CHAPTER 3

Important Milestones in the Human and Ecological History of the Upper Mississippi River System

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Figure 3-1. According to archaeological finds, the city of Cahokia, located near modern-day St. Louis, Missouri, was inhabited from about A.D. 700 to 1400. At its peak from A.D. 1100 to 1200, the city covered nearly six square miles and had a population as great as 20,000 people living in extensive residential sections. Houses were arranged in rows and around open plazas. The main agricultural fields lay outside the city. The fate of the Cahokians and their city is unknown. Depletion of resources probably contributed to the city's decline. A climate change after A.D. 1200 may have affected crop production and the plant and animal resources needed to sustain a large population. War, disease, social unrest, and declining political and economic power also may have taken their toll. A gradual decline in population began sometime after A.D. 1200 and, by 1400, the site had been abandoned (Source: William Iseminger, Illinois Historic Preservation Agency, Collinsville, Illinois).

Humans have lived in the Upper Mississippi River basin since approximately 9000 B.C. During most of this time, their effect on the river was relatively minor, especially when compared to the last 150 years in which the ecology of the river, floodplain, and basin has been influenced significantly by human presence. Historic use of the river and floodplain resources ranges from subsistence to the more recent introduction of structures and environments engineered on a large scale to fit economic needs.

No single reference is available to summarize the complete human history on the Upper Mississippi River. Humans have been present as transients in the basin for almost as long as they have been on the North American continent. When the river environment stabilized after the Wisconsinan ice age, human populations became more settled, developed agriculture, and established trade routes. Settlement near waterways guaranteed transportation and valuable food resources. Both the Mississippi and Illinois Rivers were important trade routes from the start and historians have only begun to compile the rivers' rich archaeological history (Figure 3-1). In this report, however, we focus on human activities after European "discovery" of the Upper Mississippi River.

The river's importance as a shipping route declined in the mid-1800s because most commerce began moving east to west on railroads or through the Great Lakes and St. Lawrence River

Early Explorers and Trappers

The French were the first Europeans to reach the Mississippi River. Jesuit missionary Jacques Marquette and explorer Louis Joliet entered the Mississippi River from the east via the Wisconsin River in 1673, returning up the Illinois River to Lake Michigan. In subsequent periods French trade and religious influence altered the lives of native peoples in the Mississippi valley dramatically. Native Americans traded with the new immigrants and trapped beaver and other fur-bearing mammals in vast quantities for the French. The original population of 10 to 40 million beaver was decimated by the late 1800s. They were considered extinct in Illinois by mid-century (Hey and Philippi 1995). Decimation of the beaver population may have caused significant hydrologic, and thus ecologic alterations throughout the basin because over 50 million acres (20 million hectares) of surface water that had been stored behind beaver dams was lost (Hey and Philippi 1995).

Soon after first contact with Europeans, smallpox and influenza took a heavy toll on the native peoples. Estimates vary, but conservatively speaking the total pre-European native population of North America (about 18 million people) was reduced by between 70 and 90 percent before extensive exploration of the interior of the continent took place. Diseases unknowingly introduced by early European explorers and trappers were distributed even wider by a highly mobile native population. The ultimate fate of the basin's native population as the European influence spread westward was dislocation and assimilation.

Early Development in the Mississippi River Basin (1800s)

Zebulon Pike explored the Upper Mississippi River for the U.S. Army soon after the Louisiana Purchase was completed in 1805. Land purchased from the local Sioux tribes ultimately became the site of Fort Snelling (Figure 3-2), the farthest northwest outpost of the U.S. Army. Establishment of Fort Snelling encouraged immigration to the Upper Mississippi region by European settlers moving north to harvest the vast white pine forests of Minnesota and Wisconsin, west to plow the prairies into wheat fields, and southeast to mine lead deposits in Wisconsin and Illinois.

Immigrants used the Mississippi River as a conduit to markets as far south as St. Louis, Missouri. The river's importance as a shipping route declined in the mid-1800s because most commerce began moving east to west on railroads or through the Great Lakes and St. Lawrence River. Shipping south was not economical because most materials were being shipped to northern Europe and passage down the Mississippi and back up the Atlantic coast took much longer. A second decline in river shipping between 1895 and 1915 is attributed to the final decimation of the great pine forests in the north (Hoops 1993).

