CHAPTER 9

Floodplain Forests

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The geological definition of a floodplain as it relates to forest communities is *that area of a river valley covered with materials deposited by floods* (Maddock 1976). Forests that grow on the floodplain are called "floodplain forests" to differentiate them from upland forests. Floodplain forests are structurally complex environments that generally include three tiers of plants. Most often the ground cover is herbaceous plants or small tree seedlings; the understory is composed of small tree species, saplings, and shrubs; and the canopy consists of mature trees that dominate the community.

The ecosystem as a whole benefits from floodplain forests. Besides serving as a rich habitat for wildlife and fish during floods (Harris and Gosselink 1990; Taylor et al. 1990), the forests reduce soil erosion, improve water quality, and provide a pleasing scenic and recreational landscape. Leaf fall from floodplain trees in the Upper Mississippi River System (UMRS) is a significant source of organic matter for secondary aquatic production (Grubaugh and Anderson 1989). Floodplain forests support a larger number of avian species than other habitats on the Upper Mississippi River (Eileen Kirsch, USGS Upper Mississippi Science Center, La Crosse, Wisconsin, personal communication; Figure 9-1). In addition, these forests are essential habitat for wood ducks, hooded mergansers, prothonotary warblers, and red-shouldered hawks (Emlen et al. 1986; Knutson 1995).

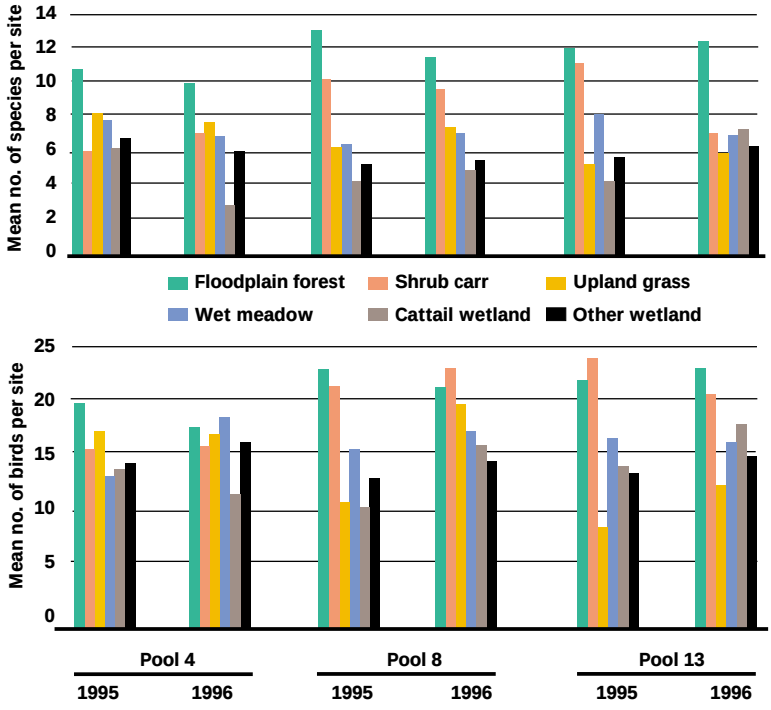

Figure 9-1. **Distribution of bird species among several vegetation communities in Pools 4, 8, and 13 in 1995 and 1996 reveals that the highest numbers of species and large numbers of birds were associated with floodplain forests during spring migrations (Source: Eileen Kirsch, USGS Upper Mississippi Science Center, La Crosse, Wisconsin).**

Community Types

Major community types in the UMRS floodplain forests include willow, cottonwood, mixed silver maple, and oak-hickory. Willow communities are dominated by black willow and are present on channel borders and along lake margins and point bars where other species often cannot establish themselves because of their inability to survive in the wet, hydrologically variable shoreline environment.

