



photo by N.E. Aaseng MN DNR

Kettle River, Pine County, MN

General Description

Floodplain Forest (FF) communities are present on occasionally or annually flooded sites on terraces and floodplains of streams and rivers. FF communities are dominated by deciduous trees tolerant of saturated soils, prolonged inundation, and frequent erosion or deposition of sediment. Common species include characteristic floodplain trees such as silver maple, American elm, cottonwood, and black willow, and wet and mesic forest trees such as black ash, green ash, basswood, and white spruce. The understory often is 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 ostrich fern (*Matteuccia struthiopteris*). Pools or mucky depressions in old channels are characteristic of more actively flooded sites. FF communities are associated with streams and rivers throughout the Laurentian Mixed Forest (LMF) Province but are generally not as extensive as those associated with rivers in the Eastern Broadleaf Forest or Prairie Parkland Provinces, which have larger rivers with broader floodplains.

Flooding along streams and rivers is fed by surface flow as well as base flow that enters stream and river beds as groundwater. Most of the surface flow reaches streams or rivers over frozen or saturated ground in the spring, initiating flooding in the lower reaches of the watershed. After spring flooding, base flow maintains river levels and stable, high water tables on 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 or physiological stresses, especially lack of the oxygen necessary for plant metabolism and decomposition of litter. Although the annual pattern of flooding is predictable, the timing, duration, and energy vary from year to year. Flooding causes a rather constant shifting of sediment and features such as point-bars, meander scrolls, levees, and backwaters that control where understory plants occur in the community.

Plant Adaptations

Among forested 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 a variety



of adaptations and strategies for withstanding inundation and sedimentation. All are good colonizers and 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 dominant trees on regularly and severely flooded sites—silver maple, American elm, cottonwood, and black willow—are all capable of rapid growth and root sprouting. All are extremely resistant to physical battering caused mostly by spring ice floes. Older trees are often multiple-stemmed, having re-sprouted from damaged main trunks. It is also common to see ice-scarred trunks with little more than a few inches of intact cambium supporting a full, live crown. Trees limited to upland habitats generally have seeds with mechanisms that delay germination until the next advantageous growing period, usually the following spring. In floodplain settings, the dominant species shed seeds that germinate immediately, usually early in the growing season after floodwaters have receded, leaving exposed mineral soil. These seeds survive well in pools but can die within hours if desiccated. Carpets of germinating tree seedlings (up to a million per acre) are a common feature of floodplains by late summer and fall, but in spite of this, it is exceedingly rare to see established seedlings and saplings beneath the canopy. The cover of established seedlings and saplings in FF communities is one-quarter to one-half that of any other forested System in Minnesota. Successful recruitment of seedlings and saplings occurs most often when the seedlings are embedded within thickets of sandbar willow (*Salix exigua*) or cottonwood.

Other strategies for dealing with inundation and sedimentation include survival during flooding as seeds or vegetative propagules. Nearly 10% of the plants recorded in FF plots 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 understory plants, including bulb-bearing water hemlock (*Cicuta bulbifera*), knotty rush (*Juncus nodosus*), and river bulrush (*Scirpus fluviatilis*), are capable of vegetative reproduction via bulbils, tubers, or corms that detach from the parent plant, float downstream, and root where they become stranded. Other species, such as creeping lovegrass (*Eragrostis hypnoides*), grow prostrate on mud flats, 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 highly dissected aquatic leaves when submerged and “normal” leaves upon emergence. Many species develop adventitious roots, an adaptation to either standing water or siltation. 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 previous soil-surface levels.

The most important physiological stress on plants in FF communities is lack of oxygen for plant respiration. During the flood stage, anoxia affects above-ground portions of woody plants as well as their roots. Woody vegetation is least 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 and why the perennial understory vegetation in FF communities develops much later than in surrounding terrestrial forests. Equally important, floodplains and river terraces have persistently high water tables, a property shared with Wet Forest and Wet Meadow/Carr communities. Deep soil layers are continuously saturated, anaerobic, and chemically reducing. Rooting in these layers is limited to plants that can supply oxygen to their roots, mostly by means of specialized gas-conducting cells (aerenchyma).



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, FF communities produce much more organic matter, which is augmented by 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 organic matter deposited on floodplains is processed 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. Any unprocessed organic material on the soil surface tends to be washed away by subsequent floods. Therefore, FF communities, unlike upland forests, have no bank or reserves of organic matter.

Floristic Regions and Variation Within the FF System

Based on geographic variation in species composition, FF communities in Minnesota are divided into two "floristic" regions: the Northern Floristic (FFn) Region and the Southern Floristic (FFs) Region (Fig. FF-1). The FFn Region covers most of the northern half of Minnesota, including the LMF Province. The FFs Region covers the southern half of Minnesota. FFs communities are present only occasionally in the LMF Province.

FFn communities are divided into two classes based on variation in flooding regime and the effect of this variation on community composition. Communities on sites affected by annual episodes of severe flooding are classified as Northern Floodplain Forests (FFn67). Such sites typically include low areas on true river floodplains that are flooded annually in the spring, experience devastating summer flooding, are not exposed until late in the growing season, are sandy, lack surface organic material, and have rooting zones closer to the permanent water table. Communities on sites subjected only to occasional flooding are classified as Northern Terrace Forests (FFn57). These sites typically include river terraces above normal flood stage or riparian areas along smaller streams or rivers that lack true floodplains. Northern Terrace Forests

also develop on higher sites on fluted river floodplains characterized by elongated low channels and elevated mounds. In contrast to sites that support Northern Floodplain Forests, sites where Northern Terrace Forests develop are flooded only occasionally in the spring, are exposed early in the growing season, are silty, can have thick deposits of surface organic matter, and are well above the permanent water table.

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