The original mode of travel along the Mississippi River was the canoe—usually a hollowed log or a frame covered with bark or animal skins—used by the Native Americans and adopted by early European explorers. As the number of passengers and cargo increased, larger capacity keelboats that could be poled or pulled from shore became a popular river vessel. The first steamboat entered the Lower Mississippi River in 1811 but it was not until 1823 that self-propelled watercraft entered the Upper Mississippi.

Expanded commercial traffic soon followed (Figure 3-3) but was limited to high-water periods when the river rapids were submersed and the river exceeded its 3-foot (0.9-m) average depth. Below the Missouri River, steamboat traffic was not limited by river conditions. Many riparian forests were clear-cut for wood to feed the growing fleet (see Chapter 9). Clear-cutting destabilized river banks and led to significant erosion and changes in the river's width near St. Louis (Strauser 1993; Norris 1997; see also Chapter 6).

The treacherous nature of the Mississippi River was well known to early river pilots and businessmen, many of whom lost vessels or had shipments delayed. In 1838 and 1839, the U.S. Army Corps of Engineers (USACE) was authorized to improve navigation by blasting a channel—5 feet deep (1.5 m) and 200 feet wide (61 m)—through the Des Moines Rapids. By 1854 the USACE was authorized to create a channel through the Rock Island Rapids and clear snags and other hazards in the river. Competition with river traffic came at this time in the form of the railroad as it advanced into the Midwest. The railroad provided another method for shipping commodities and greater access to markets in the East and West. This, combined with the hazardous river conditions, further hastened the decline of river traffic.

Figure 3-2. Built between 1820 and 1824 under the direction of Colonel Josiah Snelling, Fort Snelling lies at the confluence of the Minnesota and Mississippi Rivers. The fort was one of a series used to protect American trade and expansion on the frontier against British influence and Native Americans. It served as a center for Native American contact, including the doling out of annuities for land. Although no pitched battles occurred at its gates, Fort Snelling was considered an "isle of safety," and the cities of Minneapolis and St. Paul, Minnesota, and the entire region grew under its guard. As Americans settled the Upper Mississippi River Valley, Fort Snelling was no longer needed to keep the peace. It remains, however, a strong and picturesque reminder of the region's early history (Source: John Anfinson, U.S. Army Corps of Engineers, St. Paul District, St. Paul, Minnesota).

After the Civil War (in 1866) Congress authorized a 4-foot (1.2-m) channel project that utilized a combination of dredging and snag clearing to maintain a navigable channel. The 4-foot channel project was replaced by a 4.5-foot (1.4-m) project in 1878 (Figure 3-4). Under pressure from navigation and business interests, Congress authorized a 6-foot (1.8-m) channel project in 1907, a plan outmoded before it was finished. In 1930, a 9-foot (2.7-m) channel was authorized and is the project operated and maintained by the USACE to the present day.

Toward the end of the nineteenth century, almost seven decades of channel improvement projects began to take their toll on the river environment. Side channels and backwaters were isolated by closing structures. The channel bed was scoured by increased current velocities between the wing dams. Sediments started to accumulate in slack water habitats. Introduction of the steel plow to turn the prairie to cropland and the logging of northern white pine forests increased erosion and sediment delivery from tributary streams. Logging waste, sewage, and industrial wastes were

Figure 3-3. St. Louis Harbor, circa 1848. By 1860, 735 steamboats operated daily on the Mississippi River near St. Louis and their fuel consumption (preferably cured oak, beech, ash, or chestnut) was enormous. Norris (1997) estimated the daily "cordwood" consumption of a single large steamboat was equal to the amount needed to construct 15 small frame houses. He extrapolated a conservative estimate for an annual wood consumption for the entire fleet equal to 670,687 buildings. The environmental impact of intensive wood harvests was noted early. Surveyors in 1842 recorded that 50 percent of the trees had been harvested along survey lines ending at the river bank (Nelson et al. 1994). Deforestation led to bank destabilization and channel migrations that destroyed many colonial villages and other archeological sites (Norris 1997; see also Chapter 4) (Source: Missouri Historical Society, St. Louis).

