Chapter 3: The Refuge Environment

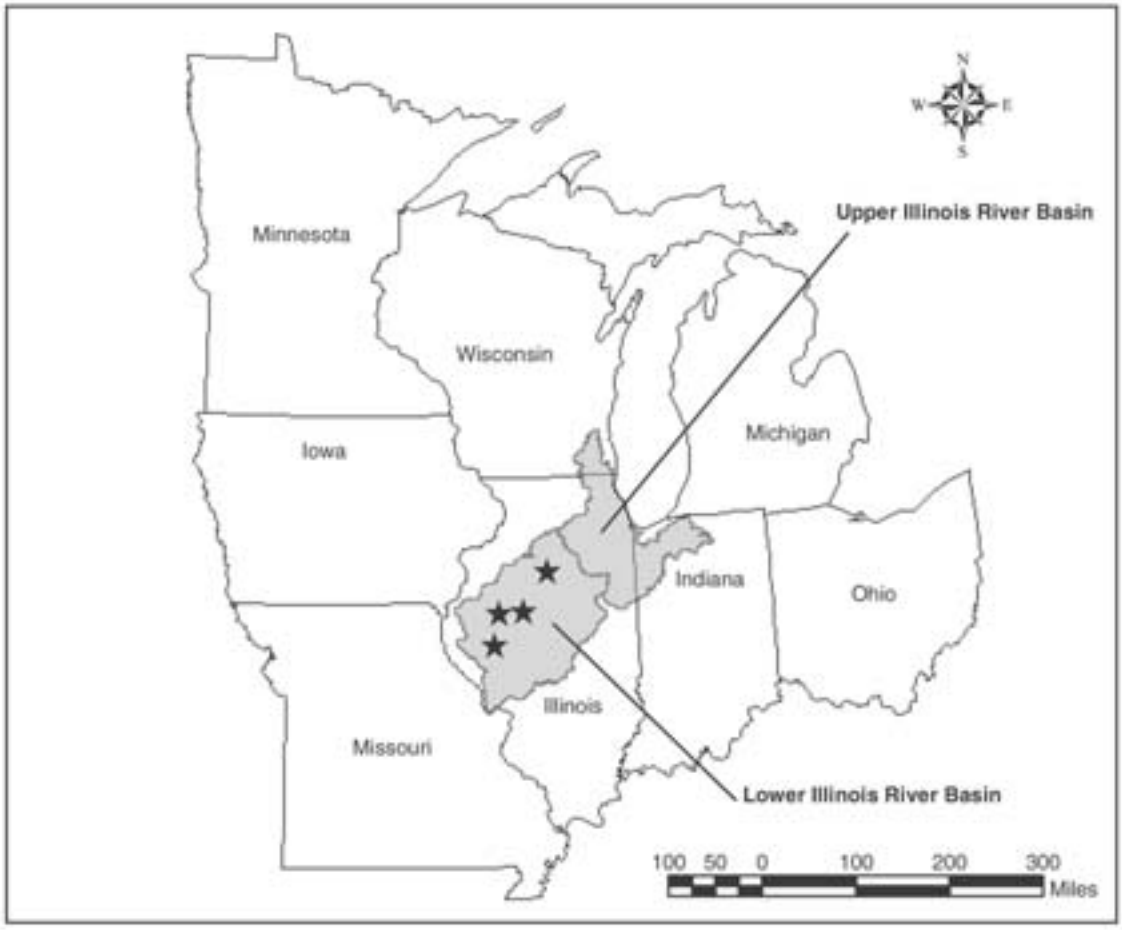
3.1 Geographic/Ecosystem Setting

3.1.1 Geography, Topography and Hydrology

The Illinois River flows 273 miles from the junction of the Des Plaines River and Kankakee River south of Joliet, Illinois, to Grafton, Illinois, where it joins the Mississippi River and flows south to the Gulf of Mexico. The Illinois River Basin (Figure 4) drains about 30,000 square miles (7.7. million acres) in three states, Wisconsin, Indiana, and Illinois.

Ecologically, the Refuge Complex is located in the Central Tallgrass Prairie Ecoregion (ecoregion), which encompasses 110,468 square miles extending from

Figure 4: Illinois River Basin Location



eastern Nebraska and northeastern Kansas east to northwestern Indiana. It comprises the eastern lobe of the Prairie Parkland Province and two ecoregion sections (Central Dissected Till Plains and Central Till Plains) as delineated by Bailey et al. (1994). The ecoregion is characterized by flat, gently rolling topography with steep bluffs bordering major river valleys, three of which traverse the region: the Mississippi, Missouri, and Illinois. During the Pleistocene Epoch, glaciers advanced and retreated at least four times across all or portions of the ecoregion, depositing large areas of glacial drift and loess and creating the characteristic rolling topography seen today. The ecoregion is influenced to some degree by the rain shadow of the Rocky Mountains that create habitat favoring grasses.

