Upper Mississippi and Illinois River Floodplain Forests

Desired Future and Recommended Actions

UPPER MISSISSIPPI RIVER CONSERVATION COMMITTEE

September 2002

Silver maple trees surrounded by high water in Mississippi River Pool 11 near Guttenberg, IA. (U.S. Army Corps of Engineers.)

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Compiled by: **The UMRCC Wildlife Technical Section**
Editors: **Randy Urich, Gary Swenson and Eric Nelson**

Front Cover Photos Courtesy of: **U.S. Army Corps of Engineers (aerial scene), Jon Stravers (forest scene), and Ray Marinan (leaf on water).**

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North River bottomland hardwood stand near Hannibal, MO. (U.S. Army Corps of Engineers.)

Executive Summary

Recent documents such as the Long Term Resource Monitoring Program's "Ecological Status and Trends of the Upper Mississippi River System 1998" and the Upper Mississippi River Conservation Committee's "A River That Works and a Working River," have noted the significance of the Upper Mississippi River ecosystem and acknowledged the importance of the navigation infrastructure that is operated and maintained by the U.S. Army Corps of Engineers.

Mississippi River Floodplain Forest (Courtesy of Jon Stravers.)

This document speaks to the forested component of the Upper Mississippi River System. These forests are very important habitat for migratory and nesting birds as well as other wildlife. They have been significantly affected by man's use and manmade modifications of the Mississippi and Illinois Rivers and their floodplains.

While the existing forest may appear to casual observers to be natural and pristine, some of the important processes that determine forest growth and survival have become artificial and are much harsher than pre-settlement conditions.

Those who are responsible for stewardship of these forests need to recognize the changes that have occurred in recent history, and make management decisions based on the type of forest that will develop and flourish on this altered landscape.

This document reviews some of the past practices that have shaped the nature of the existing forests, describes processes currently underway, and recommends management actions to shape the future of Mississippi and Illinois River forests.

Lock and Dam 5A, Winona, MN. (U.S. Army Corps of Engineers.)

Section I. Introduction

This report highlights the ecological importance of floodplain forests in the Upper Mississippi and Illinois Rivers and provides management recommendations to achieve desired future conditions of those forests. Members of the Upper Mississippi River Conservation Committee (UMRCC), Wildlife Technical Section, and Vegetation Ad Hoc Committee compiled this report.

This document targets river managers, agency administrators, and the interested public. Audiences can be assured that this forest vision represents a unified position of UMRCC river managers, foresters and biologists. It is a reference anyone may use in identifying UMRCC's desired future conditions of the Upper Mississippi River System (UMRS) forest. Managers will be able to incorporate stated goals into their management plans. In addition, the authors urge agency administrators to provide funding and initiate programs that will enhance the floodplain forest resource. Finally, the interested public will be able to view this UMRCC vision, provide input and then support future management of the UMRS floodplain forests. Recommendations are essentially a call to action toward the protection and enhancement of our huge, yet deteriorating forest resource.

Forested islands in Polander Lake, Mississippi River Pool 5A. (U.S. Army Corps of Engineers.)

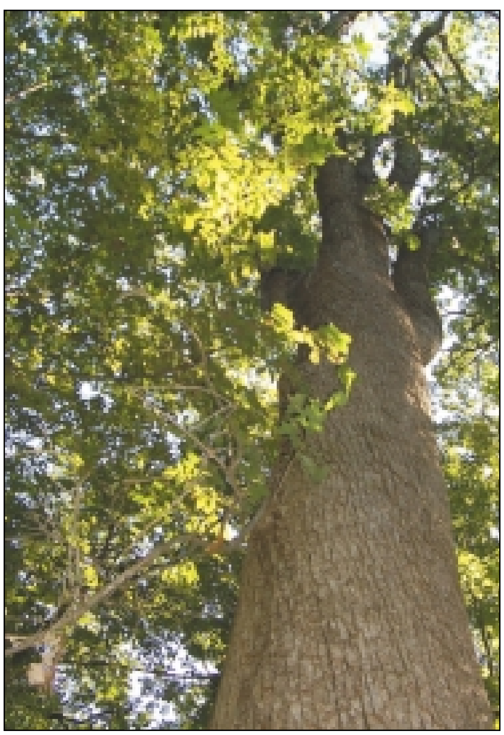
The Upper Mississippi River System.
Based on a map from "A River That Works and a Working River," page 24, UMR CC, 2000.

The floodplain forests referenced herein are part of the UMRS, defined as the natural floodplain between the head of navigation at Minneapolis, Minnesota and the confluence with the Ohio River at Cairo, Illinois and the entire Illinois River. The System is administered by the U.S. Army Corps of Engineers (COE) within the St. Paul, Rock Island, and St. Louis Districts. Most of the Mississippi River floodplain between the confluence of the Chippewa River near Pepin, Wisconsin and Rock Island, Illinois lies within the Upper Mississippi

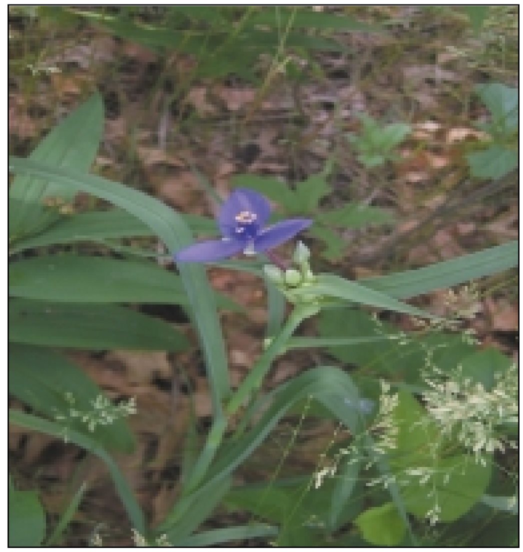
River National Wildlife and Fish Refuge (Refuge), headquartered in Winona, Minnesota. State, county, city and private entities own other lands within the floodplain.

Floodplain forests are important to the biological integrity of the UMRS. As stated in the 1999 report "Ecological Status and Trends of the Upper Mississippi River System 1998" (USGS 1999), "The ecosystem as a whole benefits from floodplain forests. Besides serving as a rich habitat for wildlife and fish during floods; the forests reduce soil erosion, improve water quality and provide a scenic and recreational landscape."

Floodplain forests are declining in the Mississippi and Illinois River systems due to agricultural and urban developments, changes in the natural riverine flood pulses, the rising water table, and island loss due to wind and wave action (USGS 1999). The forests



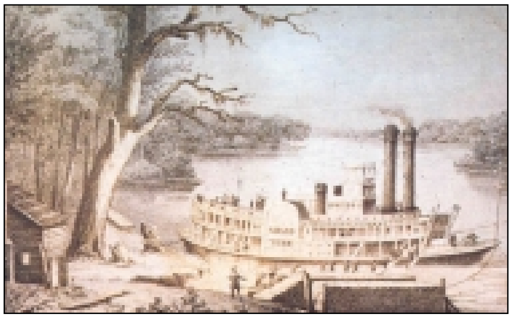
Swamp white oak (U.S. Army Corps of Engineers.)



Spiderwort (U.S. Army Corps of Engineers.)

that remain are changing in composition from a diversity of species, including mast trees; to a more monotypic forest stand dominated by silver maple. Furthermore, many forest stands are even aged mature trees with little or no understory or seedling regeneration. Actions recommended in this report will attempt to protect the floodplain forest from these threats and ensure that it remains a healthy component of the ecosystem.

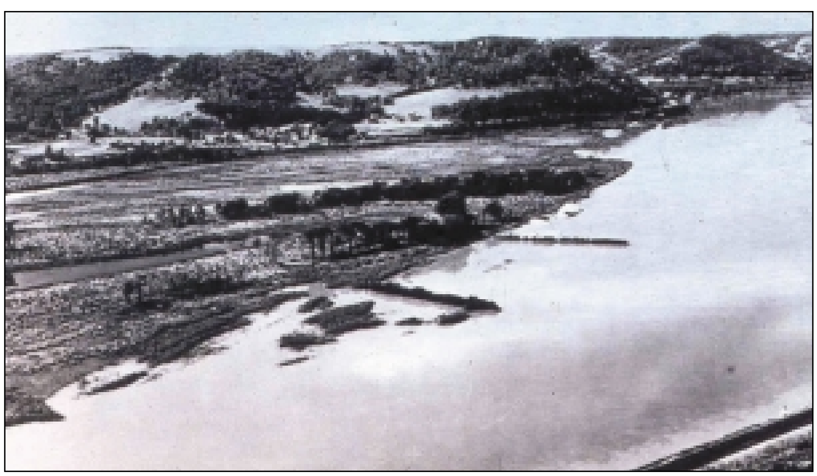
Section II. Historic Impacts



The Steamboat "Grand Turk" Wooding at Night.
(Henry Lewis, artist, Minnesota Historical Society.)

European settlers who developed the Mississippi River valley during the 1800's utilized floodplain forests extensively for lumber and firewood. Much of the fuel that heated the boilers of steamboats plying the waters of the UMRS was firewood cut from the River's forested islands and shorelines. During the same period forested land was cleared for agricultural purposes. By the 1920's and 1930's federal land acquisition for the Refuge and the Upper Mississippi River Nine-foot Navigation Channel Project profoundly changed how forests were utilized.

