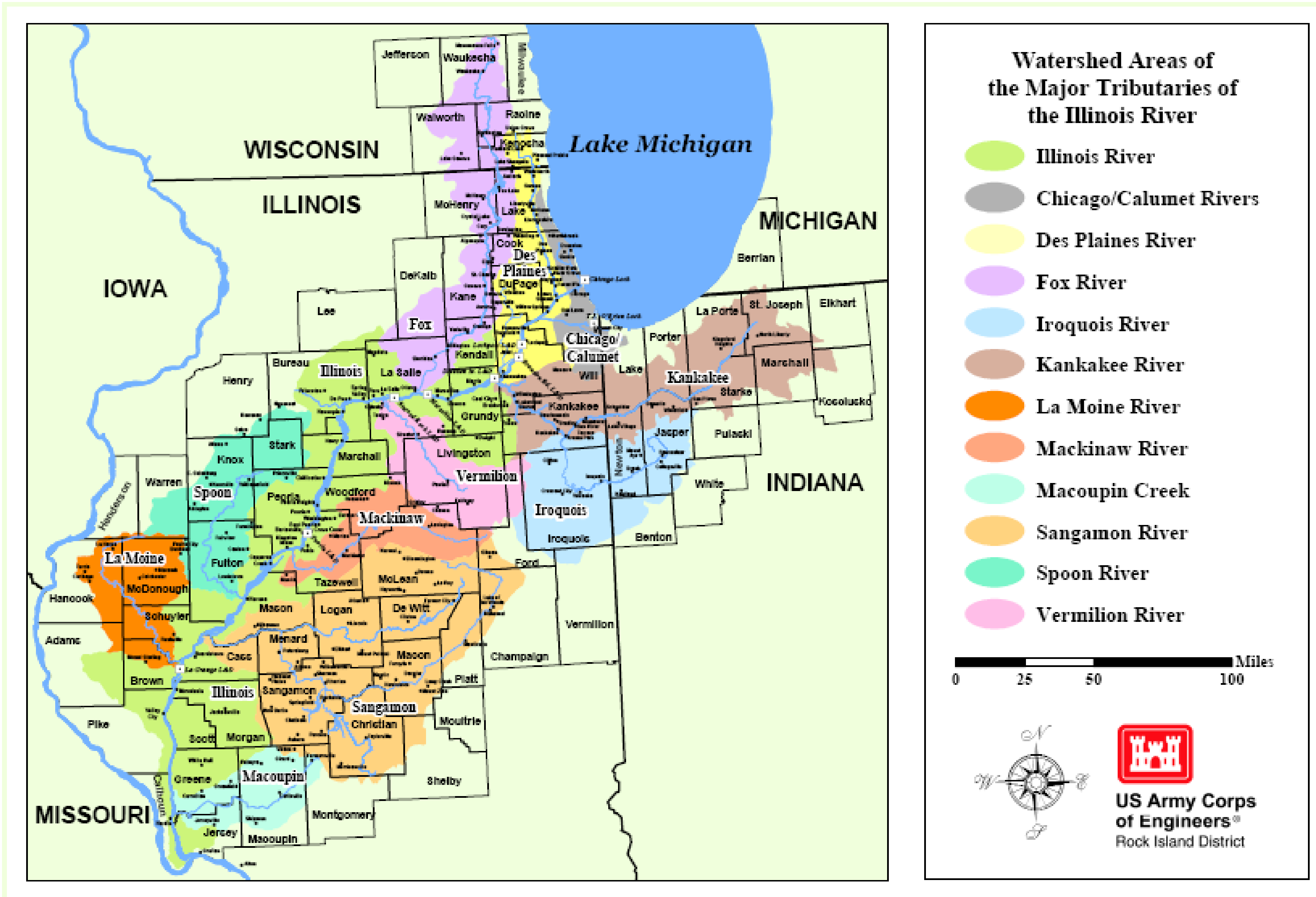

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Figure 2-1. Illinois River and Tributaries

2. STUDY CONTEXT AND SETTING

A. NEED FOR ACTION

The Illinois River Basin has experienced the loss of ecological integrity due to sedimentation of backwaters and side channels; degradation of tributary streams; increased water level fluctuations; reduction of floodplain and tributary habitat and connectivity; and other adverse impacts caused by human activities. Figure 2-1 depicts the Illinois River and its tributary streams.

The combined effects of habitat losses—through changes in land use, human exploitation, habitat degradation and fragmentation, water quality degradation, and competition from aggressive invasive species—have significantly reduced the abundance and distribution of many native plant and animal species in the Illinois River Basin. Additional human alterations of Illinois River Basin landscapes have changed the timing, magnitude, duration, and frequency of habitat forming and seasonal disturbance regimes. The cumulative results of these complex, systemic changes are now severely limiting the ecological integrity of the basin.

Increased sediment loads from the basin have severely degraded environmental conditions along the main stem Illinois River by increasing turbidity and filling backwater areas, side channels, and channel border areas. Improved conservation practices have reduced the amount of sediment generated from many agricultural areas, but large quantities of sediment are still delivered to the river due to eroding channels and tributary areas, including urban and rural construction sites. The most critical problems resulting from the increased sediment loads are the loss of depth and habitat quality in off-channel areas connected to the main stem river. Similar problems can be seen at other areas within the basin where excessive sediment has degraded tributary habitats.

A dramatic loss in productive backwaters, side channels, and channel border areas due to excessive sedimentation is limiting ecological health and altering the character of this unique floodplain river system. In particular, the Illinois River has lost much of its critical spawning, nursery, and overwintering areas for fish; habitat for waterfowl and aquatic species; and backwater aquatic plant communities, limiting ecological health and altering this unique floodplain river system. A related problem is the need for timely action. If restoration is not undertaken soon, additional significant aquatic areas will be converted to lower value and increasingly common mud flat and extremely shallow water habitats.

Land use and hydrologic change have reduced the quantity, quality, and functions of aquatic, floodplain, and riparian habitats. Flood storage, flood conveyance, habitat availability, and nutrient exchange are some of the critical aspects of the floodplain environment that have been adversely impacted.

There is diminished aquatic (upstream/downstream fish passage) connectivity on the Illinois River and its tributaries. Aquatic organisms do not have sufficient access to diverse backwater and tributary habitats that are necessary at different life stages. Lack of aquatic connectivity slows repopulation of stream reaches following extreme events, such as pollution, low flows, or flooding, thereby reducing genetic diversity of aquatic organisms.

Basin changes and river management have altered the water level regime along the main stem Illinois River, stressing the natural plant and animal communities along the river and its floodplain. Land use changes, the construction of the locks and dams (which create relatively flat navigation pools), and isolation of the river main stem from its floodplain have all impacted the water level regime to varying extents. Two of the most critical results from the basin changes and river management, are the increased frequency and increased magnitude of water level fluctuations, especially during summer and fall low water periods. The lack of the ability to mimic natural hydrologic regimes in areas upstream of the navigation dams is also a problem. Increased flow variability has reduced ecological integrity in tributary areas as well.

Water resources in the Illinois River Basin are impaired due to a combination of point and non-point sources of pollution. Although effective regulatory efforts have reduced contributions from point sources, non-point sources of water quality impairment (such as sediments and nutrients) continue to degrade the surface waters.

The general ecosystem health, or integrity, of the Illinois River Basin is still declining in spite of the dramatic water quality improvements made as a result of the Clean Water Act and increasing numbers of local restoration efforts. Pressure on the remaining habitats will continue to increase as the basin's population increases. Finally, changes to the ecosystem, over time, have been dramatic. Current trends may be difficult to reverse, but with significant commitments of resources and time, this nationally-significant basin can be restored.

B. SIGNIFICANCE OF THE ILLINOIS RIVER BASIN ECOSYSTEM

The benefits of ecosystem restoration and protection projects are difficult to measure in monetary terms. When determining Federal interest, it is important that the significance of the resources being studied for restoration be clearly identified. The Corps of Engineers' *Principles and Guidelines* defines significance in terms of institutional, public, and technical recognition of the resources. For years, the State of Illinois and other agencies have been engaged in activities that clearly demonstrate the institutional, public, and technical recognition of the resources of the Illinois River Basin.

1. Institutional. The formal recognition of the Illinois River Basin in laws, adopted plans, and other policy statements of public agencies and private groups illustrates the significance of the basin to a variety of institutions. At the Federal level, the Illinois River's importance as an environmental and economic resource has long been recognized by congressional action and through the activities of several agencies. The U.S. Congress recognized the Illinois River, part of the Upper Mississippi River System (UMRS), as a unique, "…nationally significant ecosystem and a nationally significant commercial navigation system…" in Section 1103 of the Water Resources Development Act of 1986 (WRDA 86). The Upper Mississippi River System - Environmental Management Program (UMRS-EMP) was established in 1986 and has been conducting monitoring and habitat restoration activities along portions of the main stem of the Illinois River. The EMP brings together the expertise of the U.S. Army Corps of Engineers, the U. S. Fish and Wildlife Service (USFWS), the U.S. Geological Survey, and the U.S. Environmental Protection Agency (EPA). Congress reaffirmed the significance of the Upper Mississippi River System by reauthorizing the UMRS-EMP in 1999. The U.S. Department of Agriculture selected the Illinois River Basin as one of the first seven areas in the country for the Conservation Reserve and Enhancement Program (CREP), a program allowing enhanced Federal and State partnership opportunities to implement land conservation practices.

The Midwest Natural Resources Group (MVRG) is an ongoing partnership of 12 Federal Agencies, bringing focus and excellence to Federal activities supporting the vitality and sustainability of natural resources and the environment. On May 10, 2000, the U.S. Departments of Agriculture (USDA), Army, and Interior; the U.S. EPA, Federal Highway Administration, Maritime Administration and the U.S. Coast Guard signed an Intergovernmental Partnership Agreement stating that they shall work, in partnership with State and local governments, non-governmental organizations, private landowners and individuals, to restore and protect the ecological integrity of the Illinois River Basin in a manner consistent with reducing flood damage, protection of private property rights and maintaining an effective navigation system.

The State of Illinois has clearly demonstrated its institutional recognition of the Illinois River Basin as a significant resource. The state has developed, adopted, and begun implementation of the *Integrated Management Plan for the Illinois River Watershed* (1997); enacted the Illinois River Watershed Restoration Act; invested $51 million to match $271 million in Federal dollars in implementing the CREP on 110,000 acres with the potential to expand to 232,000 acres; and set the vision for Illinois Rivers 2020, a proposed $2.5 billion, 20-year Federal and State program to restore the Illinois River Basin.

The *Integrated Management Plan for the Illinois River Watershed* (1997) was the culmination of several years of effort by local and State governments in Illinois to build a consensus-based partnership with citizens and interest groups to address the issues that face the Illinois River Basin. The plan identifies 33 goals addressing restoration, economics, recreation, etc. Conservation groups, environmental groups, industry, and Federal, State, regional and local governments participated in shaping a vision for the future of the basin.

In July 1997, the State of Illinois enacted the Illinois River Watershed Restoration Act. The legislative purposes of the Act are to: (1) create a group of leaders representing agriculture, business, conservation, and the environment to encourage the implementation of efforts to restore the Illinois River Watershed in accordance with the recommendations of the *Integrated Management Plan for the Illinois River Watershed Technical Report;* (2) work with local communities to develop projects and regional strategies; and (3) make recommendations to appropriate State and Federal agencies.

More than $450 million in Federal and State funding has been targeted to improve the Illinois River through the CREP, which uses State funding to enhance existing USDA Conservation Reserve Program (CRP) activities. The CREP initiative will help preserve up to 232,000 acres of sensitive land surrounding the Illinois River and its tributaries, including upland areas. From 1998 to 2004, 110,000 acres were enrolled in Federal CRP easements and 73,000 acres in state CREP easements. While most state assets were acquired on lands enrolled in the Federal program, the State also acquired State-only easements on numerous adjacent areas and now holds roughly 28,000 acres in these State-only easements. In August 2005, the State of Illinois announced that its budget for the upcoming year included $10 million to leverage $40 million in Federal funds allowing for CREP easements on approximately 15,000 more acres.

In 2000, the Governor of Illinois set the vision for the Illinois Rivers 2020, a proposed $2.5 billion restoration effort. Illinois Rivers 2020 seeks to bring together the efforts of the Illinois Department of Natural Resources (DNR), Illinois Department of Agriculture, and Illinois EPA with Federal agencies. It is a voluntary, incentive-based approach that is much broader and more inclusive for the entire Illinois River and its tributaries than previous efforts. The support for implementation of Illinois

Rivers 2020 is very broad, including hundreds of individuals, elected officials, organizations, and businesses that officially support this effort.

In addition to Federal and State recognition, local communities, counties, and non-governmental organizations have also focused attention on the Illinois River Basin. More than 35 management plans have been developed that call for restoration of all or a portion of the Illinois River Basin. Many communities and groups have begun implementation of restoration projects. Both The Nature Conservancy and The Wetlands Initiative have made major investments by purchasing levee and drainage districts for the purpose of restoration. In total, they have recently acquired more than 11,000 acres of Illinois River floodplain and adjacent habitats. This is in addition to the 135,000 acres in State and Federal ownership within the Illinois River Basin.

Another example of the institutional significance is the Tenth Biennial Governor's Conference on the Management of the Illinois River System was held from October 4 [h] through the 6, 2005, in Peoria, Illinois. The conference focused on a systems approach to river management. Over 250 individuals from Federal, State, and local governments, as well as private citizens, attended the conference. The diversity of the groups attending demonstrates the importance of the Illinois River Basin to not only policy makers, but to the public as well.

2. Public. The Illinois River Basin is significant based on wide public recognition of the environmental resources present in the basin. The basin is noteworthy in that, while encompassing approximately 44 percent of the land area of the State, it includes nearly 90 percent of Illinois' population approximately 11 million people. Some level of significance of the Illinois River Basin to the public is measured through the actions of elected officials and policy makers who have forwarded legislation and enacted laws mentioned above to protect and enhance the watershed.

A further recognition of the value of the basin is the amount of participation by landowners in conservation programs. Approximately 138,000 acres of land have been enrolled in the Federal and State CREP and CRP programs. Each year, more Illinois landowners apply for the CREP program than are accepted. This demonstrates a willingness on the part of the landowners to set aside farmland to aid in the conservation of the Illinois River Basin.

Another example of public recognition is the participation by individuals and organizations in the State of Illinois' Conservation 2000 (C2000) program, which provides funding for streambank stabilization, wetland restoration, prairie restoration, riparian buffers, vegetative covers on construction sites, and restoration of oxbows in tributaries of the Illinois River. As of 2005, $61 million had been invested in all C2000 ecosystem projects. Although the program does not require matching, 52 percent of the program's overall value came from citizens and groups that invested additional money, land, and time to see projects completed. The strong public interest in restoration has resulted in State dollars consistently being matched or exceeded.

Recreation in the Illinois River Basin includes water-dependent activities such as fishing, waterfowl hunting, boating, and swimming. Recreation also includes activities that are enhanced by the proximity to water, such as hiking, picnicking, bird watching, and camping. These types of recreation are provided by local, State, and Federal agencies such as park districts, forest preserve districts, the DNRs, and the USFWS. Many private concerns also provide similar recreation opportunities.

The Illinois DNR owns or leases hundreds of outdoor recreation sites throughout the State including: State parks, conservation areas, nature preserves, natural areas, fish and wildlife areas, greenways, trails, and forests. The average annual attendance over the last 5 years at these sites was estimated to be over 42 million. This translates to about $500 million a year spent on trips to State parks and other recreational sites, leading to $790 million in economic output, 8,500 jobs, and $240.5 million in earnings. According to the 2001 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, outdoor recreation activities contribute significantly to Illinois' economy—more than $4 billion in economic output, 42,000 jobs, and $315 million in State and local taxes.

The Illinois River Basin contains some of the most productive agricultural soils in the world. These soils, combined with favorable climate, excellent transportation via water, highway and rail, and highly productive farming systems, make the Illinois River Basin a world leader in agriculture and a major exporter of agricultural products, producing more crops than 40 other states. In 2000, the farms in the basin produced approximately $2.6 billion in crops, 50 percent of the Illinois State total (Illinois Agricultural Statistics Service, http://www.agstats.state.il.us/). The basin also produced more than $600 million in livestock.

3. Technical. Numerous scientific analyses and long-term evaluations of the Illinois River Basin have documented its significant ecological resources. Since the early 20th century, researchers, government agencies, and private groups have studied the large river floodplain system and proposed ecosystem restoration in the Illinois River Basin. A few examples of the efforts to identify, quantify, and understand the ecological significance of the basin are described in the following text.

In a 1995 report, the U.S. Department of the Interior (DOI) listed large streams and rivers as endangered ecosystems in the United States. The U.S. DOI documented an 85 to 98 percent decline in this ecosystem type since European settlement. In particular, large floodplain-river ecosystems, , have become increasingly rare worldwide. Two of the large floodplain-river ecosystems lie within the UMRS, namely, the Upper Mississippi and Illinois Rivers. These two ecosystems still retain seasonal flood pulses, and more than half of their original floodplains remain unleveed and open to the rivers (Sparks et al. 1998). The UMRS is one of the few areas in the developed world where ecosystem restoration can be implemented on large floodplain-river ecosystems (Sparks 1995).

The Nature Conservancy (TNC) has developed basin-level planning documents to guide restoration efforts. In these documents, the TNC states, "The Illinois River remains one of a handful of world-class floodplain-river ecosystems. These include the Nile, Amazon, the Mekong and portions of the Mississippi, where biological productivity is enhanced by annual flood pulses that advance and retreat over the floodplain and temporarily expand backwaters and floodplain lakes." (TNC 1998)

The UMRS-EMP conducted a Habitat Needs Assessment (HNA) in 2000 to help guide future habitat projects on the UMRS. The HNA highlighted the need to restore depth to 25 percent of the existing backwaters on the Illinois River, increase depth diversity and connectivity, and restore hydrologic conditions needed to restore and maintain backwater habitats.

The Illinois River has historically hosted a vast fishery, including numerous ancient fishes, and, at the turn of the century, produced 10 percent of the nation's catch of freshwater fish (yielding 178 pounds per acre in 1908). The Illinois River and its tributaries are currently home to over 100 species of fish. Side channels and backwaters serve as nurseries and spawning areas. Sport fish at home in the Illinois include: white bass, largemouth bass, bluegill, black crappie, channel catfish, carp, buffalo, bullhead, walleye, sauger, and many other warm-water species. Game fish in the upper river include largemouth bass, black bullheads and white bass, especially around Starved Rock State Park in Utica, IL. The middle river has historically been the most productive because of the aquatic habitat in the backwater lakes and wetlands along its banks. The lower river, from Beardstown to Grafton, features approximately the same mix of fish species as the middle river, but populations are smaller.

The Illinois River is a major component of the internationally significant Mississippi River Flyway, a route followed by migratory waterfowl between Canada and the Gulf Coast. The Mississippi River Flyway, shown on figure 2-2 as the Mackenzie Valley-Great Lakes-Mississippi Valley Rivers and Tributaries, is utilized by 40 percent of all North American waterfowl and 326 total bird species, representing 60 percent of all species in North America. A survey conducted by the Illinois Natural History Survey in the fall of 1994 found that 81 percent of the fall waterfowl migration in the Mississippi Flyway utilized the Illinois River. Approximately 20 species of waterfowl, primarily ducks and geese, make their home in the Illinois River Basin. Hundreds of thousands of birds migrate along the Illinois River each year, resting temporarily in the wetlands, sloughs, and backwater lakes in the basin.

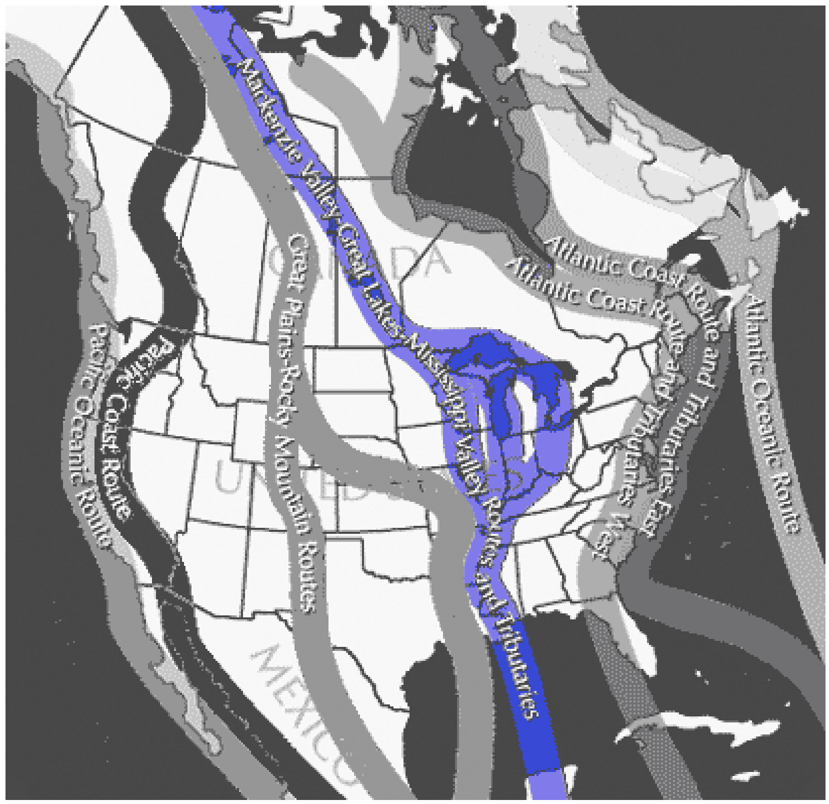


Figure 2-2. North American Flyways

The Illinois River has also been historically important to a multitude of avian species. The backwaters of the Illinois River serve as habitat for 20 to 30 species of shorebirds, 15 species of gulls and terns, and several species of marsh birds. The cottonwoods and black willows along the middle and lower river and its wetlands are host to various types of herons, egrets, plovers, sandpipers, and other migrating wading shorebirds, as well as gulls and terns. Wading shorebirds represent the farthest ranging visitors to the Illinois River Valley, traveling annually between the Arctic and South America, specifically Chile and Argentina. The river valley is a major wintering ground for the endangered bald eagle. In recent years, as many as 375 bald eagles have been counted annually, which represents about 3 percent of the total wintering population of bald eagles in the lower 48 states.