3.1.2 Surface Hydrology

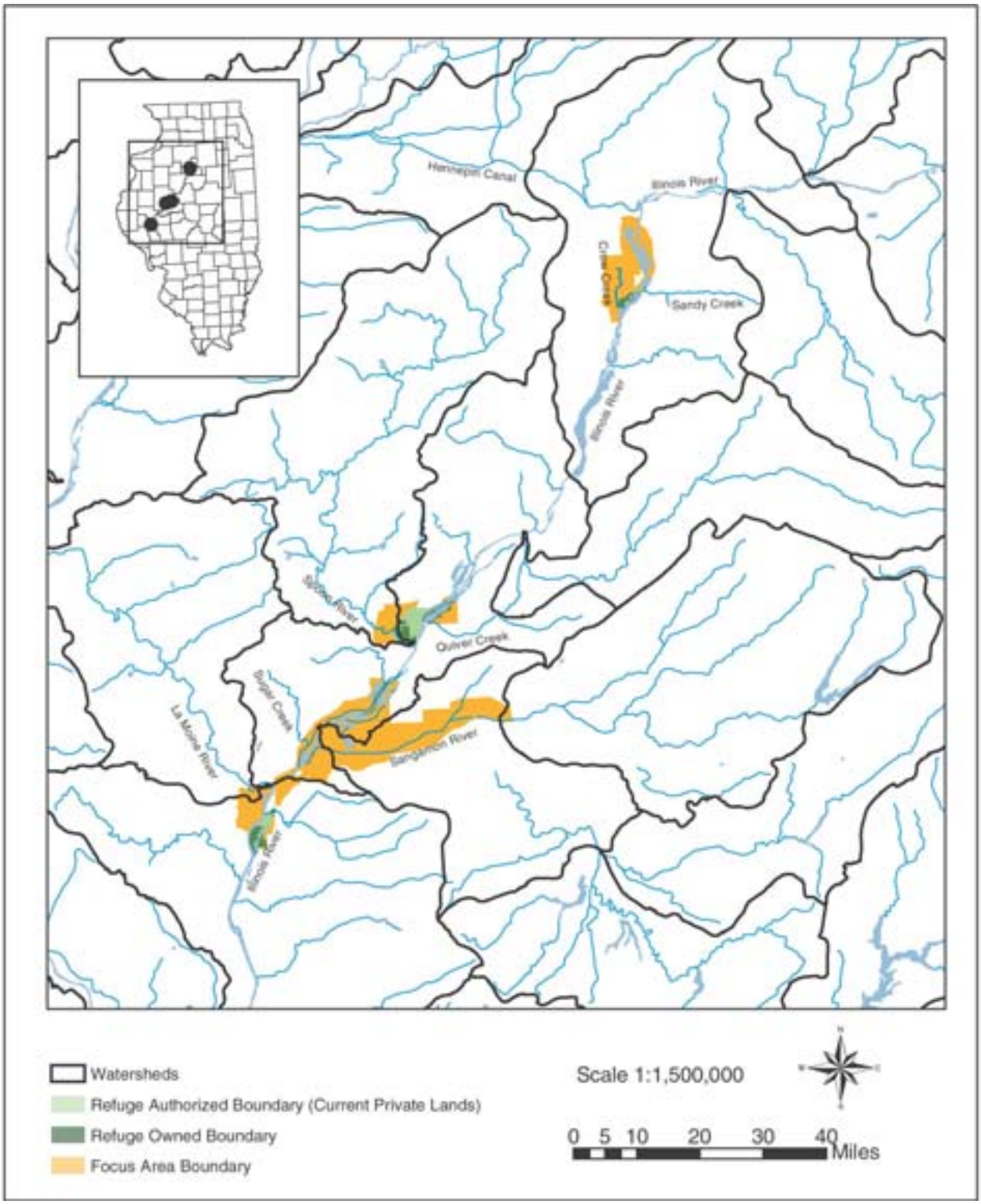
Water supplied to Refuge Complex land comes from four primary sources: the Illinois River, Quiver Creek, Crow Creek, and the Spoon River (Figure 5). The single most important event impacting the surface hydrology of the Illinois River system (and Refuge Complex) was the opening of the Chicago Sanitary & Ship Canal in 1900. This one event introduced major changes to Illinois River surface hydrology, namely it created a major navigation corridor, became the recipient of Chicago's wastewater, and dramatically changing the river's flow pattern, raising the river's average water level by 1.5 to 4 feet, increasing both average flows and the frequency and severity of floods. Water levels for navigation are managed with a series of locks and dams that were constructed in the 1930s to maintain a navigation corridor 300 feet wide and 9 feet deep. Diverted water from Lake Michigan and the locks and dams along the river has increased the mean summer minimum water levels and significantly expanded the open water surface area.

Streamflow in the Illinois River is representative of climatic events and human influences covering the upper Illinois River watershed. Several recent studies have shown that annual peak flows on the Illinois River for the period 1941-1985 have increased about by 50 percent. Higher flows, it was found, were caused by concurrent increases in precipitation in the river's watershed. Northeastern Illinois, in particular, has experienced significant increases in the magnitude and frequency of heavy precipitation (Kunkel et al., 1997). Average flows and low flows have been noticeably greater since 1970 compared to previous periods throughout the mid-1900s, and appear to be related to average annual precipitation. However, average river streamflows vary greatly from year to year, and can also show sizable variation between decades.

1.1.3 Floodplain Structure and Function

Water quality, quantity, velocity, timing, frequency, and duration are the primary determinants of the Illinois Rivers floodplain structure and function. When the Illinois River flooded under natural conditions, it typically altered its shape by scouring new channels and inundating riverside lands, depositing sediments, and building new banks and beaches. These functions, called reset mechanisms, are as important to a healthy river systems as a fire is to a prairie. Just as a prairie is sustained by natural fires, a river system and associated plants and animals depend upon the periodic advance and recession of flood waters across their floodplain. For instance, the federally-listed endangered plant decurrent false aster (*Boltonia decurrens*) relies on the exposure of freshly-deposited mud flats for regeneration (Schwegman and Nyboer 1985; U.S. Fish and Wildlife Service

Figure 5: Watersheds in the Area of the Illinois River NWR



1990). The cottonwood, favored for perching by Bald Eagles and for nesting by herons and egrets, seems to have similar requirements. The river-floodplain also functions as a corridor for long-distance migrants, mostly birds (raptors, neotropical songbirds, shorebirds, ducks, geese, swans and others) but also for one species of migratory fish, the American eel, which spawns off the coast of Cuba in the Sargasso Sea. Most aquatic animals, however, use the Illinois river-floodplain system as a permanent home, undertaking short migrations within the system to spawning, rearing or feeding areas in rapids, tributaries, backwaters, or on the floodplain. Fish yields and production are strongly related to the extent of accessible floodplain, whereas the river channel may serve as a migration route for most fishes (Junk et al. 1989).

Flood cycles associated with the Illinois River are characterized by two peaks: a major one in spring and a smaller one in fall. The construction of levees, channels, locks, and dams has altered the natural structure and function of the river-floodplain relationship. The seasonal hydrologic fluctuations that normally provide the vehicle for transfer between the floodplain and the river has been modified. Vast floodplain areas have been virtually excluded from the river system through dike and levee construction.

3.1.4 Climate

Wide temperature fluctuations and persistent winds characterize the climate of this ecoregion, with an annual precipitation of 27 to 40 inches.

The climate patterns that support the Illinois River Refuge Complex is typical of many continental locations in that there are wide temperature fluctuations. The average high temperatures (Fahrenheit) in the summer are in the 80s with average lows in the 60s. Winter highs are generally in the 30s with lows in the teens. Temperature extremes range from the minus 20s to highs over 100 degrees.

The average annual rainfall for the Refuge Complex is 34.5 inches, with over 50 percent normally falling during the months of April through August. Snowfall normally accounts for less than 10 percent of the total precipitation. There is an average of 5 months without frost each year.

3.1.5 Archaeological and Cultural Values

Responding to the requirement that comprehensive conservation plans include "the archaeological and cultural values of the planning unit," the Service contracted for a cultural resources overview and management study. This short section of the CCP derives mostly from the report, "Cultural Resources Overview Study of the Illinois River National Wildlife and Fish Refuges: Cameron-Billsbach, Chautauqua, Emiquon and Meredosia Wildlife Refuges, Mason, Cass, Fulton, Marshall, and Morgan Counties, Illinois," by William Gordon Howe (draft 2001).