Figure 3-4. Snag clearing in 1885 (top photo) contributed to the instability of the river bank because trees were removed 100 to 200 feet (30 to 60 m) back from the shoreline to reduce future hazards. Wing dams constructed in 1891 by placing consecutive layers of willow mats and rock together (bottom photo) were used to constrain the channel, increase water levels, scour the channel, and reduce shoreline erosion (Source: John Anfinson, U.S. Army Corps of Engineers, St. Paul District, St. Paul, Minnesota).

Figure 3-5. The Nutwood Levee is the last in a series that isolates much of the Lower Illinois River from its floodplain.

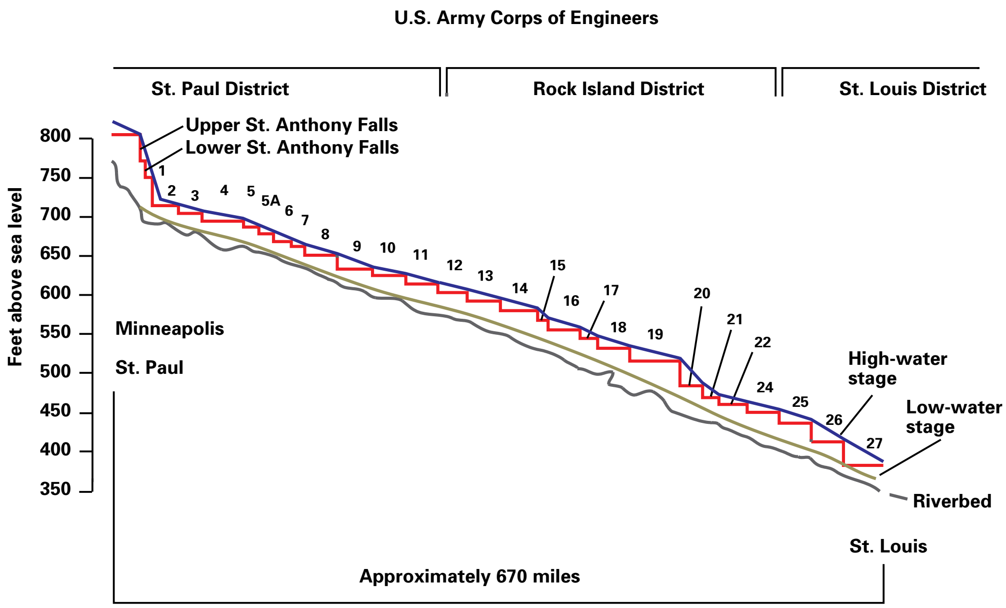
creating problems downstream from urban areas. Logging and agricultural land conversions were beginning to have an impact on large expanses of the fertile floodplain (see Chapters 4 and 9).

Concurrent with navigation system development, the human population expanded greatly along the river. (In the greater basin, the larger populations required increased use of resources and contributed to the extirpation of bison and elk and severe declines in the abundance of deer.) River fishes were used to support growing urban populations and, eventually, many of the large fishes (sturgeon, paddlefish, catfish) reported by early explorers became rare. Concentration of people in large urban areas resulted in development of sewage systems that, until recent times, discharged raw sewage directly into the river. Fish kills and water quality problems were common downstream of large cities.

Modern Development in the Mississippi River Basin (1900s)

In 1900, completion of the Chicago Sanitary and Ship Canal created a permanent connection between Lake Michigan and the Illinois River through the Des Plaines River. The project was created to improve water quality in Lake Michigan, long degraded by sewage discharges directly into the lake from the Chicago area. Diversion of water from the lake allowed wastes to flow downstream from Chicago, thus protecting the city's vital water supply. The diversion increased Illinois River flows, raised water levels about 3 feet (1 m), and permanently inundated an additional 22,500 acres (9,100 ha) of terrestrial and wetland floodplain habitats (Havera and Bellrose 1985). As described in Chapter 14 of this report, the canal diversion was an ecological tragedy that severely degraded the Illinois River, filling it with domestic sewage and industrial pollutants. Thanks to modern environmental regulations and effective waste treatment, however, recent signs of the river's recovery demonstrate the value of recognizing a human-made problem, taking action, and giving the self-restorative powers of the river the chance to work.