Cottonwood communities occur on newly

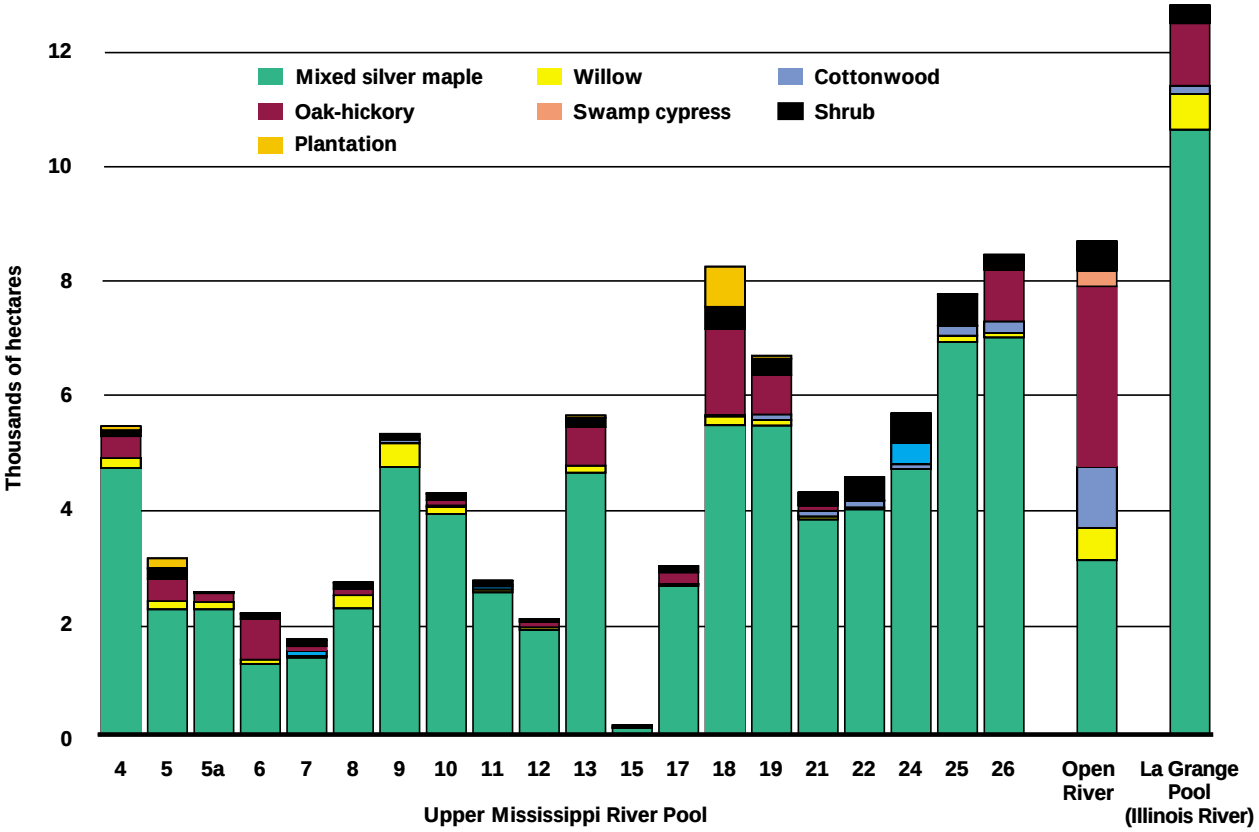

Figure 9-2. **Forest community distribution throughout the Upper Mississippi River System (UMRS) in 1989 reveals the dominance (80%) of mixed silver maple communities throughout the pooled reaches of the UMRS. Oak-hickory (10%) is the next-most abundant. The proportion of oak-hickory, cottonwood, and maple in the Open River (Unimpounded Reach) differs markedly from the impounded reaches; swamp cypress communities are found only in this reach because of the warmer climate.**

exposed and moist sandy substrates and are dominated by eastern cottonwood. Many floodplain species (of which silver maple is one of the most abundant) survive in the understory of mature cottonwood stands.

Mixed silver maple communities can emerge from beneath a canopy of mature willow and cottonwood communities or establish themselves as a pioneer species on newly formed sites. The mixed silver maple community is considered a late-successional community type on annually or periodically flooded sites. While silver maple generally dominates these communities, numerous possible codominant species include eastern cottonwood, elms, green ash, and river birch.

Unless the sites become well-drained, silver maple, green ash, elms, and river birch are perpetuated through successful regeneration in the understory. There is concern, however, that recent regeneration will not maintain the present level of forest diversity, but it will take many years to assess the change.