Archeological evidence shows that people have lived in the American Midwest for the past 12,500 years. The earliest culture, Paleoindian, was small groups of highly mobile people subsisting on a hunting and gathering economy, heavily dependent on the megafauna that died out during this period. Site 11-F-682 within the Refuge is reported to have a Paleoindian component.

The following Archaic period lasted from 9,500 to 2,750 years before present. These people developed a more diverse subsistence economy and, as the climate turned cooler and wetter, people became more sedentary, began limited plant cultivation and created extensive trade networks. Within the Refuge, 24 sites contain Archaic components.

Pottery, the bow and arrow, gardening, and religious activities associated with mound building characterized the Woodland period 2,700 to 1,000 years ago. Human populations increased substantially. Woodland cultural components are found within 15 of the reported sites within the Refuge.

The final prehistoric culture in the Refuge area was the Mississippian tradition from 1,000 to 500 years ago. Characteristics of this culture include a stratified society, temple mounds, and farming. Within the Refuge areas, however, cultural practices appear to have been more of a continuation of the late Woodland period. Components of these late prehistoric cultures are found in 11 sites within the Refuge.

The connection between late prehistoric cultures and historic period Indian tribes is not clear. When the first Europeans arrived in the Illinois country, native groups were in a state of flux. The historic period tribes have been identified as the Illini, Miami, Kickapoo, Mascouten, and Potawatomi, all of which lived in summer villages and farmed lands near streams and springs, with a seasonal round of hunting and maple sugaring in winter camps. Tribes became increasingly involved in the fur trade and otherwise adopted European crops and practices.

The first recorded European expedition on the Illinois River was that of Jolliet and Marquette in 1673 on their return from the Mississippi River. The French subsequently built forts, churches, and houses along the Illinois River.

When Illinois entered the Union in 1818, nearly all American settlers lived in the south of the state, but they soon moved into the Illinois River valley. The General Cass and Simon Girty Indian council occurred in the vicinity of the south end of Cameron NWR. The first steamboat ascended the Illinois River in 1828. Settlements grew along the river at ferry crossings, then usually became steamboat landings. Through the 20th century, farming and related essential industries of grist, saw, and flour mills were the basis for economy. The Chautauqua NWR area was a favorite area for hunters and trappers into the mid-20th century.

The Refuge has been subjected to 19 cultural resources studies. Most dealt with the Liverpool Lake site, but intensive archeological surveys have covered 210 acres and reconnaissance surveys have covered 6,630 acres of the Refuge. These studies and other sources have identified 58 sites on Refuge land and 149 sites on identified expansion areas.

The Refuge Complex has no museum, but holds five items of artwork that are covered under the Region-wide scope of collections statement.

A review of the National Register of Historic Places identified 58 properties listed in Brown, Cass, Fulton, Marshall, Mason, and Morgan counties. Most of the properties are houses, buildings, structures, and districts located in towns.

Several bridges are listed, and two farms. Several archeological sites are listed including three in the vicinity of Emiquon NWR. Although no National Register properties are located within the four units of the Refuge, their presence in the surrounding counties can be indicative of the kinds of properties to be found on the Refuge.

The cultural resources management study includes a predictive model of archeological potential on the four units of the Refuge Complex:

- The Cameron-Billsbach unit has high potential for containing prehistoric sites. It has low potential for Paleoindian and for Early Archaic, moderate potential for Middle Archaic, good potential for Late Archaic, moderate potential for Early Woodland, good potential for Middle and Late Woodland, and moderate potential for Mississippian sites.

- Chautauqua NWR has many known prehistoric sites. It has low potential for Paleoindian and low to moderate for Archaic sites. It has low potential for Early Woodland, but good potential for Middle and Late Woodland sites; and low potential for Mississippian sites. Twentieth century cabin sites along the east shoreline are known and can be anticipated.

- Emiquon NWR is in an area of many known important archeological sites. Mastodon skeletons with butcher marks have been found in excavation for drainage ditches in Thompson Lake, which indicates potential for late Pleistocene human use. Thus the Refuge has moderate potential for Paleoindian sites, as well as for Early and Middle Archaic sites and good potential for Late Archaic sites. It has moderate potential for Early Woodland and good potential for Middle and Late Woodland sites and for Mississippian sites.

- The study area of Meredosia NWR has been subject to numerous archeological investigations. Prehistoric sites are typically found on landforms that were slightly higher than the surrounding floodplain. One Paleoindian site is known within the study area and others, deeply buried, are anticipated. Early, Middle, and Late Archaic sites are known and more are likely, some not deeply buried. Likewise many Early, Middle, and Late Woodland sites are known and more can be expected. Mississippian sites are also reported within the study area.

Extensive turmoil among the Indian tribes occupying the Refuge areas in the early period of European contact in North America continued for two centuries. Thus the relationship of late prehistoric cultures represented in the archeological record cannot be tied to historic period tribes, so recognized tribal interests are confined to the historic period.

In the early historic period the Illini tribes had villages along the Illinois River. Illini tribes included the Cahokia, Kaskaskia, Michigamea, Moingwena, Peoria, Tamaroa, Korakoenitanon, Chinko, Tapouro, Omouahoas, and Chepoussa. These tribes disappeared, some merged with related tribes, and the remaining modern tribe is the Peoria.

The Miami tribes moved into the region including the Refuge area. Miami tribes included the Wea, Piankashaw, Atchatchakangouen, Kilatika, Pepicokia, and Menagakonkia. Of these tribes, the Wea and Piankashaw ultimately merged with the Peoria and the Miami.

Throughout the 1680s the Kickapoo and Mascouten migrated into the Illinois River valley. They may have retained permanent settlements in Wisconsin and established only hunting camps in the Refuge area. The two tribes may have merged; in any event, the Kickapoo remain as modern tribes.

The Potawatomi, originally located east of Lake Michigan, arrived in the Chicago area in the 1740s and by the 1760s included the Illinois River in their hunting grounds. A hunting band was reported in the Lake Chautauqua area in 1832. In the Cameron-Billsbach are, the tribe had a village at Lacon. The Potawatomi remain as modern tribes.

The Delaware Tribe has identified interests in the Illinois River valley as well as other areas.

Although Indian tribes are generally considered to have concerns about traditional cultural properties, sacred sites, and cultural practices, other groups such as church groups could also have similar concerns. But no groups other than Indian tribes have been identified.