Expanded levee construction to protect rich river-bottom farmland and urban areas from moderate floods also affected floodplain ecology. Levees and agricultural encroachment sequestered highly productive river floodplains that previously supported vast habitats and the animals depending on them (Figure 3-5; also see Figure 4-11 and Chapters 4 and 9). A by-product of increased sedimentation and levees was the trapping of sediments within the confines of the river and the levees. This resulted in a gradual loss of depth and overall aquatic area in the remaining backwaters. Recently deposited sediment was unconsolidated (soft) and easily resuspended by waves. This action clouded the water and contributed to the loss of aquatic plants (Sparks et al. 1990; see Chapters 4 and 14). Levee building was active but uncoordinated in the late 1800s. After



Cross section diagram of 9-foot channel, Upper Mississippi River

Figure 3-6. An elevation profile of the Upper Mississippi River System (dams numbered) illustrates the increase in low-flow river stage caused by navigation dams. Also important—the river at flood stage exceeds stages necessary for navigation and is allowed to flow freely through and over the dams (Source: John Nelson, Illinois Natural History Survey, Alton, Illinois).

disastrous flooding in 1927, levee construction in the Unimpounded Mississippi River was coordinated by the USACE. Levee development in the Upper Mississippi and Illinois Rivers continued to be implemented by individuals or cooperative levee districts.

The most significant change to the Upper Mississippi and Illinois River ecosystems was construction of the 9-foot (2.7-m) channel project; the Upper Mississippi River System (UMRS). Promoted in the 1920s and early 1930s by farmers, shippers, and businessmen who believed a deeper channel (and Government-supported barge line) would help lower railroad rates, the project was opposed by conservationists, some Congressional representatives from states along the river, and a few high-ranking members of the USACE. Nevertheless, authorization came in 1930 but the project received minimal funding during the early years of the Great Depression and the last years of the Hoover administration. With the Roosevelt administration and the New Deal in 1933, the channel project was resurrected to put people back to work in the Midwest (Hoops 1993). It led to construction of 29 locks and dams on the Mississippi River and 8 locks and dams on the Illinois River.

These new navigation dams created a flowing-water river stairway (pools) that enabled modern towboats to surpass historic obstacles and easily traverse the 400-foot (122-m) elevation gradient and the 670 miles (1,078 km) between St. Louis, Missouri, and Minneapolis, Minnesota (Figure 3-6; also see Chapter 4). The navigation system raised water levels and inundated thousands of acres of floodplain habitat (see Chapters 4 and 6). Whereas initial construction of the 9-foot channel produced great aquatic productivity in the newly created shallow backwater wetlands, productivity has declined as sediments from the uplands have accumulated in backwater areas. Stabilized water levels also eliminated the abiotic controls (i.e., flooding and drying) that previously helped maintain highly productive river floodplain habitats.

Development and refinement of the internal combustion engine and its use on farms affected the entire basin. Before motorized tractors, farmers were limited in the amount of land they could till with horse-drawn equipment. Development of the

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Figure 3-7. Modern agricultural tools transformed the face of farming after World War II. Mechanization and the development of chemical fertilizers and pesticides promoted row crop agriculture. The effects are wide-ranging in terms of sedimentation, nutrient enrichment, and chemical contamination (Source: U.S. Fish and Wildlife Service, Onalaska, Wisconsin).

gas-powered tractor in the 1920s allowed farmers to expand their influence throughout the basin. Although limited before World War II, row crop agriculture expanded greatly after the war (Figure 3-7). Poor land-use practices in the uplands produced high levels of soil erosion and these eroded soils ultimately accumulated in UMRS backwater and channel border areas (Bhowmik and Adams 1989).

In Wisconsin, soil erosion problems on steep slopes were noted earlier than in flatter regions of the basin. Soil conservation practices implemented in the 1930s greatly reduced soil loss, but the stream network still stores much of the eroded soil (Knox 1977).