Over 4.26 million acres of Illinois land is in forest. Much of it is located adjacent to the Illinois River and its tributaries. Forest product utilization and management is important to the Illinois economy and environment. Forested riparian areas adjacent to the Illinois River and its tributaries provide a necessary buffer for surface water drainage and serve as the transition zone between land and water. Water quality benefits associated with the riparian forest are critical to the well-being of the tributary watershed. Many aquatic and terrestrial wildlife species utilize and depend upon the riparian forest found in the Illinois River Valley.

The Illinois River also serves as one of the sources for the public water supply system serving Peoria, which uses three well fields. The cities of Aurora, Elgin, Kankakee, Pontiac, Streator, Decatur, Taylorville, Springfield, Jacksonville, and Canton use water from tributaries of the Illinois River. Numerous industrial and utility providers also utilize Illinois River Basin waters for cooling purposes.

The Illinois River is a major conduit for the transport of treated wastewater throughout Illinois. It is estimated that 2,109 outfalls are currently located in the Illinois River Basin. Illinois has taken significant steps to obtain compliance for effluent limitations by dischargers in the basin. From the municipal facility perspective, approximately $5.6 billion has been expended for treatment facility construction in the Illinois River Basin alone. It can be safely estimated that several hundred million dollars have also been expended by industrial dischargers. Although the Illinois River ranks among Illinois' top recreational resources, at one time it was a primary channel for the transport of human, animal, industrial, and agricultural waste.

Archaeological and historical sites and fossil localities are found throughout the basin. Archaeological sites—localities once occupied by prehistoric or historic peoples—have been documented along the river shoreline, on the floodplain, and in valley margin and upland settings. Camps and villages established near the river by Native Americans are buried in river-deposited sediment. Major villages were often established along the river valley margin. Over the millennia, sediments eroding from nearby bluffs slowly accumulated. Preserved in these deposits, separated by lenses of sediment, are the remains of village sites representing centuries of cultural development.

C. BACKGROUND AND HISTORY

> *"The placid Illinois traverses this territory in a southwestern direction, nearly 400 miles ... Unlike the other great rivers of the western country, its current is mild and unbroken by rapids, meandering at leisure through one of the finest countries in the world. . . upwards of 400 yards wide at its mouth...The banks of the Illinois are generally high. The bed of the river being a white marble, or clay, or sand, the waters are remarkably clear. It abounds with beautiful islands,... It passes through one lake, two hundred and ten miles from its mouth, which is twenty miles in length, and three or four miles in breadth, called Illinois Lake [Lake Peoria]."* S. R. Brown 1817

The Illinois River arises at the confluence of its headwater basins, the Des Plaines, and Kankakee, and winds southwesterly through northern Illinois (figure 2-1). Along this stretch, known as the "Upper Illinois," currents are swift because the river flows down a fairly steep incline through a narrow, young valley. The upper river flows to Hennepin in Putnam County, where it encounters the "Great Bend," which marks the beginning of the middle river. Here, the Illinois turns southward and flows past Peoria to Beardstown with a gentle gradient through a broad, shallow valley 3 to 6 miles wide, the ancestral Mississippi River Valley. The banks along this stretch of the Illinois are lined with dozens of lakes and backwaters. The lower river extends from Beardstown to Grafton and was once rich with backwaters.

The Illinois River is the largest tributary of the Mississippi River above the mouth of the Missouri River. Major tributaries to the Illinois include the Des Plaines, Kankakee, Fox, Vermilion, Mackinaw, Spoon, Sangamon, and La Moine Rivers. Agriculture and urban development impacted and changed the landscape of the Illinois River Basin and the river itself. To appreciate the natural communities still found in the Illinois River Basin, one must first look at how the basin was formed, its history, and how it was developed.

1. Formation of the Illinois River Basin. The landscape of the Illinois River Basin was created by extraordinary geological processes that shaped the upper Midwest over the past one and one-half million years. The Ancient Mississippi River originally flowed in a now-buried valley from the northwest corner of Illinois near Galena to Tazewell and Mason Counties, south of Peoria, where it was joined by the westward-flowing Mahomet River. During the Pleistocene era, great continental-scale glaciers repeatedly entered Illinois from the northwest and northeast. These glaciers originated in central Canada more than 1,000 miles north of the modern Illinois River (figure 2-3). At least three major glaciations affected Illinois, and each strongly modified the landscape. Most of the lobes of glacial ice that covered Illinois emanated regionally from the Lake Michigan basin, but there is evidence that ice also flowed in from the northwest. Flowing ice and related geological agents, including winds and meltwater streams, sculpted the bedrock and pre-existing sediments, leaving sedimentary deposits up to several hundred feet thick.

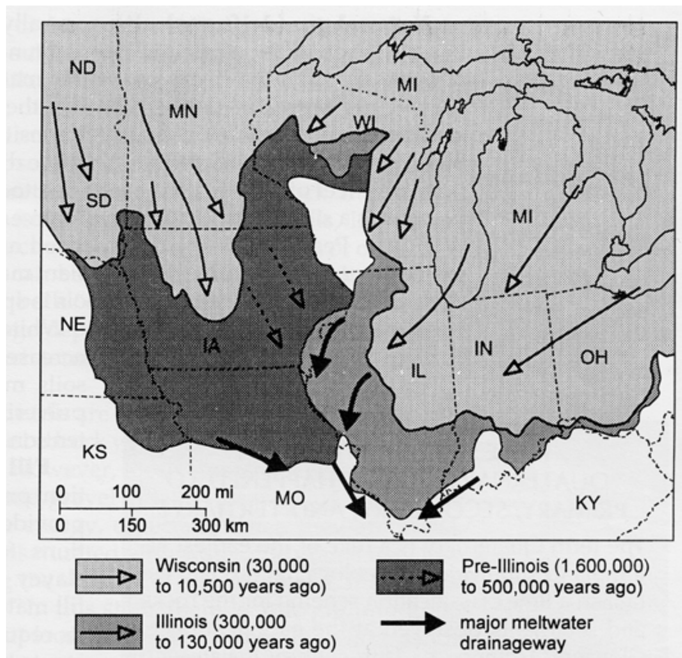


Figure 2-3. Furthest Extent of Pleistocene Ice Advances Open arrows indicate general ice flow directions; closed arrows indicate major meltwater drainage ways.

Creation of complex morainal topography, widening and incision of the Illinois Valley by huge floods, and deposition of a layer of wind-blown silt over most of the watershed uplands are effects of the last glacial episode that are perhaps most important to us today. Figure 2-4 illustrates the alterations in the flow paths of the major rivers in Illinois due to glaciation. Modification of this landscape continues today by both natural and human processes.

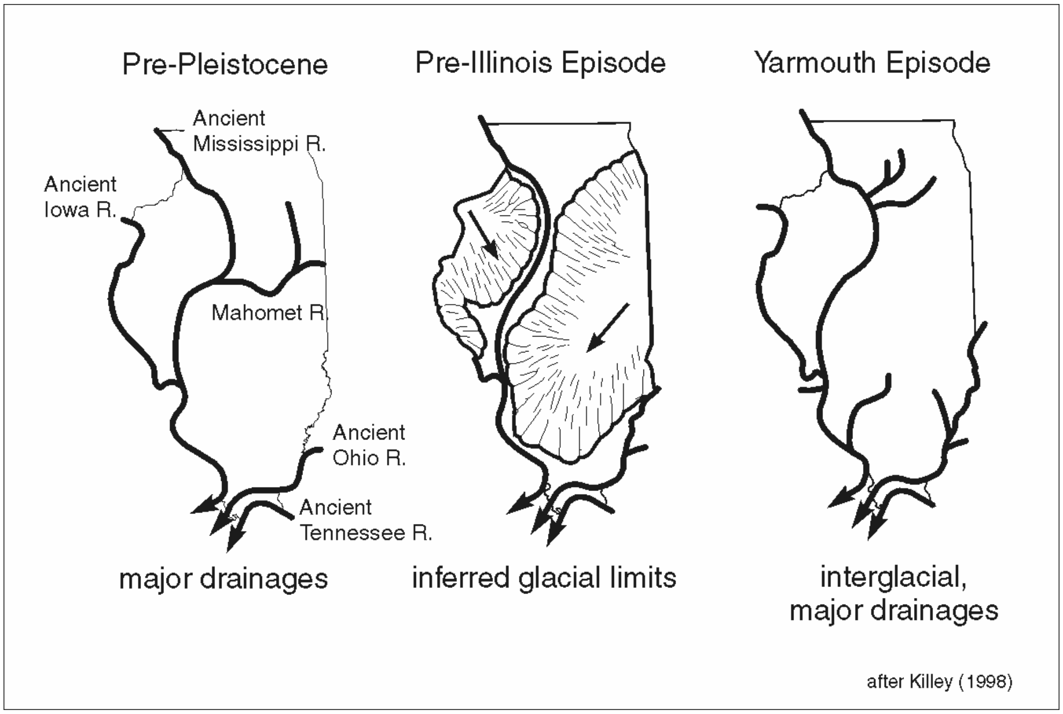


Figure 2-4. Changes in the Flow Paths of the Rivers in Illinois Over Time

The Mississippi River once occupied the lower Illinois Valley from above Henry to Grafton. With the advancement of the Wisconsin glacial-episode (~21,000 years ago), the Mississippi River was pushed westward to its present location. With the recession of the glacier and the ensuing warmer climate, meltwaters formed the Kankakee and Des Plaines Rivers, which converged into the Illinois River southwest of Chicago. From this confluence, the Illinois flowed westward, cutting a new channel until it reached the ancient and deep valley of the Mississippi River above Henry.

As the Illinois River turned southward in Putnam County, it followed a much wider and deeper glacial valley. As the waters of the Illinois entered this wide basin, their low volume produced a river of a gentle rate of fall, creating a floodplain river ecosystem. This low gradient resulted in a sluggish river that had difficulty moving the sediment load contributed by the tributary streams. Over the centuries, the sediment was deposited during overflow conditions at the interface between the faster moving water in the river channel and the slower moving waters in the bottomlands. As a result, natural levees rose, pinching off over 300 bottomland lakes and sloughs from the river channel. The floodplain below the Great Bend contains so many side channels, sloughs, swamps, and other backwater wetlands, that the river valley resembled a boundless marsh when early explores and settlers arrived.

Historical observations and measurements of flows from undisturbed areas indicate that storm flow rates from Illinois River watersheds prior to European settlement were probably much lower than current rates. Many current streams or ditches were historically ephemeral channels, wetland swales, or simply did not exist (Rhoads and Herricks 1996), and the hydrologic and hydraulic conditions likely led to a more steady discharge of water to the Illinois River from its watershed. Prior to 1900, when significant modification along the main stem began, researchers have determined that much of the

Illinois River experienced a cyclical regime in which water levels gradually rose from the late fall through the spring and then fell to stable, low levels in the summer.

2. Climate. Illinois has a continental climate, which means that its winters are cold and dry and its summers are warm and wet. The transition season of spring tends to be very wet, while the fall seasons tend to be dry. Using Peoria as representative of the basin, average temperature for the year is 50.7 degrees Fahrenheit, with a peak maximum temperature of 113 degrees Fahrenheit on July 15, 1931, and a low minimum temperature of -27 degrees Fahrenheit on January 5, 1884. The average yearly precipitation is 36.25 inches, including an average snowfall of 26.2 inches per year. During the latter half of the 20th century, there was a 2.1 percent per decade increase in annual precipitation, which has contributed to the increase in the rate of runoff (5.5 percent per decade). This upward trend may be a manifestation of natural variability and will not necessarily be sustained into the future.

3. Land Cover. The predevelopment Illinois River floodplain was a complex mosaic of prairies, forests, wetlands, marshes, and clearwater lakes (Mills et al. 1966, Talkington 1991, Theiling 1999, Theiling et al. 2000). A broad view of the Illinois River Basin prior to intensive settlement illustrates the dominance of prairies across the landscape (figure 2-5). Riparian corridors formed along waterways, and the middle and lower reaches of streams and rivers were lined with forests. Densely wooded regions occurred in the Spoon and LaMoine River watersheds, topographically diverse areas compared to the rest of the basin. In the main stem river floodplain, the main channel threaded through a variety of connected and isolated backwater lakes, bottomland forests, prairies, marshes, and swamps. Bottomland lakes, sloughs, and marshes supported abundant beds of aquatic plants, such as pondweeds (*Potamogeton* spp.), coontail (*Ceratophyllum demersum*), and water lilies (*Nymphaea tuberosa*). Common emergent plants were two or more species of duck potato (*Sagittaria latifolia, S. rigida*), marsh smartweed (*Polygonum coccineum*), river bulrush (*Scirpus fluviatillis*), as well as other, less common plants, including wild rice (*Zizania aquatica*). The abundance of aquatic plants attested to the water clarity and organic sediments. Scores of small lakes and ponds, rather than large lakes, dominated the floodplain (Bellrose et al. 1983). In this system, there was relatively free movement among scales or to similar habitats in different locations through stream channels, riparian corridors, or frequently spaced wetlands.

The presettlement landscape of the basin was approximately 66 percent prairie and 29 percent forested. Open water and wetlands accounted for 4 percent of the basin area (figure 2-5). Wetlands were not particularly well mapped in the Government Land Office surveys because their methods were coarse and many wetlands were small, isolated units that might have been easily missed. Havera (1999) used soil surveys to locate hydric soils that formed under wetland conditions as a surrogate of the former distribution of presettlement wetlands throughout Illinois. A conservative estimate of a little more than 8.2 million acres of wetland, or 23 percent of the entire State was derived for Illinois. Although only 78 out of 102 counties have been resurveyed, the presettlement wetlands estimate has been increased to almost 8.9 million acres (Havera 1999). Calculating the change from presettlement conditions revealed a 90.3 percent loss of presettlement wetlands. Most of the loss occurred in the northern two-thirds of the state, particularly through the center of the Illinois River Basin.

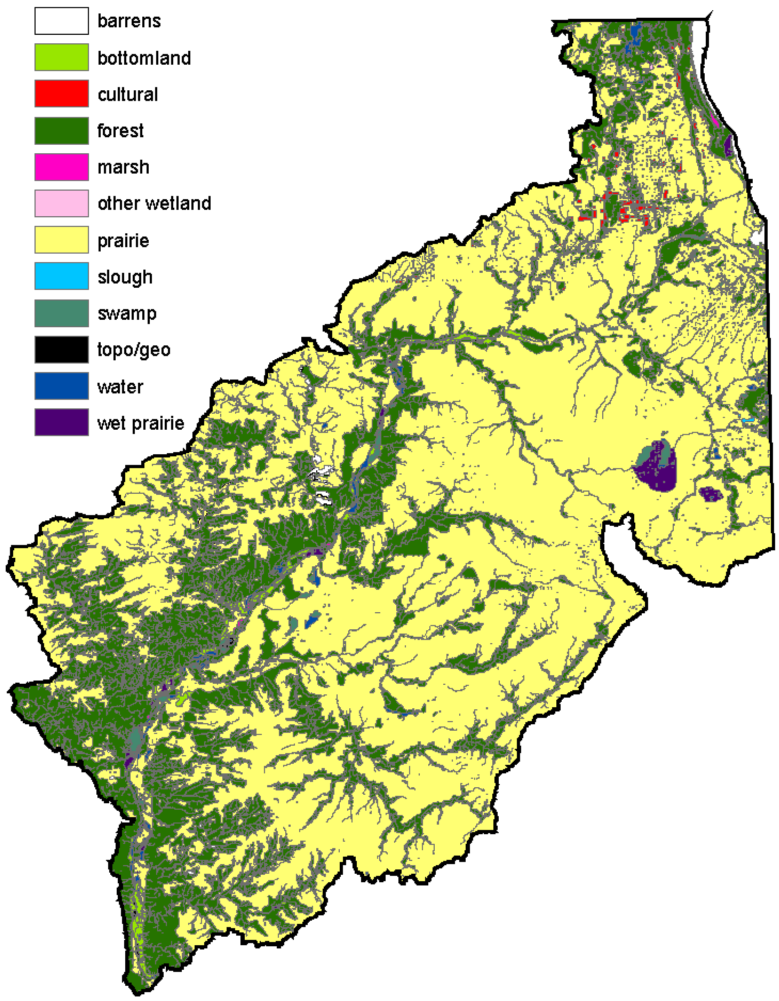


Figure 2-5. Presettlement Land Cover of the Illinois River Basin as Interpreted from Government Land Office Surveys (Szafoni 2001)

Landscapes can be described by differences in topography, glacial history, bedrock, soils, and the distribution of native plants and animals. Using these natural features, Illinois can be divided into 14 natural divisions. A division contains similar landscapes, climates, and substrate features like bedrock and soils that support similar vegetation and wildlife over the division's area.

Six of the fourteen divisions are found in the Illinois River Basin—Northeastern Morainal, Grand Prairie, Upper Mississippi River and Illinois River Bottomlands, Illinois River and Mississippi River Sand Areas, Western-Forest Prairie, and Middle Mississippi Border (figure 2-6).

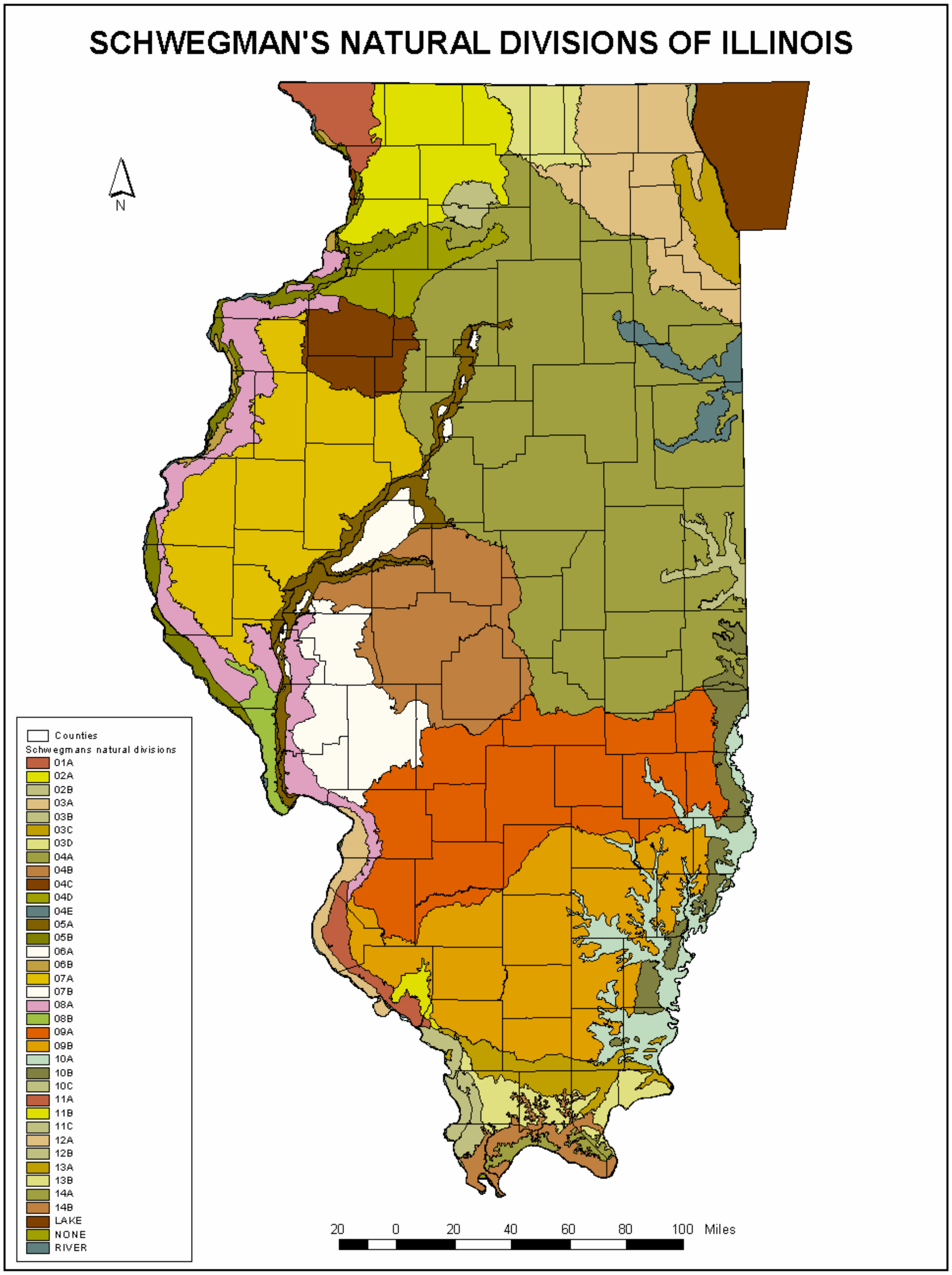


Figure 2-6. Schwegman's Natural Divisions of Illinois

Northeastern Morainal Division

- *Morainal Section (O3A)* - This section contains the moraines and related geologic features resulting from late advances in the Wisconsinian glaciation period. Most of Illinois' glacial lakes and peatlands are found here.