The Refuge archeological collections contain prehistoric artifacts currently not associated with any modern tribe. Furthermore, the collections contain human remains but no funerary objects, sacred objects or objects of cultural patrimony as defined in the Native American Graves Protection and Repatriation Act. Although sites of historic period Indian occupation have not been identified on the Refuge, they could be located and could contain cultural items.

3.1.6 Social and Economic Context

The Refuge Complex and associated Focus Areas presented in this CCP are located in 10 counties–Brown, Morgan, Schuyler, Cass, Menard, Mason, Fulton, Marshall, Putnam and Bureau. Compared to the entire State of Illinois, this 10-county area has a smaller population growth rate and is less racially and ethnically diverse. The area's population has a lower average income and less college education than the state's population.

3.1.6.1 Population

The total population of the 10 counties that include the area of this plan was 185,993 in the 2000 Census. The population of the counties increased 1.86 percent during the 1990s while the state's population increased 8.6 percent. There was a great variation in population change among the 10 counties: Brown County increased 19.1 percent, Schulyer County decreased 4.1 percent. The population for the 10-county area is projected to increase to 189,466 by 2015. The 10-county population was 95.3 percent white in 2000; the state population was 73.5 percent white. In Illinois, 19.2 percent of the people 5 years and older speak a language other than English at home; in the 10-county area it is 3.75 percent.

3.1.6.2 Employment

In 2000 there were a total of 85,516 full- and part-time jobs in the 10-county area. Farm employment accounted for 10.4 percent of the jobs across the area. Schuyler County had the highest proportion of farm employment, 19.1 percent. Other sectors with sizable proportions of jobs are the services, retail, and manufacturing sectors.

3.1.6.3 Income and Education

Average per-capita income in the 10-county area was $18,258 in 1999; in Illinois it was $23,104. The median household income in the 10–county area was $37,880 in 1999; in the state it was $46,590.

In the 10-county area, 14.75 percent of persons over 25 years of age hold a bachelor's degree or higher. The comparable figure in the state is 26.1 percent.

3.2 Refuge Resources And Public Uses

3.2.1 Refuge Resources

Early French explorers of the Illinois River described vast expanses of bottomland forests, clearwater lakes, sloughs and marshes and abundant fish and wildlife populations associated with them. The Illinois River system supported the life needs of native American tribes as evidenced by the numerous archeological sites identified up and down the river. Since those days of pristine habitats, native American populations have been replaced by an agricultural and industrial society of European descent. Human modifications to the Illinois River watershed such as wetland drainage, conversion of prairie and bottomland forests to croplands, construction of navigation locks and dams, diversion of Lake Michigan water, stream channelization, agricultural levees, ditches, field tiles, urbanization, and introduction of non-native species dramatically changed the floodplain function and hydrology of the river. These modifications to the river and floodplain have resulted in substantial changes in the distribution, abundance, and general health of the plant and animal communities along the river.

3.2.1.1 Chautauqua National Wildlife Refuge

The 4,488-acre refuge (Figure 6) includes roughly 3,250 acres of backwater lake, 930 acres of bottomland hardwoods, and 320 acres of woodlands and prairie (Figure 7).

Habitat protected within Chautauqua NWR contributes to the goals of the North American Waterfowl Management Plan. In addition, based on an evaluation of the ecological resources in the State of Illinois, Chautauqua NWR includes the "Roundtree Nature Preserve" and is located in the "Middle Illinois Resource Rich Area." Chautauqua NWR provides a haven for waterfowl, supporting roughly 45 percent of the waterfowl using the Illinois segment of the Mississippi River flyway and nearly 70 percent of the waterfowl that use the Illinois River Corridor. The Refuge has been designated as an Illinois River Valley Partnership "Model Project," an "Important Bird Area" in the American Bird Conservancy's United States Important Bird Areas program, and is included in the Western Hemisphere Shorebird Reserve Network. Chautauqua NWR is a popular desti-

nation for birders throughout the Midwest. Fishing and waterfowl hunting are popular consumptive uses of Refuge resources.

The Cameron-Billsbach Division (a unit of Chautauqua NWR) is located in Marshal County between Sparland, Illinois, and Henry, Illinois (Figure 8). The Cameron unit includes 1,064 acres of backwater lake habitat, 634 acres of bottomland hardwood forest, and 10 acres of upland forest (Figure 9). The unit includes the 177-acre Cameron Research Natural Area, which was established in 1972. The unit supports a population of decurrent false aster plants and has a Bald Eagle nest. Waterfowl peak numbers commonly exceeded 50,000 birds in the fall but declined precipitously after 1973 because of habitat degradation.

The 1,072-acre Billsbach Unit is located along the east side of the Illinois River and joins the center portion of Billsbach Lake. The Billsbach unit supports an active Bald Eagle nest (probably the same pair that built a nest on the Cameron Unit). Billsbach Lake is badly degraded because of excessive sedimentation and continuous resuspension of silt by wind, tows, and exotic fish.

The three backwater lakes that make up Cameron-Billsbach Division exhibit typical characteristics of most backwater lakes within the Illinois River System. They are directly affected by the lock and dams with extreme variability in water levels (as much as 10 to 12 feet in one month) and water is extremely laden with silt.

3.2.1.2 Meredosia National Wildlife Refuge

The Refuge presently owns and manages 3,852 acres of land within the approved 5,255 acre boundary (Figure 10). Meredosia Lake is a meandered lake and, therefore, is under the control of the Illinois Division of Water Resources. The Illinois Department of Natural Resources manages waterfowl hunting and fishing on Meredosia Lake.

Meredosia NWR is a backwater lake component of the Illinois River floodplain (Figure 11). There are currently eight small impoundments with associated levees, ditches, and water control structures on the Refuge. The impoundments range in size from 4 to 20 acres and are primarily managed for moist soil vegetation. Controlled flooding of impoundments is conducted by pumping from the river or Meredosia Lake. There are roughly 5.2 miles of river bank habitat.

Meredosia Lake is a meandered backwater of the Illinois River. The lake is nearly 5 miles long and three-quarters of a mile wide at its widest bay. Water elevations on the lake fluctuate according to Illinois River water levels. A riprap dam with a fixed elevation of 423.2 MSL is located in the lake inlet. A survey in 1978 revealed the average depth to be 2 feet with a maximum depth of roughly 4.5 feet. Much of the lake edge is only inches deep and gently sloping to the middle. Sediment deposition from 1903-56 averaged 1.3 cm annually. Average total sediment in the lake during this period was 68.9 cm. The lake is mostly void of aquatic vegetation.

The Refuge has fertile sand soils classified as mixed loam, ranging from clay to loamy sand. Most of the Refuge is poorly drained. Vegetation includes burr reed, rice cutgrass, smartweed, pigweed, horseweed, buttonbush, foxtail, Walter's millet, and nutgrass. Timber stands includes mature bottomland species including cottonwood, willow, maple, oak, and ash.