Oak-hickory communities prevail on well-drained and often higher grounds or terraces. They are dominated by pin oak, bur oak, and swamp white oak. Shagbark hickory, shellbark hickory, bitternut hickory, and hackberry all are common associates.

The floodplain forests in the UMRS also include swamp cypress communities, plantations, and shrub communities. Swamp cypress is found only at the southern terminus of the Upper Mississippi River in southwestern Illinois, where it is dominated by bald cypress. Plantations in the UMRS grow white pine, red pine, and jack pines. Shrub communities are woody terrestrial plants 16 feet (5 m) or less in height and consisting of frequent multiple stems.

Present Status

Acreage

Using 1989 satellite data, 303,933 acres (123,000 ha) of floodplain forests were

identified as covering 18.6 percent of the land (excluding water; 14.3 percent of the landscape [including water]) in the Upper Mississippi River Valley. Also, 78,467 acres (32,000 ha) of floodplain forests were identified as covering 17.6 percent of the land (14.3 percent of the landscape) in the Illinois River Valley (see Figure 3-9). The data also indicate that forests in the UMRS are unevenly distributed along floodplain areas. Forests are more often present in periodically flooded lands adjacent to the rivers. They are less often present in areas that are rarely flooded, such as terraces or levee protected land. Despite a reduction in acreage over the past two centuries, the floodplain forests in the UMRS remain a vital component of the river ecosystem by serving the needs of fish, wildlife, and human communities.

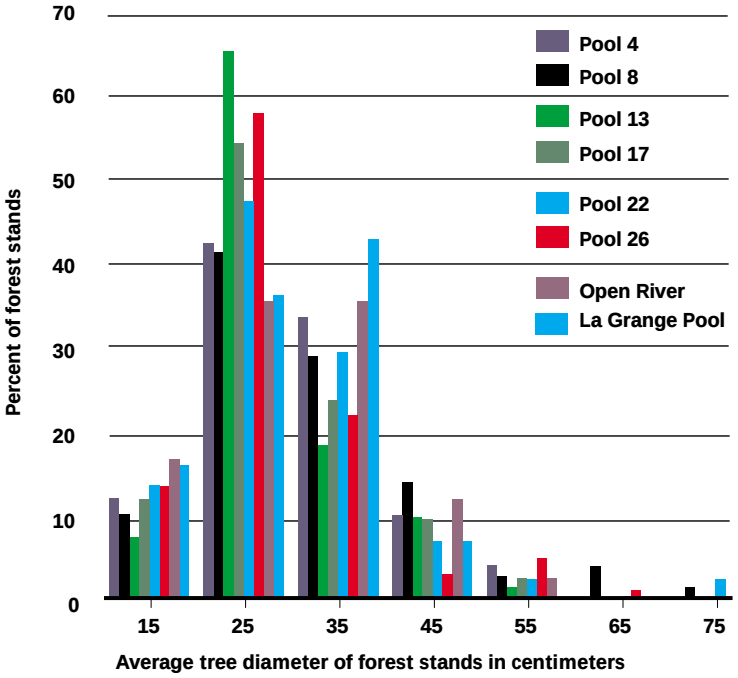

Figure 9-3. **Research on forest stand size distribution reveals a large cluster of trees in the 8- to 11-inch (20- to 29-cm) size class, indicating that most forests in the Upper Mississippi River System are of similar age.**

Composition

Mixed silver maple communities constitute the majority of the floodplain forests in the UMRS (Figure 9-2). Approximate composition of UMRS floodplain forests is 80 percent mixed silver maple, 10 percent oak-hickory, 5 percent willow and cottonwood combined, and 5 percent other communities.

The postsettlement decline of mast-producing oak-hickory communities and early successional willow and cottonwood communities has been extensive (Yin et al. 1997). In most cases, they have been replaced by silver maple communities (Yin et al. 1997). The acreage of oak-hickory communities was reduced drastically because the rarely flooded, well-drained terraces they occupied were more desirable for cultivation and because the wood was valued for fuel and building material. In many areas, a decrease in willow and cottonwood communities came about because these communities require specific flooding and drying cycles and new depositional soil to reproduce—events that do not occur regularly since lock and dam construction. Nonetheless, in some backwater lake areas regeneration of willows is successful.