- *Lake Michigan Dunes Section (O3B)* - The Lake Michigan Dunes Section is distinctive for its unique plants that grow on the dunes and beaches. Plant succession from shifting sand to stabilized sand results in a variety of species. Beach grass, trailing juniper, and bearberry are three examples.

- *Chicago Lake Plain Section (O3C)* - This flat, poorly drained area is composed of the lakebed sediments of glacial Lake Chicago. Long ridges of shore-deposited sands are conspicuous features. A few natural lakes exist near Calumet City. The original vegetation of this section was prairie and marsh with scrub-oak forests on sandy ridges.

Grand Prairie Division

- *Grand Prairie Section (O4A)* - This section includes the part of Illinois that was affected by the late stages of the Wisconsinian glaciation, that is outside the Northeastern Morainal Division and that does not include outwash and sand areas. The Shelbyville and Bloomington moraines form the boundaries of this section. Black-soil prairie, marshes, and prairie potholes are common in this poorly drained area. The Kankakee mallow is found in this section, growing only on an island in the Kankakee River.

- *Springfield Section (O4B)* - The Springfield Section is part of the area covered by the Illinoian glaciation. Prairies grew on this land in presettlement times. It has better drainage than the younger Grand Prairie Section. Deep loess (a wind-blown silt) deposits support dry hill prairies along the lower Sangamon River. Large areas of floodplain forest grow in the valley of the lower Sangamon River and its tributaries.

- *Western Section (O4C)* - The Western Section was covered by the Illinoian glaciation. This well-drained land was predominantly prairie in presettlement times.

- *Kankakee Sand Area Section (O4E)* - The sand of the Kankakee Sand Area Section was deposited by the Kankakee Flood during the later stages of the Wisconsinian glaciation. Sand prairie and marsh were the predominant vegetation of this section before the land was drained for cultivation. Scrub-oak forests exist on drier sites. The primrose violet is restricted to this section in Illinois. The clear, well-vegetated, sand-bottomed streams contain fishes like the weed shiner, ironcolor shiner, and least darter.

Upper Mississippi River and Illinois River Bottomlands Division

- *Illinois River Section (O5A)* - The Illinois Section of this division is characterized by its backwater lakes and forest vegetation. Spring bogs exist along the river bluffs.

Illinois River and Mississippi River Sand Areas Division

- *Illinois River Section (O6A)* - This section differs from the Mississippi River Section by the absence of several plant and animal species.

- *Mississippi River Section (O6B)* - This section has several plant and animal species that are absent from the Illinois River Section including false heather and rock spikemoss. Both of these plants form large mats that stabilize dune blowouts.

Western Forest--Prairie Division

- *Galesburg Section (O7A)* - The Galesburg Section is the area of the Western Forest-Prairie Division that lies north of the Illinois River Valley. At the time of settlement, there were about equal amounts of forest and prairie in this section, with forests mainly along the tributaries to the Illinois River.

- *Carlinville Section (O7B)* - The Carlinville Section of this division is the land southeast of the Illinois River Valley. Originally, it was covered mostly by forest, with prairie accounting for about 12 percent of the area.

Middle Mississippi Border Division

- *Glaciated Section (O8A)* - The topography of this area was modified by the pre-Illinoian and Illinoian glaciation stages. Limestone underlies most of this section and may often be seen in cliffs along the river bluffs.

- *Driftless Section (O8B)* - This area of the state is apparently unglaciated. It has many sinkholes and sinkhole ponds.

For more than 150 years, the Illinois landscape has been shaped to serve the economic development needs of the State. Landscape development has occurred for many purposes ranging from waterway transportation, lumber harvesting, urban and suburban development, and industrial and agricultural development. The result is a managed landscape that is highly altered from its presettlement form and function. This development of the river basin has had profound effects on the river and floodplain landscape.

4. Disturbance Regimes. Disturbances such as floods and fires maintain the mosaics of habitats needed to maintain a naturally functioning ecosystem. Most of these disturbance regimes have been greatly altered or even eliminated altogether. This alteration of disturbance regimes has resulted in a more homogeneous environment, with an associated loss in ecological integrity.

Hydrology is a primary driving force for aquatic and floodplain ecosystem processes and habitats. The magnitudes, timing, and duration of flows and water levels often regulate the nature of chemical and biological functions in these systems. Because of this, unfavorable hydrologic regimes can prevent desirable levels of ecosystem function, thereby reducing biodiversity. The obvious natural disturbance pattern on the main stem Illinois River and its tributaries is the annual flood and low-flow cycle (Poff et al. 1997, Theiling et al. 2000). Prior to development, the Upper Illinois was hydrologically similar to the streams and rivers that fed it from the basin; floods rose and fell rapidly in response to storms. During low-flow periods, the river experienced base flow conditions and was fed by ground water. Some streambeds may have been nearly dry during low flow periods. On the main stem, snowmelt, spring rains, and basin runoff combined to create a long spring flood that rose into the summer and fell through the fall in what was described as a unimodal hydrograph (Sparks 1995).

Fire is another disturbance that helps shape the floodplain landscape (Nelson et al. 1996). For example, savanna and prairie habitats, both diverse habitat types, require fire disturbance to maintain their unique vegetative characteristics and accompanying biodiversity. Prior to intensive settlement, Native Americans used fire to help maintain these habitats. Fire also plays a key role in bottomland forest structure and species composition. Fire suppression is altering the species composition of forested habitat, resulting in the maple dominance of these forests (CTAP 2001). Other disturbances, such as ice and wind, sometimes kill sections of forests and create unique microhabitats that are exploited by species to create diverse landscapes (Theiling et al. 2000).

5. Biological Resources. Father Jacques Marquett (one of the first Europeans to visit the Illinois River Basin) described his impressions on the Illinois River, in 1673, as follows:

> *"We have seen nothing like this river…as regards to its fertility of soil, its prairies and woods, its cattle, elk, deer, wildcats, bustards, swans, ducks, parroquets, and even beaver. There are many small lakes and rivers."*

The productivity of the predevelopment system was illustrated by the millions of migratory birds that either stopped to rest and feed on their northward and southward migrations, or stopped to nest in the floodplain marshes (Havera 1999). The Illinois River historically was host to a vast fishery. The forests supported a higher diversity of trees, including many that produced fruit and seeds that were exploited by animals and people (Nelson et al. 1994). Although today's flora and fauna are but a remnant of these historic levels, they still include some of the richest habitat in the Midwest, even some unique to North America (Talkington 1991).

6. Development of the Basin. The assessment of the Illinois River Basin landscape history provides perspective on how and when change occurred. Native Americans arrived in the basin at least 12,000 years ago and hunted and gathered for their subsistence, causing very little impact on the habitat. Native Americans began cultivating plants in the Basin gradually, beginning around 2,000 B.C. Food production supplemented food procurement, eventually giving rise to larger, longer-term settlements, which had greater impact on local habitat.

Early explorers and trappers were in the region in the 1600s and 1700s, relying on a subsistence economy of hunting, gathering, and food production. They also introduced domesticated animals. It was not until the early 1800s, during America's Westward Expansion, that substantial numbers of settlers arrived in the Illinois River Basin. During the early 1800s, the Government Land Office (GLO) surveys of the Illinois River Basin were conducted. Significant events in history of the Illinois River are listed in table 2-1.

Table 2-1. Illinois River Timeline

Year	Event
1872	The first low dam is constructed at Henry, Illinois.
1900	The Chicago Sanitary & Ship Canal opens. The untreated wastes from a densely populated Chicago area are channeled into the Illinois River.
1902	The drainage/levee districts are established, and by 1929 there would be a total of 41 in the Illinois River Valley.
1908	The 207-mile stretch of river between Hennepin and Grafton produces 10% of the nation's catch of freshwater fish.
1910	More than 2,600 mussel boats work the Illinois River.
1919	State of Illinois begins construction in the Illinois Waterway.
1923	Illinois River devoid of oxygen to Chillicothe
1930	Levees & drainage districts removed 200,000 acres, ½ floodplain
1939	Significant completion of lock and dams.
1944	During the fall waterfowl migration, a remarkable weekly observation is recorded by biologist Frank Bellrose – over 3.6 million mallards in parts of the Illinois Valley.
1948	Last Pearl Button Factory closes
1950	Fingernail clams (major food source) disappear
1955	Aquatic Vegetation eliminated from connected aquatic areas

Settlements were first established along the lower reach of the Illinois River and on the upper reaches of its tributaries, such as the Sangamon River. Peoria, Springfield, and Chicago were in existence in the early 1800s.

The Illinois River Basin is an area that has been and remains subject to human disturbances. Some biologists argue that the degradation of the Illinois River Basin began with its opening to steamboats in 1828, while others indicate that until the turn of the century, the Illinois River remained relatively unblemished, and its waters provided a livelihood for many adjacent communities. In 1908, 2,500 commercial fishermen took nearly 24 million pounds of fish from the Illinois. The river was once one of the most productive mussel streams per mile in the United States; in 1910, over 2,600 mussel-fishing boats plied the river. Abundant waterfowl in the fall made the valley a mecca for commercial and sport hunters. As the human population increased in the basin, the prolific days of the river ended. With the increase in population came physical changes to the Illinois River and its basin that would greatly affect the river system.

Beginning in the 1830s, human activities started to exert a deleterious effect on the Illinois River and its watershed. Navigation, agriculture, levee building, and urbanization affected the natural flow of the Illinois River and the associated sedimentation processes that formed backwater wetlands. Large-scale public works projects, such as the construction of the Illinois and Michigan Canal, and private undertakings, especially draining of wetlands for agriculture, resulted in the most profound changes in the Illinois River Basin.

a. Agriculture. The Illinois River Basin is endowed with some of the best soils and climate, which support the greatest agricultural production that can be found anywhere in the world. Over the past 150 years, agriculture in the Illinois River Basin has undergone significant changes. In early settlement days, farming meant raising an assortment of crops and livestock, which would ultimately provide the food and clothing to support the farmer's family. By 1860, most of the basin's prairie had disappeared as agriculture gained in predominance. Crop production became more specialized in the late 1800s and into the 1900s as farm size and urban populations increased.

Agriculture became industrialized after the turn of the century, but especially after World War II with advances in farm machinery and chemical use. The rate at which agricultural innovations have been introduced and adopted has significantly increased over the past several decades. Adverse environmental impacts of landscape development were noticed early in the development sequence, but formal programs to address declining resource quality were not enacted until after the economic impacts to agriculture were recognized and the conservation movement became more prominent. With mechanized and labor-saving farm equipment available, intensive row crop agriculture and increased crop production became the norm. By 1935, only 20 percent of the Nation's labor force worked in farming, decreasing to 4 percent in 1974 and less than 2 percent in 2002. Since the 1950s, many farmers dramatically changed their farming operations, from diversified livestock and grain farms to specialized farms with primarily corn and soybean production, resulting in a 67 percent increase in row cropland between 1945 and 1986. From 1960 to 2000, oat, wheat, and hay acreage decreased by more than 50 percent, while soybean acreage almost doubled. This change in farming systems has resulted in considerably less land planted today with soil-conserving crops of hay, pasture, and cereal grains and significantly more land being planted to row crops that provide less protection from erosion, such as soybeans and corn. However, many farmers have implemented soil conservation practices to reduce soil erosion (Post and Wiant 2004).

b. Floodplain Alterations. Between 1902 and 1923, drainage districts greatly modified the landscape, removing approximately one-third of the terrestrial and aquatic habitat from the floodplain for agricultural purposes. By 1929, 38 organized drainage and levee districts and three private levees enclosed roughly 200,000 acres of the Illinois River Valley. Levees erected early in the 20th century isolated and facilitated the drainage of almost all of the lakes and wetlands along the lower river. Only about 53 backwater lakes now survive along the full length of the river, and the connected floodplain of the Illinois River is now just over 200,000 acres, about half its size 100 years ago. Spring and Thompson Lakes, long known for their fisheries and their concentrations of waterfowl, were leveed, drained, and converted to agricultural uses, as were a host of smaller lakes and sloughs. These levee districts isolated and altered approximately 40 percent of the total floodplain by allowing conversion of wet and mesic floodplain prairies to crops. Actual water surfaces now account for only about 60 to 100 square miles (40,000 to 70,000 acres) in the basin. The levees affected the hydrology and sediment transport processes of the river. They increased flood stages by reducing the space available for water flow, storage, and sediment deposition. The levees effectively constricted the floodplain right to the edge of the river.

c. Hydrologic Alterations. On January 1, 1900, the Chicago Sanitary and Ship Canal opened. This canal connected the Des Plaines and Illinois Rivers to Lake Michigan and as a result gave the City of Chicago a means of flushing untreated domestic sewage and industrial wastes away from Lake Michigan into the Illinois River system by diverting water from Lake Michigan into the Illinois River. At first, the diverted water enhanced the aquatic habitats of the Illinois River valley; habitats available to fishes increased as the diverted water doubled the surface area, and extended and deepened the bottomland lakes and marshes. As a result of all the water, thousands of acres of bottomland timber were inundated and eventually died as many small lakes, sloughs, and marshes were united into larger bodies of water. As late as 1940, "dead snags from this 'drowned forest' were still in evidence."

d. Navigation and Dam Alterations. Although the amount of diverted water from Lake Michigan was reduced in 1938, river levels were further altered by the construction of navigation dams. During the 1930s, six navigation dams were built along the Illinois, eventually a total of 8 locks and dams were constructed. These dams, constructed to create a 9-foot channel for commercial navigation, had a major impact on the river. This effect was not uniform along the length of the river. The upper dams raised water levels and created pools, slowing the rate of flow even more. The lower dams stabilized water levels, but did not create pools or slow river flow appreciably.

The construction of navigation dams and diversion of flows from Lake Michigan have generally increased the river water surface elevation and have altered the nature of the flooding regime along certain reaches of the river. As the water surface elevation of the river increased, so did the water surface elevations of the associated backwaters and wetlands, resulting in as many as 300 long, narrow backwater or bottomland lakes. Each dam keeps the water level in the pool upstream high enough to ensure a 9-foot navigation channel and, as a result, the floodplains immediately upstream of each dam are more continuously inundated than they would be under undammed conditions.

Short-term water level fluctuations on the mainstem, that is, water level changes over the course of several hours to several days, have been implicated in degradation of Illinois River ecosystem function because of the stress that rapid changes in river conditions places on plants and animals. The magnitude and frequency of water level fluctuations have notably increased in portions of the river since daily water level monitoring began in the 1880s.

e. Water Quality . The opening of the Chicago Sanitary and Ship Canal increased the sewage load in the Illinois River, and by 1923, the oxygen content of the river from below Chicago to Peoria was negligible. In 1911, Stephen Forbes wrote,

> "*Immediately below the mouth of the canal we have in the Des Plaines a mingling of these waters, and the Illinois River itself, below the junction of the Des Plaines and the Kankakee, the septic contributions of the former stream are largely diluted by the comparatively clean waters of the latter. Nevertheless, we had in July and August what may be called septic conditions for twenty-six miles of the course of the Illinois from its origin to the Marseilles dam. At Morris, which is on the middle part of this section, the water, July 15, was grayish and sloppy, with foul, privy odors distinguishable in hot weather*."

The pollution history of the Illinois River closely parallels population growth and hydrologic modifications by the very nature of the most influential project, the Chicago Sanitary and Ship Canal. While originally draining a basin somewhat protected from the growing population of the Chicago area, the canal increased the drainage basin by only 800 square miles (<3 percent), but increased the population pressure on the river to 4.2 million people by 1914. Untreated waste and its adverse effects progressed rapidly downstream from Chicago and Peoria. In 1911, Forbes and Richardson described the river between Morris and Marseilles as reaching its "lowest point of pollutional distress" (quoted in Starrett 1972). They describe the river during the warm summer months as completely anoxic and sludge-like, with most bottom fauna (except sludge worms and *Chironomus* larvae) and fish extirpated. The river cleared with cooler temperatures and higher river stages, but the pollution spread downstream. By 1912, the zone of degradation spread downstream to Spring Valley, and by 1920 as far as Beardstown, about two-thirds of the way to the Mississippi River. Waste treatment efforts began during the 1920s, but struggled to keep up with population growth. In 1960, wastes from a population equivalent of 9.5 million people were reduced to 1.15 million through effective treatment before being discharged to the river (summarized from Starrett 1972). Although upstream water quality and some aquatic communities have improved through time with the expenditure of more than $6 billion in waste treatment facilities, many important aquatic communities still suffer the consequences of prior perturbations and continued sedimentation (Sparks 1992).

f. Tributary Alterations. In many areas of the Illinois River Basin, current storm flows are higher than occurred under pre-development conditions due to land use changes and increased efficiency brought about by channelization in urban and rural areas. Hydrologic changes tend to be most apparent in small basins and during fairly frequent events (Knox 1977). Channelization increases peak flows as it allows flood waves to pass more quickly through the basin (Campbell et al. 1972), increasing both the volume and the erosive force of the water. In addition, drainage generally reduces low flows by lowering groundwater levels and intercepting groundwater throughflow. Small creeks that have been modified by dredging and drainage are often unstable aquatic environments because of extreme water level fluctuations and desiccation during dry periods (Larimore and Smith 1963; Rhoads and Herricks 1996).

g. Biological Impacts. As the Illinois River Basin's population increased, the combined impacts of the basin alterations described above began cause measurable changes to the flora and fauna of the basin. From 1916 to 1922, the organic pollution discharged into the Illinois River resulted in the virtual elimination of aquatic plants from the River. Aquatic vegetation returned to the river between the late 1930s and mid 1950s in response to early waste treatment efforts (Starrett 1972). After 1955, greater amounts of flocculent sediments that had accumulated in the backwater lakes and impounded areas were more frequently resuspended by wind- and boat-generated waves. Resuspended sediments lowered water clarity, and mucky sediments made poor rooting substrate, thus limiting aquatic plant growth (Mills et al. 1966, Bellrose et al. 1979, Bellrose et al. 1983, Sparks 1984, Sparks et al. 1990). As more plants were lost, a critical threshold level of plant density was reached, beyond which recovery was unlikely. Sparks and others (1990) trace the problem to the loss of plants on the perimeter of the beds that stabilized sediments and buffered wave action. As the plants on the perimeters were lost, the entire plant beds were slowly eliminated by wave disturbance and poor water quality.

In the early 1900s, the Illinois River was considered one of the most productive mussel streams in America, and young mussels (unionids) contributed a significant portion—25 percent—of the channel catfish diet. By the 1970s, extensive harvest and chemical and organic pollution resulted in the loss of 25 of the 49 species recorded in the river, and no young mussels were found in catfish guts north of Beardstown (Starrett 1972). These declines were reflected in declines in commercial activities. The last button factory on the Illinois closed in 1948, and by 1976, only two full-time commercial fishermen worked the river. The river was closed to commercial mussel harvest around 2000. In the upper Illinois River, all freshwater mussels were extirpated at one time, but they have been slowly recovering since water quality has improved. Surveys during the mid-1990s found six species had returned to the Illinois Waterway above the confluence of the Des Plaines and Kankakee Rivers (table 2-2). Beginning in 1991, unionids have been forced to compete with the exotic zebra mussel (*Dreissena polymorpha*) for food and space. Unionids also suffered from the degraded water quality common near high densities of zebra mussels.

Table 2-2. Numbers of Species of Mussels Present in the Navigation Pools of the Illinois River at Different Points in Time (Whitney 2001).

Navigation Pool	1870–1900	1906–1909	1966–1969	1993–1995
Marseilles	38	0	0	11
Starved Rock	36	0	0	8
Peoria	41	35	16	15
La Grange	43	35	18	15
Alton	41	36	20	17

Fish communities first increased dramatically with the expansion of aquatic habitat following the diversion, and the introduction of carp (Fremling et al. 1989). Commercial catch rates increased from about 8 million pounds in 1900 to over 20 million pounds in 1908. After 1908, however, fish catches declined despite a relatively high demand for fish (Starrett 1972; Fig. 32). In addition to lower catch rates, the physical condition of fishes declined through the 1970s, with the poorest condition noted in more northern reaches (Sparks 1984). There was a very high incidence of external abnormalities on sediment-associated fishes (50 to 100 percent) in the upper river during the late 1960s. There have been anecdotal and empirical observations of a small number of individuals of tolerant species with cancerous lesions and eroded fins, but the occurrence of such abnormalities has declined in all river reaches through time (Lerczac et al. 1994; Cochran, 2001)

Before the 1950s, the Illinois River Valley was one of the most productive waterfowl areas in the country, drawing local market hunters and sportsmen from around the world (Havera 1999). In 1948, the Illinois Natural History Survey initiated aerial inventories that have revealed clear patterns of the decline of the Illinois River as productive waterfowl habitat since that time. Diving ducks (lesser scaup, canvasback, etc.) were abundant before 1954 in the Illinois River Basin (figure 2-7).