During construction of the Nine-foot Channel Project in the 1930's, many acres of federally acquired land were cleared prior to impoundment of the navigation pools. Within the Corps of Engineers Rock Island District, 93,600 acres were acquired in fee title for the navigation project. Of that, over 40,000 were permanently flooded, and by 1947, 20,000 acres were in agricultural use (crops or pasture) and 23,000 acres were in merchantable timber. At present, virtually all the agricultural land has been converted back to floodplain forest. During the 1941 to early 1970's period, the Corps of Engineers managed timber for revenue-generating and fiber-producing purposes. Very little of the Rock Island District was left unlogged during this time. The Corps of Engineers St. Paul and St. Louis Districts also operated active timber management programs; but the exact acreage affected is not known due to limited records. Federal lands within the Refuge were also actively managed for timber production but many of the exact locations are also unavailable. More recently, beginning in the early 1980's, the Rock Island District began operating a forest management program coordinated with U.S. Fish and Wildlife Service (USFWS) and the State conservation departments. The St. Paul District followed with a similar program later in the 1980's. These programs were implemented through Operational Management Plans that had broad based goals of promoting fish and wildlife habitat, thereby replacing goals of timber and fiber production.

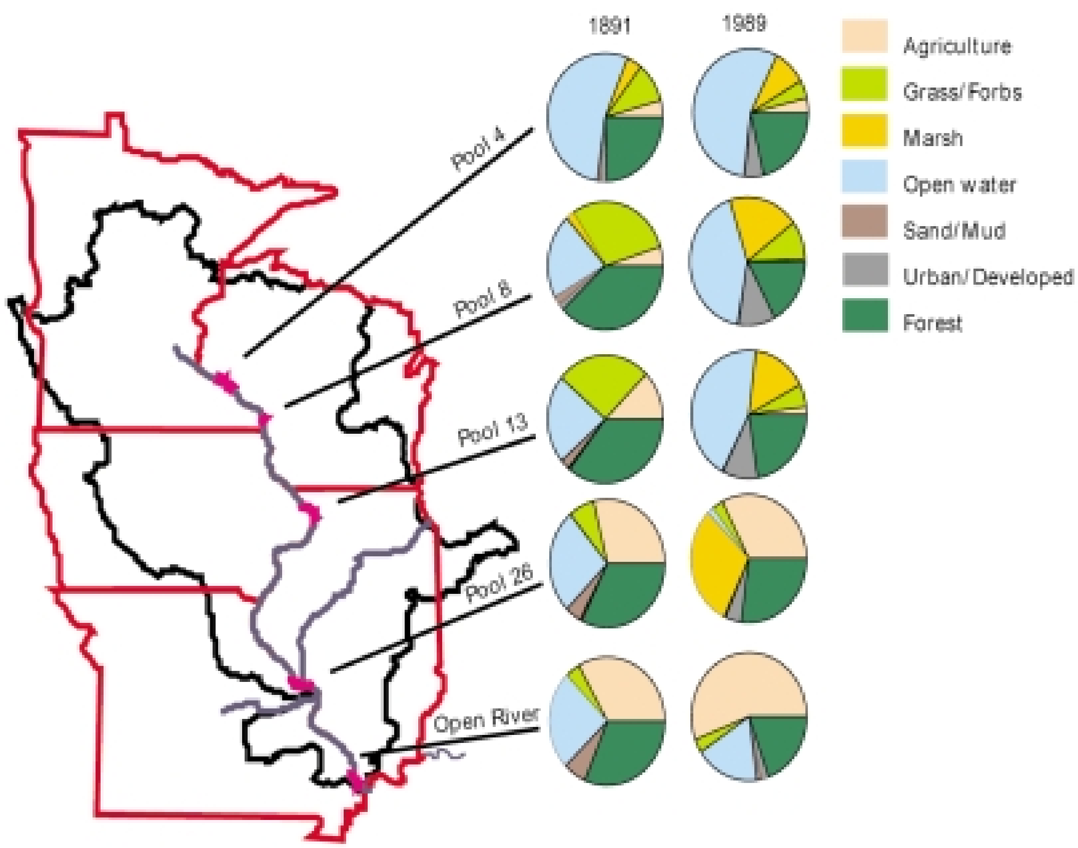


1930's - Clearing in Upper Miss. River Pool No. 6. (U. S. Army Corps of Engineers.)

Scaling logs cut from Upper Miss. Refuge; circa 1941. (U.S. Fish and Wildlife Service.)

Beyond direct forest management activities, other manmade factors have significantly impacted the UMRS floodplain forests. Among these are: increased silt loads from erosion of agricultural lands throughout the watershed, altered flooding regimes caused by watershed development, and altered water tables caused by impoundment.

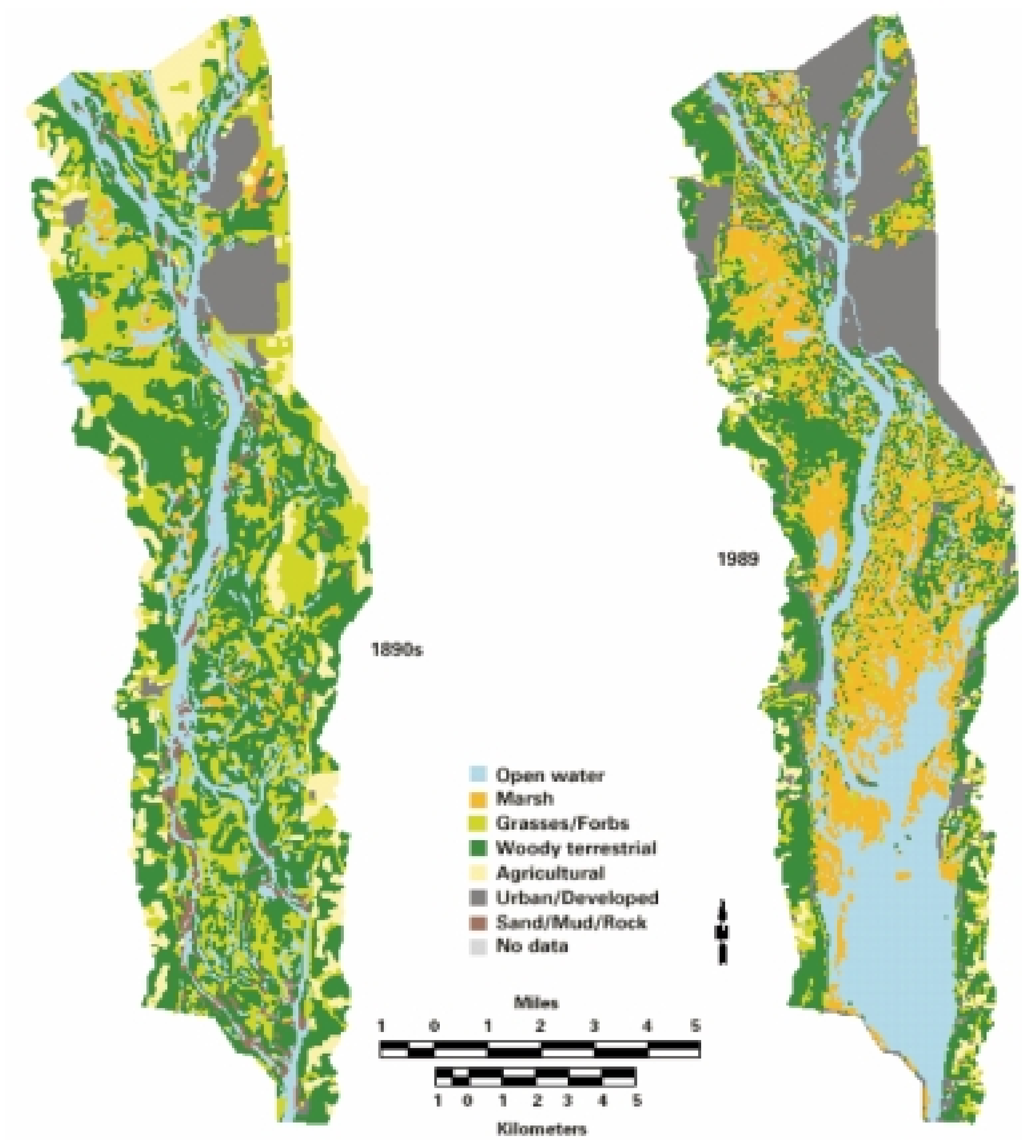
Upper Mississippi River floodplain forest tree species each fit into ecological niches defined mostly by their ability to survive various levels of flooding. Lower lying areas typically support the most flood tolerant of species, including willow, cottonwood, silver maple, and green ash. Trees located on higher elevations have less tolerance to flooding and high water tables. Such is the case with species like oak and hickory that occupy formerly high points of land in the floodplain but are no longer able to reproduce successfully because of inundation and elevated water tables. Just as an



Land cover and land use change between 1891 and 1989. (USGS, Upper Midwest Environmental Sciences Center.)

overhead view would show how acreage of forested land diminished following construction of the Nine-foot Channel Project – through clearing and inundation; a side view would show how elevated water levels, caused by impoundment of each pool, has reduced the acreage available for less flood tolerant species (oak and hickory).