Structure

To display the size-class distribution of trees in floodplain forests, stand size is measured as the average diameter of all the trees greater than 4 inches (10 cm) in diameter at breast height. Young stands ranging in size from 4 to 7.5 inches (10 to 19 cm) constitute less than 20 percent of the population (Figure 9-3). In contrast, 35 to 65 percent of the stands, depending on the river reach, belong to the 8 to 12 inch (20 to 29 cm) size class. The rest of the stands contain even larger trees. Silver maple or eastern cottonwood trees usually are the largest species in the community. The floodplain forests along the Upper Mississippi, Illinois, and Missouri Rivers appear to be similar in average tree size, average basal area, density, and diversity (Figure 9-4).

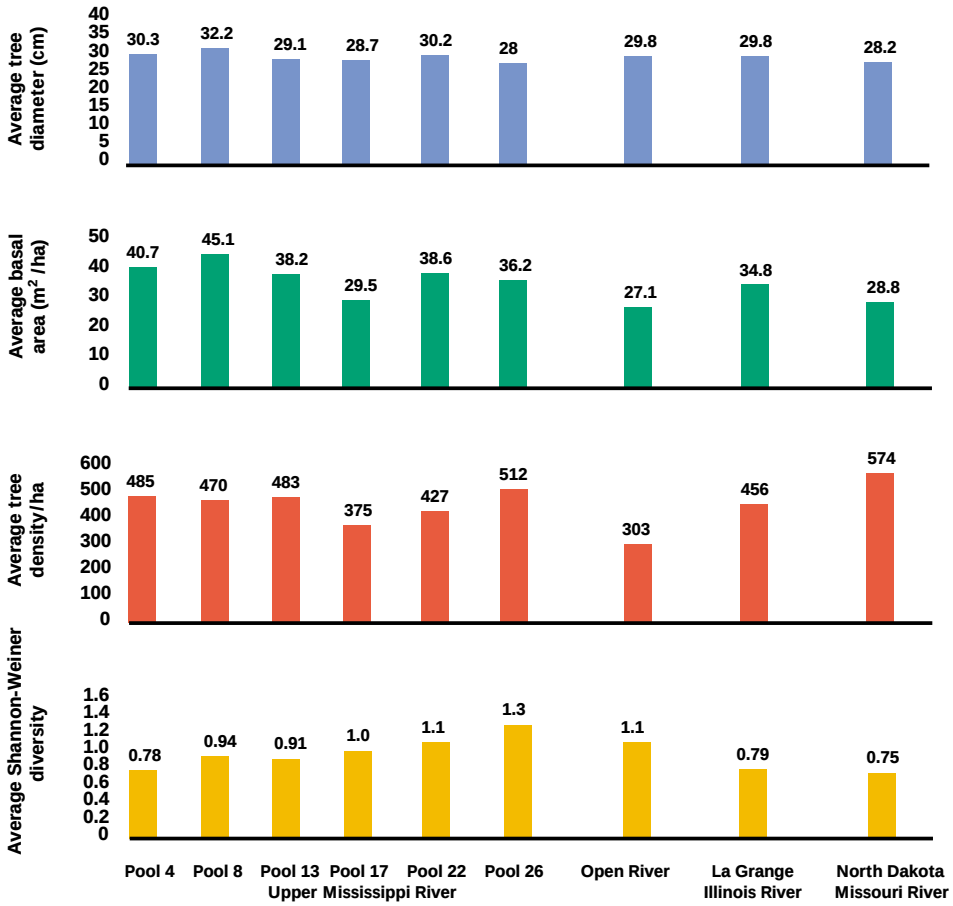

Figure 9-4. **Average tree size, average basal area, density, and species diversity are consistent throughout the Upper Mississippi River System (UMRS), providing evidence that forest communities in the UMRS share similarities.**

Floodplain forest acreage decreased rapidly in the nineteenth century because of the conversion to agricultural land and the harvesting of trees for fuel wood and lumber.