Figure 6: Ownership and Authorized Boundaries, Chautauqua NWR and Emiquon NWR

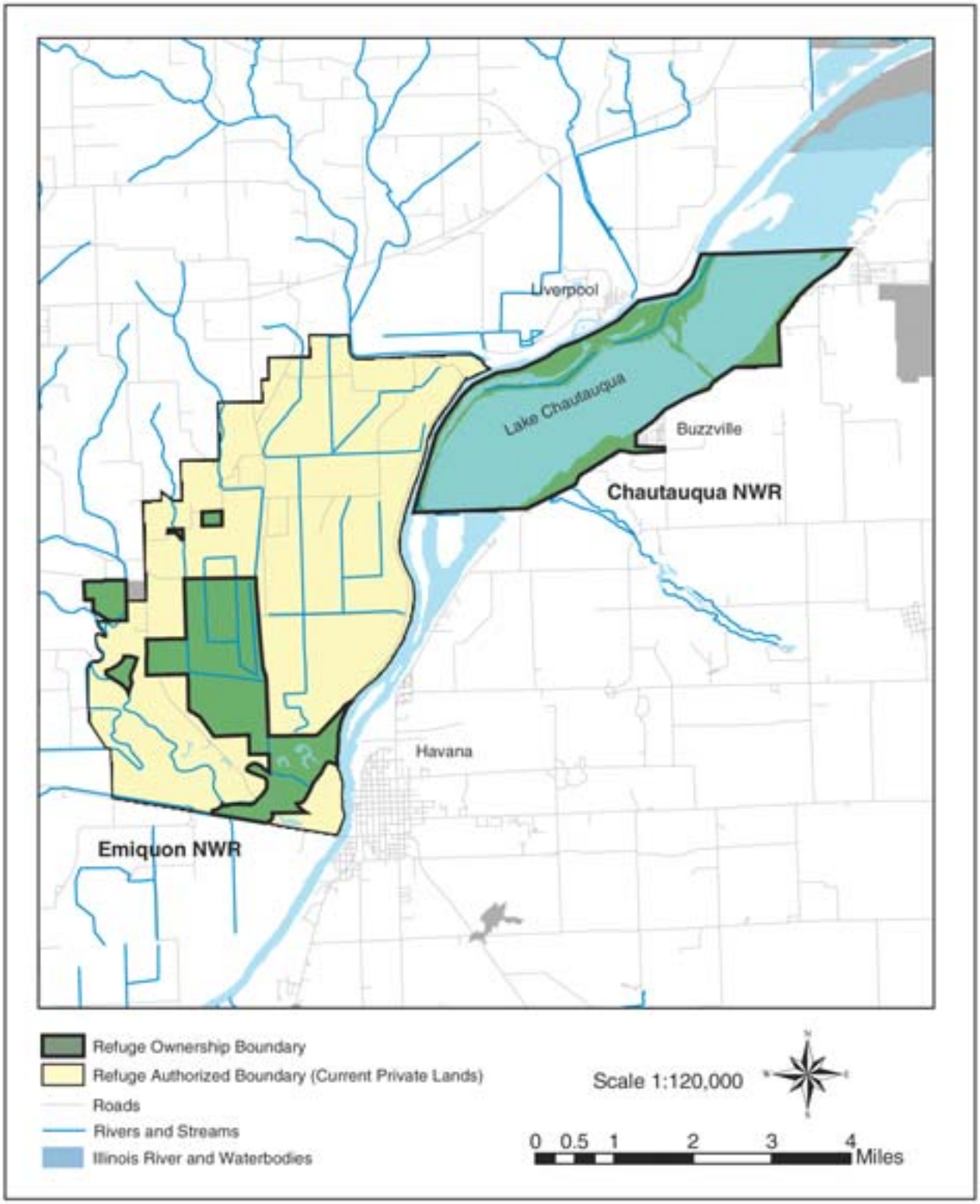


Figure 7: Land Cover, Chautauqua NWR and Emiquon NWR

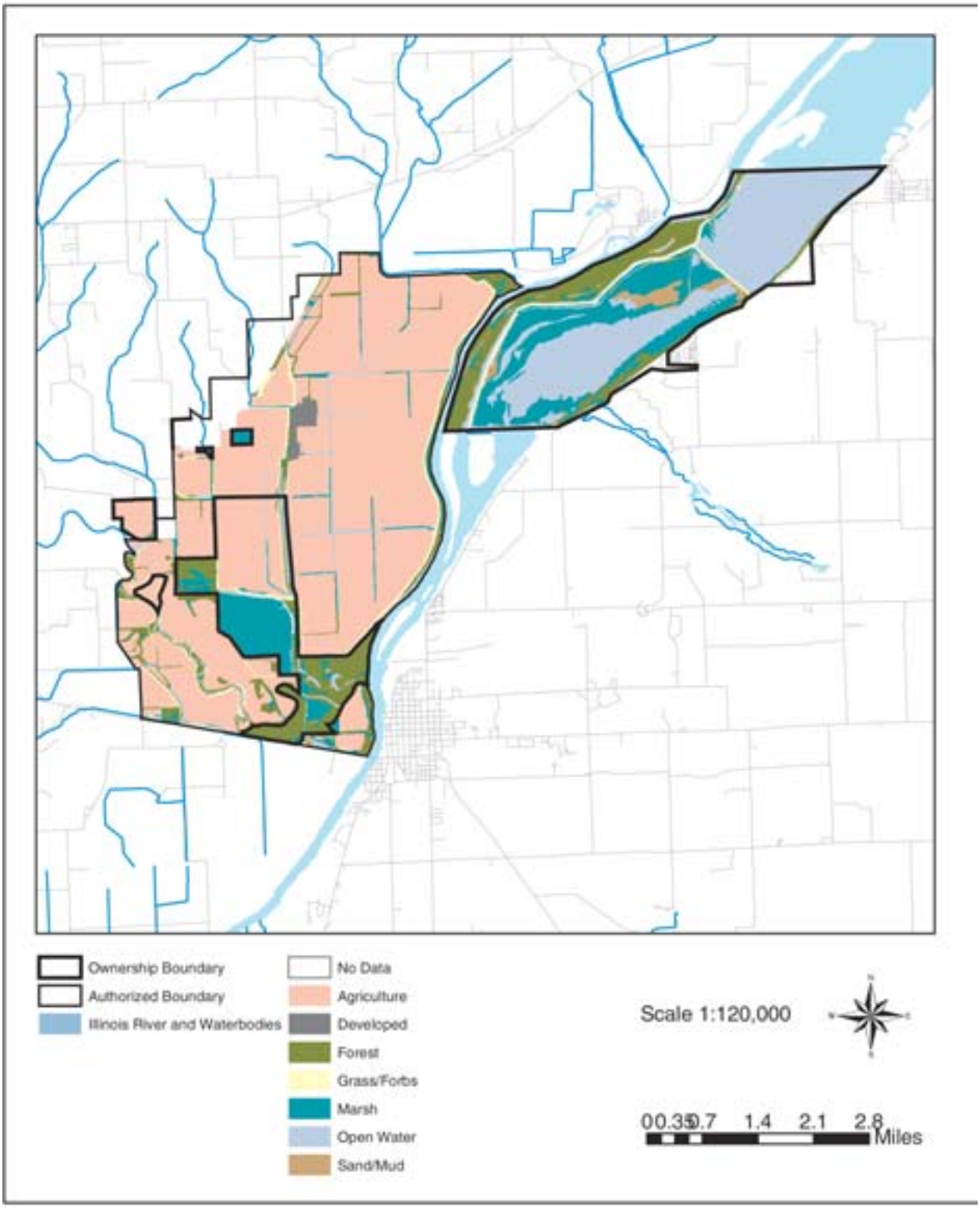


Figure 8: Ownership and Authorized Boundaries, Cameron-Billsbach Unit of Chautauqua NWR