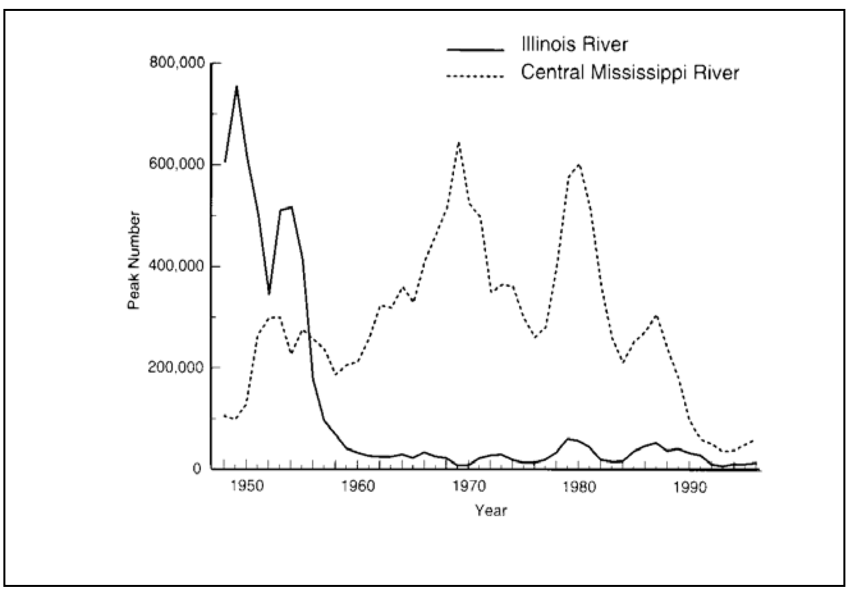
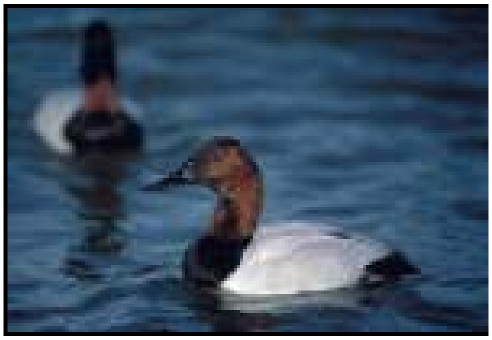


Figure 2-7. Three-Year Moving Average of Peak Numbers of Diving Ducks, Aerially Inventoried During the Fall in the Illinois River and Central Mississippi River Regions, 1948-1996 (Havera 1999)



Photograph 2-1. Canvasback Duck

The population of diving ducks along both the Mississippi and Illinois Rivers fluctuated during the early 1950s. While the Mississippi River population increased until the 1990s, the Illinois River population decreased and never recovered. The loss of fingernail clams and *Vallisneria* (primary diving duck food sources) in the mid 1950s apparently reduced the habitat value for diving ducks, such as the canvasback (photograph 2-1), in the Illinois River to the point where they shifted their migratory use patterns to the Mississippi River Valley (Havera 1999). Diving duck populations are now in serious decline nationally. Dabbling ducks were also affected by habitat loss (figure 2-8) between 1948 and 1996.

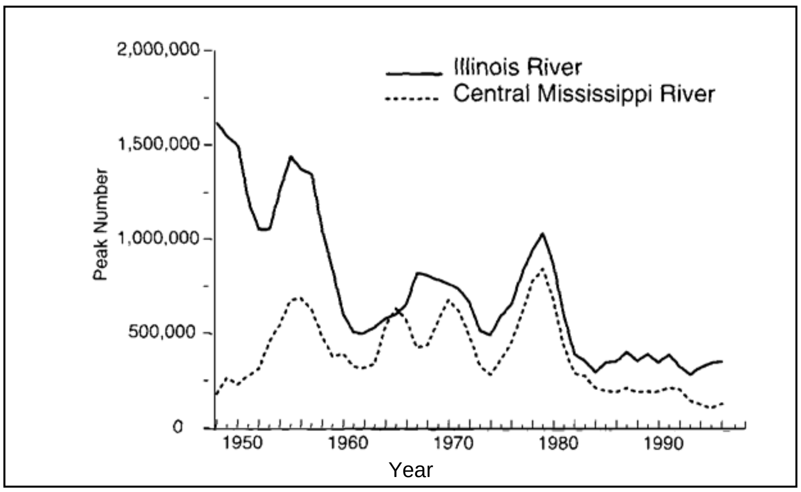


Figure 2-8. Three-Year Moving Average of Peak Numbers of Dabbling Ducks, Aerially Inventoried During the Fall in the Illinois River and Central Mississippi River Regions, 1948-1996 (Havera 1999).

Soil erosion, combined with the low gradient and flow of the Illinois River, allowed fine clay and silt particles to settle in the backwater lakes. During the 1950s, sediment deposition in the backwater lakes appears to have crossed a critical threshold, transforming the clear, vegetated lakes to turbid, barren basins (Sparks et al 1990). Fish and duck populations declined and, by the early 1960s, backwater productivity ebbed dramatically (Bellrose et al 1979).

Despite the ecological damage and degradation, the landscape and river system remain surprisingly diverse and biologically productive. The Illinois River system is home to approximately 35 mussel species, representing 12 percent of all freshwater mussels found in North America. Fish diversity is similarly high, with 115 fish species found, 95 percent of which are native species. Many of these species require both riverine and backwater (floodplain) habitat as part of their life cycle. A survey conducted by the Illinois Natural History Survey in the fall of 1994 found that 81 percent of the fall waterfowl migration in the Mississippi Flyway utilized the Illinois River. The Illinois River currently attracts more migratory ducks than nearby stretches of the Upper Mississippi River.

D. EXISTING CONDITIONS

The Illinois River Basin is ecologically degraded because of 150 years of intensive human development in the region. Figure 2-9 illustrates the change in the distribution of land cover in the Illinois River Basin. Not only have the landscapes changed, but the hydrologic regime, which drives the ecology of streams and rivers, has changed due to major initiatives to dredge channels, ditches, and drains.

In some cases, the landscape and streams are still adjusting to changes imposed by human development especially where suburban sprawl is encroaching into sensitive habitats and prime farmland. In other cases, the ecosystem has stabilized within the bounds imposed by development, and biological communities are recovering from prior disturbances.

Despite the ecological damage and degradation, the landscape and river system remain surprisingly diverse and biologically productive. The Illinois River system is home to approximately 35 mussel species, representing 12 percent of the freshwater mussels found in North America. Fish diversity is similarly high, with 115 fish species found, 95 percent of which are native species. Many of these species require both riverine and backwater (floodplain) habitat as part of their life cycle.

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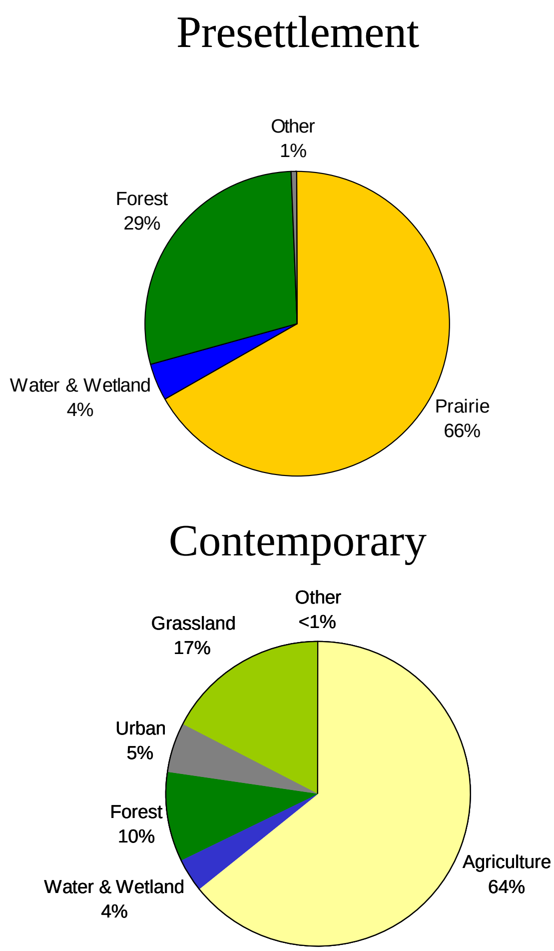


Figure 2-9. Presettlement and Contemporary Land Cover Distribution in the Illinois River Basin

1. Land Cover and Associated Biological Communities. The current basin-wide land cover, as evaluated from satellite imagery, is predominantly row crop agriculture (figure 2-9, table 2-3).

Table 2-3. Basin Land Cover in Illinois

Land Cover	Square Miles
Row Crop	14,671
Rural Grassland	3,621
Woodland/Forest - Deciduous/Closed Canopy	1,980
Small Grains	984
Urban Grassland	620
Urban/Built-Up - Medium Density	518
Woodland/Forest - Deciduous/Open Canopy	354
Urban/Built-Up - High Density	351
Forested Wetlands	344
Urban/Built-Up - Low Density	305
Open Water	260
Shallow Water Wetlands	142
Shallow Marsh/Wet Meadow	108
Urban/Built-Up - Medium High Density	106
Deep Marsh	31
Barren	15
Woodland/Forest - Coniferous	12
Orchards/Nurseries	9
Swamp	0
TOTAL*	**24,432**

* sum of urban classes not included = 1,279 $mi.^2$

In contrast to the presettlement land cover distribution (which was primarily prairie), today the landscape is approximately 64 percent agriculture, 17 percent grassland, 10 percent forest, 5 percent urban or developed, and 4 percent open water and wetlands. Row crops are widely distributed, but occur in the highest density in the central portion of the Illinois River Basin. Row crops occur in lower densities in the Spoon, LaMoine, and lower Illinois watersheds, where the hilly topography is not conducive to this type of agriculture. The area of row crops is four times greater than the next most abundant land cover class, rural grassland, which includes pasture, hay fields, conservation set asides, grass waterways, roadside grasses, and other grasses. Rural grasslands are widely distributed throughout the basin, especially along waterways. Closed canopy forests occur along the main stem river bluffs, especially in the Spoon, LaMoine, and lower Illinois watersheds. Closed canopy forests are also relatively abundant in the northeast region of the basin in county forest preserves. Urban/build-up classes are widely distributed, but there are several large clusters (figure 2-10), particularly in the greater Chicago area, Springfield, and Peoria.

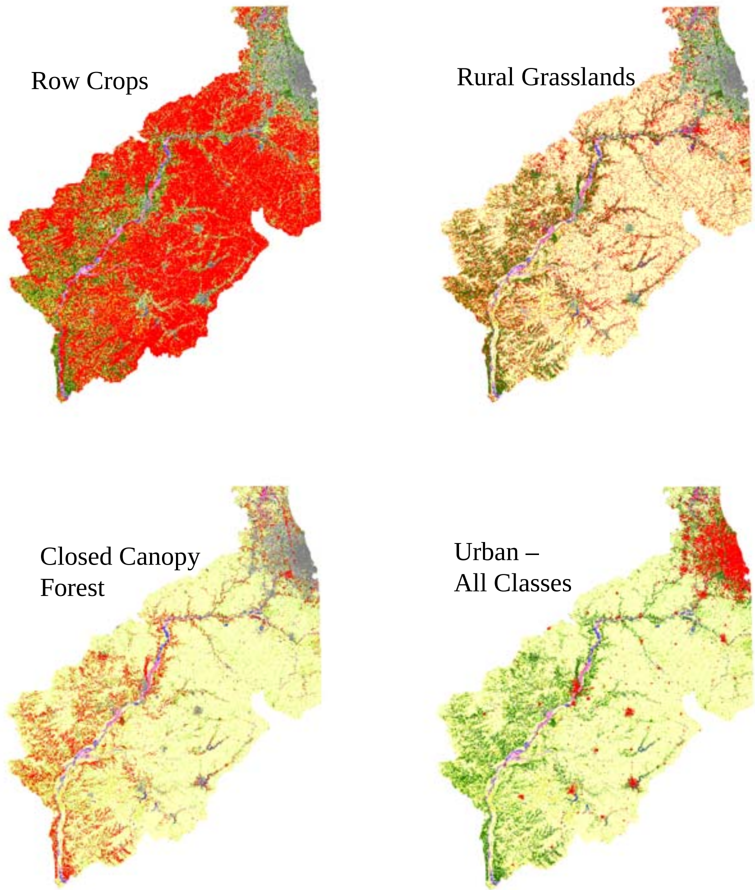


Figure 2-10. The Four Most Abundant Land Cover Classes (shaded red) in the Illinois River Basin

In addition to the losses of natural habitats in all classes, the remaining areas are highly fragmented and degraded to varying degrees. It is uncommon to find continuous natural land cover along the riparian corridor of an entire stream. Construction of roads, fields, dams, and losses of movement corridors have resulted in habitat fragmentation and the creation of small, isolated areas of forests, wetlands, prairies, and riparian corridors. Modern agriculture and the development of cities and towns have also contributed to habitat fragmentation.

The remaining animal and plant communities in these isolated tracts may only contain a few individuals or groups of each individual species. As tract size decreases, the population size of individual species also decreases because the local populations are vulnerable to disease and inbreeding stresses. Population size is the best predictor of extinction probability. Thus, fragmentation may increase the propensity for small, isolated populations to become locally extirpated (IDNR 1994, Wilson 1992). Species richness has been shown to be negatively affected with the decreasing size and increasing isolation of habitat fragments [The Nature Conservancy (TNC) 1998, Critical Trends Assessment Program (CTAP) 2001]. Fragmented habitats are often too small for species that require large home ranges or habitat blocks (such as the cerulean warbler), or are edge sensitive. Habitat fragmentation may favor competitors, predators, and parasites over native species and increases the vulnerability of native species to predators along new habitat edges. Fragmentation also severs the natural landscape links that connect blocks of similar habitat or provide access to different habitat types required by various species for different life cycle functions. Habitat loss, degradation, and fragmentation have led to measurable losses in species diversity throughout the Illinois River Basin (Fitzgerald et al. 2000, CTAP 2001).

Finally, disturbances maintain the mosaics of habitats needed to maintain a naturally functioning ecosystem. Most of these disturbance regimes have been greatly altered or even eliminated altogether. This alteration of disturbance regimes has resulted in a more homogeneous environment, with an associated loss in ecological integrity.

a. Resource Rich Areas (RRA). Critical Trends Assessment Program (CTAP) scientists used land cover data and geo-referenced biological data, such as the quantity of forests, wetlands, Illinois Natural Areas Inventory (INAI) sites, and Biologically Significant Streams (BSS), to determine where the most biologically rich areas of the state are located. Thirty such resource rich areas were identified throughout the state, 11 of which lie at least partially within the Illinois River Basin (figure 2-11).

1. Driftless Area
2. Sugar River
3. **Chain O' Lakes - Fox River**
4. Illinois Beach
5. Kishwaukee River
6. Rock River
7. **Du Page River**
8. Mississippi - Lower Rock
9. **Des Plaines River**
10. **Thorn Creek**
11. **Prairie Parklands -Midewin**
12. **Kankakee - Iroquois**
13. **Peoria Wilds**
14. Nauvoo
15. **Mackinaw River**
16. **Middle Illinois River**
17. Vermilion River
18. **Big Rivers**
19. Embarras River
20. **Sangamon River**
21. Upper Wabash River
22. Southern Till Plain
23. Karst/Cave Area
24. Lower Wabash River
25. Kaskaskia Bottoms
26. Middle Fork Big Muddy
27. Illinois Ozarks
28. Shawnee Hills
29. Cache River
30. Cretaceous Hills

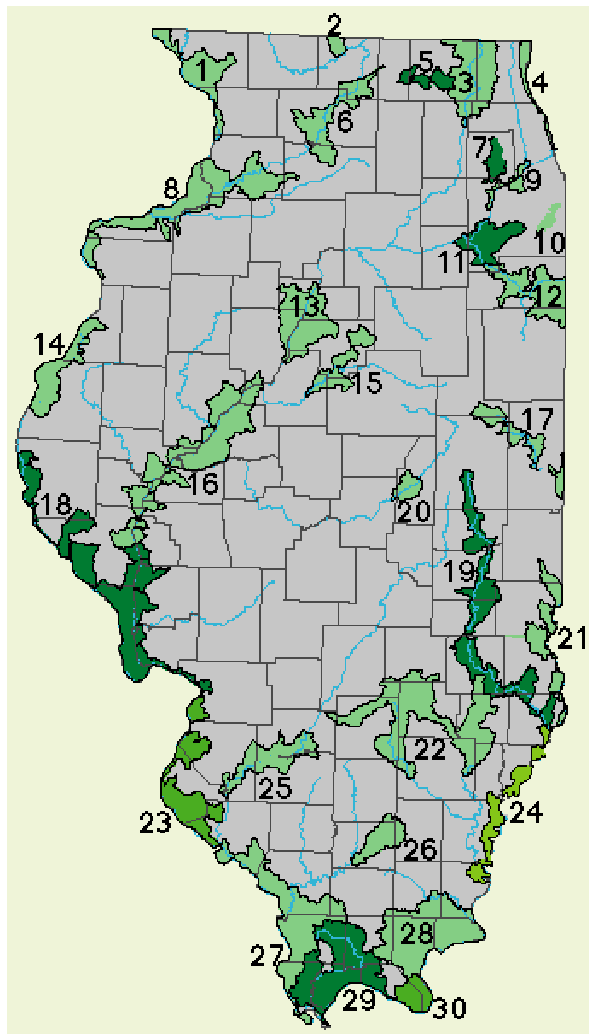


Figure 2-11. Resource Rich Areas (CTAP 2001). Those RRAs in bold are within the Illinois River Basin, wholly or in part.

The RRAs in the Illinois River Basin vary in size from 20,614 to 626,795 acres (table 2-4).

Table 2-4. Illinois Natural Areas Inventory (INAI), Biologically Significant Streams (BSS), and Natural Heritage occurrences for Resource Rich Areas within the Illinois River Basin

Resource Rich Area	Total Acres	INAI	# INAI Sites [1]	BSS Miles	# Heritage Occurrences
Chain O Lakes-Fox River	285,844	9,442	72	35.6	476
DuPage River	51,653	1,576	7	0	17
Des Plaines River	43,470	2,115	11	0	61
Thorn Creek	20,614	927	5	0	13
Prairie Parklands	152,669	10,037	18	23.8	85
Kankakee-Iroquois	231,005	6,731	17	63.3	67
Peoria Wilds	277,847	1,859	24	0	51
Mackinaw River	125,008	1,139	4	26.9	7
Middle Illinois River	575,515	13,474	38	0	134
Big Rivers	626,795	10,514	61	28.9	150
Sangamon River	53,734	880	2	15.5	8

[1] Natural areas occurring in more than one RRA are counted only once.

In most RRAs, the existing natural resources occupy a concentrated portion of the watershed, often along riparian corridors, and only a small fraction of these areas are protected from encroachment or development by being in State or Federal ownership (table 2-5).

Table 2-5. State- and Federally-Owned Lands in Resource Rich Areas

State Lands [1]						Federal Lands		
Resource Rich Area	**# of Parks**	**# Cons Areas**	**# of Forests**	**# of FWA**	**State acres**	**% of RRA**	**Federal acres**	**% of RRA**
Chain O Lakes-Fox River	2	0	0	0	5,338	1.9	0	0.0
DuPage River	0	0	0	0	0	0.0	0	0.0
Des Plaines River	0	0	0	0	0	0.0	0	0.0
Thorn Creek	0	0	0	0	0	0.0	0	0.0
Prairie Parklands	2	1	0	0	7,324	4.8	26,904	17.6
Kankakee-Iroquois	1	1	0	0	6,415	2.8	0	0.0
Peoria Wilds	0	4	0	1	9,570	3.4	1,589	0.6
Mackinaw River	0	0	0	1	1,397	1.1	0	0.0
Middle Illinois River	1	5	1	2	31,630	5.5	21,499	3.7
Big Rivers	1	1	0	0	9,547	1.5	37,901	6.0
Sangamon River	0	0	0	0	0	0.0	0	0.0

[1] Parks, Cons Areas (Conservation Areas), Forests, and FWA (Fish and Wildlife Area) refer to state lands

The RRAs include 45 percent of the bottomland, 43 percent of the nonforested wetland, and 34 percent of the upland forest in Illinois while occupying less than 20 percent of the state's total area. The RRAs include 76 percent of all INAI acreage and 55 percent of all INAI sites in the state. Forty-eight percent of all BSS mileage lies within RRA sites. The RRAs in the northeast portion of the Illinois River Basin, in and around the greater metropolitan Chicago area, are especially vulnerable to urban encroachment.

This inventory of resource rich areas has helped to establish priorities for Illinois' Conservation 2000 Ecosystem Program. Most of the program's Ecosystem Partnerships have a resource rich area in their core. These partnership groups work together to maintain and enhance ecological and economic conditions within a defined area (CTAP 2001).

b. Grassland Communities. Prairies once covered 61 percent of the Illinois landscape. While grassland still accounts for almost 7 million acres (20 percent) of the entire state of Illinois, only 2,300 acres (about 0.01 percent of the former area) of high quality prairie remains (CTAP 2001). The remainder of the grassland habitat has been plowed, heavily grazed, or frequently mowed. Scientists from CTAP monitored 71 grassland sites statewide from 1994-2001. The average number of vascular plant species per sample site was 20; the lowest diversity sites averaged 6 species and the highest diversity sites (prairie remnants) averaged 33 species per site. By comparison, high quality prairie habitats may contain 10-140 species in a few acres. Of the terrestrial habitats, grasslands are the most heavily dominated by introduced species, primarily meadow fescue and Kentucky and Canadian blue grasses. Although many introduced grasses dominate these grasslands, they still harbor many grassland-dependent species that rely on the structure and extent of the habitat more than the specific plant species.