Change Over Time and the Flood of 1993

The modern forests represent only a small portion of presettlement floodplain forests. The 56 percent of the landscape covered by forests at the confluence of the Illinois and Mississippi Rivers in 1817 was reduced to 35 percent by 1975 (Nelson et al. 1994). Almost 190 years ago, forests in the middle Mississippi floodplain covered 71.4 percent of the landscape in a 63-mile (102-km) reach in southwestern Illinois; this cover was reduced to 18.3 percent of the landscape by 1989 (Yin et al. 1997; Figure 9-5).

Floodplain forest acreage decreased rapidly in the nineteenth century (Telford 1926) because of the conversion to agricultural land and the harvesting of trees for fuel wood and lumber. This forest acreage continues to decrease in the twentieth century, but at a slower rate (Figures 9-5 and 9-6).

More recently, a large portion of floodplain forest areas in the UMRS are recovering from natural disturbance caused by the great Midwest flood in 1993 (Yin et al. 1994; see Chapter 15). Floodplain forests can endure brief inundation, but prolonged inundation can be deadly. While floodplain forests above Pool 13 experienced slight mortality, that mortality escalated sharply in downstream reaches as the flood continued. In Pool 26, 37.2 percent of trees 4 inches (10 cm) or greater in diameter and 80.1 percent of trees between 0.8 and 3.9 inches (2.0 and 9.9 cm) in diameter were killed. Mortality rates were positively correlated with flood duration and negatively correlated with the diameter of the trees (Figure 9-7). Hackberry and