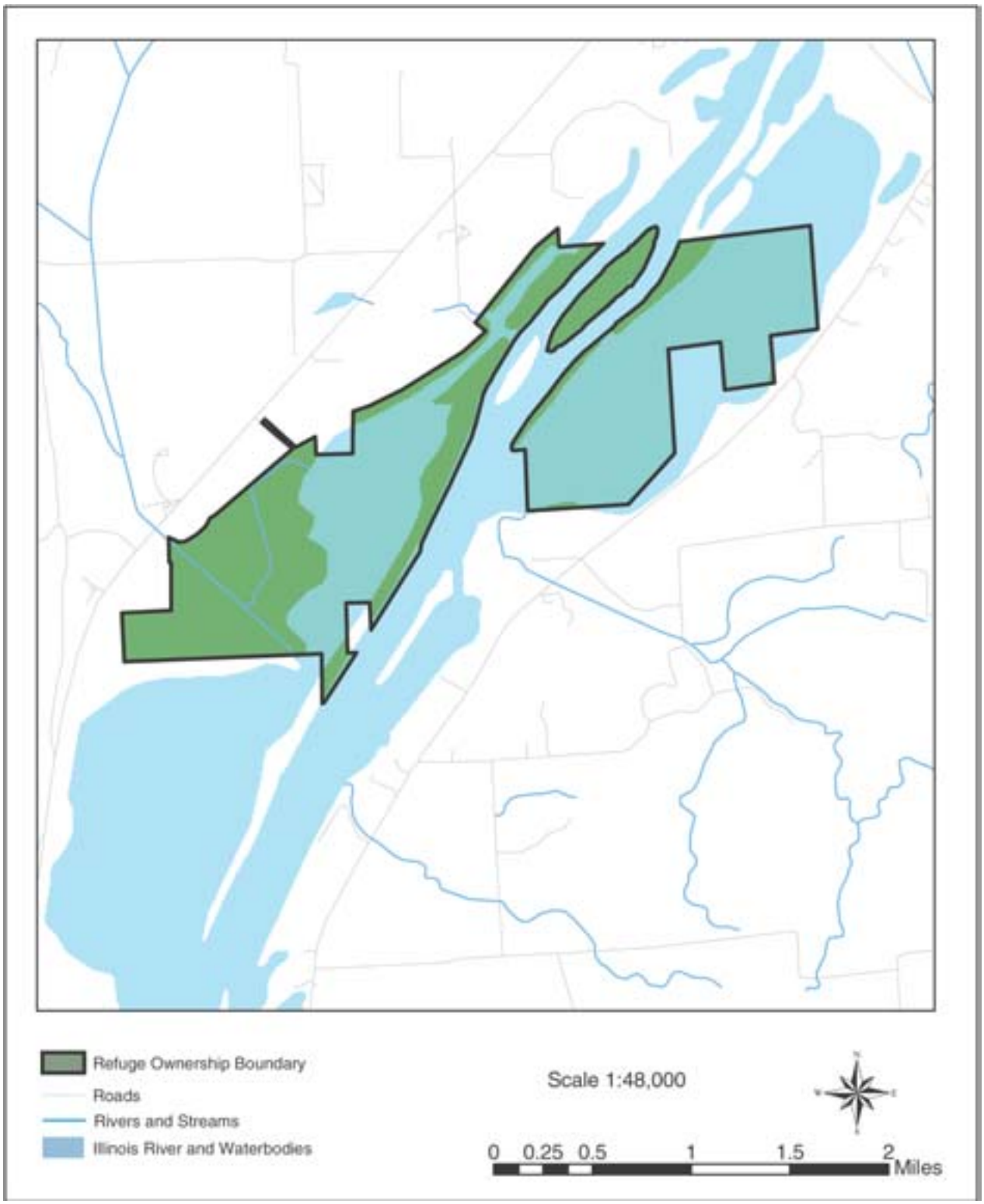


Figure 9: Land Cover, Cameron-Billsbach Unit of Chautauqua NWR

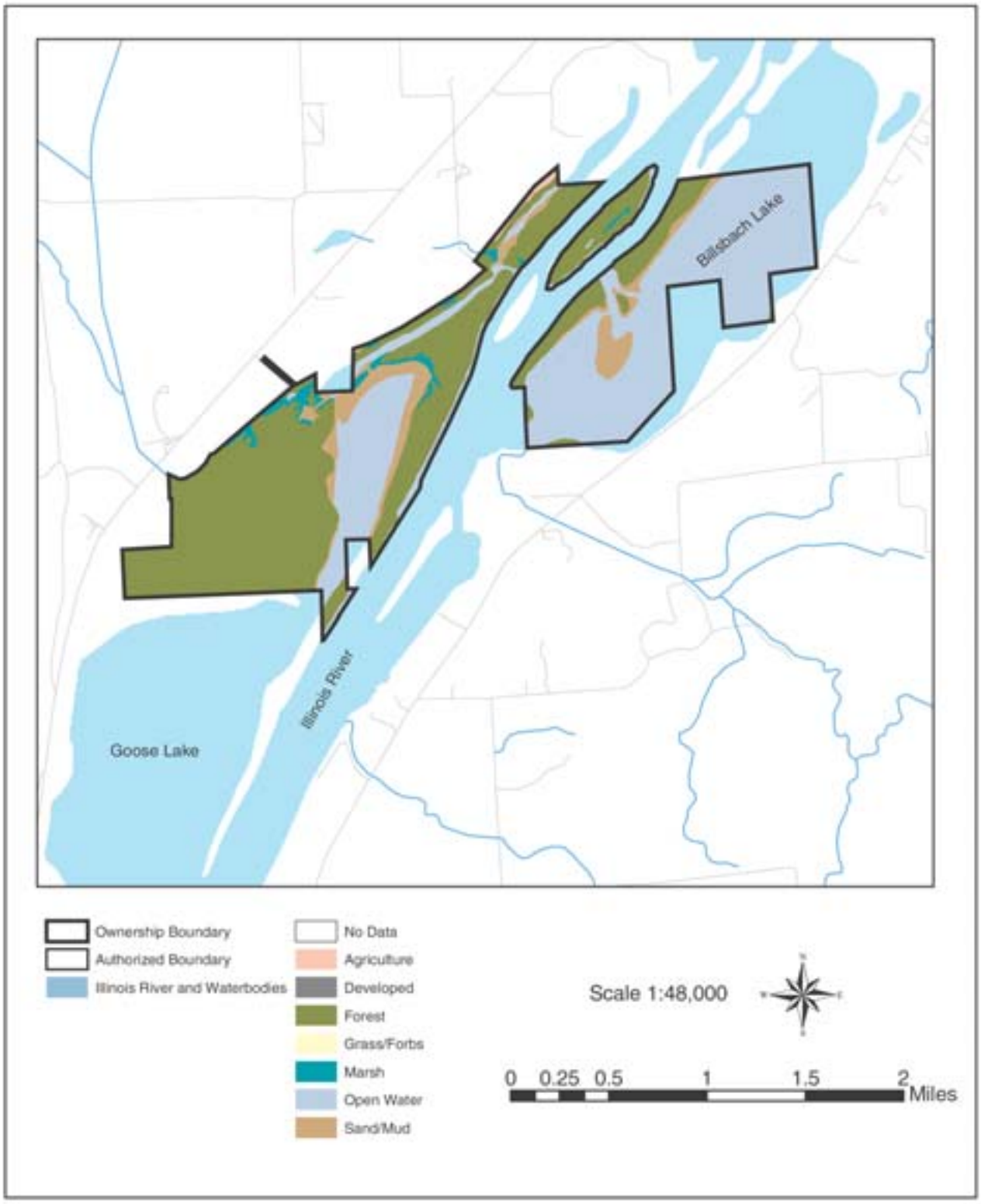


