rolling till plains into the deep valley. At the mouths of these streams, deltas blocked the flow of the Minnesota River and served as natural dams creating strings of natural lakes (Big Stone Lake, Marsh Lake, and Lac qui Parle, formed by deltas of the Whetstone, Pomme de Terre, and Lac qui Parle rivers, respectively, are present-day examples of this phenomenon). As the tributaries continued to deliver sediment to the valley, much of it settled in the quiet water of these lakes until alluvium covered the floor of the Minnesota River valley. High-energy floods have since shaped and reshaped the alluvium across the floor of the Minnesota River valley.

The deep-water deposits of Glacial Lake Agassiz provide a setting for FF communities that is rather distinctive in Minnesota. Where the valleys of the Red River and its tributaries are strongly winding and sufficiently deep to interrupt the spread of prairie fires (typically at least 25ft [8m] below the surrounding Agassiz lake plain), the rivers were lined in the past by gallery forests consisting almost entirely of terrace forest communities (i.e., Northern Terrace Forest [FFn57]). These FF communities occurred on patches of silty or clayey alluvium nearly encircled by hairpin river bends, which protected them from prairie fires. Outside bends in the rivers were not sufficiently protected from fire to support forest development and were occupied by prairie or fire-dependent woodland communities. Alluvial deposits along the Red River and the lower reaches of its tributary rivers tend to be well drained because of local relief within the channel, favoring the formation of terrace forest or even Mesic Hardwood Forest (MH) communities over the true floodplain forests characteristic of active floodplain sites, which have poorly drained soils. The unusual flooding regime of the Red River also favors development of terrace forest communities over true floodplain forest communities. Flooding along the Red River is caused largely by inflow of spring meltwater along upper reaches of the river while lower reaches to the north are still frozen or dammed with ice. In springs where snowmelt is more rapid in Minnesota and North Dakota than in Canada, the river backs up and spills for tens of miles beyond its banks across the flat Agassiz lake plain. The flooding regime along the Red River amounts to intermittent, low-energy ponding accompanied by the deposition of fine alluvium, not unlike the extreme backwaters of other rivers in Minnesota where terrace forest communities are present on occasionally flooded sites. The tributaries of the Red River that lie entirely within the Glacial Lake Agassiz basin, including the Roseau, Two Rivers, Tamarac, Snake, and Thief rivers, are sluggish, with shallow valleys and poorly developed channels. These rivers had only scattered areas of FF communities along their banks and instead were flanked mainly by prairies or fire-dependent woodlands. In contrast, tributaries with headwaters in the high moraines east of the Agassiz basin, including the Red Lake, Clearwater, Sand Hill, Wild Rice, Buffalo, and Otter Tail rivers, have sufficient fall and volume to have cut deeper, winding valleys across the deep-water sediments. These rivers often have galleries of FF communities much like the Red River. Most of these rivers also cut through the sandy, shallow-water deposits and beach ridges that ring the Agassiz basin. In these stretches, the valleys are deeper, tributaries are more common, the land is rolling and dissected, and bottomlands have at least some sandy alluvial features. According to the early surveyors, these stretches of river were continuously lined with forest. At present, terrace forest communities are most common along these stretches, although there are a few examples of true floodplain forest communities on sites with sufficient alluvium.