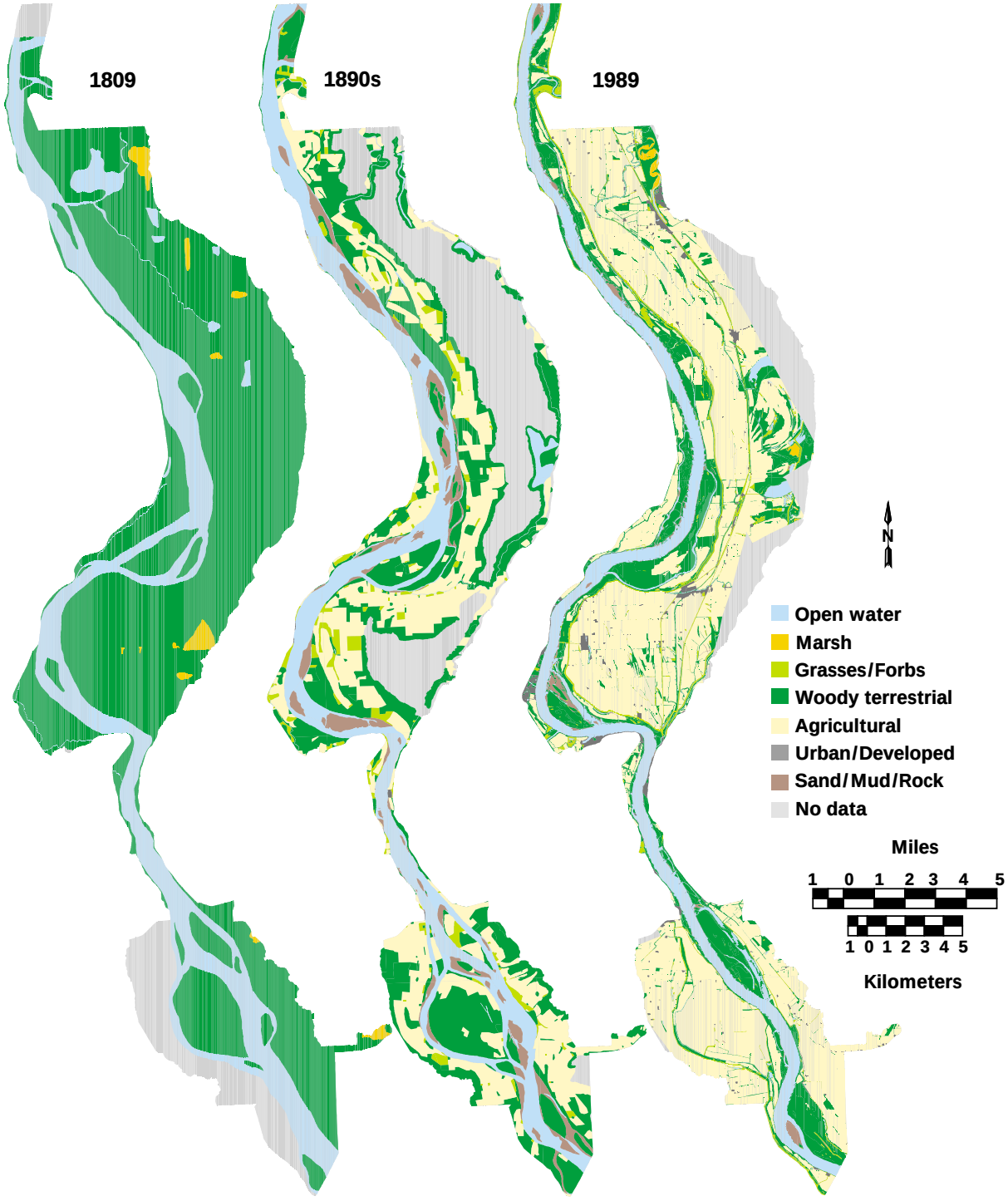

Figure 9-5. **An examination of land cover for the 1809 period recreated using land survey records compiled after the Louisiana Purchase reveals the dominance of the woody terrestrial class (forests). Early agricultural clearing and forest harvesting changed the landscape considerably by the time of the Mississippi River Basin Commission Survey took place in the 1890s. Levee construction and drainage projects continued to change the landscape through the twentieth century until forests were restricted mainly to the riverward side of set-back levees (Source: USGS Environmental Management Technical Center, Onalaska, Wisconsin).**

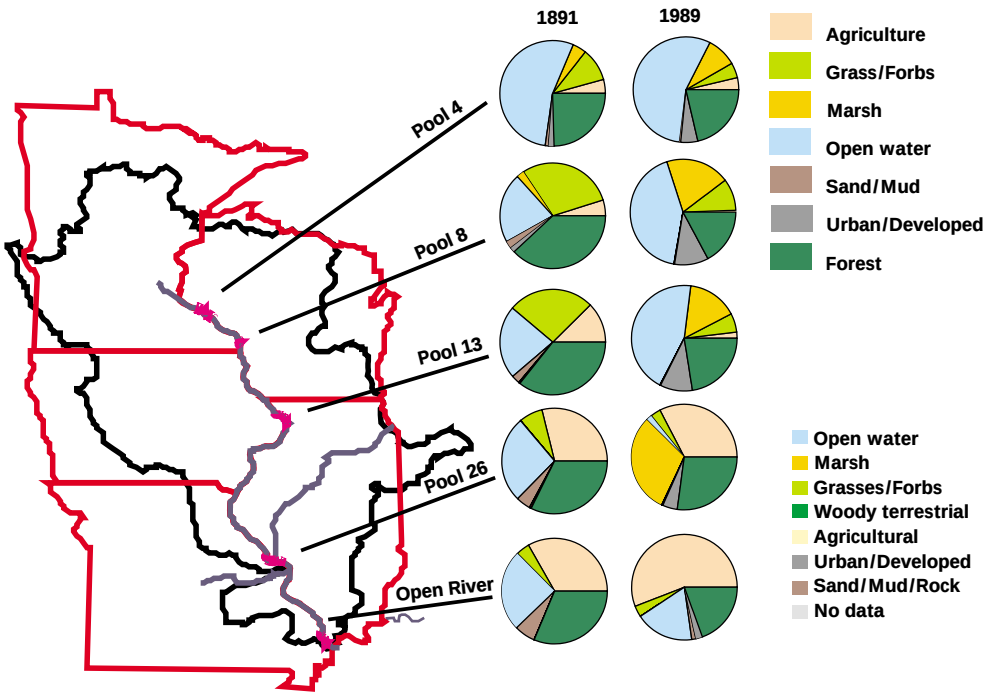

Figure 9-6 **Land cover and land use change between 1891 and 1989 (Source: Mary Craig, USGS Environmental Management Technical Center, Onalaska, Wisconsin).**

The flood disturbance of 1993 assures that the aerial extent of willow and cottonwood communities will not continue to decline in the Unimpounded Reach for 50 years.

pin oak were the two species most severely affected.