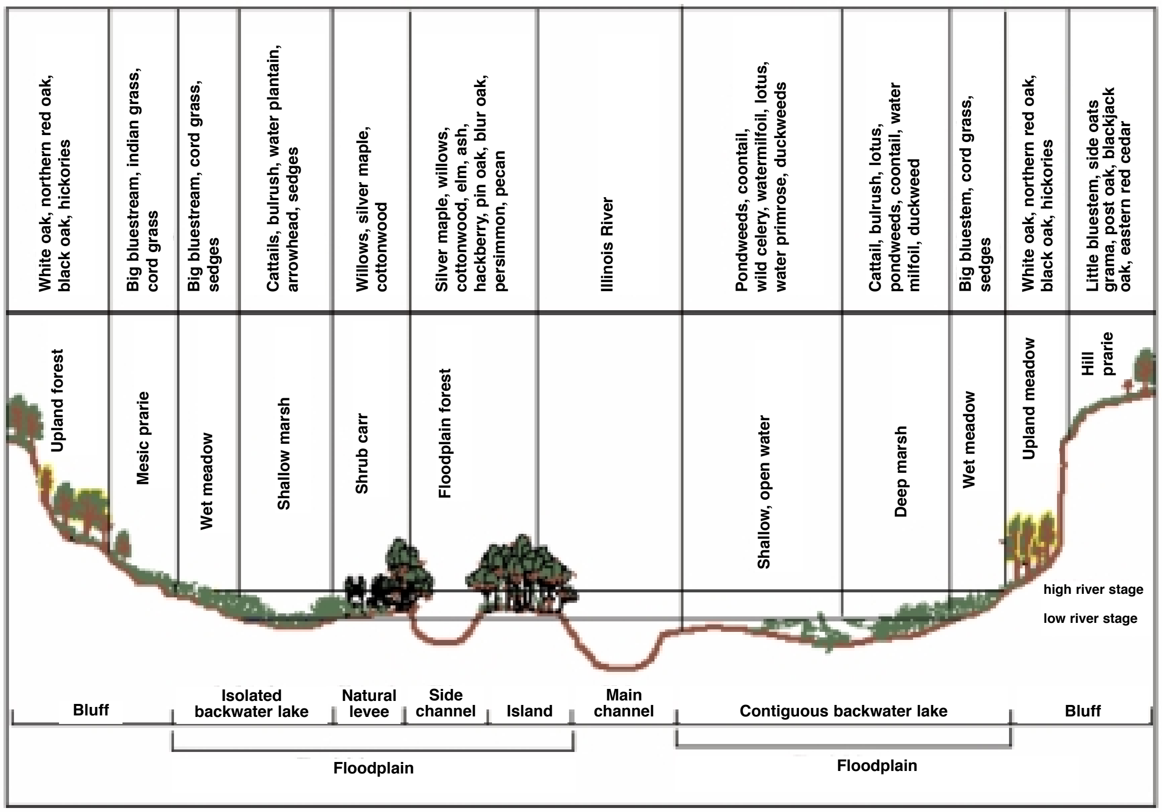
The historic conversion of floodplain forests to agricultural land on the UMRS progressed along similar upward trends until the Upper Mississippi River National Wildlife and Fish Refuge was established in 1924. Formation of this refuge placed a significant amount of the Mississippi River floodplain into federal ownership and allowed for natural reforestation over much of the area. However, conversion of bottomland forest into agriculture has continued on the Illinois River floodplain up to the present day.



Turn-of-the-century (1890s) and modern (1989) land-cover maps of Pool 8 demonstrate the effect of impoundment on the river in most of the upper impounded reach. Water levels were increased permanently in the lower half of the pools to create open-water areas close to the dams and marshy areas near the middle reaches of the pools. The upstream reaches scoured deeper but were largely unchanged in shape. (USGS, Upper Midwest Environmental Sciences Center.)

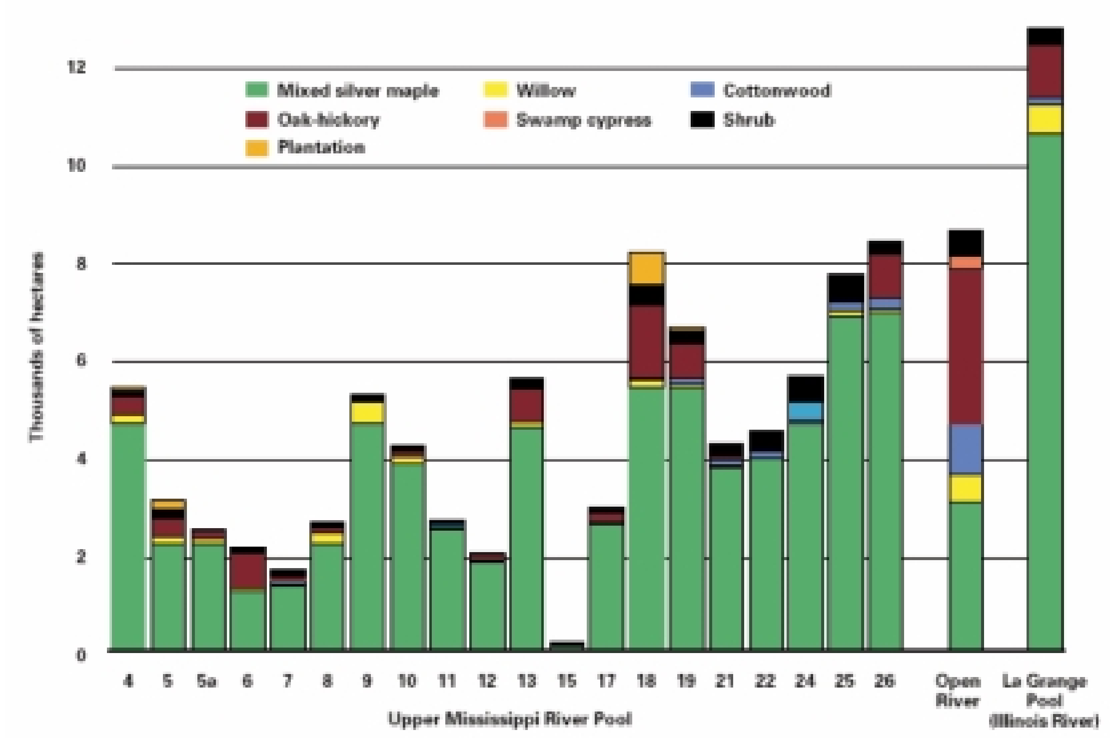
Section III. Current Status

The following illustrations from the USGS Report, Ecological Status and Trends of the UMRS 1998 (USGS 1999), provide an excellent description of the UMRS floodplain forests in their current condition. The first graphic of a typical river cross-section shows the interrelationship between river stage and vegetative community type.



A hypothetical floodplain cross-section illustrating the habitat types likely to occur on the Upper Mississippi River System. (USGS, Upper Midwest Environmental Sciences Center.)

Recent forest inventories on COE lands show a heavy dominance by silver maple throughout the St. Paul and Rock Island Districts. Other common tree species of lesser frequency include: Eastern cottonwood, green ash, black willow, river birch, sycamore, American elm, boxelder, swamp white oak, pin oak, bitternut hickory, black walnut and pecan. Average tree age is generally between 50 and 70 years. Statistics on timber size class distribution from the Rock Island District (Pools 11- 22), show over 40% of trees are 18 inches or larger in diameter at breast height (DBH). Over 30% fall between 12 and 18 inches DBH. These numbers indicate a maturing forest with mostly even-aged trees and a disproportionate number of replacement trees in a juvenile stage of growth. The next illustration of forest community distribution throughout the UMRS in 1989 also points out the dominance (80%) of the mixed silver maple community.

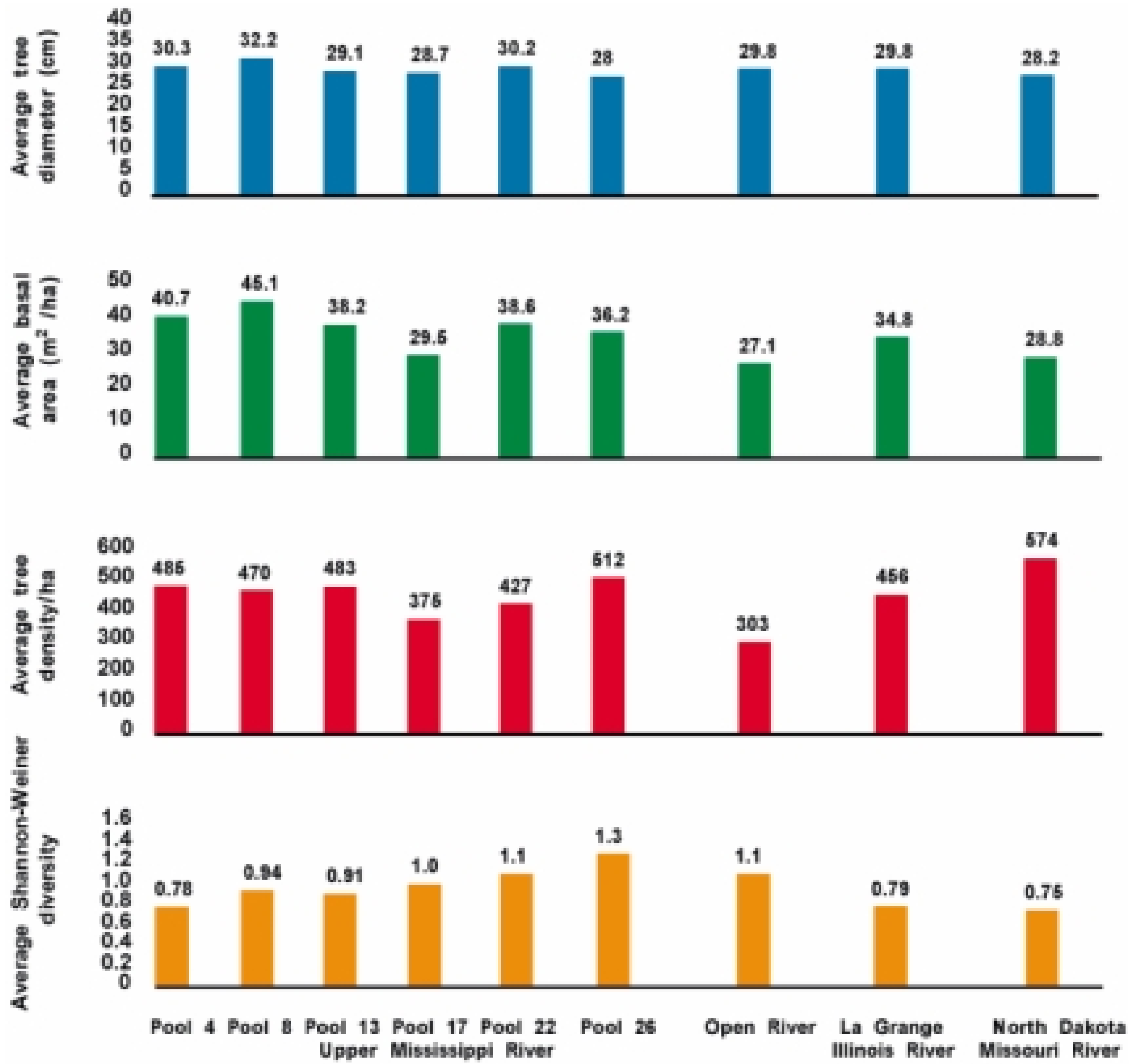


Forest community composition on the UMRS, 1989, is dominated (80%) by a mix of silver maple communities on the pooled reaches of the Upper Mississippi River System. (USGS, Upper Midwest Environmental Sciences Center.)