The landscape context of FF communities along the Minnesota River and its tributaries contrasts sharply with that of FF communities in the Red River drainage, primarily because the Minnesota River valley is so deeply incised into the landscape. The depth of the Minnesota River valley provides tributary streams with much greater energy than those in the Red River drainage. These streams have eroded deep valleys and deposited sediment in valley bottoms in a complex array of fluvial landforms. The large volumes of sediment deposited in the bottoms of the Minnesota River by the Glacial River Warren and afterward by tributaries of the Minnesota provide continuous habitat for FF communities as the river flows through the PPA Province, including floodplain forests on low, annually flooded alluvial bottoms and terrace forests on higher, occasionally flooded sites such as terraces and levees. Other river valleys in the watershed have more limited habitat for development of FF communities. Many of the tributaries of the Minnesota River are characterized by headwaters high in the Prairie Coteau region southwest of the Minnesota River or in moraines to the northeast of the river. These tributaries, including the Lac qui Parle, Redwood, Cottonwood, Pomme de Terre, and Chippewa rivers, erode down through the uplands of the Coteau and the moraines and then cross flat plains before falling rapidly through deep valleys just before they enter the Minnesota. The headwater stretches of these rivers have deep valleys but limited amounts of alluvium, enabling development of terrace forests but not true floodplain forests. Where these rivers cross the flat plains, often in broad glacial meltwater channels, the channels are shallow, and prairies and marshes historically adjoined the rivers. Although the early surveyors described scattered timber and narrow bands of cottonwood, willow, ash, elm, and box elder along these stretches, it is unlikely that these characteristic FF trees formed large forest stands. Where these rivers fall to the Minnesota River, their valleys are deep, with alluvial bottoms that provide habitat for either terrace or true floodplain communities. In the southeastern corner of the PPA Province, the tributaries of the Minnesota River drain what is essentially the basin of Glacial Lake Minnesota. These rivers, including the Blue Earth, Maple, Cobb, and Le Sueur, form a well-developed, fan-shaped system of drainages cut well into the old lake bed. Because of this dissection, forests were historically rather common in the region, with FF communities lining the lower valleys of these rivers and occurring intermittently upstream as the valleys become shallower and offered less protection from prairie wildfires.

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). Communities of the FFn Region are present in the TAP Province and the eastern edge of the RRV in the PPA Province, where rivers course through the sandier, shallow-water deposits of the Glacial Lake Agassiz basin. Communities of the FFs Region are present in the PPA Province in the Minnesota River drainage and in the headwaters of rivers tributary to the Mississippi and Missouri rivers in the CGP. FF communities along the Red River and the portions of its tributaries that traverse the Glacial Lake Agassiz basin in northwestern Minnesota are currently included in the FFn Region. However, there were few vegetation samples in this area suitable for inclusion in development of the classification presented in this field guide. The distinct character of the Red River valley makes it likely that these FF communities are more similar to floodplain forests to the northwest in Manitoba than to FF communities to the east in northern Minnesota (i.e., FFn communities). If this is supported by collection and analysis of additional vegetation samples, FF communities in the LAP and much of the RRV may be placed in a separate, northwestern floristic region within the FF System, analogous to northwestern floristic regions in the Fire-Dependent Forest/Woodland (FD) and MH systems.

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. Because of this, FFn communities are more likely than FFs communities to occur in proximity to plant communities from a variety of other systems and consequently are more likely to contain plant species characteristic of these systems. For example, plant species characteristic of WF communities are common in FFn communities in the TAP Province because WF communities are often present in the province on river terraces cut into fresh glacial drift. Among these species are sweet-scented bedstraw *(Galium triflorum)*, black ash, highbush cranberry *(Viburnum trilobum)*, and side-flowering aster *(Aster lateriflorus)*. Another group of species more common in FFn than FFs communities include species characteristic of FD communities, which commonly occurred as a buffer between northern riparian forests and prairies. Among these species are bur oak, Canada mayflower *(Maianthemum canadense)*, beaked hazelnut *(Corylus cornuta)*, and American hazelnut *(C. americana)*. A surprising number of plants diagnostic for FFn relative to FFs communities have their highest presence in Minnesota in MH communities. MH communities are not common in the PPA and TAP provinces, so the presence of characteristic MH species in FFn communities is not likely to be related to proximity with MH communities. It is likely that these species have become increasingly abundant in the region as a result of fire suppression, including species such as Clayton's sweet cicely *(Osmorhiza claytonii)*, chokecherry *(Prunus virginiana)*, and early meadow-rue *(Thalictrum dioicum)*. Of the species that help to separate FFn from FFs communities, only ostrich fern, nannyberry *(Viburnum lentago)*, starry false Solomon's seal *(Smilacina stellata)*, starry sedge *(Carex rosea)*, prickly ash *(Zanthoxylum americanum)*, common hops *(Humulus lupulus)*, and tall scouring rush *(Equisetum hyemale)* have their peak presence in the FF System.