Following World War II, industrial activity and urbanization increased throughout the country, especially along major waterways (Figure 3-8). At first praised as economic success, post-war growth produced massive amounts of industrial, urban, and agricultural pollutants. In response, a massive ongoing investment was made to eliminate or reduce the use of toxic chemicals and develop new wastewater treatment methods. Control of point-source industrial pollutants and sewage improved during the 1960s and 1970s and harmful agricultural chemicals (DDT and DDE) were outlawed. Nonpoint pollution, however, is still a major problem; sediment-related factors and agricultural chemical delivery continue to impact the Mississippi River ecosystem (see Chapter 7).

Present Status

The UMRS and its associated floodplain areas presently support multiple, sometimes competing uses. The navigation system frequently has been used to define the spatial extent of the UMRS (i.e., navigable waterways). Ecological communities and human use do not conform to artificial boundaries but instead respond to physical attributes of the river environment. Physical attributes differ along the length of the river, therefore human use, ecological communities, and human impact on the river floodplain environment also exhibit differences along the river.

Referring to spatial scales discussed in Chapter 2, human activity at each scale has an effect on river resources. On the basin and stream network scales, agriculture and urban development are two very important factors affecting the UMRS. Navigation, floodplain agriculture, and river recreation are activities usually considered within the river floodplain only, but they are important factors spanning the entire UMRS. Levee development, navigation impacts, and recreation can be compared among floodplain reaches but the ecological effect on individual plants and animals in the system is best illustrated on the pool- or habitat-area scale.

Agriculture presently dominates 60 percent the UMRS basin landscape. The most heavily cultivated areas are in the central and northwestern regions of the basin and make up a large portion of the Midwest corn belt. Major cash crops include corn and soybeans, two large components of the U.S. agricultural export market. The stream network also has been modified, primarily through field tiles and stream channelization, to increase the rate of water delivery from farm fields. The result has been high rates of basin erosion, stream degradation, nutrient enrichment, and sedimentation in the Mississippi and Illinois Rivers, although erosion rates have declined recently (See Chapter 5). Agricultural development is responsible for elimination of 26-million acres of wetlands in the basin over the last century (Dahl 1990).

The UMRS basin population is approximately 30 million people, with the highest population density in cities along the rivers. Urban development is most evident in the metropolitan areas of Minneapolis-St. Paul, Minnesota; the Quad Cities (Bettendorf and Davenport, Iowa, and Rock Island and Moline, Illinois); Chicago and Peoria, Illinois; and St. Louis, Missouri. However, many smaller cities, such as La Crosse, Wisconsin; Dubuque, Iowa; Quincy, Illinois; and Cape Girardeau, Missouri; support large populations on the rivers. Urban development increases the rate of water delivery to the stream network because of the conversion of permeable soils to concrete, asphalt, and roof tops. Storm runoff in urban and suburban locations is contaminated with a variety of automobile wastes, industrial contaminants, and residential pesticides and fertilizers. For the most part, urban runoff enters the rivers untreated in storm waters, but some cities are modifying their sewer systems to treat storm runoff. Municipal and industrial pollution has been controlled to a great extent in most cities and towns.

Population distribution has been analyzed for the USACE districts that approximates the floodplain reach classification described in Chapter 2. The St. Paul District (Pools 1–10) has about 2.2 million people and the Rock Island District about 1 million people on the Mississippi River. The Rock Island District also has about 1 million people on the Illinois River (exclusive of Chicago). The St. Louis District (Pool 24–Ohio River) has about 2.6 million people (USACE 1993).

Figure 3-8. Urban and industrial development, as seen along the Upper Mississippi River near St. Louis, Missouri, historically have been the source of large amounts of sewage, garbage, and toxic chemicals. Water quality regulations passed in 1972 have been an impetus for waste treatment infrastructure development that has improved water quality throughout the Upper Mississippi River System (Source: *St. Louis Post-Dispatch*).