Yin (USGS 1999) provides additional information on the current structure of these floodplain forest communities:

> *…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 and Illinois Rivers appear to be similar in average tree size, average basal area, density, and diversity.*

The next graphic illustrates the relative uniformity of forest tree characteristics along hundreds of miles of river floodplain. These forests are even-aged and have low species diversity.



Average tree size, average basal area, density and species diversity are consistent throughout the UMRS. (USGS, Upper Midwest Environmental Sciences Center.)

The floodplain forests of the UMRS are dominated by mixes of silver maple communities that occur in even-aged stands between 50 and 70 years old. There is limited regeneration of silver maple or other trees present. Mast producing tree communities occur on less than 10% of the UMRS floodplain.

Section IV. Future Floodplain Forests

Like all ecosystems, the floodplain forests of the Upper Mississippi and Illinois Rivers are dynamic. The forest we see today will be different in fifty years. The variation in growth, survival, and composition of the floodplain forest is caused by many factors.

The floodplain forest of the Upper Mississippi and Illinois Rivers cannot continue to meet our expectations in a self-sustaining manner while being influenced by human impacts described in this document. Active forest management is needed to help meet our resource objectives.

Mississippi River Floodplain Forest (Courtesy of Jon Stravers.)

It is important to consider future forest conditions due to the significant social values we place on this ecosystem. We value: wildlife habitat and scenery, wood products, biodiversity and other types of ecological functions, and spiritual experiences. We hope that these values and benefits will continue to be available to us, and to future generations. It is by looking forward that we will be compelled to take appropriate stewardship actions to ensure the desired future condition.

Future Trends Without Active Management

Some may argue that these forests are self-sustaining and require no human intervention to ensure their future existence. Such ideas would probably be correct if we were talking about the UMRS forests before the mid-1800s. Since that time, human influence has been significant. The physical processes of the river, which would normally play a major role in shaping floodplain forest composition and diversity, have been altered through navigation improvements and levee construction.

Channel meandering and seasonal water fluctuations are two factors intertwined in the natural succession of a floodplain forest. They often resulted in the creation of new islands, or exposure of mudflats, where conditions were suitable for regeneration of trees. These same processes destroyed islands, with subsequent loss of older trees and forest vegetation. The regular and unrestrained flow of these processes brought about a high degree of forest diversity, by allowing a greater mix of tree sizes, ages and species throughout the floodplain. Since river alterations have been made, these forces, although still present to a lesser degree, are less powerful to bring about the same results. Without active forest management, some of the changes we might expect to see over the next 50 years include:

- ❑ A reduction in cottonwood and willow. These are typically pioneer species that become established on newly accreted islands or exposed substrates. They require open sunlight and will not regenerate in the shaded understory of an established forest.

- ❑ More open forest canopy. Much of the current floodplain forest is closed canopy, where trees are spaced close enough together to create a continuous layer of upper tree crowns. As these trees age, die-off and fall to the ground, openings will be created. If conditions are not present for regeneration of trees, these canopy gaps may be invaded by herbaceous vegetation and remain in an open condition for many years. Even if conditions are suitable for tree regeneration, maple and ash may continue to dominate.

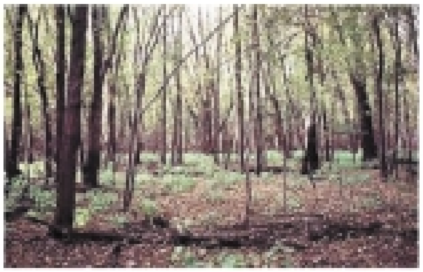
- ❑ Continued loss of forest in the lower parts of the pools. Gradual loss of islands to erosion will also result in fewer trees and less overall forest area.

- ❑ Conversion from forest to other vegetation types in the mid-pools. As a result of dam construction and water level control, the water table is higher in islands and shorelines located within the lower and middle portions of each pool. This creates site conditions that may be less suitable for forest, but better for other species, such as reed canary grass. Thus, the trend may be a gradual replacement of forest species with herbaceous vegetation.

- ❑ Fewer mast trees. Mast trees, such as oaks and hickories, are less tolerant of flooding and saturated soil conditions than other floodplain tree species. They also produce a heavy seed, which is not as widely dispersed as the lighter, wind-carried seed of cottonwood, willow, maple, and ash. These two factors may contribute to a continued reduction of mast within these floodplains.

- ❑ Increase in shade tolerant species. Box elder and mulberry are highly tolerant of shade. Since much of the current forest is dense canopy, it is likely that these two species will increase through natural establishment in the understory of existing maple stands. Although there is some habitat value associated with them, box elder and mulberry are not considered as desirable as other floodplain tree species.

A Life Cycle Example



A typical UMRS stand of silver maple.

Recent inventories of the forest have shown that the UMRS floodplain is dominated by silver maple. These trees average fifty to seventy years of age, seventy-five feet in height, and seventeen inches in diameter. The crowns of these closely spaced trees form a dense canopy, which prevents much of the sunlight from reaching the forest floor. Relatively little advanced regeneration, in the form of seedlings and saplings, exist in the understory of the dominant forest trees.

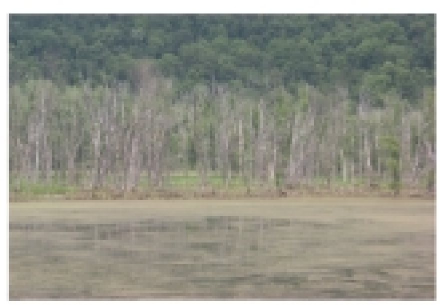
Since the expected lifespan of a silver maple tree is 125 years or less, this stand will need to achieve successful replacement with a new generation of trees sometime within the next fifty-five to sixty-five years to ensure continuation of forest cover. Ideally, there would be seedlings and saplings already in the understory at the time the older trees die-off. If not, a number of specific site conditions are needed to promote successful tree seed germination and growth.

Advanced growth of silver maple regeneration.

Silver maple seed on recently deposited fine sediment.

Silver maple trees are prolific seeders that usually produce good seed crops on an annual basis. However, tree establishment and survival depend on having adequate soil conditions for germination and adequate light for tree growth.

When all conditions are favorable, the tree seed will germinate. With every inch of new growth, the seedling has a better chance of surviving future floods. However, even saturated soils can stress established trees by inhibiting respiration through tree roots and literally starving them of oxygen.

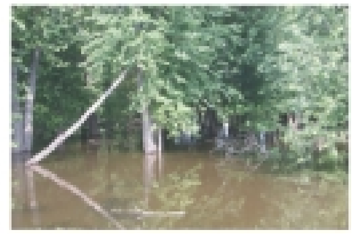


Dead standing trees in the UMRS floodplain.

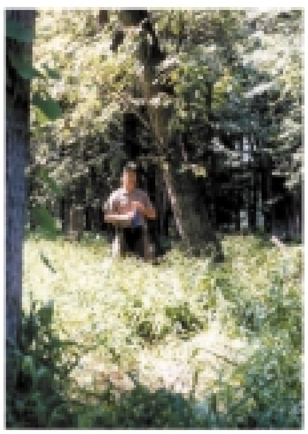
A carpet of recently germinated silver maple seedlings under heavy shade.

Another critical factor in silver maple survival is the seedling' s natural ability to cope with shade. Research (Hosner and Minkler 1960) has shown that silver maple seedlings will disappear from the understory of a dense maple stand within five years if they do not receive adequate sunlight. If openings do not occur in the overstory tree canopy, the seedlings cannot tolerate the shade conditions and will die off.

Other factors can influence successful natural seeding on the UMRS floodplain. Tree seed that falls during a flood can be swept away by river currents, or may loose viability due to excessive moisture.



Trees surrounded by high water during the active growing



Robust growth of grasses within a canopy opening in a stand of silver maple.

If the forest floor is relatively dry at the time of seed drop, there may already be an established cover of herbaceous vegetation that is dense enough to prevent most of the silver maple seed from contacting soil.

We cannot predict when all the necessary conditions for tree germination, growth and long-term survival will fall into place along the floodplain. But having some understanding of the life history requirements of various trees, along with knowledge of river dynamics, make it fairly apparent that the chance of natural forest stand replacement under current hydrologic constraints is limited.

Exotic, Invasive Species, and Other Damaging Agents

Introduced species and other damaging agents have had major affects on floodplain forests for many years, and are likely to be a significant influence in the future. Dutch elm disease changed the face of the bottomlands in the 1960' s when it effectively eliminated the American elm as a dominant component of the floodplain forest. Although not an epidemic at this time, the oak wilt fungus can be locally severe, with potential to impact the few black and red oaks that occur at higher elevations along the floodplain. Swamp white, bur, and pin oaks are less susceptible. The Gypsy moth is an exotic that can cause defoliation on a number of hardwood tree species, especially black willow.