Trends of succession in eight reaches of the UMRS before and after the 1993 flood indicate two different futures for early successional willow and cottonwood communities between the Impounded and the Unimpounded reaches (Figure 9-8). Acreage of willow and cottonwood communities is predicted to decline further in the impounded reaches, but remain at the same level in the Unimpounded Reach. Before the flood, willow and cottonwood were regenerating poorly and declining in all eight reaches. After the flood, willow and cottonwood seedlings occurred abundantly in the Unimpounded Reach. Patches of willow and cottonwood seedlings have since colonized openings created by the flood and show rapid growth. The flood disturbance of 1993 assures that the aerial extent of willow and cottonwood communities will not continue to decline in the Unimpounded Reach for 50 years (Yin 1998).

By contrast, in the seven reaches where the river's flow is regulated by navigation dams, willow and cottonwood communities did not regenerate vigorously after the flood. It is unclear why these specific floodplain forest communities regenerated well in the Unimpounded Reach but poorly in Pool 26, even though both reaches were equally disturbed. What is clear, however, is that willow and cottonwood communities in the impounded reaches will decline further in the future unless other management actions are taken.

Discussion

Construction of river-training structures such as levees, dams, dikes, and revetments altered the fluvial-geomorphologic characteristics of the UMRS. As a result, the river environment today differs markedly from that of two centuries ago. Although we know that river-training structures affected the quantity and diversity of the floodplain forests, we unfortunately do not know the exact extent of those effects. Some of the uncertainty is because logging and agricultural conversion of floodplain forests was happening at the same time as construction

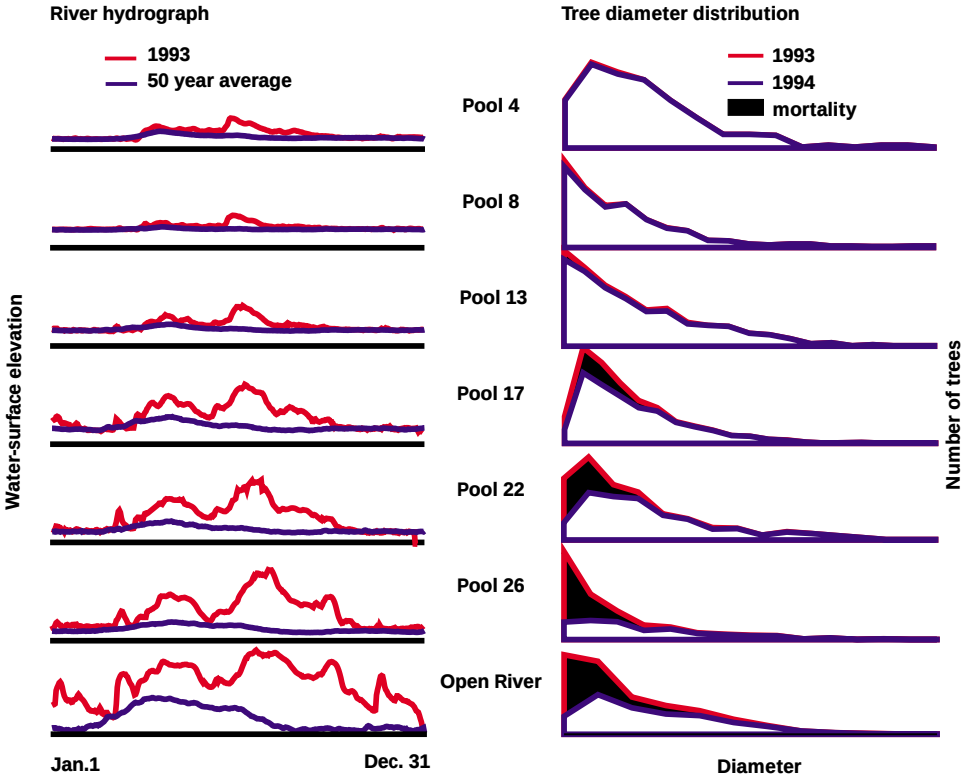

Figure 9-7. **These 1993 hydrographs illustrate differences in flood magnitude and duration throughout the Upper Mississippi River System. Tree mortality (right) correlated positively with flood duration (left) and correlated negatively with size, showing that in the Flood of 1993 more trees were killed in the southern reaches and smaller trees suffered the most.**

of river-training structures. Additional work is needed to more precisely determine the contributions of each factor.