Navigation, recreation, and floodplain agriculture are ecologically important human activities when considering the UMRS and its floodplain. The UMRS provides bulk-commodity transport of grain, coal, and petroleum, with grain being the leading product shipped. In 1995, shippers transported 126 million tons (114 metric tons) of cargo on the system’s 1,300 commercially navigable miles (2,092 km). Commercial navigation on these inland waterways saves the nation’s economy about $1 billion per year in transportation costs according to the USACE 1990 Reconnaissance Study (Paul Soyke, USACE Rock Island District, Rock Island, Illinois, personal communication). The system of locks, dams, and channel structures supporting commercial navigation is a public resource that has required an average of more than $120 million in annual Federal expenditures over a 5-year period (1993–1997) to operate and maintain (Henry Bordolon, USACE Mississippi Valley

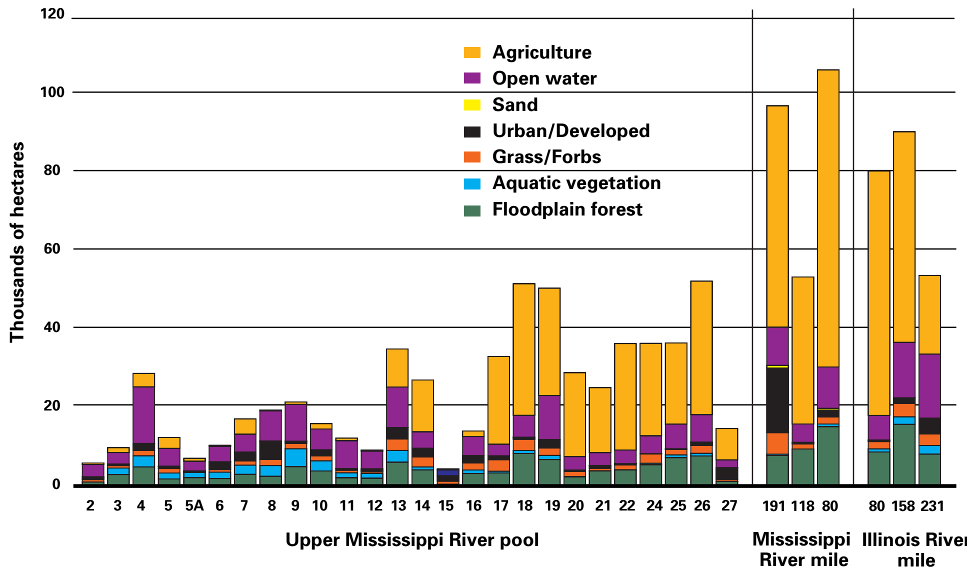

Figure 3-9. Land-cover classes derived from 1989 satellite imagery reveal the distribution of land use, the increasing size of the floodplain, and the decreased proportion of permanent water within the river floodplain among various river reaches. Agriculture is more prominent in the Lower Impounded (Pools 14–26), the Unimpounded, and the Illinois River reaches. The size of the floodplain also increases in a downstream direction. This means though the total amount of water remains about equal, the proportion of the water as part of the floodplain decreases. Much agricultural land has been isolated from the river by levees (Source: Yao Yin, USGS Environmental Management Technical Center, Onalaska, Wisconsin).

Division, Vicksburg, Mississippi, personal communication). In 1986, a 20-cent-per-gallon fuel tax was established to support a nation-wide trust fund to help offset costs of major improvements to the inland waterway. The UMRS is a key component in a network that links Midwest farms with economically important international grain markets.

Recreation is another major use of the UMRS. Fishing and boating are among the most popular pastimes on the river, but hunting, birding, swimming, camping, and visits to historic towns and archeological sites also are common activities. Recent statistics show the total annual economic benefit of recreation to communities bordering the rivers exceeded $400 million and created 7,000 jobs (USACE 1993). The total benefit, by including indirect effects throughout the five Upper Mississippi River states, exceeded $550 million and created 10,000 jobs. The national annual economic benefit of UMRS recreation spending was $1.2 billion (USACE 1993). However, recreational activities are not distributed evenly along the river. The St. Paul District (Pools 1-10) alone accounted for 60 percent of the total for the UMRS. The Mississippi River portion of the Rock Island District (Pools 11-22) accounted for 31 percent of the UMRS recreation total. Recreation spending on the Illinois River portion of the Rock Island District accounted for only 2 percent of the total and the St. Louis District (Mississippi River), only 6 percent.