Bark beetle has been a minor problem on silver maple, causing staining problems in logs harvested from the floodplain. Ash yellows is a plant disease that can cause poor growth or decline symptoms in green ash. These are just a few examples of the many types of forest diseases and insects that can impact future forests.

Reed canary grass is an invasive species that is causing management problems in the floodplain forest. This aggressive grass can establish itself quickly in the understory of floodplain forests, then prevent germination or out-compete tree seedlings on some areas. The result could lead to a gradual loss of tree

Reed canary grass in Mississippi River Pool 8 (U.S. Army Corps of Engineers.)

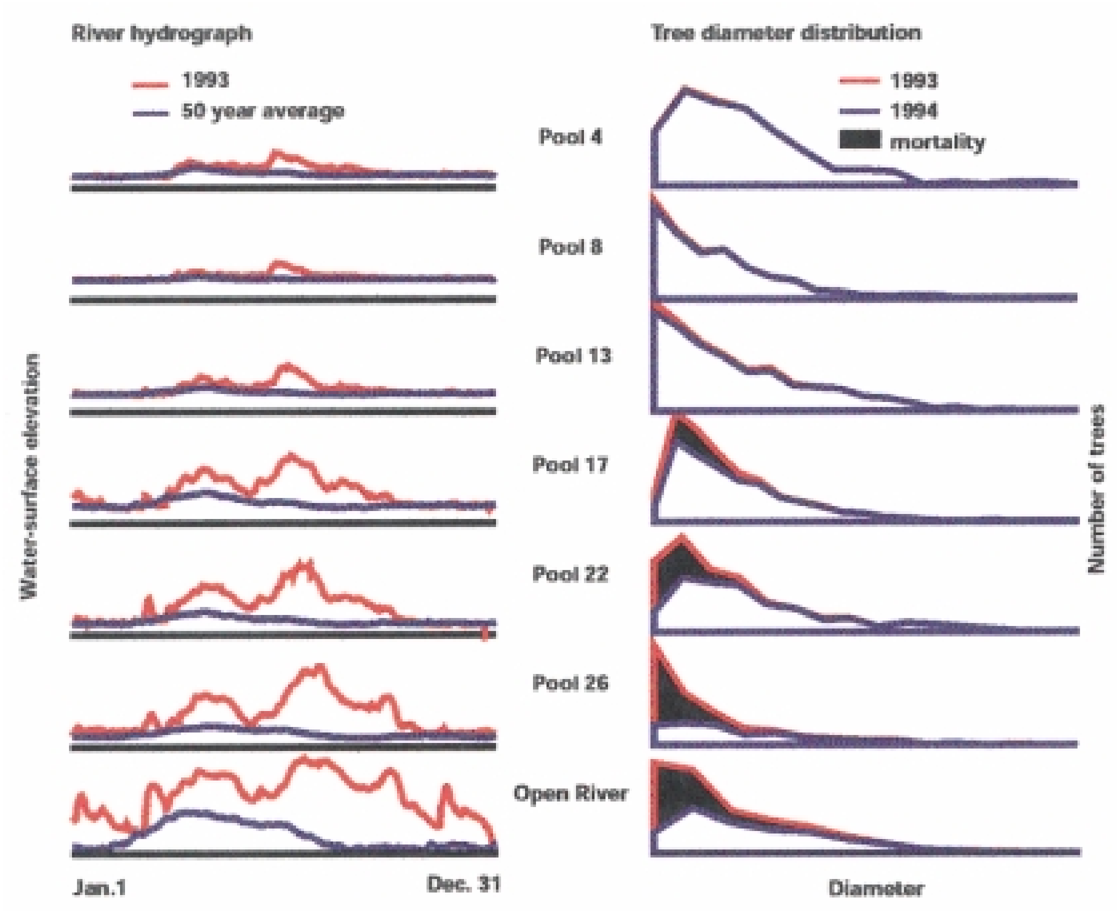
canopy and the proliferation of open grassland or brush conditions. The European buckthorn is an exotic shrub that is gaining a foothold in many forests. Its seed is widely distributed by songbirds. This aggressive plant can dominate an area by out-competing other vegetation, thus reducing overall species diversity. Garlic mustard, a biennial herb, also poses a significant threat to native floodplain plants by taking over the ground layer of vegetation on the forest floor and minimizing the availability of light, moisture, nutrients, soil, and space.

Increased management and improved techniques are needed to reduce the detrimental impacts of invasive and exotic species.

Impacts of the 1993 Flood

The Upper Mississippi River was flooded in the summer of 1993 for varied durations depending on longitudinal locations. The flood lasted about two weeks at Lake City, Minnesota; but lasted throughout the entire summer at Cape Girardeau, Missouri. Although floodplain forests are known to be capable of surviving brief inundations, the great Midwest flood of 1993 demonstrated that prolonged inundation is lethal to these forests. Post-flood surveys (Yin 1998; USGS 1999) were conducted at seven reaches along the Mississippi River. In the heavily impacted southern reaches of the UMRS between St. Louis and Cape Girardeau, Missouri, flood-induced tree mortalities were found to have reached 40% for trees greater than 10 cm in diameter and 80% for smaller trees. Also, tree mortality rates increased as duration of the flood increased; larger trees survived better than smaller trees; and different species displayed varied tolerances to the flood.

Based on the species composition of seedlings recruited in two years immediately following the flood, two different trends of succession were identified (Yin 1998; USGS 1999). Over the next 50 years, acreage of willow and cottonwood communities is predicted to decline in the impounded reaches above St. Louis and to remain at current levels in the open river below St. Louis. Before the flood, acreage of willow and cottonwood was predicted to decline at both the impounded and the open river reaches over the next 50 years.



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. (USGS, Upper Midwest Environmental Sciences Center.)

Investigation of the changes on flood characteristics was also conducted after the 1993 flood. The following discussion (Wlosinski and Yin 2000) addresses the potential effects of such changes on floodplain forests. This analysis is limited to areas between the levees.

> *We studied three water surface elevation gages from the UMRS that have a nearly complete daily record for 98 years or more; Muscatine, Iowa (1901-1998), St. Louis, Missouri (1861-1998), and Valley City on the Illinois River (1885-1998). We examined trends in flood heights, flood duration, and flood frequency. Although the data were extremely variable, significant trends in all three factors were evident at all three stations. The average flood height, from linear regression analysis, is now about 1.5 meters higher than when these data were first collected. Flood frequencies are also greater. After dividing the record for...*

…each station into two equal periods, we calculated the number of floods that occurred in each period. Twenty floods occurred at St. Louis during the early 69-year period and 33 during the later years. Numbers of floods increased from 14 to 28 at Muscatine (57 year periods) and from 18 to 37 at Valley City (49 year periods). The 10 greatest floods, as measured by water surface elevations, occurred in the later period at all three stations. Flood duration was also longer in the latter periods. Linear regression showed that the number of days above flood stage in a year increased between 18 and 35 days over the period of record.

We believe that these changes in the hydrograph will lessen forest regeneration after major floods, because seedlings and saplings fully submersed for a week usually suffer 100% mortality. With floods now occurring twice as often and having a longer duration, seedling success is lower. Higher floods will also negatively affect a larger area of the floodplain. We predict that flood-tolerant and faster growing species will start to dominate higher and higher elevations, and modern forest canopies will be more open than their historical counterparts. Forest restoration can be improved by incorporating these results in future planning efforts.

The impacts of the 1993 flood were not as severe on the majority of the Illinois River as the UMR. The exception was in the southern reaches of the Illinois River where record flooding was caused by water backing into the Illinois from the Mississippi River. Tree mortality rates in this area were higher than rates along the northern part of the Illinois.

Kain's Siding Area, Mississippi River Pool 9 (U.S. Army Corps of Engineers.)

Potential Impacts on Current Benefits and Values

Bald eagle (U.S. Army Corps of Engineers.)

Current trends in water regimes, plant succession, and human influences on the UMRS will result in significant changes in tree species composition and the conversion of forests to grassland or shrubs over the next 50 to 75 years. The following is a discussion of how these changes will influence wildlife, recreational, cultural, and other resources of the river.

Floodplain bird life will change with anticipated forest habitat changes. Bald eagles, great blue herons, great egrets, and cerulean warblers (a possible candidate species for Threatened or Endangered Status by the USFWS) favor taller trees such as cottonwood and swamp white oak for roosting and nesting habitat. It is clear that only a minor amount of natural cottonwood and oak regeneration is occurring on the floodplain. Without direct management promoting growth of these trees, tall tree habitat will continue to diminish. These birds now utilize silver maple as a substitute to tall trees, yet future widespread occurrence of silver maple is also in question due to competition with reed canary grass.

Both resident and long-distance migratory songbirds utilize the closed canopy, silver maple forest for nesting and migrational habitat. In some areas, silver maple forests occur in large contiguous blocks of habitat, meeting a life history requirement of certain bird species for maintenance of viable populations. These species are referred to as area-sensitive and are represented by the red-shouldered hawk, prothonotary warbler, and eastern wood pewee. If current low levels of natural regeneration of silver maple are not reversed, these forests may become more fragmented by infusion of herbaceous vegetation (e.g., reed canary grass) and thus, less suitable for some songbird species.

Bird use in floodplain forests differs from adjacent upland forests in terms of species composition, relative abundance, and nest success (Knutson et al. 1996). During three years of bird censuses, 84 bird species were noted in Knutson's study areas located in Pools 5A through 10 (Winona, Minnesota to Guttenberg, Iowa). Species common to both uplands and floodplains included the American robin, house wren, great crested flycatcher, Baltimore oriole, American redstart, eastern wood pewee and yellow-bellied sapsucker. Nesting species such as prothonotary warbler, brown creeper, yellow-billed cuckoo,

Cerulean Warbler (Courtesy of Victor W. Fazio III.)

yellow-bellied sapsucker, and great crested flycatcher prefer floodplain forests to upland forests. Floodplain forest specialists included the prothonotary warbler, red-shouldered hawk, and bald eagle.