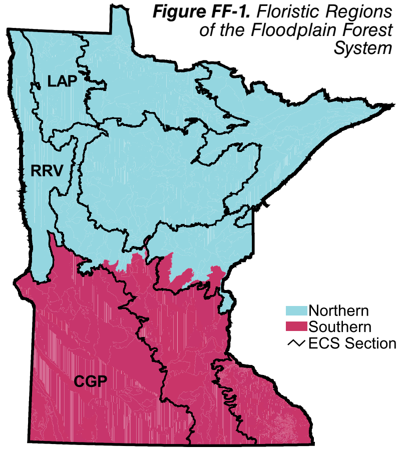

Figure FF-1. *Floristic Regions of the Floodplain Forest System*

Plant species with high fidelity for FFs relative to FFn communities are listed in Table FF-2. Nearly all of the plants in this table are diagnostic for FFs communities because of their affinity for extensive alluvial bottoms, which are more common in the FFs than the FFn region. FFs communities are characterized by a rather large group of species that reach their peak presence in the FF System, including plants such as silver maple, Ontario aster *(Aster ontarionis)*, hackberry, clearweed *(Pilea* spp.), white grass *(Leersia virginica)*, ambiguous sedge *(Carex amphibola)*, and greenbrier. All of these plants have much higher presence in FF communities than in other systems, making them rather good indicators of the FF System in general as well as indicators of FFs relative to FFn communities. FFs communities are also characterized by higher presence of species typical of marsh, meadow, and prairie communities, including bur marigold or beggarticks *(Bidens* spp.*)*, tall bellflower *(Campanula americana)*, rice cut grass *(Leersia oryzoides)*, woundwort *(Stachys palustris)*, and fragrant cyperus *(Cyperus odoratus)*. Although historical descriptions of bottomlands in the FFs Region mention marshes, meadows, and prairies mixed with FF communities, these open communities are now infrequent in bottomlands in the PPA Province, in part because they have

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

Region	Affinity	Common Name	Scientific Name	frequency (%) FFn	FFs
Northern Floristic Region	Fire-Dependent Forest /Woodland Affinity	Bur oak (U)	*Quercus macrocarpa*	52	7
		Canada mayflower	*Maianthemum canadense*	41	-
		Beaked hazelnut	*Corylus cornuta*	35	-
		American hazelnut	*Corylus americana*	29	-
		Prickly or smooth wild rose	*Rosa acicularis* or *R. blanda*	29	-
		Poison ivy	*Toxicodendron rydbergii*	29	-
		Columbine	*Aquilegia canadensis*	23	-
		Gray dogwood	*Cornus racemosa*	23	-
		Quaking aspen (U)	*Populus tremuloides*	23	-
		Common strawberry	*Fragaria virginiana*	23	-
		Lindley's aster	*Aster ciliolatus*	17	-
		Snowberry or wolfberry*	*Symphoricarpos* spp.	17	-
		Tall meadow-rue	*Thalictrum dasycarpum*	52	-
		Canada anemone	*Anemone canadensis*	41	-
		Northern bedstraw	*Galium boreale*	23	-
		Giant goldenrod	*Solidago gigantea*	17	-
	Floodplain Forest Affinity	Ostrich fern	*Matteuccia struthiopteris*	64	-
		Nannyberry	*Viburnum lentago*	47	-
		Starry false Solomon's seal	*Smilacina stellata*	41	-
		Starry sedge	*Carex rosea*	23	-
		Prickly ash	*Zanthoxylum americanum*	23	-
		Common hops	*Humulus lupulus*	17	-
		Tall scouring rush	*Equisetum hyemale*	17	-
	Mesic Hardwood Forest Affinity	Clayton's sweet cicely	*Osmorhiza claytonii*	58	7
		Chokecherry	*Prunus virginiana*	58	7
		Early meadow-rue	*Thalictrum dioicum*	52	7
		Red baneberry	*Actaea rubra*	41	-
		Hog peanut	*Amphicarpaea bracteata*	35	7
		Basswood (U)	*Tilia americana*	35	7
		Wild sarsaparilla	*Aralia nudicaulis*	29	-
		Dewey's sedge	*Carex deweyana*	29	-
		Pennsylvania sedge	*Carex pensylvanica*	29	-
		Bloodroot	*Sanguinaria canadensis*	29	-
		Downy arrowwood	*Viburnum rafinesquianum*	23	-
		Wood anemone	*Anemone quinquefolia*	17	-
		Pale bellwort	*Uvularia sessilifolia*	17	-
		Large-flowered bellwort	*Uvularia grandiflora*	17	-
		Lopseed	*Phryma leptostachya*	17	-
	Wet Forest Affinity	Sweet-scented bedstraw	*Galium triflorum*	64	7
		Black ash (U)	*Fraxinus nigra*	52	-
		Highbush cranberry	*Viburnum trilobum*	41	-
		Side-flowering aster	*Aster lateriflorus*	35	-
		Nodding trillium	*Trillium cernuum*	35	-
		Bladder sedge	*Carex intumescens*	29	-
		Jack-in-the-pulpit	*Arisaema triphyllum*	29	-
		Meadow horsetail	*Equisetum pratense*	23	-
		Philadelphia fleabane	*Erigeron philadelphicus*	23	-
		Dwarf raspberry	*Rubus pubescens*	23	-
		Spinulose shield fern	*Dryopteris carthusiana*	17	-
		Balsam popular (U)	*Populus balsamifera*	17	-