Agricultural development in the floodplain is heavily weighted toward the southern half of the Mississippi River and the Illinois River below Peoria (Figure 3-9). This is due to morphological features of the floodplains that widen significantly below Rock Island and Peoria. The floodplain width of the Mississippi River south of Rock Island and the Illinois River below Peoria averages 4–6 miles (6.5–10 km) but exceeds 10 miles (16 km) in some spots. Levees contribute to the success of floodplain agriculture but they too are unevenly distributed. Major reaches along the UMRS have been leveed as follows: about 3 percent (15,000 acres; 6,071 ha) of the floodplain in the Upper Impounded Reach, about 53 percent (530,000 acres; 214,491 ha) of the floodplain in the Lower Impounded Reach, about 82 percent (543,000 acres; 219,752 ha) of the floodplain in the Unimpounded Reach, and about 50 percent (120,000 acres; 48,564 ha) of the floodplain in the Illinois River Reach (UMRBC 1982). Floodplain agriculture has a long history and accounts for significant income to river communities. The economic statistics for floodplain crop production (compared to county-wide estimates) have not been isolated so the value of floodplain farming cannot be readily quantified.

Fish and wildlife habitat value also differs among the four major floodplain reaches. Differences primarily relate to the types of land uses in both the basin and the river floodplain. Habitat value can be roughly ranked as best in the Upper Impounded Reach, followed by the Lower Impounded Reach, the Illinois River Reach, and the Unimpounded Reach. Human effects and ecological mechanisms that relate to these differences are the focus of the remainder of this report, but some major differences are introduced here.

Discussion

Human settlements have a rich cultural connection with the Upper Mississippi and Illinois Rivers that is touched on only briefly in this chapter. Major land-use practices, infrastructure developments, and population distributions that affect the rivers' ecology are described in greater detail. It is clear that, although we have only engineered the river environment for the last 150 years, the changes have been significant and, for the foreseeable future, permanent.

Development throughout the basin and the river floodplain is closely related to physical structure and available land cover. The first settlers in the north were drawn by vast pine forests and mineral deposits. Settlers in the central basin were drawn by the broad prairies they could convert to farms. In the river floodplain, settlement was more closely related to the river. Many people who settled along the rivers were attracted by its bountiful resources of fish and game (especially fur bearing animals). Others created commerce based on the river's resources, such as the shell button industry (see Chapter 11). Industries were attracted to the rivers to tap the water resource and ship products. Farmers were attracted by the rich alluvial soils in the vast floodplains in the southern portions of the rivers.

Modern development closely followed early patterns. Cities grew and their waste disposal affected river resources hundreds of miles from the rivers' source. Farmers in the lower portions of the Illinois and Mississippi Rivers converted much of the floodplain to agriculture and eventually constructed levees to protect crops from moderate floods. Navigation development modified the river floodplain throughout the entire system to provide reliable transportation and recreational infrastructure.

Throughout the development period, concern for the rivers' natural resources was expressed but generally ignored. Purchase of lands for the Upper Mississippi River National Wildlife and Fish Refuge north of Pool 14 was an important exception. It not only limited development, but allowed for recreational access and natural resource management. Other areas suffer from a lack of public lands. Much of the floodplain land in other river reaches was privately owned and unavailable for purchase when the navigation system was built.

Present day use of the rivers still reflects the physical environment provided by the river, but also signifies earlier development decisions. Where the river provides a rich mosaic of floodplain vegetation, braided channels, islands, and vegetated backwaters on public land, recreation use and expenditures are high. Where the river has broad fertile floodplains converted to agriculture, few backwaters and little public land, recreational use and expenditures are low. Industrial activity remains largely tied to urban centers. Navigation is still central to the management of the rivers and continues to affect the ecology and economy of the region.

This chronology of the history of the Upper Mississippi River System illustrates the inextricable link between the physical environment, human use and impacts, and the ecological condition of the rivers. It also serves as background for the detailed reviews in this report on individual factors in the river ecosystem.

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