Most of the bird species of concern for this physiographic region, identified by Partners in Flight (a cooperative effort focusing on bird conservation in the Western Hemisphere) are grassland birds (Fitzgerald et al. 2000). Grassland bird communities were assessed from 1994-2001 and CTAP scientists found fewer grassland-dependent bird species than expected. Of 12 grassland-dependent indicator species and an expectation of at least 6 species at any site, an average of only 1.8 species per site were found among 45 sites surveyed statewide. Except for the eastern meadowlark, brown-headed cowbirds (nest parasites) were detected more often than any grassland-dependent bird species. The species that were found most often exhibited only low to moderate sensitivity to grassland fragmentation.

c. Forest Communities. Two hundred years ago, 38 percent of the state was forested; only 14 percent remains as forest today (CTAP 2001). These losses are the result of conversion to agricultural land and timber harvesting for fuel wood and lumber. Floodplain forests serve as habitat for wildlife and, during floods, for fish; reduce soil erosion; and improve water quality. Leaf litter is a significant source of organic matter for secondary aquatic production (Yin 1999). Seventy-one randomly-selected forest sites around the state were monitored between 1997 and 1999. Results of CTAP forest monitoring revealed that upland forests are oak-hickory-ash-elm and bottomland forests are predominantly ash-elm-maple (CTAP 2001). Considering the total number of vascular plants, bottomland forests were less diverse than upland forests. Landowner reports and preliminary survey results indicate that many forests are in early stages of succession, comprise primarily young trees, are often small woodlots, and show evidence of grazing, logging, or farming. Older growth forests were rarely encountered. Timber harvesting of maple trees is becoming increasingly common (Timmons 2001). Scientists from CTAP identified three common disturbance related problems: (1) forests have lost disturbance sensitive species, (2) forests are being dominated by introduced invasive species, and (3) fire suppression is leading to maple dominance (with a concurrent decline in oak and hickory species). The species composition in bottomland forests has also been altered by higher water tables, resulting in decreased oak regeneration and also adding to maple dominance (Theiling et al. 2000).

Floodplain forests support a larger number of avian species than any other habitats in the Upper Mississippi River System, providing essential habitat for wood ducks, hooded mergansers, prothonotary warblers, and red-shouldered hawks (Yin 1999). Scientists from CTAP detected the impacts of forest structural and compositional change in bird communities. An average of 6.4 forest-dependent species was found at each site. Out of a total of 24 possible species, 10 area-sensitive species were found between 1997 and 1999 for this statewide monitoring program. A positive correlation between percent forested area within 1 km and the number of bird species was also detected. Despite the lack of historical data for comparison, the occurrence of fewer than one species (0.56) per site reflects the degraded condition of the average forest patch in Illinois (CTAP 2001).

Illinois forests provide the major habitat for more than 420 vertebrate species. Losses in the quality and quantity of forest habitat severely affect wildlife populations; 82.5 percent of mammals, 62.8 percent of birds, and 79.7 percent of amphibians and reptiles require forested habitat for a portion of their life cycle (IDNR 1994).

d. Wetland Communities. To date, approximately 90 percent of Illinois wetlands have been lost. The wetlands that remain are degraded by fragmentation, siltation, altered hydrology, and the introduction of aggressive species (Havera et al. 1997, CTAP 2001). High quality wetlands tend to be relatively free from aggressive introduced species, so species richness and the presence of introduced species were the indicators CTAP scientists used to assess wetland quality. Among 78 monitored sites statewide, the most important native species were Joe Pye weed (*Eupatorium dubium*), rice-cut grass (*Leersia oryzoides*), common reed (*Phragmites australis*), river bulrush (*Scirpus fluviatilis*), water smartweed (*Polygonum amphibium*), and broad-leafed cattail (*Typha latifolia*). There were generally few introduced species at each site, but many degraded wetland communities were dominated by a single aggressive species such as narrow-leaved cattail (*Typha angustifolia*), reed canary-grass (*Phalaris arundinacea*), and meadow fescue in the north, and common reed (*Phragmites australis*) in the south. Reed canary-grass, the most commonly encountered introduced species, often completely dominates wetland plant communities and was the dominant species in 22 of 78 monitoring sites (CTAP 2001). The northeastern counties (Cook, Lake, and McHenry) supported the greatest number of rare wetland plant species in Illinois. The extirpations of threatened and endangered wetland plants have been exceptionally high in several counties in the Illinois River Basin (IDNR 1994).

Photograph 2-2. Great Blue Heron

Most of the birds, mammals, amphibians, and reptiles in Illinois use wetlands to satisfy some or all of their life requisites. Up to 266 species of birds use wetlands in Illinois during some stage of their life cycle (IDNR 1994). Scientists from CTAP identified 15 wetland-dependent bird species, such as the great blue heron (photograph 2-2), that could occur in southern wetlands and 27 in northern wetlands. Among the 50 wetland sites surveyed statewide, an average of only 1.3 wetland-dependent bird species per site were detected. No wetland-dependent species were detected at half of the sites. Six species were detected in at least 10 sites. Only three of the 12 state-listed threatened or endangered wetland-dependent birds were found, at one site each. The rarity of these wetland-dependent birds is indicative of the degraded wetland conditions in the state (CTAP 2001).

Of the 59 mammal species in Illinois, at least 36 species use wetland habitats, including 8 of the 10 endangered and threatened mammal species that are wetland-dependent (photograph 2-3). Thirty-seven of 41 species of amphibians in Illinois use wetlands; all three threatened or endangered amphibians are dependent on wetlands. Forty-seven reptile species, out of 60 statewide, utilize wetlands, including seven of nine species listed as threatened or endangered. Twelve of the 29 endangered and threatened fish species occur in wetlands or use them for spawning. Overall, of the 94 vertebrate species listed as threatened or endangered throughout the state, 64 percent utilize wetlands for at least some portion of their life cycle (IDNR 1994).

Photograph 2-3. North American River Otter

e. Riparian Corridors. The riparian corridor is an important structural and functional element of the stream ecosystem. Riparian corridors are the transition areas between aquatic and terrestrial habitats. Riparian areas provide movement corridors along rivers and streams. The bank line forests provide shade and input organic matter into the aquatic ecosystem. Riparian habitat is critical habitat for migrating and breeding birds. Preserving large tracts of contiguous habitat is important for maintaining high levels of vertebrate and invertebrate biodiversity. Fragmentation or development of this habitat can disrupt migration and breeding patterns and could limit species that favor expanses of connected habitat.

Detailed analyses of riparian corridor changes have not been conducted, but the change in the distribution of forest, prairie, and wetland cover between the present and presettlement periods has been extensive. The current composition of bankside land cover is mostly forest or grassland (table 2-6). However, the dominant riparian land cover within a 300-meter (328 yards) buffer area is agriculture.

Table 2-6. Riparian Bankside and 328 yd. Buffer Land Cover (ISIS 1999)

Land Cover Class	Bankside (%)	328 yd. Buffer (%)
Agriculture/Cropland	1	66
Disturbed/Barren	0	1
Forest	49	14
Grass	33	5
Mixed	14	7
Reservoir	2	2
Urban	1	4
Water	0	1

f. Stream Communities. There is a great diversity of stream types in the Illinois River Basin, including small, coldwater, spring-fed creeks; stony and sandy-bottomed coolwater or warmwater streams; and soft-bottomed, warmwater streams and rivers. The diversity of habitats helps support a diversity of aquatic plant and animal species. The majority of streams have been manipulated either directly by modifications within the streams, or indirectly by modifications in the surrounding landscape, or both. Dams and channelization are the most apparent changes to small streams and rivers. Many streams that originally drained the prairies of Illinois were straightened and their canopies and riparian buffers were removed. Many current streams or ditches, constructed to provide more effective land drainage, were historically ephemeral channels, wetland swales, or simply did not exist (Rhoads and Herricks 1996). Landscape changes have also led to increased runoff rates. Much of the land that is currently used for agricultural purposes was tiled to drain more rapidly than it did historically. Increased bed and bank migration has resulted from the higher energy flows and erosive forces of these stream systems. This development in the basin has resulted in streams that are more structurally simple and homogeneous than in the past.

Several methods—including the Biological Stream Characterization (BSC) Index and habitat quality assessments performed as a part of the CTAP—were used to assess the stream quality within the state The BSC and habitat quality assessments are based on different criteria; therefore, the results display some similarities as well as differences. The BSC is based on biological data, while the habitat quality assessments are based on physical parameters of the streams. These two methods are described below.

Biological Stream Characterization. Illinois DNR and Illinois EPA managers developed the BSC Index to rank stream quality uniformly across the state. The BSC is a mix of quantitative variables based primarily on the Index of Biotic Integrity for fish (Karr et al. 1986), and to a lesser extent on macroinvertebrate biotic indices and qualitative judgments of Illinois DNR biologists (Bertrand et al. 1996). The results for the 1999 Illinois River Basin assessment are shown in table 2-7 and figure 2-12. In that assessment, the Mackinaw watershed had the most highly rated stream miles. Highly valued and moderate stream reaches were the most common, and they were widely distributed throughout the Illinois River Basin. Limited value streams occurred in the urban watersheds of the Des Plaines, Fox, and Chicago Rivers, the agricultural watersheds of the Sangamon River, and the Spoon River watershed. Restricted stream reaches occurred mainly in the Chicago region, and comprised only a small fraction of the total streams assessed.

Stream Habitat. State scientists have been monitoring stream water quality, habitat, aquatic insects, and fishes throughout Illinois since 1995 as part of the CTAP (CTAP 2001). Habitat quality assessments, modified from the USEPA procedure, have been conducted by CTAP scientists, examining 12 stream habitat parameters that relate to the quality and width of bankline vegetation, quantity and quality of in-stream cover, condition of banks, and relative straightness of the stream course. Natural habitat features of most Illinois streams, such as wooded riparian corridors, winding channels, and in-stream habitat such as coarse rocks and woody debris, have been removed to facilitate agriculture. The statewide average habitat index score was 88.6 out of a maximum possible 180, indicating fair habitat quality. The lowest and highest scores in Illinois were 25, indicating severe landscape and drainage alterations, and 146, indicating an aquatic and riparian resource of the highest quality. Highly agricultural basins, including the Kankakee, Vermilion, Mackinaw, and Spoon scored below the statewide average. The Sangamon basin scored higher than average since it is larger and more flood-prone, discouraging row crop agriculture close to the banks. Habitat quality scores of the streams in the Illinois River Basin reflect the modifications to the floodplain that have occurred over the past 150 years (CTAP 2001).

Table 2-7. Illinois River Sub-Basin Stream Miles Ranked Using the Illinois Department of Natural Resources Biological Stream Characterization (Bertrand et al. 1996: ISIS 1999)

Watershed	Unique	High	Moderate	Limited	Restricted
Des Plaines	11.3	68.8	189.2	260.0	19.5
Upper Fox	0.0	94.6	99.0	46.1	0.0
Chicago	0.0	0.0	64.9	156.7	24.1
Lower Fox	16.5	164.1	310.8	9.4	0.0
Lower Illinois-Senachwine Lake	8.8	124.2	113.4	0.0	0.0
Upper Illinois	45.0	163.4	28.9	0.0	0.0
Kankakee	0.0	228.8	92.6	0.1	0.0
Spoon	0.0	159.2	487.9	130.4	0.0
Vermilion	55.9	223.8	122.0	0.0	0.0
Iroquois	0.0	167.6	33.1	0.0	0.0
Lower Illinois-Lake Chautauqua	0.0	50.1	60.5	0.0	0.0
Mackinaw	156.1	211.5	65.4	1.2	0.0
LaMoine	19.6	176.3	231.9	0.6	0.0
Upper Sangamon	46.2	117.5	250.5	34.1	0.0
Salt	18.7	184.2	234.4	53.6	0.0
Lower Sangamon	0.0	12.8	193.9	36.1	0.0
Lower Illinois	0.0	219.7	33.9	0.0	0.0
South Fork Sangamon	0.0	0.6	116.1	81.8	0.0
Macoupin	0.0	101.2	0.5	0.5	0.0
Total Stream Miles	**378.1**	**2,468.4**	**2,728.9**	**810.6**	**43.6**
Percent of Sampled	**5.9%**	**38.4%**	**42.4%**	**12.6%**	**0.7%**

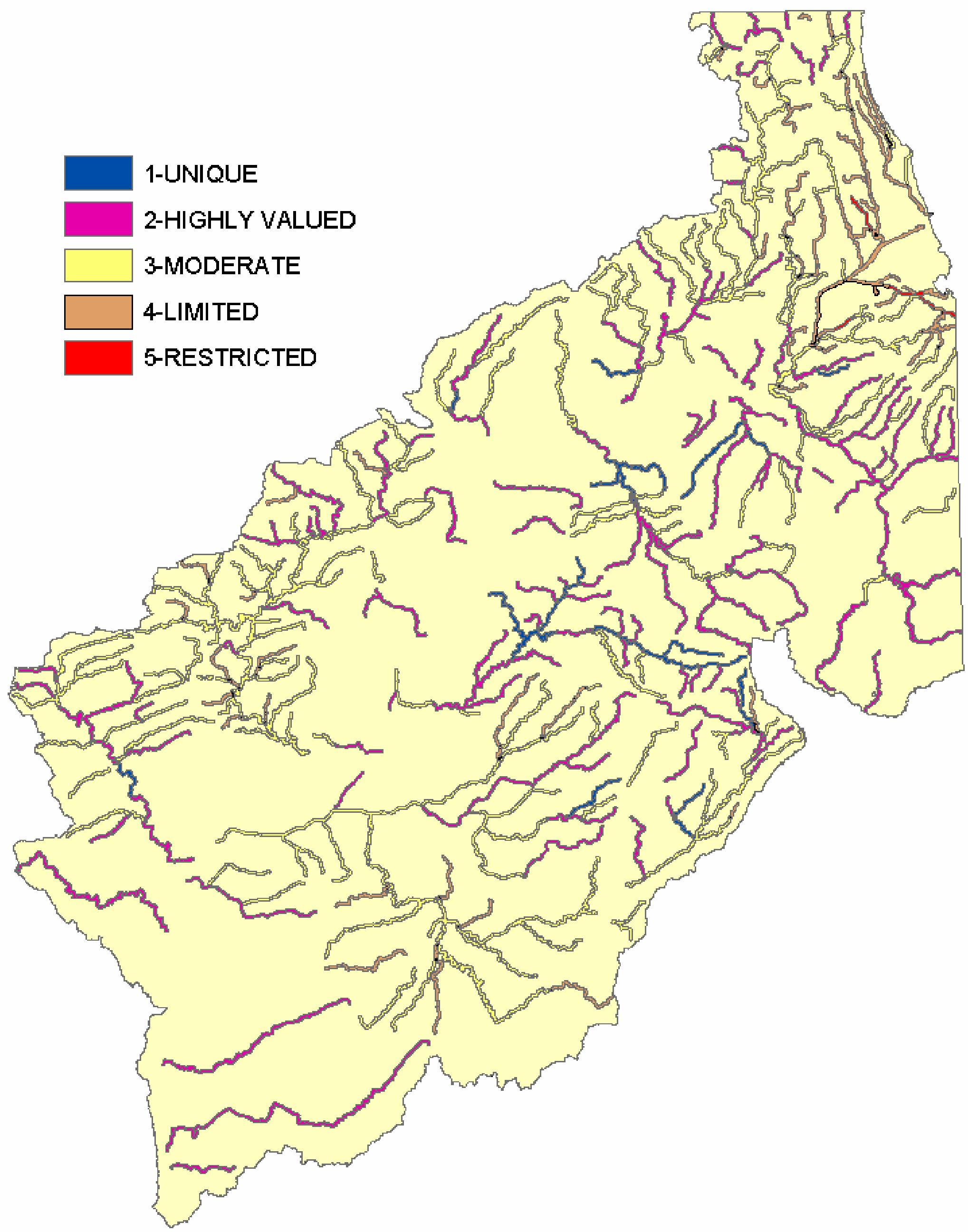


Figure 2-12. Biological Stream Characterization for Some Illinois River Basin Streams (Bertrand et al. 1996; ISIS 1999)

Compared to the species found in flowing waters in Illinois at the start of the last century, approximately 19 percent of the fish, 34 percent of the amphibians and reptiles, 55 percent of the freshwater mussels, and 22 percent of the crayfish have been extirpated or are threatened by extinction (IDNR 1994). These changes can be attributed to habitat loss, degradation due to siltation and/or poor water quality, contaminated sediments, construction of dams and levees, introduction of exotic species into the system, and overharvesting (IDNR 1994).

g. Floodplain Communities. The degree of connectivity between the main channel and its floodplain is a primary structural attribute of river ecological integrity (Lubinski 1999). Seasonal floods, creating and maintaining a mosaic of habitat types that exhibit a high degree of biodiversity, characterize river-floodplain ecosystems (Sparks 1995). The lower Illinois River, including Peoria, La Grange and Alton Pools, is a remnant of the ancient Mississippi River that once flowed across northwestern Illinois. The floodplain in this reach is exceptionally large for the current river discharge and has been filling with fine loess sediments for millennia (Theiling et al. 2000).

Prior to navigation and agricultural development, the backwaters were very numerous and diverse. Currently, water level regulation maintains fewer, larger lakes with uniform shallow depths and silty substrates. Agriculture dominates the floodplain, which is about 50 percent leveed in La Grange Pool and about 70 percent leveed in Alton Pool (Theiling et al. 2000). The levees also concentrate river flows and sediment carried in suspension. Sediment-laden waters are currently concentrated in the remaining contiguous floodplain, where it settles out, causing rapid filling in backwater lakes (Bellrose et al. 1983). Levees reduce river-floodplain connectivity, which may limit production of floodplain spawning fishes and reduce nutrient transfer between the river and its floodplain (Sparks 1995, Ward 1999).

The overall productivity of the river system may have been reduced from a natural floodplain river system with significant changes in seasonal water levels to an ecosystem in which seasonal low water conditions no longer occur (Bayley 1991). These alterations to the landscape and the flood pulse and river-floodplain connectivity have initiated long-term changes in the ecosystem that are difficult to reverse (Sparks 1995).

h. Aquatic Vegetation. _Historically, emergent, submersed, and floating aquatic plants were very important components of the Illinois River floodplain ecosystem (Bellrose et al. 1979, Havera 1999). The vast floodplain marshes and backwater lakes were the resources that attracted and supported the huge abundances of migratory waterfowl and other waterbirds that have been so highly valued. The ecological response to the multiple and continued disturbances of the Illinois River has been well documented through time (see Mills et al. 1966, Starrett 1972, Bellrose et al. 1979, Sparks 1984, Bellrose et al. 1983, Theiling 1999, and USGS 1999 for comprehensive reviews). From all accounts, the river was in good condition prior to 1900. After 1900, however, the diversion from Lake Michigan permanently altered the nature of the system. Initially, the expanded backwaters were vegetated with about 50 percent cover of many species of aquatic plants, such as pondweeds (*Potamogeton* spp), coontail (*Ceratophyllum* spp), bulrush (*Scirpus* spp), and wild celery (*Vallisneria* spp) (Bellrose et al. 1979, Sparks 1984).

Photograph 2-4. Degraded Backwater

Aquatic plants have not recovered from the effects of organic pollution in the early 1900s and increased wave action from wind and boats after 1955 (Bellrose et al. 1979, Sparks 1992, Havera 1993, Havera 1999, Yin et al. 2004). The continued absence of aquatic plants in backwaters and channels open to the Illinois River is significant (photograph 2-4). When submersed aquatic vegetation died out in the mid-1950s, several things occurred: backwater substrates became easily disturbed; turbidity increased; fish communities became dominated by species tolerant of low dissolved oxygen and poorer habitat conditions; and waterfowl shifted their migrations away from the river. Currently, aquatic plants in the Illinois River are largely restricted to backwaters isolated from the river by low levees (Rogers and Theiling 1999). In addition to the physical constraints to aquatic plant re-establishment, the high abundance of rough fish, including carp, exert significant grazing pressure on any plants where they are able to grow, further limiting their re-establishment.

i. Aquatic Macroinvertebrates. In the Illinois River, the aquatic macroinvertebrate community (mayflies, fingernail clams, chironomids, and worms) was seriously affected by organic pollutants and served as a strong indicator of environmental quality (summarized by Starrett 1972 and Sparks 1984). Studies conducted by Richardson in 1915 (Richardson 1921) indicated a diverse benthic community with a dominance of small mollusks (fingernail clams and snails). By 1920, pollution-tolerant sludge worms (*Tubificidae*) and bloodworms (*Chironomus* spp) dominated the benthos.

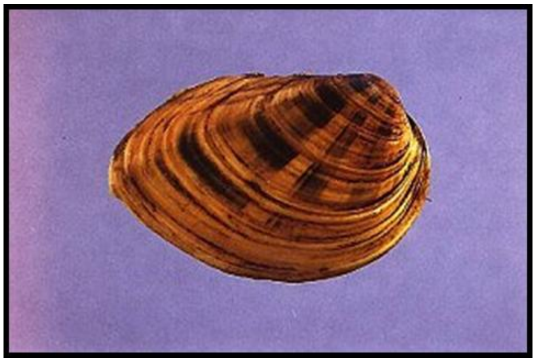
Fingernail clams were the dominant food source for many benthic feeders (diving ducks, buffalo, catfish, carp) until the mid 1950s when fingernail clams experienced a dramatic population decline (Mills et al. 1966). The likely causal agent was determined to be periodic high concentrations of ammonia, a problem from which the river has not yet recovered (Sparks and Ross 1992) and may still be occurring. The decline of fingernail clams had a substantial effect on their vertebrate predators.