Figure 10: Ownership and Authorized Boundaries, Meredosia NWR

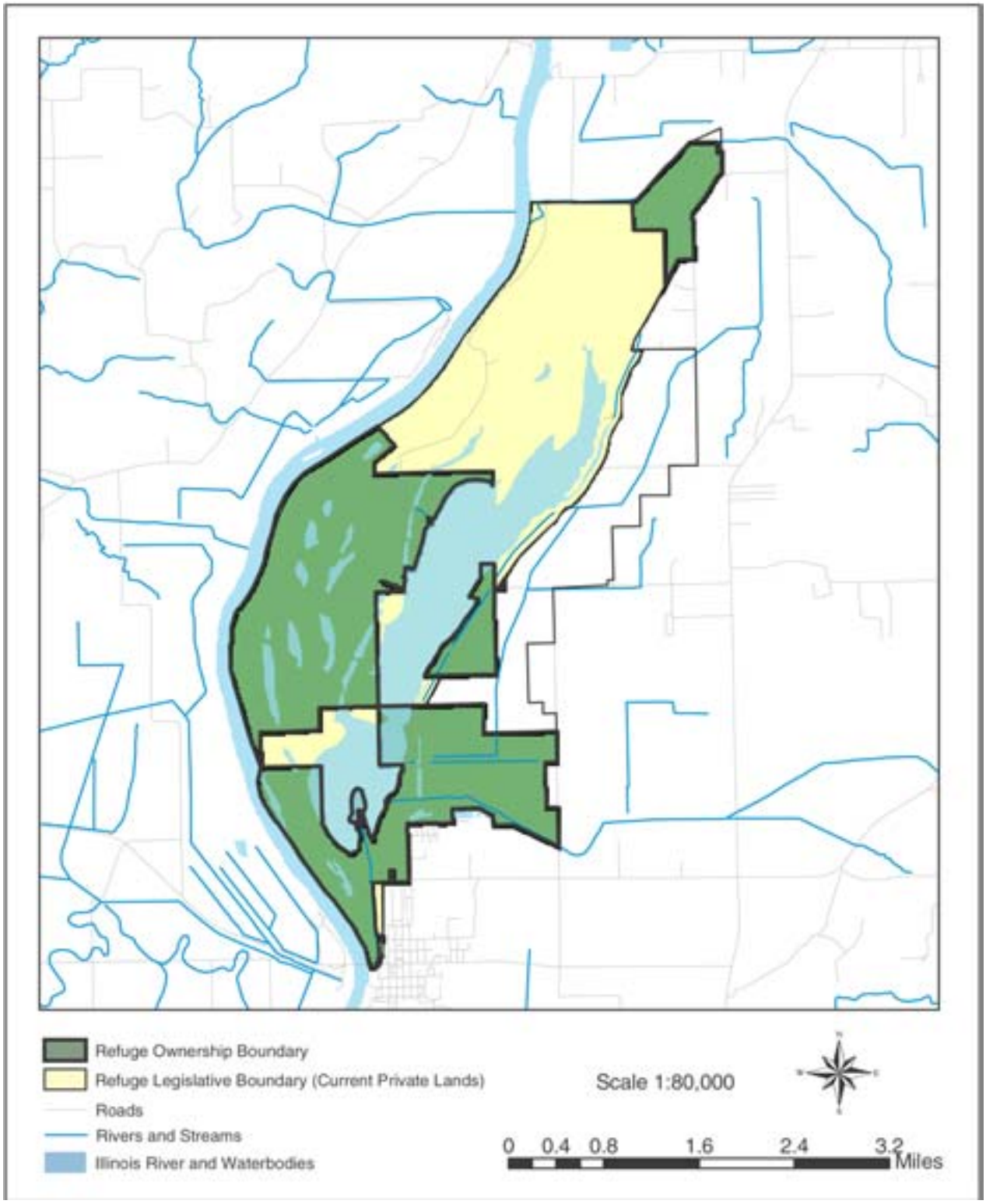
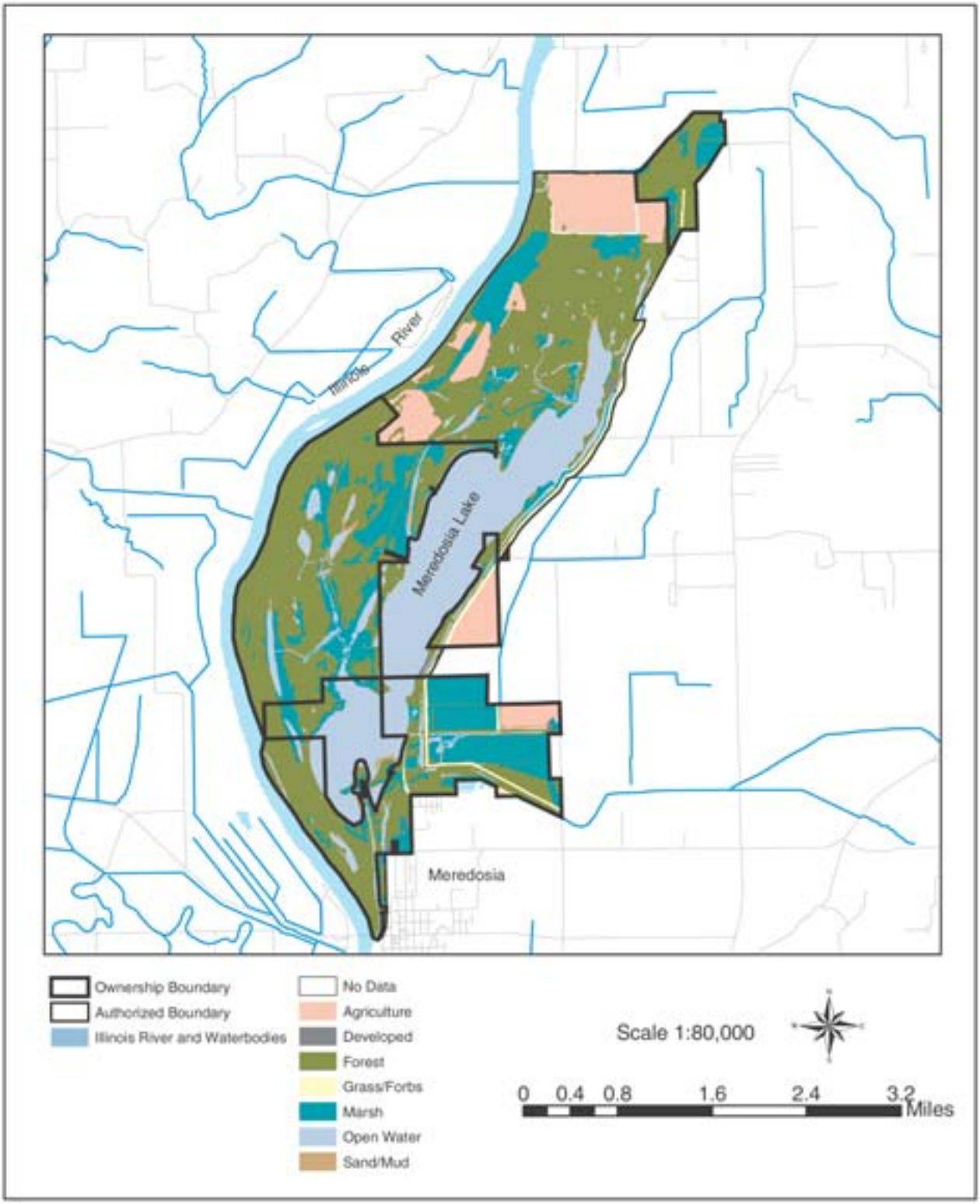