(U) = understory tree *Snowberry or wolfberry (*Symphoricarpos albus* or *S. occidentalis*)

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

		Common Name	Scientific Name	frequency (%) FFn	FFs
Southern Floristic Region	Floodplain Forest Affinity	Silver maple (U)	*Acer saccharinum*	5	69
		Ontario aster	*Aster ontarionis*	-	61
		Hackberry (U)	*Celtis occidentalis*	5	53
		Clearweed	*Pilea* spp.	5	53
		White grass	*Leersia virginica*	-	46
		Ambiguous sedge	*Carex amphibola*	-	30
		Greenbrier	*Smilax tamnoides*	-	30
		White snakeroot	*Eupatorium rugosum*	-	23
		Cleavers	*Galium aparine*	-	23
		Blue monkey flower	*Mimulus ringens*	-	15
		Aniseroot	*Osmorhiza longistylis*	-	15
		Blue phlox	*Phlox divaricata*	-	15
		Gregarious black snakeroot	*Sanicula gregaria*	-	15
		Broad-glumed brome	*Bromus altissimus*	-	7
		Maple-leaved goosefoot	*Chenopodium simplex*	-	7
		Woodland goosefoot	*Chenopodium standleyanum*	-	7
		False rue anemone	*Enemion biternatum*	-	7
		Southern or yellow wood sorrel	*Oxalis dillenii* or *O. stricta*	-	7
		Lady's thumb	*Polygonum persicaria*	-	7
		Peach-leaved willow	*Salix amygdaloides*	-	7
		Black willow	*Salix nigra*	-	7
		Canadian black snakeroot	*Sanicula canadensis*	-	7
	Marsh, Meadow & Prairie Affinity	Bur marigold and beggarticks	*Bidens* spp.	5	38
		Tall bellflower	*Campanula americana*	-	23
		Rice cut grass	*Leersia oryzoides*	-	15
		Woundwort	*Stachys palustris*	-	15
		Fragrant cyperus	*Cyperus odoratus*	-	7
		Germander	*Teucrium canadense*	-	7
		Sandbar willow	*Salix exigua*	-	7
		Tall thistle	*Cirsium altissimum*	-	7
		Witch grass	*Panicum capillare*	-	7
		Virginia ground cherry	*Physalis virginiana*	-	7
		Autumn sneezeweed	*Helenium autumnale*	-	7
	Other	Mad dog skullcap	*Scutellaria lateriflora*	-	38
		Bitternut hickory (U)	*Carya cordiformis*	-	7
		Sharp-lobed hepatica	*Anemone acutiloba*	-	7
		Giant Solomon's seal	*Polygonatum biflorum*	-	7
		Red-berried elder	*Sambucus racemosa*	-	7

(U) = understory tree

been converted to fields and in part because they have been flooded by dams. The continued presence of marsh, meadow, and prairie species in FF communities is likely from persistence of these species in small openings in forests, along treeless overflow channels, on shorelines, and on sand bars in river bottomlands. FFs communities are also more likely to have annual species such as clearweed, cleavers, maple-leaved and woodland goosefoots *(Chenopodium simplex* and *C. standleyanum)*, lady's thumb *(Polygonum persicaria)*, bur marigold and beggarticks, fragrant cyperus *(Cyperus odoratus)*, and witch grass *(Panicum capillare)*, possibly because the bottomlands of rivers in the FFs Region experience more flooding and erosion than FFn rivers, creating increased areas of the ruderal habitats favorable for annual plants.