Twenty-four of the 84 species noted by Knutson were considered to be species at risk because of regional or continental population declines. Some of these were the downy woodpecker, blue-gray gnatcatcher, warbling vireo, rose-breasted grosbeak, cerulean warbler, and ovenbird.

Great-crested flycatcher (Courtesy of Dr. Dan Sudia.)

Knutson confirmed that cavity-nesting birds were a significant component of the floodplain forest bird community. A total of 23 cavity nesters were found, including primary cavity nesters (seven woodpecker species) and secondary nesters (great-crested flycatcher, prothonotary warbler, white-breasted nuthatch, brown creeper, wood duck, bluebird, and purple martin). It is apparent that the abundance and size of snags in the floodplain is greater than in the upland due to differences in harvest practices and water regimes.

Knutson suggests that for some species, nest success may be higher in floodplain

Young red-shouldered hawks (Courtesy of Jon Stravers.)

forests than in upland forests, and in these cases floodplains are an important recruitment or "source" areas for certain bird populations. This applies to red-shouldered hawk and prothonotary warbler populations in the floodplain forests. Her study also suggested that area-sensitive species populations require relatively smaller blocks of floodplain forest habitat than upland habitat.

The conservation of floodplain forest birds, writes Knutson, depends on efforts to restore degraded floodplains, maintain wide forested corridors, and provide hydrologic conditions that promote the natural regeneration of a high diversity of species including silver maple, ash, cottonwood, sycamore, and sweetgum.

The floodplain forest bird community can be maintained by conserving existing forest as close to their present state as possible. Forest management should promote natural forest successional processes that produce diversity in age and structure of trees. (Knutson et al. 1996)

Floodplain forests of the UMR provide habitat for furbearers and other mammals, amphibians, and reptiles. There are over 50 species of mammals on the UMR, of which at least 28 are associated with forest habitats. The beaver, nearly extirpated by the early

Muskrat (U.S. Fish and Wildlife Service.)

1900's, is an important furbearer as well as an integral part of the floodplain forest ecosystem. Beavers impact forest resources through consumption and altering flow and elevations on a localized level. Populations have remained stable in recent years. Other forest-dwelling furbearers include raccoon, gray fox, and river otter. White-tailed deer occur throughout the floodplain forest. They can influence tree regeneration and rely on early to mid-successional stage habitat for most life requirements. There are at least 40 species of reptiles and amphibians on the UMR floodplain. About 22 species are associated with floodplain forest habitats.

The vast, flowing pattern of forested islands and shorelines along the rivers provides a scenic value that is difficult to measure. Changes to this pattern as a result of vegetative conversion to non-forested cover, will have a negative impact on aesthetic benefits. Recreational boating and camping are important public use activities on public waters and lands within these river floodplains. Campers tend to migrate towards sandy beaches adjacent to dense stands of forest. A vegetation trend toward more open, grassland types of habitat would diminish recreation values for those campers who enjoy timbered cover.

Cultural values may be impacted or lost as vegetation types and amounts change and soil holding capabilities weaken. Other intangible benefits, such as spiritual values and sacred places may also be negatively impacted.

Recreational beach use along the Upper Mississippi River. (U.S. Army Corps of Engineers.)

Biodiversity conservation and productivity values will be held at much less than optimal levels with a continuation of the trend toward minimal variation in forest age, size, and species. The natural range of spatial and temporal variability will be diminished, as will the structure, function, and composition of the forest. The loss of genetic, species, and ecosystem diversity will also result.

On a regional scale, the floodplain forest role as a contributor to carbon storage will be diminished as canopy densities decrease and conversions in vegetation type take place.

Watershed protection benefits may dwindle with the probable loss of erosion protection afforded through floodplain forest.

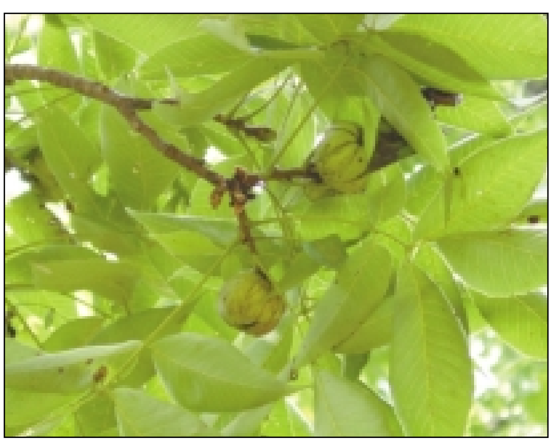
Potential for timber supply, botanical products or other economic opportunity will become less as ecosystem diversity levels diminish and forests are converted to other cover.

The Ideal Floodplain Forest - What would the ideal floodplain forest look like and why?

We believe that an "ideal" floodplain forest would be one that supports habitat for wildlife and fish. Therefore, our goal is to maintain a healthy, nearly contiguous forest that spreads across wide stretches of the floodplain and contains sufficient diversity of tree species, size, and age to provide a wide array of habitat structure and food (mast) resources.

Species Diversity

The ideal floodplain forest would have a wide range of tree species present,



Bitternut hickory (U.S. Army Corps of Engineers.)

Hackberry (U.S.Army Corps of Engineers.)

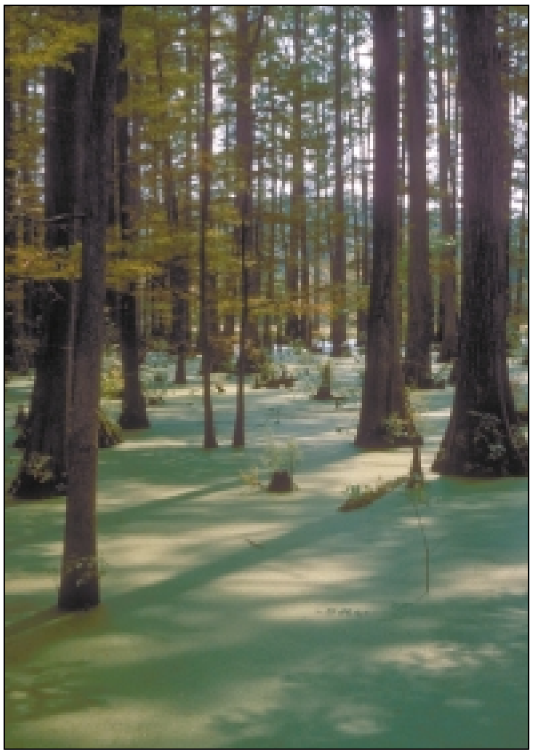
including all those that are known to have existed on the floodplain but may not be there today. A good example of this would be American elm. There have already been attempts by researchers and nurseries to produce disease-resistant elms. In the future, it may be possible to reestablish healthy elms across the floodplain. A forest with more mast trees is also desirable. Hard mast, such as acorns, pecans, and hickory nuts, are important food sources for the wood duck, mallard, squirrel, deer, beaver, blue jay, and other wildlife.

Size and Age Diversity

Size and age diversity would be another key characteristic of this ideal forest. A forest with trees in all stages of development provides a wider range of habitat, while also ensuring a source of new and middle-aged trees to carry-on after the older trees reach maturity and die-off. Age diversity automatically brings size diversity, which benefits wildlife, as some species require younger trees for their various life stages. Others, such as the bald eagle, need older trees to use as nest and roost areas.

Structural Diversity

Structural diversity is an important forest component. Forests can be categorized into different levels or zones of structure. The older, taller trees make up the highest level of structure, or the main



Floodplain forest at Calhoun Point near the confluence of the Mississippi and Illinois Rivers. (U.S. Army Corps of Engineers.)

forest canopy. Under these dominant trees, there could be another layer of vegetative structure made up mostly of co-dominant or sapling-sized trees. The next layer might be shrub species or tree seedlings. The lowest layer of vegetation could be made up of forbs, grasses, sedges, mosses, and other plants. The ideal forest would also include snag and cavity trees to provide nesting and feeding places for various wildlife species. The density of these snags would be at a level that would maximize use by these particular species.

Diversity of Vegetative Type

Blocks of other vegetation types, such as savanna or open grasslands, would be available at different locations adjacent to the forest, providing more variation in structure and species composition.

Forest Management: Options and Alternatives

How can we get closer to the ideal?

The floodplain forest ecosystem of the UMRS is currently dominated by tree species with intolerance for shade. The driving force of forest change or succession in this type of environment is ecological disturbance, such as flooding, tornados, severe windstorms, and fire. Floodplain species thrive on these powerful influences. Through careful application of forest management techniques, similar types of disturbances can be introduced and will help steer the resource into a desired future condition. The following are examples of suggested options and alternatives:

- ❑ Group or selective removal of trees can result in canopy openings that provide additional sunlight and soil scarification for germination and seedling development. The results will be improved diversity of age, size, height and species.

- ❑ Management of snags and downed woody debris, or woody shrubs in the understory can provide structural features to improve the quality of the habitat for various species of wildlife.

- Harvest prescriptions should be developed with consideration of what should be left standing for seed production, snags and other habitat requirements.

Marking trees that will not be cut during a timber harvest. (U.S. Army Corps of Engineers.)

- Identification of suitable planting sites for mast tree species should be a primary management focus. Mast is an important component of the forest and should be increased.

- Reestablishment of cottonwood, oak, and willow stands can ensure a continued source of future nest and roost trees.

- Special emphasis should be placed on managing forest stand size to maintain habitat for forest interior birds that require a minimum block size to maintain population viability.

- Best management practices (BMPs) should be implemented during logging operations to ensure minimal site impacts and maintain important ecological components. BMPs are forest management practices intended to minimize non-point pollution and ecological impacts of forestry activities.