Benthic communities are still poor in the northern reaches of the river, but mayflies and fingernail clams occur in low abundance in lower parts of the river. Macroinvertebrate populations in the Illinois River, such as burrowing mayflies and fingernail clams, are substantially smaller than those found in the Upper Mississippi River (Heglund 2004). However, new populations of fingernail clams have been recently documented at a few locations on the upper river (Sparks and Ross 1992, Yin et al. 2004).

Environmental conditions within the streams of the Illinois River Basin are better than those in the Illinois River itself. The EPT taxa richness index (Ephmeroptera, Trichoptera, Plecoptera) measures the number of pollution-intolerant mayflies, caddisflies, and stoneflies present in a sample. Higher EPT index values indicate less organic pollution, or better stream health. The index scores ranged from 0 to 17 statewide with an average of 7.1 EPT taxa per stream, which is a fair rating. The Illinois

River Basin watersheds scored above and below the statewide mean, with the Kankakee watershed scoring the lowest, the Fox almost at the mean, the LaMoine above the mean, and the Sangamon and Spoon higher than the mean. Hilsenhoff Biotic Index and Macroinvertebrate Biotic Index scores followed similar trends as the EPT scores, with the Spoon indicating less impaired conditions (CTAP 2001).

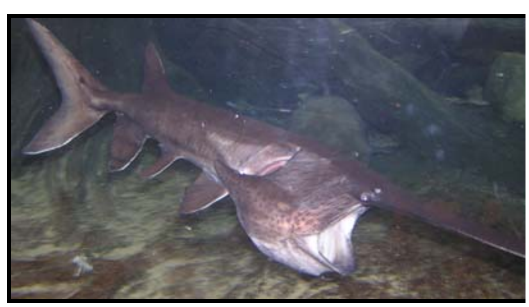
j. Mussels. Freshwater mussels (Unionaceae) (photograph 2-5) are another sediment-associated fauna that has suffered from the impacts of pollution and sedimentation; they are among the most imperiled fauna in North America (Neves 1993, Cummings and Anderson 2003). Not only are the numbers of freshwater mussels reduced due to poor water quality, the competition from zebra mussels (an invasive species) has also led to the decline in freshwater mussels. The zebra mussel infestation, which significantly affected the mussel communities in the Illinois River, has subsided considerably since 1995. No zebra mussels were detected in over 10,000 mussels collected in Alton Pool by commercial fishers in a specially regulated research harvest (Robert Maher, Illinois DNR, Brighton, Illinois, personal communication) but they can be found on riprap and other hard surfaces (Matt O'Hara,2001)



Photograph 2-5. Clubshell Mussel

The Illinois River system still retains approximately 35 mussel species, representing 12 percent of the freshwater mussels found in North America. Five mussel species are listed by the State of Illinois as threatened or endangered, one of which is a candidate for Federal listing. However, the general trend for mussels is still declining, both in population numbers and numbers of species, attributed to excessive siltation, loss of habitat, chemical pollution (including herbicide and insecticide runoff), and competition from exotic species (zebra mussels).

k. Fish . Fish communities provide a high-level indicator of environmental quality because of their position on the food chain and because they cannot significantly alter their distribution other than to escape into suitable tributaries or downstream. While Illinois streams contain a diversity of fishes (188 native species), they are often dominated by just two to three fish species, sometimes by one or more of the 15 introduced species found in the state (CTAP 2001). Fish species diversity is still considered high in the basin, with 115 species found, 95 percent of which are native species. Many of these species require riverine, backwater, and floodplain habitat as part of their life cycle. Eighteen fish species are listed by the State of Illinois as threatened or endangered. Many of these species are endemic to the basin and/or are intolerant of high silt levels. A group of aquatic organisms that is particularly representative of the Illinois River is the "Ancient Fishes," such as the paddlefish (photograph 2-6) and sturgeon. The majority of these fishes are migratory in nature and utilize a variety of habitats.



Photograph 2-6. Paddlefish

Fisheries monitoring, as part of the Long Term Resource Monitoring Program (LTRMP) conducted under the Environmental Management Program (EMP), and the Long Term Electrofishing (LTEF) conducted by the Illinois DNR since 1973, suggest that two distinct populations of fishes exist within the main stem of the Illinois River. Index of Biotic Integrity (IBI) trend data show no significant changes in populations in the lower three pools (Alton, La Grange, Peoria). However, these data reflect a recent increase in IBI scores in the upper three pools (Starved Rock, Marseilles, Dresden), approaching the IBI score for the lower pools. These differences in scores may be due to the inherent physical differences between these two areas, as well as lingering effects of water quality impacts to the upper pools (Pegg 2001). The long-term outlook (without-project conditions) may be for populations and native species diversity to decline gradually, due to increasing invasive species, declining suitable habitat, and loss of main stem benthic community.

Photograph 2-7. Green-winged Teal

l. Waterfowl and Birds. The Illinois River Basin is a critical mid-migration resting and feeding area of the Mississippi River Flyway. The numbers of waterfowl feeding and resting in the basin have dwindled since the first half of the 20th century. Diving duck numbers have not recovered from their rapid population decrease in the 1950s, due to habitat changes and loss of food resources. Waterfowl, and particularly diving ducks, have shifted their migrations away from the Illinois River. Peak numbers of dabbling ducks have hovered around 300,000 birds. By comparison, in the late 1940s, there were over 1,500,000 dabbling ducks in the Illinois River region each fall (photograph 2-7). Mallard numbers in the Illinois Valley have declined over 80 percent since the late 1940s.

Twenty-six avian species are state listed as threatened or endangered; one of which, the Bald Eagle**,** is a listed as a Federal Threatened Species, and four others are species of concern. Many of these species are associated with wetlands or grasslands, and are also sensitive to landscape fragmentation.

2. Threatened and Endangered Species. The Illinois River Basin currently contains 257 state listed threatened or endangered species in Illinois, of which 13 are federally listed and 1 is a Federal candidate species (table 2-8). Three additional federally-listed species occur in Indiana (total of 13 species, including 2 candidate species and 1 critical habitat designation). No additional threatened or endangered species occur in Wisconsin (two total species, including one candidate species). Five mussel species that live in the Illinois River Basin are listed by the state of Illinois as threatened or endangered, one of which is a candidate for Federal listing. Eighteen fish species are listed by the State of Illinois as threatened or endangered. Many of these species are endemic to the basin and/or intolerant of high silt levels. Federally listed species are discussed more completely in Section 5 and Appendix G (Coordination Act Report) of this document.

Table 2-8. Threatened and Endangered Species in the Illinois River Basin

Group	Illinois State Listed	Illinois Federal Listed Species	Indiana Federal Listed Species	Wisconsin Federal Listed Species
Birds	26	1	2 [1]	
Fish	18	0	0	
Mammals	2	2	1	
Mussels	5	1	4 [2]	
Reptiles/Amphibians	9	1[2]	2 [2]	1[2]
Insects	11	2	2	
Crustaceans	1	0	0	
Plants	185	7	2	1
TOTAL	**257**	**14**	**13**	**2**

[1] includes critical habitat designation
[2] candidate species

3. System Limiting Factors. The Illinois River Basin continues to experience a loss of ecological integrity due to: sedimentation of backwaters and side channels, degradation of tributary streams, increased water level fluctuations, reduction of floodplain and tributary connectivity, introduction of invasive species, and other adverse impacts caused by the intensive human development over the last 150 years. While many of the original plant and animal species are still present in the basin at reduced levels, the physical habitats (structure) and the processes that create and maintain those habitats (function) have been greatly altered. These alterations have contributed to a decline in the ecological health of the Illinois River Basin to the point where: aquatic plants beds have been virtually eliminated from the lower river; macro-invertebrate numbers have declined significantly; the loss of backwaters areas with sufficient depth for spawning, nursery and overwintering habitat is now considered limiting for many native fish; and floodplain, riparian, and aquatic habitat loss and fragmentation is a threat to the population viability of state- and federally-listed species in the basin.

a. Excessive Sedimentation. Increased sediment loads from the basin (photograph 2-8) have severely degraded environmental conditions along the main stem Illinois River by increasing turbidity and filling backwater areas, side channels, and channel border areas.

Photograph 2.8. Deposition at the Mouth of Lick Creek in LaGrange Pool

Increased sediment loads from the basin have severely degraded environmental conditions along the main stem Illinois River by increasing turbidity and filling backwater areas, side channels, and channel border areas. Excessive sediment has also degraded tributary habitats. Effective erosion control, due to the implementation of soil conservation practices, has reduced the average rate of erosion from croplands. Channel erosion from unstable streams accounts for 30-40 percent of the sediment delivered from eastern Illinois River Basin watersheds, and up to 80 percent of the sediment delivered from watersheds in the western part of the basin.

Channelization of streams has increased both flow rates and velocities within the streams, which has led to increased channel erosion. An average of 12.1 million tons of sediment per year were delivered to the Illinois River, above Valley City, for water years 1981-2000, of which 6.7 million tons per year were deposited within the river and its bottomlands. The physical effects of excessive sedimentation, coupled with an absence of complementary erosive forces, accelerate changes to aquatic and floodplain habitats, including the smothering and filling of habitats Low-velocity areas, such as backwater areas and side channels, are particularly susceptible. Addressing the contribution of fine sediments from the watershed is an effective way of reducing the negative effects of sedimentation in backwater areas because fine sediments can even be carried by slow-moving flows. Excessive sedimentation in the Illinois River Basin is discussed more fully in Section 3 under Goal 1.

b. Loss of Productive Backwaters, Side Channels, and Channel Border Areas. The loss of productive backwaters, side channels, and channel border areas due to excessive sedimentation can be attributed to the ecological problems in the Illinois River Basin, particularly because the Illinois River has lost much of its critical spawning, nursery, and overwintering areas for fish; habitat for waterfowl and aquatic species; and backwater aquatic plant communities. On average, the backwater lakes along the Illinois River have lost 72% of their capacity. The current quality of the existing backwaters is low due to the relatively shallow depths (less than 1 foot) and relatively uniform bottom surface lacking depth diversity. If current conditions persist, additional significant aquatic areas will be converted to lower value and increasingly common mud flat and extremely shallow water habitats. The loss of these areas in the Illinois River Basin is discussed more fully in Section 3 under Goal 2.

c. Loss of Floodplain, Riparian, and Aquatic Habitats and Functions. Land-use and hydrologic changes have reduced the quantity, quality, and functions of aquatic, floodplain, and riparian habitats. Flood storage, flood conveyance, habitat availability, and nutrient exchange are some of the critical aspects of the floodplain environment that have been adversely impacted. The use of levees has disconnected large areas of the floodplain from the Illinois River and its tributaries. Habitat loss and fragmentation are widespread problems that, in the long term, could limit attempts to maintain and enhance biodiversity. The degree of connectivity between the main channel and its floodplain is another primary structural attribute of river ecological integrity (Lubinski 1999). Isolation of the floodplains from the river has resulted in a reduction of habitat quality, availability, and function.

An analysis of the current main stem Illinois River floodplain cover types reveals a loss of approximately 75 percent of the forest, 81 percent of the grassland, and 70 percent of the wetlands. In addition, nearly 50 percent of the floodplain has been isolated from the river. A similar analysis of the tributary floodplains reveals approximate losses of 16 percent of the forest, 36 percent of the grassland, and 70 percent of the wetlands.

Alterations within the watershed have also had a pervasive negative effect on basin stream systems. Based on the IEPA analysis, channelization potentially impairs approximately 1,400 of perennial stream miles within the Illinois River Basin. However, unassessed streams tend to be smaller, and CTAP (1994) identified that the smaller streams tend to be channelized to a disproportionately high extent. Lopinot (1972) estimated that 27 percent of streams in the state were channelized at the time of publication; this would correspond to nearly 3,000 stream miles in the Illinois River Basin. Channelization of streams shortens overall stream lengths and results in increased velocities, bed and bank erosion, and sedimentation (photograph 2-9). Modified stream channels often have little habitat structure and variability (life requisites) necessary for diverse and abundant aquatic species. Channelization also disconnects streams from floodplain and riparian areas that are often developed into agricultural or built environments.

Photograph 2-9. Stream Incision and Stream Bank Erosion

In addition to habitat loss and fragmentation, habitat forming disturbance regimes have been altered, affecting habitat and species diversity. The degree of connectivity between the main channel and its floodplain is a primary structural attribute of river ecological integrity (Lubinski 1999). Seasonal floods, creating and maintaining a mosaic of habitat types that exhibit a high degree of biodiversity, characterize river-floodplain ecosystems (Sparks 1995). Flooding and low water regimes have been reduced or eliminated in some areas. Fire plays an important role in creating a mosaic of terrestrial habitat types, which, in turn, maintains the biodiversity of the system. Fire suppression has resulted in the increased invasion of woody species into primarily herbaceous systems and has shifted the relative abundance of species away from fire-adapted species. Fire can also suppress or kill non-native species. The loss of the oak-hickory forests in the basin is largely explained by the maple take-over, in which mature oak-hickory forest are unable to regenerate themselves because the tree seedlings are intolerant of the excessive shade that results from the absence of fire (IDNR 1994). The loss of these areas and functions in the Illinois River Basin is discussed more fully under Goal 3, “Improve floodplain, riparian, and aquatic habitats and functions.”

Photograph 2-10. Low Head Dam

d. Loss of Aquatic Connectivity (fish passage) on the Illinois River and its Tributaries.

There is diminished aquatic hydrologic connectivity on the Illinois River and its tributaries due to dam construction (photograph 2-10). Aquatic organisms do not have sufficient access to diverse habitat such as backwater and tributary habitats that are necessary at different life stages. Lack of aquatic connectivity slows repopulation of stream reaches following extreme events, such as pollution or flooding, and reduces genetic diversity of aquatic organisms. Construction of dams on the main stem and tributaries alters the temperatures, flow regime, sediment transports, chemical concentrations, and isolates biotic communities. There are seven dams on the Illinois Waterway and approximately 467 within the basin. Lateral connectivity in the Illinois River Basin is discussed more fully under Goal 4, "Restore and maintain aquatic connectivity on the Illinois River and its tributaries, where appropriate, to restore or maintain healthy populations of native species."

e. Altered Hydrologic Regime. The alteration of the hydrologic regime is considered to be the most significant change affecting aquatic biodiversity. In the developed watersheds of tributary streams feeding the river, stormwater inflows likely have higher peak flows than occurred under pre-development conditions, due to land-use changes and increased efficiency brought about by channelization. These stormflows result in rapidly rising and falling water levels and more uneven delivery of flows to the Illinois River. Land-use changes and drainage are believed to have increased the volume and the erosive force of water delivered to the river and may contribute to water level fluctuations in the main stem. A major impact of increased drainage is the decrease in base flows that impact aquatic communities in the tributaries during low water periods.

Land use changes in the basin and river management have altered the water level regime along the main stem Illinois River, stressing the natural plant and animal communities along the river and its floodplain. The increased number of water fluctuations, especially during summer and fall low water periods, and the constant inundation of the areas upstream of the navigation dams have altered the hydrologic regime of the river (figure 2-13), thereby contributing to the degradation of the river system. The biotic composition, structure, and function of aquatic, wetland, and riparian ecosystems depend largely on the hydrologic regime. The flow regime (magnitude, frequency, duration, timing, rate of change) affects water quality, energy sources, physical habitat, and biotic interactions, which, in turn, affect ecological integrity (Poff et al. 1997). Past management efforts have focused on requirements of one or few species of fish. The range of flows needed to sustain aquatic and riparian ecosystems may be much greater. Elimination of the summer low water periods prohibits compaction of sediments. Therefore, suspended sediments settle only loosely to the lakebed, creating a soft bottom in which aquatic plants cannot take root.

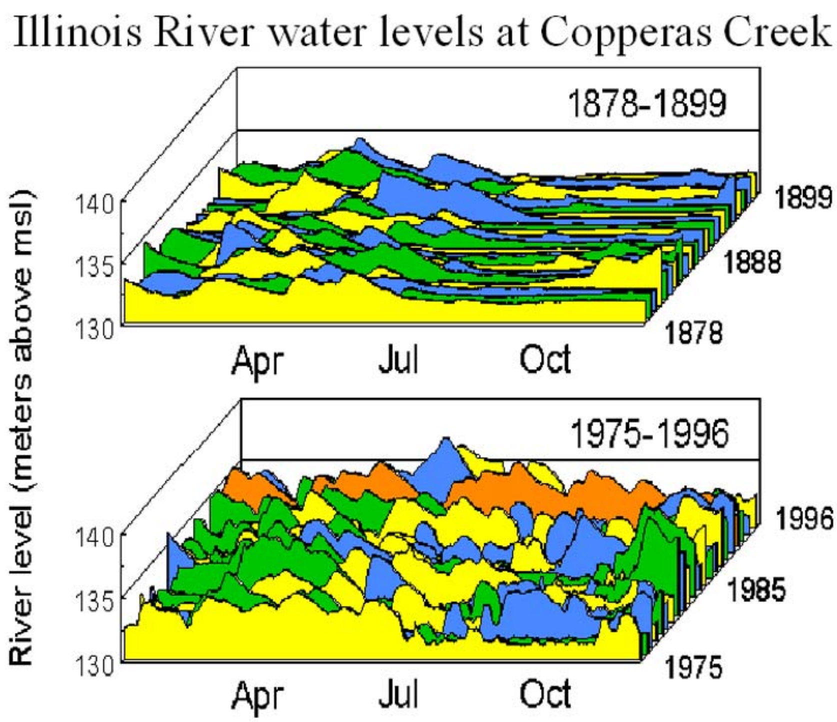


Figure 2-13. Change in Water Level Fluctuations at Copperas Creek Gage

Rapidly changing water levels of the Illinois River during the growing season (a.k.a. the summer "bumps") frequently flood young, moist soil plants on mud flats before they are developed enough to survive inundation. In predevelopment conditions, water levels receded during the summer and allowed moist soil plants to grow on exposed mud flats. The summer "bumps" appear to be a critical factor, limiting these plants growing in areas within or connected to the river. Significant water level fluctuations occur during the growing season, severely limiting plant germination, growth or survival. Past efforts may have failed to consider the full range of hydrological variability and the influence of hydrologic process on geomorphic changes and ecosystem functions (Richter et al. 1996). Hydrologic modifications to the Illinois River Basin are discussed more fully in Section 3 under Goal 5, "Naturalize Illinois River and tributary hydrologic regimes and conditions to restore aquatic and riparian habitat." See the following paragraph on water and sediment quality for a discussion of the effects of altered hydrology and turbidity on aquatic plants.

f. Water and Sediment Quality. Water resources in the Illinois River Basin are impaired due to a combination of point and non-point sources of pollution. Although effective regulatory efforts have reduced contributions from point sources (such as wastewater treatment plants), non-point sources of water quality impairment (such as sediments and nutrients) continue to degrade the surface waters.

Water clarity is the primary factor limiting submersed aquatic plants. During periods of high turbidity, aquatic plant growth is limited, since suspended sediments interfere with light penetration into the water. The high rates of sediment delivery, and subsequent resuspension, are thought to be the primary causes of this turbidity. Loss of aquatic plants also decreases the stability of the bottom substrates for colonization by rooted plants (Wiener 1997). Under the current degraded habitat conditions, including excessive sedimentation and altered hydrology, it will be difficult to achieve the critical mass to maintain healthy aquatic plant beds. Goals 1 and 5 in Section 3 address both of these limiting factors.

In addition to turbidity, the quality of the sediments, particularly in the main stem, may limit macroinvertebrates, such as fingernail clams. Ammonia, an agricultural fertilizer, is found in the upper layers of the sediments, sometimes in toxic amounts. Toxic conditions in the sediment may have contributed to the widespread decline of fingernail clams in the Upper Mississippi River Basin, including the Illinois River (Wilson et al. 1995). Fingernail clams are very sensitive to un-ionized ammonia. During drought conditions, concentrations of un-ionized ammonia in the sediment pore water may become high enough to adversely affect fingernail clams (Frazier et al. 1996). The declines in fingernail clams may adversely affect bottom-feeding fish and wildlife, such as migrating lesser scaup, which feed heavily on this mollusk (Wilson et al. 1995). This trend has already been observed on the Illinois River since the 1950s, and may also be occurring on the Upper Mississippi River (Sparks 1984, Weiner 1997).

The impaired water and sediment quality in the Illinois River Basin is discussed more fully under in Section 3 under Goal 6, "Improve water and sediment quality in the Illinois River and its watershed."

g. Invasive Species. Invasive species threaten biodiversity, habitat quality, and ecosystem function. These biological invasions produce severe, often irreversible impacts on agriculture, recreation, and our natural resources. They are the second-most important threat to native species, behind habitat destruction, having contributed to the decline of 42 percent of U.S. endangered and threatened species. Introduced species also present an ever-increasing threat to food and fiber production. In the United States, the economic costs of non-native species invasions reach billions of dollars each year (Pimentel et al. 2000). Invasive species compete with native species for habitat and food. Some invasive species are less sensitive to the changes that have taken place in the Illinois River Basin than the native species.

An introduced species can change the look and makeup of an entire system by changing species composition, decreasing rare species, and even changing or degrading the normal functioning of the system. Maintaining intact natural systems is important to ensure the continuation of ecosystem goods and services upon which humans depend. Many factors may cause nonindigenous species to become abundant and persist. These include the lack of natural predators and artificial and/or disturbed habitats that provide favorable conditions for invasive species (Pimentel et al. 2000).