Finally, many of the present UMRS woodlands emerged from abandoned cropland acquired by the Federal government during development of the navigation system. These woodlands contain fewer species and have fewer oaks and hickories proportionally than presettlement floodplain forests (Nelson et al. 1994; Yin et al. 1997).

Information Needs

Woodlands of the UMRS need to be reevaluated for their potential to support oaks and hickories again and to determine whether oaks and hickories can recover through natural regeneration. Early successional willow and cottonwood communities can be promoted by creating openings inside mixed silver maple communities (such as occurs when an area is logged for timber) in the impounded reaches. However, the optimal timing and stand size needs to be determined through more detailed experimentation (Randy Urich, USACE, St. Paul, Minnesota, personal communication). Above all, it is essential to know how the life cycles of individual tree species interact with the fluvial geomorphologic processes of the rivers.

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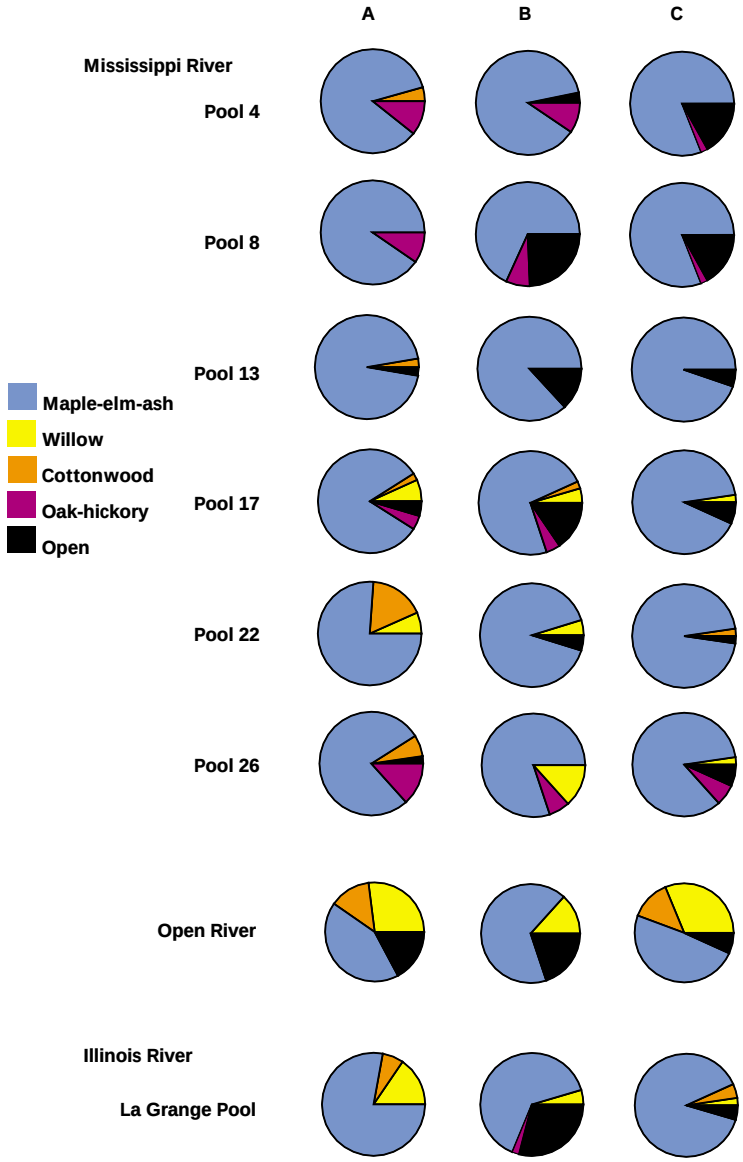

Figure 9-8. **Successional trends in floodplain forest species composition were demonstrated by community change after extreme floods in 1993. Column A represents mature trees present prior to flooding, Column B represents seedlings present prior to the flood, and Column C shows sapling composition in 1995, 2 years after the flood. Mixed maple forests likely will continue to dominate forest types in the pooled reaches, but the Open River (Unimpounded Reach) had greater regeneration of cottonwood and willow communities (Source: Long Term Resource Monitoring Program).**

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