- Where possible, natural regeneration should be encouraged as a method of conserving genotypes and maintaining other aspects of biodiversity.

- The full range of forest values (aesthetic, genetic, recreational, protective, etc.) will be considered in the development of management prescriptions. The foundational management philosophy should be to avoid any potential actions that may result in long-term harm to the ecosystem.

- ❑ Forest pathogens, especially introduced diseases and pests, should be diligently monitored and action plans developed and implemented where necessary to minimize unnatural, negative impacts to the forest. These action plans may include partnerships with the U.S. Forest Service to aggressively control infestations using biological, chemical, or mechanical methods.

- ❑ Managers should follow-up all cutting practices with post-sale cultural work or timber stand improvement, which includes tree thinning, cull tree removal, and slash treatment.

All of these techniques should be implemented under an adaptive management concept, where results are thoroughly monitored, documented, and future actions are modified to make effective use of the newly acquired information. Along the way, managers must continue to observe the natural dynamics of the ecosystem, learn from them, and develop management practices that mimic them. Active implementation of these alternatives by the river resource agencies, along with planning and volunteer assistance from the public, will help us reach and maintain our vision for the future floodplain forest.

Halloween Pennant dragonfly (Courtesy of Jon Sobiech.)

Section V. Recommended Actions

Acorns (mast) on a bur oak (U.S. Army Corps of Engineers.)

Management Opportunities

Differing levels of management opportunities are available for successful implementation. While forest management practices are relatively easy to apply on federal land to meet habitat goals and objectives, it is somewhat more difficult to meet similar goals and objectives through forest management application on private lands. A number of forest management incentive programs (mostly through US Department of Agriculture) are available to private landowners to help meet their goals and objectives. On public land, management implementation is more a matter of ' will of the agency.' While the process of proper application of management practices may appear somewhat cumbersome due to the regulations that apply, it is possible. As stewards of public resources, federal application of management practices must be accomplished within legal and regulatory guidance, including, but not limited to: National Environmental Policy Act, Endangered Species Act, Section 10/404 Clean Water Act, and the National Wildlife Refuge Systems Improvement Act of 1997.

Forest management opportunities differ between the Illinois and Mississippi Rivers. The major challenge is in ownership. Quite simply, most of the Mississippi River forestland is in public ownership, where the majority of Illinois River forestland is private. As such, forest management decisions are not made with regards to a single management plan covering an extensive area, but rather as a patchwork of management where not all landowners are working toward similar habitat goals. On the Mississippi River this challenge is much less a problem because responsible agencies are striving for coordinated efforts to achieve mutual habitat management goals.

Silver maple regeneration (U.S. Army Corps of Engineers.)

Forest Regeneration Recommendations

Management of the Mississippi River' s forests falls under a variety of federal and state agencies, including the COE, USFWS, and the five Upper Mississippi River System states (Illinois, Iowa, Minnesota, Missouri, and Wisconsin). Silvicultural methods used by these agencies are based on the management objectives set by interagency coordination. These management objectives are set in accordance with ecosystem management principles.

Tree regeneration methods presently used, particularly clear-cutting, work well if new tree germination occurs within the first year. This works best when bare mineral soil is exposed for germination—particularly for the sun-loving species such as silver maple and cottonwood—and slash is removed. If seed germination does not occur right away, annual herbaceous, and occasionally perennial grass species, can capture and dominate the site. Regeneration of trees may then take significantly longer, depending on the particular species that now dominate the site. Herbaceous competition is often seen as a major limiting factor in regenerating forests of the Mississippi River floodplain. Other regeneration methods should be tested and monitored to determine if other systems can be used to regenerate the Rivers' bottomland forests. Methods such as the shelterwood and group-selection harvest methods should be tested. All methods of regeneration should provide bare mineral soil as a seedbed, if possible. Sites should be carefully chosen with respect to the water table elevation and associated soil surface. For example, removing the current canopy can make the site more hydric, and unable to support trees.

Stand of cottonwood regenerated after a timber harvest. (U.S. Army Corps of Engineers.)

Skidder hauling logs to landing area during timber harvest operations. (U.S. Army Corps of Engineers.)

Shelterwood Harvest Method

The shelterwood method allows forest regeneration to establish itself in partial shade before the entire canopy is removed (Smith 1986). Part of the canopy is removed initially, the residual stand of trees is left as a shelter for regeneration, and then the remaining canopy is removed when regeneration is

Girdled tree (U.S. Army Corps of Engineers.)

accomplished. This method produces an even-aged forest stand. The advantage over full removal of the canopy (i.e. clearcutting) is that in clearcutting, annual and perennial herbaceous and grass species can shade out tree regeneration, and in some instances, may be allellopathic to tree species. In such cases, dominant plants can distribute organic compounds that inhibit growth of adjacent plants. It is expected that the partial shade created by the shelterwood method will eliminate much of the herbaceous competition that requires direct sunlight, thus giving regenerating trees a better chance for survival.

This method can be adapted to a variety of ground conditions. The one commonality to the technique is that the next generation of trees is established before the entire canopy is removed. Several variations of this method may be applicable to the Mississippi River' s forests, and should be tested. Treatments should allow for bare mineral soil to be exposed (unless releasing an existing canopy).

One variation that may be readily adaptive for present conditions is the "one-cut shelterwood method", or "over-story removal." This method is used if advanced regeneration already exists under the present canopy. The entire canopy can be removed in one cutting, as the regeneration doesn' t need shelter to protect it. These conditions may exist in areas where there was heavy thinning in the past, accomplished under selective cutting forest management plan. These conditions may also be increasingly common in areas hard hit by the 1993 flood. If excessive damage is expected from logging activities in the removal of the canopy, trees could be girdled and left on site for habitat. Present geographical information systems (GIS) and field investigations will be useful in identifying potential areas for trial.

Seed Tree Method

The seed tree harvest method includes the removal of most mature timber in one cutting except for a small number of seed trees left singly or in small groups. The remaining trees provide a source of tree seed to quickly regenerate the site, but do not create a significant shading condition that certain sun-loving species

Seed trees left standing following a timber harvest.
(U.S. Army Corps of Engineers.)

will not tolerate. This method also results in an even-aged forest stand.

Group Selection Method
The group-selection harvest method is intended to mimic small openings in the canopy and regenerate small groups of trees within a stand. Species of intermediate shade tolerance are best regenerated under these conditions. The size of the openings is typically one-and-a-half to two times the height of the tallest tree (Smith 1986). This group selection method could be tried in a few areas, with differing canopy composition and structure, with follow-up monitoring, to determine if this may be an effective method of regeneration, especially for uncommon, and hard-to-regenerate species such as the oaks, hickories, sycamore, hackberry, and coffee tree. It is important to ensure that unmerchantable trees left standing after a timber sale in these small group openings be felled and slash reduced in order to promote suitable conditions for regeneration of desirable species.
The great flood of 1993 had a significant impact on the forest resource of the Mississippi River. It has been noted since the flood that small portions of the canopy have opened up due to tree mortality, hackberry in particular. These areas are rapidly being colonized by intermediate intolerant tree species like silver maple, hackberry, elm, and to a lesser extent, sycamore. These trees are competing with annual vegetation to dominate these sites, so bare soil should be exposed to give seedlings full advantage of the sun and space. Appropriate areas should be determined using existing GIS coverages, focusing on over-mature and former hard-mast and hackberry areas.

Volunteers planting trees on Horseshoe Island in Pool 8. (U.S. Army Corps of Engineers.)

Tree Planting
Hard mast trees such as oaks and hickories are much less abundant on the river than in the past, and are not regenerating successfully. Efforts should be made to obtain more information on the regeneration and survivability of hard mast trees. Advances have been made in the last several years in regards to improving the stock of planted trees, particularly with root-prune methodologies. Larger and faster growing stock has a better chance of survival against herbaceous competition. These root-pruned trees also produce seed at a considerably earlier age sometimes within five years of planting. Viable stock should also have a local seed source (within about 100 miles) that has been collected from the Mississippi River bottomlands or areas with similar moisture regimes. Every effort should be made to use existing GIS resources to plant these trees in the most appropriate areas. Some plantings have recently been made on constructed berms, usually built with a rice plow. These small ridges show promise in getting the elevation needed, and providing the necessary root aeration for growth. Efforts should be made to build berms in appropriate areas.

Post-timber harvest herbicide application (U.S. Army Corps of Engineers.)

Effort should also be made to plant other species in areas where appropriate. Sycamore should be planted in vicinities of current rookeries to ensure future stable nest trees, as heron colonies seem to prefer them. Willow posts could potentially be used to plant into reed-canary-grass fields to test if they will colonize and out-compete the canary grass.

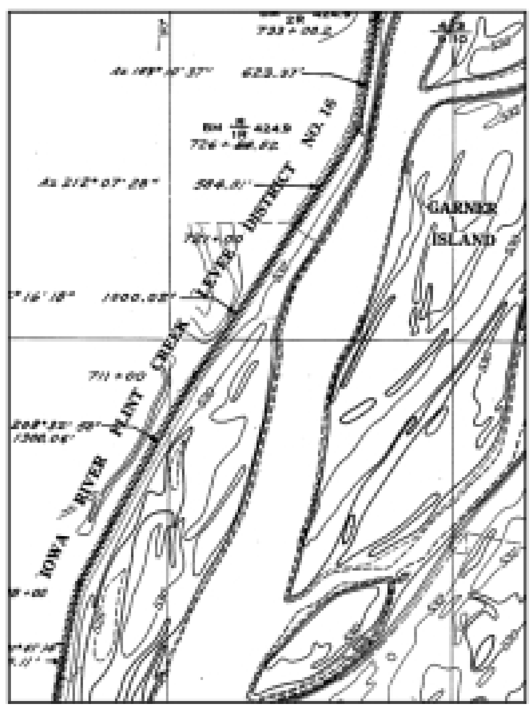
Vegetation Management Using Chemicals

Among management options is the use of pesticides. This is however an option of limited availability especially when compared to usage in upland situations. Annual flood events preclude the use of pre-emergent herbicides in a fall or winter dormant season application. Spring pre-emergent application is quite often limited by the short window of time between floods receding and herbaceous weeds beginning to grow. Post emergent herbicides are useful, but also limited by the effectiveness they have on desired woody vegetation. The logistical difficulty of getting equipment onto the site may also preclude this option.