Non-native plants can monopolize the landscape, out-competing and replacing native species in the absence of normal population controls, such as disease, insects and other controls found in their native habitats (Ikenson 2003). Invasive-dominated areas tend to provide significantly less habitat than those areas with primarily or only native species. Non-native/invasive plants common to the Illinois River Basin include reed-canary grass, purple loosestrife, garlic mustard, Japanese and shrub honeysuckle, multiflora rose, and buckthorn. Once established, these plants can be difficult and costly to control. If these invasions continue unchecked, wildlife populations will decrease as their habitat is degraded, and some species will likely become extirpated or extinct.

There are at least 15 introduced fish species in Illinois. Some of these are U.S. natives whose range has been expanded or species from other parts of the world. There has been a great nationwide increase in the total number of species introduced since 1950, and the proportion of non-U.S. species also has increased significantly (Chick and Pegg 2001). The mode of transport is shifting from intentional releases of food or sport fishes to accidental releases of aquarium fish, aquaculture species, and those carried in international shipping ballast water. The greatest proportion of non-U.S. species comes from Asia and South America.

In the Illinois River, the common carp is so plentiful and has been present for so long that few people realize it is non-native. It has been very successful since its introduction in the1880s and soon displaced buffalo and catfish as the major component of the commercial catch. More recently, grass carp have been increasing in the Long Term Resource Monitoring Program (Heglund et al. 2004) (figure 2-14) and commercial catch (figure 2-15). Asian carp are a more recent arrival and their numbers are growing rapidly. The Asian carp compete for the same food (drifting plankton and invertebrates) as gizzard shad and paddlefish. The Illinois Natural History Survey Great River Field Station is currently investigating the implications of these introductions on native species (John Chick, Illinois Natural History Survey).

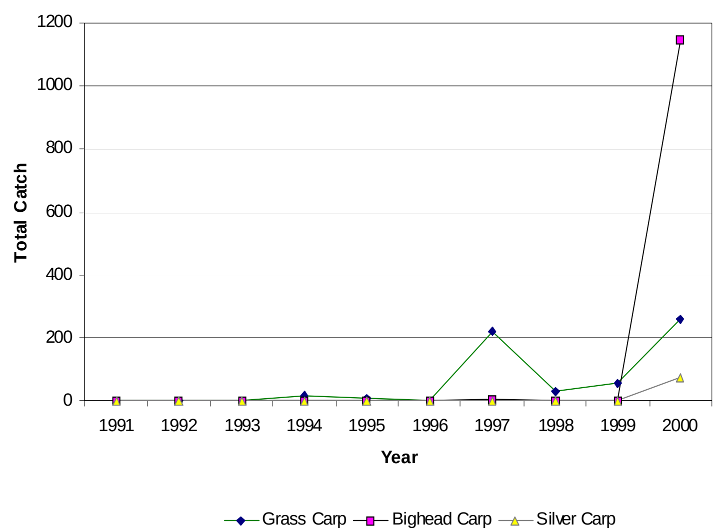


Figure 2-14. Incidence of Recently Introduced Carp Species in LTRMP Catches between 1991 and 2000

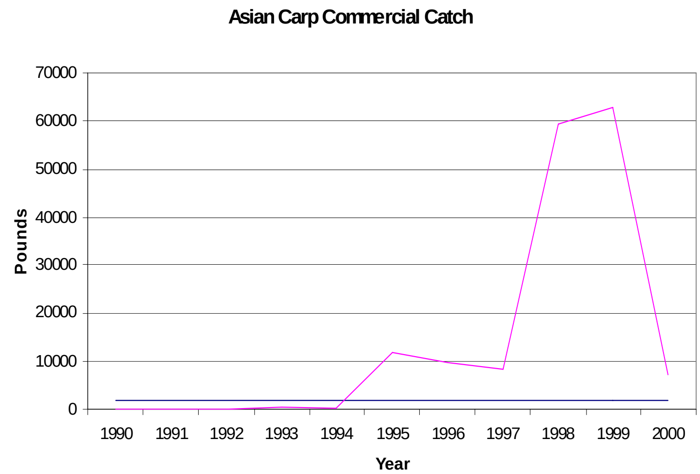


Figure 2-15. Occurrence of Asian carp in the Illinois River Commercial Catch. The great decline in 2000 is suspected to be an artifact of reduced reporting rather than a decline in abundance (Maher, 2001)

Other exotic species include zebra mussels, round gobies, European rudd, and at least two exotic zooplankton species that are entering the Illinois River system from Lake Michigan. The Corps of Engineers, the State of Illinois, the Sea Grant Program, and Smith-Root Manufacturing have recently installed an electric barrier on the Chicago Sanitary and Ship Canal to help block the movement of exotic species (figure 2-16). The initial purpose was to keep Great Lakes invaders from entering the river system, but the barriers may also prevent Asian carp from the Illinois River, such as grass carp, bighead carp and silver carp from getting into the Great Lakes. The construction of a second barrier, within one mile downstream, is currently under development. In combination, these two barriers should prevent some fish species from entering either the Great Lakes or the Illinois River. The damage done by these species will continue to impact the biodiversity of the Illinois River Basin.

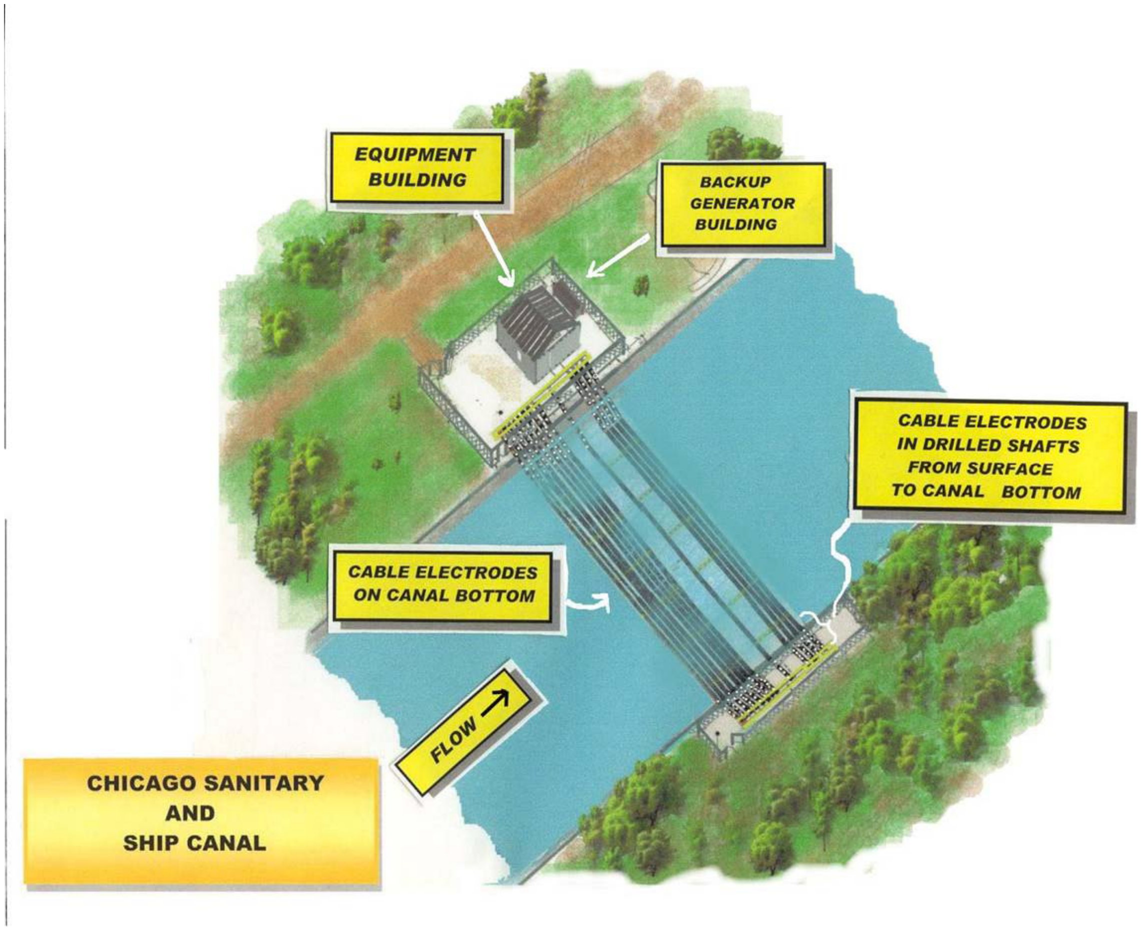


Figure 2-16. Diagram of the Fish Barrier in the Chicago Sanitary and Ship Canal

E. FUTURE WITHOUT PROJECT CONDITIONS

The future of Illinois River Basin resources is difficult to predict with accuracy. People have changed the way they treat land and water resources of the basin, which has resulted in significant improvements in environmental conditions and ecosystem health. Unfortunately, environmental conditions within the Illinois River and its basin were allowed to become extremely degraded before the changes were made.

Great strides have been made through the Clean Water Act and improved wastewater treatment facilities to curb urban and industrial pollution in an effort to improve Illinois River water quality. Through improved water quality conditions, the river has slowly regained its former oxygen carrying capacity, thus allowing fish and invertebrates to recolonize the upper river. Fish communities that were reduced to primarily the most pollution-tolerant species have become more diverse as water quality improved. Sport fishing recovered to allow professional fishing tournaments for walleye in the Upper River and largemouth bass in the lower reaches, though these species are regularly stocked by the Illinois DNR. There is evidence that fingernail clam and freshwater mussel populations are returning to portions of the upper river (Heglund et al. 2004).

Continued improvement in chemical water quality and current levels of restoration will not be sufficient to prevent further degradation of many aspects of the Illinois River ecosystem. Without further reduction of sediment entering the system from degraded tributaries and management of sediment already within the system, backwater areas will continue to rapidly fill and aquatic vegetation beds will not recover. A more subdued hydrologic regime will be necessary to allow aquatic and moist soil vegetation to return. Aquatic, floodplain, and tributary habitats that have been removed or disconnected from the system will have to be reconnected to restore appropriate system functions. Without coordinated restoration efforts, many ecological functions of the Illinois River system, such as its support of backwater fisheries and waterfowl, will continue to decline.

Natural resource managers and the public have recognized the loss of important habitats and have initiated numerous investigations and projects to better understand and reverse habitat loss throughout the Illinois River Basin. Upland terrestrial habitats show signs of recovery as landowners have taken advantage of conservation programs to protect marginal farmlands and restore grass and woodland habitats. Agriculture occupies 60 percent of the basin and the legacies from environmentally damaging practices are widespread in the basin’s stream channels. The Natural Resources Conservation Service (NRCS) offers many programs to private landowners to promote the conservation and improvement of soil, water, air, energy, plant and animal life, and other conservation purposes on private working lands. One such program, in partnership with the State of Illinois, is the Conservation Reserve Enhancement Program (CREP), discussed in Section 6 of this report.

In addition to the NRCS programs, many other restoration programs or activities are ongoing in the basin (see Section 6.). These include, but are not limited to, the Corps’ Environmental Management Program, the USFWS National Wildlife Refuge System, the EPA’s various water quality activities, and NGO floodplain restorations. However, the magnitude of these efforts, while critical in slowing further declines in the basin, is not enough to restore ecological integrity in the Illinois River Basin. Currently, there is no program in place to holistically evaluate restoration needs and implement restoration projects at the basin scale.

1. Ecological Integrity. The general ecosystem integrity, or health, of the Illinois River Basin is still declining in spite of the dramatic water quality improvements made as a result of the Clean Water Act, as illustrated in figure 2-17. Pressure on the remaining habitats will continue to increase as the population increases. Scientists and natural resource professionals believe that the Illinois River Basin will continue to see a decline in system ecological integrity and populations of native species, resulting from continued habitat loss and fragmentation, altered natural disturbance regimes, and continued invasive species colonization.

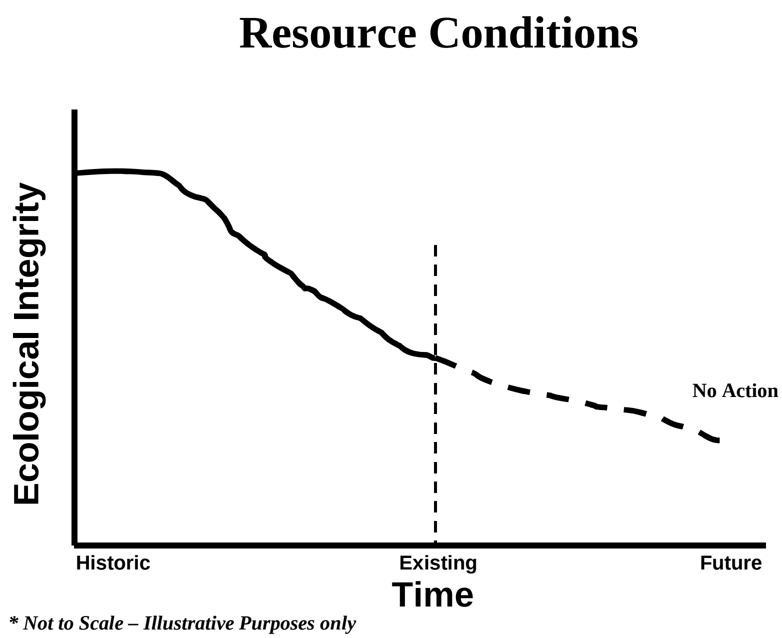


Figure 2-17. Illinois River Resource Conditions

The introduction of nonindigenous species into the Illinois River Basin is expected to continue. The electric barrier in the Chicago Sanitary and Ship Canal will only block some species from entering the Illinois River. Organisms suspended in the water column will pass through this barrier. Other non-native aquatic species may enter the system from downstream, such as the Asian carp have done. Cumulatively, these changes to the ecosystem over time have been dramatic. Current trends may be difficult to reverse and will require significant commitments of resources and time.

2. Sediment Delivery. If current conditions persist, sediment delivery from croplands and upland areas is not anticipated to decrease. Depending on economic and political conditions, the programs that have reduced sediment loading from upland practices may expand or contract in the future. Although far from certain, it is anticipated that the benefits of conservation practices will probably remain constant and possibly increase somewhat in the future. There will continue to be significant sediment transported to the Illinois River from areas not addressed by these programs, namely the stream channels themselves where approximately 40 to 60 percent of the sediment originates. Sediment delivery will increase due to continued landscape alterations, increased impervious surface area and resulting runoff, and continued channel instability due to prior alterations.

Significant sediment sources will continue to arise at points in the basin where restoration practices and sediment control regulations are inadequate or inadequately enforced. It is expected that without this program, there would be no overall program to address stream instability throughout the Illinois River Basin and that future channelization projects may destabilize additional stream miles. Without measures to naturalize the sediment transport in these streams, they will continue to incise or migrate into the foreseeable future, contributing sustained high rates of sediment loading to the main stem Illinois River.

Without action, the sediment loading to the Illinois River from unstable streams and other sources in the basin will continue at the unacceptably high levels experienced during water years 1981 - 2000. The sediment will continue to degrade vulnerable aquatic habitats and impede downstream restoration efforts. Local projects may show site-specific benefits, but the effects of high sediment loading will limit the extent where benefits may be observed.

3. Backwaters and Side Channels. By the year 2050, the Illinois River is predicted to lose a significant portion of its off-main channel backwater areas under current conditions of sediment supply, losing both surface area and volume, with continued low aquatic habitat quality. The affected contiguous and isolated backwater areas are expected to convert to mud flats or marshy wetlands. Further degradation of side channels, due to island erosion and channel sedimentation, is predicted. This will further limit off-channel habitat for fish and other aquatic species. The consensus of a number of scientists is that, due to the increasingly shallow condition of existing areas, even more rapid losses are expected in the future. This resulted in the estimation of a 1 percent loss rate per year of backwater acreage as the most likely future condition. If this rate were to continue throughout the 50-year program life, the acreage of backwaters would drop to just 32,605 acres, or a 40 percent loss of backwaters over 50 years.

Some side channel areas are experiencing sedimentation and are anticipated to be lost in the future (approximately 17 percent of side channel area in the Alton and Peoria Pools and greater in La Grange Pool). Another widespread threat to the side channels is the loss due to erosion of their protective islands. Based on data collected as part of this study, it is anticipated that, without any action, continued loss of side channel length would occur at the rate of approximately 0.25 percent per year, if it follows trends from 1903 to the present. This would result in a loss of approximately 6.5 additional miles of side channel habitats throughout the Illinois River. Some restoration of backwaters, side channels, and islands has been proposed through the NESP, though it is not currently authorized.

4. Floodplain, Riparian, and Aquatic. The habitats and ecological functions within the Illinois River main stem floodplain and the aquatic, floodplain, and riparian areas of the basin tributaries are likely to experience some further degradation in the future. The main stem Illinois River study area will likely remain relatively unchanged in terms of land use over the 50-year period of analysis. Habitat quality and ecological functions will likely remain at current degraded levels. Habitat fragmentation and unstable hydrologic regimes will continue to degrade the remaining habitat areas. Additional floodplain restoration efforts are currently proposed by several groups, including the USFWS (under the EMP), NGOs, such as The Nature Conservancy, and the Corps' Navigation Study (though not currently authorized). However, systemic restoration benefits, such as ideal spacing or connectivity of habitats, would not be as likely without a systematic plan for restoration.

The Nature Conservancy and The Wetlands Initiative have acquired more than 11,000 acres of Illinois River floodplain and adjacent habitats at Emiquon and Hennepin, respectively. Restoration efforts have begun on these sites, such as shutting off drainage pumps and planting native species.

The USFWS currently manages four refuges along the Illinois River, totaling approximately 12,000 acres. The recently completed *Illinois River National Wildlife and Fish Refuges Complex Draft Comprehensive Conservation Plan and Environmental Assessment* recommends protection management on an additional 380 acres of native grassland, 200 acres of savanna, 1,300 acres of native forest, and 4,000 acres of wetlands within the focus areas through voluntary partnerships.

Finally, the UMRS-IWW System Navigation Feasibility Study recommends restoration of 20,000 acres of Illinois River floodplain. The restoration measures identified under the Navigation Study are consistent with those of this study, and would reduce needs under this study if authorized and implemented.

Overall, the tributary floodplains are also likely to remain in a state consistent with their current degraded conditions. Urban development is perhaps more likely than on the main stem, particularly near the larger urban areas. Land conversion, outside the floodplain, to urban use and development in the State of Illinois is currently estimated at 40,000-50,000 acres of land per year. Much of this development is in the Illinois River Basin, particularly in the western Chicago suburbs. In-stream habitats throughout the basin are likely to degrade over the 50-year period of analysis. Stressors on the stream network include: (1) direct modification of stream channels for urban and rural development, (2) increases in impervious land surfaces resulting in increased runoff and higher flow, (3) increases in tile-drained agricultural areas, (4) point and non-point source pollutants into the system, and (5) invasive and exotic species invasion.

In the tributaries, the Conservation Reserve and Enhancement Program (CREP) should continue in the immediate future. While focused on sediment, the acreages that have been enrolled and are currently being enrolled are in the floodplain and riparian areas of Illinois River Basin streams. This provides opportunities for increased connectivity of various riparian habitats. These benefits may be offset by the continued degradation of aquatic stream and riparian habitats, resulting from bed and bank erosion.

5. Connectivity. No significant change in the number of dams blocking fish and aquatic species migration is anticipated. The need for potable water for increasing populations in northeast Illinois may result in construction of dams or modification of existing dams for water supply purposes. It is anticipated that new dams may be constructed to accommodate fish passage; however, any new dams would likely have some impact on connectivity. It is likely that some of the older, low-head dams will be removed in the future. Dam removal will be municipality driven and will be related to the costs of continued operations and maintenance. Municipalities will weigh the benefits and services provided by the dam with the costs of reconstruction, repair, and continued operation and maintenance. The Illinois DNR Office of Water Resources is evaluating dam modification or dam removal at State-owned dams when requested by municipalities.

6. Water Levels. Without the program, water level regulation will continue to induce fluctuations in dam tailwaters, and wicket operations will be fundamentally unchanged. Implementation of the Tunnel and Reservoir Plan (TARP), a Chicago area initiative to store stormflows in an underground reservoir system, may reduce some of the peak flows entering the river from northeastern Illinois, but increased development, even with peak flow control requirements, will increase the volume and rate of storm water entering the Illinois River, likely increasing the high-water fluctuations in the river. Without site-specific regime manipulation, backwater and floodplain areas are likely to continue to either degrade or maintain relatively low levels of ecological function.

Tributary hydrologic regimes will commonly exhibit high peak flows and low baseflows that stress aquatic biota; these conditions will likely become more stressful in areas that experience increased urbanization.

7. Water Quality. Water resources in the Illinois River Basin are impaired due to a combination of point and non-point sources of pollution. Although effective regulatory efforts have reduced contributions from point sources, non-point sources of water quality impairment (such as sediments and nutrients) continue to degrade the surface waters. Continued improvement in chemical water quality will be insufficient to prevent further degradation of many aspects of the Illinois River ecosystem. Without further reduction of sediment entering the system from degraded tributaries and management of sediment already within the system, backwater areas will continue to rapidly fill and aquatic vegetation beds will not recover. In addition to turbidity, the quality of the sediments, particularly in the main stem, may limit macroinvertebrates such as fingernail clams. Ammonia, an agricultural fertilizer, is found in the upper layers of the sediments, sometimes in toxic amounts. Minor improvements in water quality may be made due to regulation and improvements in best management practices (BMPs). The EPA's programs to reduce nonpoint source pollution and its Targeted Watersheds Grant Program will continue to provide some improvements in general water quality.

8. Natural Resources

a. Fisheries. Although fish populations improved as significant gains in water quality were made through the Clean Water Act, continuing declines in habitat quality and increasing numbers of invasive species threaten these populations. Data has been analyzed from the Illinois DNR Long Term Electrofishing Program in the main stem Illinois River (1957 to 2002), including trends and larger river IBI values. The monitoring period occurred during a period of very impaired water quality; therefore, the highest levels achieved during this time reflect impaired conditions. Fish populations and diversity are thought to be stable in the lower pools and still improving in the upper pools, although at lower levels than prior to European settlement. The long-term outlook (without-project conditions) may be for populations and native species diversity to decline gradually (increasing invasive species, suitable habitat declining, and loss of main stem benthic community).

b. Waterfowl and Wetlands. The declines in diving ducks (essentially gone since the 1950s) and dabbling ducks (80 percent decline in mallard populations) in the basin have been documented by the Illinois Natural History Survey. These losses can be linked to a loss of food sources (aquatic plants, macroinvertebrates) in the 1950s and ongoing habitat degradation and loss. On the main stem, habitat conditions are typically favorable only in areas isolated from the river. The loss of aquatic plants and the benthic community were identified as limiting factors on waterfowl populations. The current limited quantity and degraded wetland conditions, and lack of aquatic plants in areas hydraulically connected to the Illinois River are predicted to continue. Waterfowl populations that rely on these habitats are not anticipated to return to historic levels.

c. Mussels. Mussels declined severely in response to overharvesting and poor water quality, as well as ongoing problems with excessive sedimentation. After water quality improved, mussel populations improved also. This improvement was most evident in the upper river, where water quality impacts were most severe. Commercial mussels harvests have resumed in the lower main stem pools. However, the general trend is still declining (numbers and species), attributed to excessive siltation, loss of habitat, chemical pollution (including herbicide and insecticide runoff), and competition from exotic species (zebra mussels).

d. Macroinvertebrates. Long-term widespread declines in benthic macroinvertebrates are linked to domestic and industrial pollution, metal contaminated sediments and ammonia, as well as increasingly silty substrates. These declines have had adverse effects on river fishes and birds. Because of their wide distribution and potential to exhibit dramatic community changes when exposed to water and sediment pollution, they are ideal indicators of environmental quality. These declines are anticipated to continue.

e. Aquatic Vegetation. Currently, submersed aquatic plants are found only in isolated areas of the main stem. This loss of vegetation has led to easily disturbed backwater substrates, increased turbidity, poorer habitat conditions, and fish communities that are increasingly dominated by species that tolerate low dissolved oxygen and poor habitat. Limiting factors to submersed aquatic plant recovery include sediment quality, excessive sedimentation and turbidity, rough fish activity, and unstable water levels. Many of these same factors affect emergent and moist soil vegetation. Under current and predicted future conditions, the outlook for recovery of aquatic vegetation in areas hydraulically connected to the main stem river is very poor.

f. Forests. Forests in the Illinois River Basin will become increasingly fragmented though habitat conversion, timber harvest, and other disturbances. Species composition will continue the current trend towards maple dominance, with an increasing invasive species component. Without restoration efforts in both reestablishing forests and restoring species diversity, forests and forest-dependent species will continue to decline.

F. DESIRED FUTURE CONDITIONS

> **Vision.** A naturally diverse and productive Illinois River Basin that is sustainable by natural ecological processes and managed to provide for compatible social and economic activities.

Desired future environmental conditions are difficult to define for large and complex ecosystems. It is particularly difficult to balance conflicting economic, social, and environmental objectives when resources are limited. The primary goal should be to restore a diverse mosaic of habitats, increase the connectivity of habitats while reducing effects of fragmentation (photograph 2-11), and restore the natural range of habitat creating processes so that the Illinois River Basin can support and sustain diverse and productive food webs.

Scientists, natural resource managers, and the public have recognized the loss of important habitats and have initiated numerous investigations and projects to better understand and reverse habitat loss throughout the Illinois River Basin. In the past, many of the restoration efforts have focused only on small components of the basin without considering the broader basin context.

The following areas have been identified as the physical factors that limit system ecological integrity: excessive sedimentation, loss of productive backwaters, and side channels, loss of floodplain, riparian, and aquatic habitats and functions, loss of aquatic connectivity on the Illinois River and its tributaries, altered hydrologic regime, water and sediment quality, and invasive species. There are numerous opportunities for restoration.

Photograph 2-11. High-quality Backwater Area

Figure 2-18 illustrates how projects formulated addressing these system limiting factors can collectively improve ecosystem integrity to the point where higher levels of function are restored. Monitoring, at both the system and individual project level, would provide vital feedback needed to ensure success and increase understanding of the Illinois River Basin ecosystem.

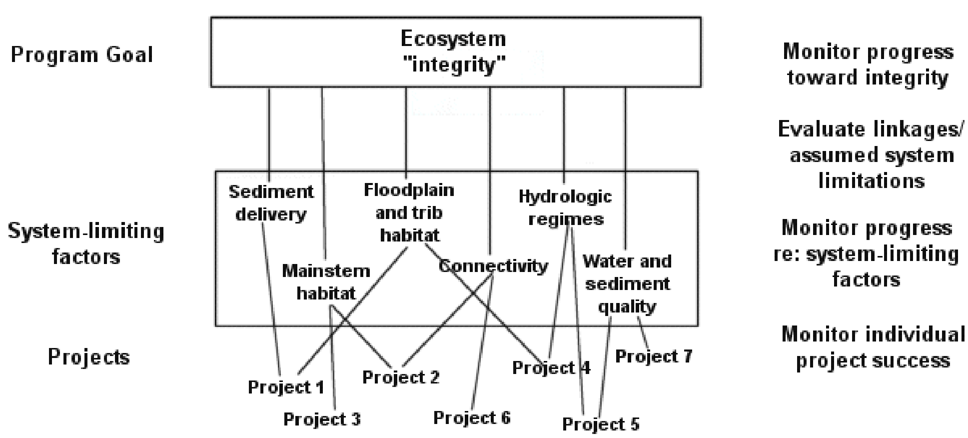


Figure 2-18. Conceptual Model of Illinois River Basin Restoration Program and Monitoring

1. Sediment Delivery. Under the desired future conditions, the rate of sediment transport within the Illinois River Basin and the main stem river, especially the transport of silt and clay particles, would be reduced to a level that will better support ecological processes. At this time, the understanding of the interconnections between sediment transport and Illinois River Basin ecosystem processes is insufficient to support definitive numerical targets for ecosystem improvement. The U.S. Army Corps of Engineers and State of Illinois scientists and managers generally accept that an overall 20 percent reduction of sediment transported to the main stem Illinois River is an appropriate initial long-term target that would demonstrate measurable positive benefits for the system. Monitoring performed as part of the Demonstration Erosion Control (DEC) project in the Upper Yazoo River Basin in Mississippi indicated that such a reduction of watershed sediment delivery is possible using proven technology (Watson and Biedenharn 1999). An interim target of 10 percent reduction of sediment transported to the main stem after 20 years was chosen to represent a measurable improvement and is feasible by treating the most significant sediment sources first. Using the sediment budget developed by Demissie et al. (2004) for WY 1981-2000 (12.1 million tons/year delivered to the Illinois River), 10 percent and 20 percent reductions represent 1.2 and 2.4 million tons per year below current levels, respectively.

Although these objectives are formulated in terms of sediment delivery to the main stem, the benefits will be achieved nearly exclusively by projects within the tributary basins. These projects would have significant benefits within their particular tributary areas. An overall 20 percent reduction in sediment delivered would necessitate higher reductions in the immediate vicinity of each project. It is envisioned that additional ecosystem benefits will be gained by placing the sediment reduction projects in areas likely to benefit high-value downstream habitats.

2. Backwaters and Side Channels. The desired future conditions were determined largely by looking at the likely future without-project conditions and assessing needs to restore aquatic habitats for fish spawning, nursery, and overwintering habitats, diving ducks, and aquatic plants.

The backwater restoration objective of restoring 19,000 acres for the Illinois River had previously been identified in the Habitat Needs Assessment. An interagency team assessing the restoration needs of the entire Upper Mississippi River System, including the Illinois River, conducted the assessment and set the restoration target. Resource managers further identified a general target of depths for backwater restoration by recommending the following distributions of depths: 5% >9 feet; 10% 6-9 feet; 25% 3-6 feet; and 60% < 3 feet. Since virtually all areas are currently less than 3 feet, restoration of up to 19,000 acres could be focused on restoring the relative depth diversity associated with the other three depth categories.

One of the major concerns on the river system is the potential loss of connected off-channel areas. The desired future condition includes the restoration and maintenance of side channel habitats, islands, and the maintenance of all existing connections between backwaters and the main channel (connections at the 50 percent exceedance flow duration).

Backwater restoration success is also related to the quality of sediments. Options should be explored to compact sediments or remove unconsolidated material to improve substrate conditions for aquatic plants, fish, and wildlife (photograph 2-12). Due to the potential for substantial amounts of dredging, additional beneficial uses of sediment should be investigated.

Photograph 2-12. Backwater Aquatic Vegetation

3. Floodplain, Riparian, and Aquatic

a. Illinois River Main Stem. The desired future condition of the Illinois River main stem floodplain is a reversal of some of the historic loss of habitat and floodplain functions and an increase in habitat area and quality. This would be accomplished by restoring up to 150,000 acres of isolated and connected floodplain areas, representing approximately 30 percent of the Illinois River Valley. This level of restoration would provide the necessary building blocks for a sustainable floodplain ecosystem in conjunction with other restoration efforts undertaken as part of this effort, particularly water level, backwaters, and side channels.

b. Illinois River Tributaries. The desired future condition for the Illinois River Basin tributaries is the restoration of a sustainable level of floodplain and aquatic habitat functions. A portion of this would be accomplished by restoring 150,000 acres of isolated and connected floodplain areas. This represents approximately 18 percent of the Illinois River Basin tributary floodplain and riparian habitat areas. This level of restoration would provide the necessary building blocks for a sustainable floodplain ecosystem within the tributaries in conjunction with other restoration efforts undertaken as part of this effort, particularly sediment delivery.

General conditions for floodplains and riparian areas include terrestrial patch size recommendations (amount shown or greater). Bottomland hardwood forest would range from 500 to 1,000 acres in size, with 3,000 acres needed for some interior avian species. Grasslands would range from 100 to 500 acres in size. Nonforested wetlands require a minimum of 100 acres, spaced 30 to 40 miles apart, and riparian zones for streams require a minimum of 100 feet on each side.

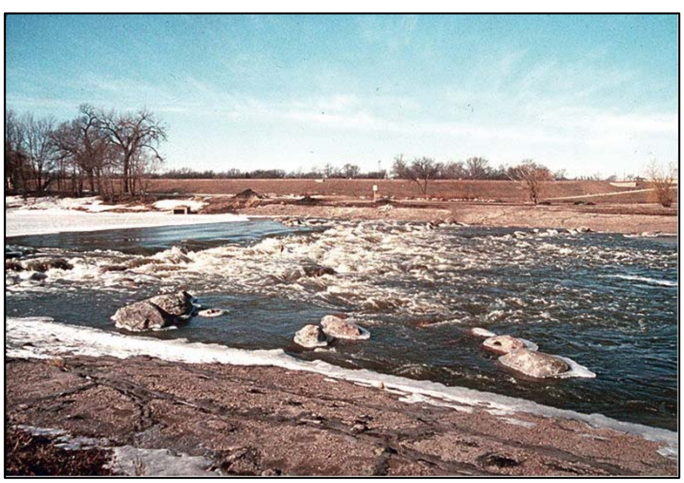
c. Aquatic Habitats. Approximately 1,000 miles of impaired streams would be restored as part of the desired future condition (photograph 2-13). This represents approximately one-third of the perennial streams impaired by channelization within the Illinois River Basin. This level of restoration would provide the necessary building blocks for sustainable aquatic environments in the perennial and intermittent streams of the Illinois River Basin.

Photograph 2-13. Restored Stream

Another general consideration for the future is developing a landscape free of introduced species that change the look and makeup of an entire system by changing species composition, decreasing rare species, and even changing or degrading the normal functioning of the system. Once the invasive species have been controlled or eliminated and restoration is initiated, ecosystems may see lost components or functions restored.

4. Connectivity. The desired future condition is a river system that provides connected habitats for native aquatic species, allowing them to utilize critical habitats at critical time periods and recolonize areas after extreme events or disturbance. This connectivity occurs at three scales; major tributary to mainstem, within the major tributary basin, and within the mainstem of the Illinois River.

The desired future condition is significant restored connectivity between the main stem and the appropriate major tributaries. The main stem Illinois River would be connected to the majority of its tributaries, including the Sangamon, Spoon, Fox, Kankakee, and DuPage Rivers. The desired future condition is to restore or maintain within-tributary connectivity in the major tributary basins (photograph 2-14).



Photograph 2-14. Rock Ramp Fish Passage

Connectivity along the main stem of the Fox River would be reestablished, and connections would be restored to a few of the Fox River tributaries. Within-tributary connection also would be restored along the main stem of the DuPage, Des Plaines, Kankakee, Vermilion, Sangamon, and Spoon Rivers.

The desired future condition is unimpeded passage of 100 percent of large-river fish on the Illinois River main stem up to RM 286 at Brandon Road Lock and Dam. This would require improved passage at Starved Rock, Marseilles, and Dresden Lock and Dams. The Lockport and Brandon Locks and Dams would continue to block fish movement, thus limiting dispersal of invasive aquatic species between the Upper Mississippi River System and the Great Lakes. Additional study is needed to assess the desirability of facilitating passage at the Brandon Road Lock and Dam. Restored connectivity between the main stem and the Des Plaines River is desirable, but this will need to be balanced with the desire to limit dispersal of invasive species.

Restoring aquatic connectivity to aquatic systems restores a measure of ecological integrity to an area. By allowing access to habitats that supply different life requisites for fish species, the future of those species is more likely. In addition, transport of mussel glochidia by different fish species ensures that mussel communities and species have access to appropriate habitats. Finally, by restoring this component to the ecosystem, some of the building blocks for a healthy and functioning system are restored.

5. Water Levels. The desirable future seeks to minimize the water level conditions that degrade ecological function in the Illinois River Basin. This does not necessarily require a return to any particular prior state, but rather creating conditions that allow ecosystem functions to sustain themselves at an acceptable level given the constraints of multiple uses throughout the basin. Rhoads and Herricks (1996) describe this concept as “naturalization.”

In regard to tributary flows, the current state of scientific knowledge suggests that flow regimes with reduced peaks and increased baseflows will provide more desirable levels of ecosystem function than currently occur. The Lieutenant Governor’s Task Force (Kustra 1997) identified an initial goal of reducing tributary peak flows by 2 percent to 3 percent. Although the precise relationships between regime components and ecosystem functions have not been fully developed, the study team analyzed the benefits of peak flow reduction measures and decided that a peak flow reduction exceeding 20 percent would be necessary to sufficiently modify the flow conditions that are currently degrading tributary ecosystems. Likewise, a significant base flow increase, 50 percent above the current levels, is desired to reduce low-flow stress to stream organisms. Finally, as a basis for project implementation, it is necessary to document and analyze the factors that lead to undesirable hydrologic conditions and assess these factors basin-wide.

Although there is a significant desire to moderate the rate of rise and fall along the main stem Illinois River, the storage available within the system is very small relative to the flows in the river (USACE 2004a). This means that river flows are driven by tributary inflows and there is very little that can be done to significantly modify the river’s flow regime. Within this constraint, the desired future conditions include a reduction in the incidence and speed of water level changes. Reducing the amount of water level fluctuation would likely provide multiple benefits to native biological communities, including sediment consolidation for improved seed germination and rooting, decreased incidence of flood-induced mortality, increased availability of spawning habitat, and a decrease in fish stranding. As such, a desired future condition would include reduced water level fluctuations, especially from the recession of the spring flood in May through the late growing season in October, but also during the rest of the year (photograph 2-15).

Photograph 2-15. Time Lapse View of Seasonal Water Level Fluctuations

The objective identified is to reduce water level fluctuations exceeding 0.5 foot to levels observed in the 1890s, during both growing season and winter time periods; a reduction of 73 percent from current conditions. One specific measure that would reduce fluctuations is a reconstruction of the wicket dams so that the dramatic water level changes associated with their operation can be removed.

Temporarily lowering water levels in the Illinois River navigation pools would provide ecological benefits to areas of the pools that are continually inundated under current conditions, allowing sediments to consolidate and encouraging reestablishment of vegetation. Significant consolidation and benefits to plant growth have been observed in drawdowns in Illinois River and Mississippi River backwaters (Dalrymple 2000, Edwards 1988) and elsewhere (Fox et al. 1977). The desired future condition would be a successful drawdown lasting at least 30 days once every 5 years in the Peoria Pool, and once every five years in the La Grange Pool.

6. Water Quality. The desired future for water quality would include all of the following: achieve full use support for aquatic life on all surface waters of the Illinois River Basin by 2025; achieve full use support for all uses on all surface waters of the Illinois River Basin in 2055; remediate sites with contaminant issues that affect habitat; achieve Illinois EPA nutrient standards by 2025, following standards to be established by 2008; work to minimize sedimentation as a cause of impairment as defined by 305(b) by 2035; and maintain waters that currently support full use or can be considered pristine waters.

7. Natural Resources. In a meeting held in August 2003 as part of this study, state scientists and natural resource professionals from the Rock Island District of the Corps of Engineers, the Illinois DNR, the USFWS Rock Island Field Office, and The Nature Conservancy met to discuss the future conditions of the Illinois River Basin. This expert panel discussed the predicted future without this restoration program and identified potential restoration targets (desired future conditions) for the basin as follows:

a. Fisheries. Data was presented from the Illinois DNR Long Term Electrofishing Program in the main stem Illinois River (1957-2002). In addition to current conditions, trends and larger river IBI values were discussed. It was proposed to set target IBIs for various pools based on the highest value measured at each individual station within that pool as an acceptable first level target. The monitoring period (1957-2005) occurred during a period of very impaired water quality; therefore, the highest levels achieved during this time reflect impaired conditions. However, the significant gains made through the Clean Water Act were dramatic, especially for the Upper Illinois River, and the group did not foresee such dramatic improvements in the future.

If these initial targets could be achieved and maintained over a significant period of time, new targets could be established. Fish populations and diversity are thought to be stable in the lower pools and still improving in the upper pools, although at lower levels than prior to European settlement. Reducing excessive sedimentation, restoring overwintering habitat, and improving water and sediment quality should be major restoration efforts that will benefit the fisheries.

b. Waterfowl and Wetlands. On the Illinois River main stem, habitat conditions for waterfowl are typically favorable only in areas isolated from the river, with its high sediment load and frequent fluctuations. The loss of aquatic plants and the benthic community were identified as limiting factors on waterfowl populations. Increasing the number of managed areas and wetlands (100 to 500 acres, spaced 30 to 40 miles apart) would be a first step in increasing waterfowl numbers. Systemic restoration measures of naturalized hydrology, reduced turbidity, reduced ammonia delivery, and invasive plant species control would be required to restore aquatic plants and macroinvertebrates necessary to regain some measure of system function for waterfowl and associated species.

Restoring diving duck populations, as a representative target species, was agreed upon as a goal for waterfowl. A return of this guild would reflect a return of improved ecological functions in the basin, including sediment delivery, water level fluctuations, the reestablishment of aquatic plants, and increased macroinvertebrate populations; all indicators of appropriate habitat.

c. Mussels. Mussel habitat restoration efforts should include the entire watershed (main stem and tributaries), including land use, management practices, and tributary health in order to reduce the limiting factors of excessive siltation and chemical pollution. As important are preserving and restoring wetlands, and preserving existing high quality aquatic habitat (Cummings and Anderson 2003).

d. Macroinvertebrates. Because of their wide distribution, important position near the base of the food chain, and potential to exhibit dramatic community changes when exposed to water and sediment pollution, macroinvertebrates are ideal indicators of environmental quality. The effect of ammonia on macroinvertebrates was identified as a study need. Knowledge of long-term population cycles is also poor. The desired future for macroinvertebrates is a return to healthy levels needed to support fisheries, waterfowl populations, and other species dependent upon these species as a food source. This could be accomplished by decreased sediment, nutrient, and contaminant delivery to the river.

e. Aquatic Vegetation. The desired future is a return of aquatic plant beds to all areas of the river, particularly those hydraulically connected to the river. Limiting factors to submersed aquatic plant recovery include sediment quality, excessive sedimentation and turbidity, rough fish activity, and unstable water levels. Many of these same factors affect emergent and moist soil vegetation.

f . Forests. The desired future includes protecting or restoring forested habitat in large blocks (keeping edge to a minimum) of 500 acres or more, spaced throughout the watershed, which would be required to stop/reverse the current declines.

g. Invasive Species. Because invasive species do not recognize property boundaries, successfully battling these invasions will require partnerships among public and private landowners, government, industry, academia, and non-governmental organizations at all levels. As invasive species are been controlled, native species, reestablished through restoration activities, will minimize the chances that an area will be reinvaded. It is also important to encourage activities that help keep lands and waters free from invasive species.