Elevation Information

Elevation information is vitally important in determining what type of trees, vegetation, and habitat would be appropriate for management areas on the river. Digital elevation data should be researched and acquired for the management of terrestrial habitat. This is perhaps the most important piece of research information needed to more effectively manage these forests.

The hydrologic regime of each site is directly related to its elevation along with its position in the pool. The level of flooding, length and frequency of inundation, and height of water table are all dependent on the elevation of the site versus the average water surface elevation. These factors in turn limit the survivability of individual species based on flood tolerance and thus define different habitat types.



1943 Topographic map of Pool 18 (U.S. Army Corps of Engineers.)

The map above is a two-foot contour topographic map developed in 1943 by COE field crews from the Rock Island District. Up to 50 crews of four or five people each worked for five years to complete this map set for the entire district. Although technology has improved immensely since that period,

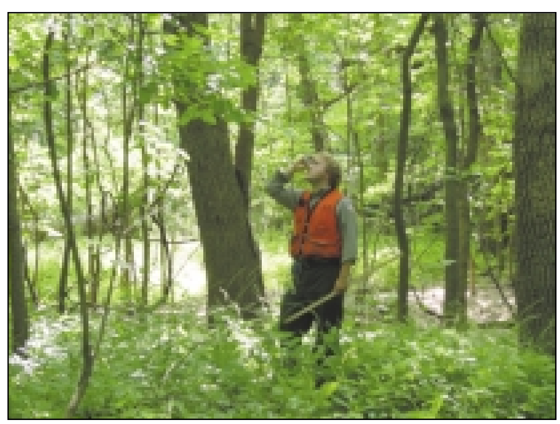
Prescribed fire (U.S. Fish and Wildlife Service.)

the cost and level of effort required for development of good elevation data in the floodplain is still significant. A partnership approach to acquiring this information for the entire UMRS floodplains may be necessary.

Modification of Site Elevations to Promote Forest Growth
The sedimentation that often occurs during floods can lead to gradual improvement of site conditions on bottomlands for forest growth. The accumulation of soil and organic material can increase elevation and cause a transition from wet to wet-mesic conditions. Silts and clays may be deposited over sand, resulting in better soils for the germination and survival of forest species. Left to vegetate naturally, these improvements may require many years to develop, and are often interrupted or reversed by the alternate process of scouring during high river flows. Consideration should be given to promoting these improved site conditions on some low-lying islands by the direct placement of sand and fine materials. Follow-up monitoring and management actions will also be required to ensure an effective vegetative response or to make additional changes such as planting of seedlings.

Prescribed Burning
Generally, fire is detrimental to most bottomland forest species due to the thin nature of the bark. Most oak species, however, do have suppressed buds and can sprout following fire. Fire could potentially be utilized to suppress more aggressive bottomland species, such as silver maple, in areas where oak and hickory species are present and have the potential to regenerate. A few sites have been tested in Lake Odessa, Pool 17. These areas should be monitored for regeneration of oak and hickory species, and new potential sites should be identified and evaluated for possible prescribed burning.

Forest Inventory
A new forest inventory should be developed by the three Corps districts and partnering agencies. Current forest inventory information is more than 20 years old in some places, and hasn' t



Measuring the height of a tree during a forest inventory.
(U.S. Army Corps of Engineers.)

been inventoried at all in others. There have been major ecological events that have altered forest structure and composition, including the Flood of 1993. There are gaps in forest structure data that should be corrected in the next inventory, and other habitat considerations should be included in the next inventory, including measuring herbaceous vegetation. Global positioning systems, GIS, and statistical sampling should be incorporated where possible, to give the best possible results. The formation of a committee of participating agencies to begin the development of an inventory system would be beneficial.

Forest Succession Monitoring
There is a need to get information on the successional patterns of the floodplain forest after the dominant overstory' s decline. It is noted, from casual observation, that in the upper pools the closed-canopy forest is turning into a silver-maple savanna, with the predominant understory being reed canary grass. This is of concern because it is not evident that trees can easily compete at these sites. In some areas willow has invaded reed canary grass and bring with it, silver maple in its' understory. There is little information about regeneration of hard-mast trees in the floodplain forest. However, it has been noted that there is very limited regeneration of these hard mast species occurring. The reasons could be that increased water levels make former mast-producing sites unsuitable for regeneration. Silver maple is known to have invaded the understory of many hard mast stands, creating conditions too heavily shaded for hard mast regeneration. In short, successional patterns are not well understood in a vastly altered system.

Conducting a forest regeneration survey. (U.S. Army Corps of Engineers.)

Monitoring of a variety of older forest types for successional patterns should be considered. This information should then be used to determine what and where silvicultural practices are needed most, or if at all.

A 1995 post-flood regeneration study looked at regeneration and the canopy of sites in select pools of the Mississippi River. These sites were visited again in 2000-2001 to determine further regeneration of the forests and further impacts of the flood. These sites would make excellent choices to permanently monitor every 10 years, or so, to better understand the natural succession in a highly disturbed system.

Water Level Management
The concept of reducing pool levels on the Mississippi River to encourage growth of aquatic vegetation may also prove to be beneficial for promoting natural regeneration of floodplain forest species. Additional attention should be focused in this area and applied where possible.

2001 Drawdown of Mississippi River Pool 8. (U.S. Army Corps of Engineers)

Research and Monitoring Activities
Research is a key component to improving forest management techniques along the UMRS. Regular funding for these activities should be a priority for the management agencies. Some of the study areas where more information is needed include: control of invasive species, experimental water level reductions, forest seeding, and planting techniques. It is also suggested that a panel of experts be convened to make additional recommendations on forest management. Representatives from academia, resource management agencies, conservation groups, forest industry, and others would make up the panel.

Opportunities to monitor forest management activities on private lands along the UMRS should also be sought. The techniques used and the natural response would be valuable information that could be applied on the federal lands.

Policy, Funding and Management Program Changes.
The restoration and enhancement of the UMRS floodplain forest requires changes in current agency funding and management programs. Forest "rotations" are long-term in nature and thus require multi-year programs for successful management. Short-term programs are inadequate. Forest management programs need to become part of the operation and maintenance of the 9-foot navigation project. Additional programs to enhance land use activities within the basin of the UMRS, on both public and private lands needs to be expanded. For example, the integration of State and Federal land use programs such as the Illinois Forestry Development Act and the federal Conservation Reserve Program provide cost-share money for enhancement of floodplain forests on private lands.

The COE and USFWS need to develop creative forest management practices to enhance the floodplain forest. Changes in floodplain forest management will require increased Corps support through the Environmental Management Program. Habitat projects need to include forestry goals of sustainability and diversity. Evaluation of forest management activities through monitoring and research activities needs to be included in an expanded Long Term Resource Monitoring Program now being implemented by the COE, USGS and cooperating States. Such monitoring must include forest inventory data collected by the COE and USFWS.

Swamp white oak seedlings protected with tree shelters. (U.S. Army Corps of Engineers.)

Great blue herons (Courtesy of Aaron Barna.)

Management Limitations

Corps of Engineer foresters in the Rock Island District observed a situation following one recent timber sale where soil moisture conditions changed significantly after the trees were removed from the site. During their attempts to regenerate the site back to trees, the foresters noted a vegetative response typical of more saturated soils, namely cattails and arrowheads. This seemed to indicate that the uptake of water by the mature trees, which had just been removed, was significant enough to regulate soil moisture and keep the site relatively dry. By removing the trees, the uptake of water may have been reduced, resulting in higher soil moisture. Currently, it does not appear that the site will support trees until a reduction in ground and surface water occurs. Scientific research would be needed to verify the processes that actually took place at this site following timber harvest. But it is important to document these and other types of management results, in order to demonstrate the potential limits of current management techniques. It is also important to note that this situation may be somewhat unique, and that many other floodplain forest areas on Corps fee title lands have been successfully regenerated through the use of timber harvest.

Many of the bottomland areas along the upper Illinois River contain thick layers of flood deposited sediments that are high in pH. Much of the sediment is from the erosion of the farmlands and bluffs where the underlying soils are very calcareous. In high pH floodplains, conversion to flood tolerant hard mast trees like pin and swamp white oak may not be feasible. These species require much lower pH levels for optimum growth. They may survive in such areas, but growth and vigor will be greatly reduced and mast crops will be poor. They may also be susceptible to stress-induced attacks by insects and disease.

Fall forest scene along the Upper Mississippi River.
(Courtesy of Eric Moore.)

Section VI. Conclusion

The forests of the UMRS floodplains are constantly changing. Within the last 70 years, society' s impacts have been especially significant. Time will bring about even more transformation of these resources. We hope this document highlights the importance of forward thinking, planning and management action by those agencies, organizations and individuals responsible for the stewardship of this essential floodplain. Through the combined efforts of these natural resource managers, we have the opportunity to influence and direct the changes to maintain a floodplain forest that contributes to the overall quality of the UMRS ecosystem.

Tree roots exposed by shoreline erosion on the Upper Mississippi River. (U.S. Army Corps of Engineers.)

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Upper Mississippi River Conservation Committee
4469 48th Avenue Court
Rock Island, IL 61201
309-793-5800
umrcc@mississippi-river.com

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