Figure 11: Land Cover, Meredosia NWR



3.2.1.3 Emiquon National Wildlife Refuge

As of April 2002, the Service owned and managed 2,114 acres of land within the 11,122-acre authorized boundary for the purpose of benefitting listed species, waterfowl and other migratory birds, native biological diversity, and native fish and mussels.

Historically two backwater lakes (Thompson Lake with 1,800 acres and Flag Lake with 1,000 acres) provided excellent habitat for migratory birds, fish, and resident wildlife. Most of the land within the acquisition boundary was ditched, cleared, leveed, tiled, and pumped in the early 1900s to facilitate row crop agriculture. Because of the levees, Thompson Lake and Flag Lake basins have not been subjected to heavy annual sedimentation and contaminants as most other backwater lakes along the Illinois River.

3.2.1.4 Conservation Focus Areas Within the Illinois River Basin

Several federal agencies have worked with the Service to identify five focus areas for conservation efforts within the Illinois River Basin (Figures 12-17). The focus areas include conservation areas managed by others. Within these focus areas, the agencies will consider the potential for restoration, preservation, and protection of hydrology, water quality, wetlands and aquatic ecosystems. Development of focus areas provides a focus for federal, state, and local conservation efforts.

The cooperating agencies include the Service, the U.S. Department of Agriculture's Natural Resource Conservation Service, the U.S. Army Corps of Engineers, the U.S. Forest Service, the Environmental Protection Agency, the U.S. Geological Survey and the Federal Highway Administration.

3.2.2 Fish and Wildlife Resources

3.2.2.1 Listed Species

There are eight federally listed and 80 state-listed threatened and endangered species that historically have been identified on or near the Refuge Complex. These include three threatened plants (decurrent false aster, Mead's milkweed, and Prairie white-fringed orchid); one endangered mollusk (Higgin's eye pearlymussel); one endangered bird (Least Tern), one threatened bird (Bald Eagle); and one endangered mammal (Indiana bat). Only the Bald Eagle and decurrent false aster have been documented on the Refuge Complex. The Indiana bat may occur on habitat associated with Meredosia NWR.

Protecting endangered and threatened species and restoring them to secure status in the wild is a primary purpose of the Service and the Refuge. No creature exists in isolation. All living organisms are part of a complex, delicately balanced network called the biosphere. It is composed of many ecosystems, each with its own complement of plants and animals and their biological, chemical, and geological processes and the interrelationships that characterize them. When a species becomes endangered, it indicates that something is wrong with the ecosystems we all depend on. Like the canaries used in coal mines whose deaths warned miners of bad air, the increasing numbers of endangered species warn us that the health of our environment has declined. The removal of a single species can catalyze a chain reaction affecting many others. The full significance of an extinction of a species is seldom apparent; much remains to be learned, and the long-term impacts are difficult to predict.

Figure 12: Conservation Focus Areas, Chautauqua NWR and Emiquon NWR

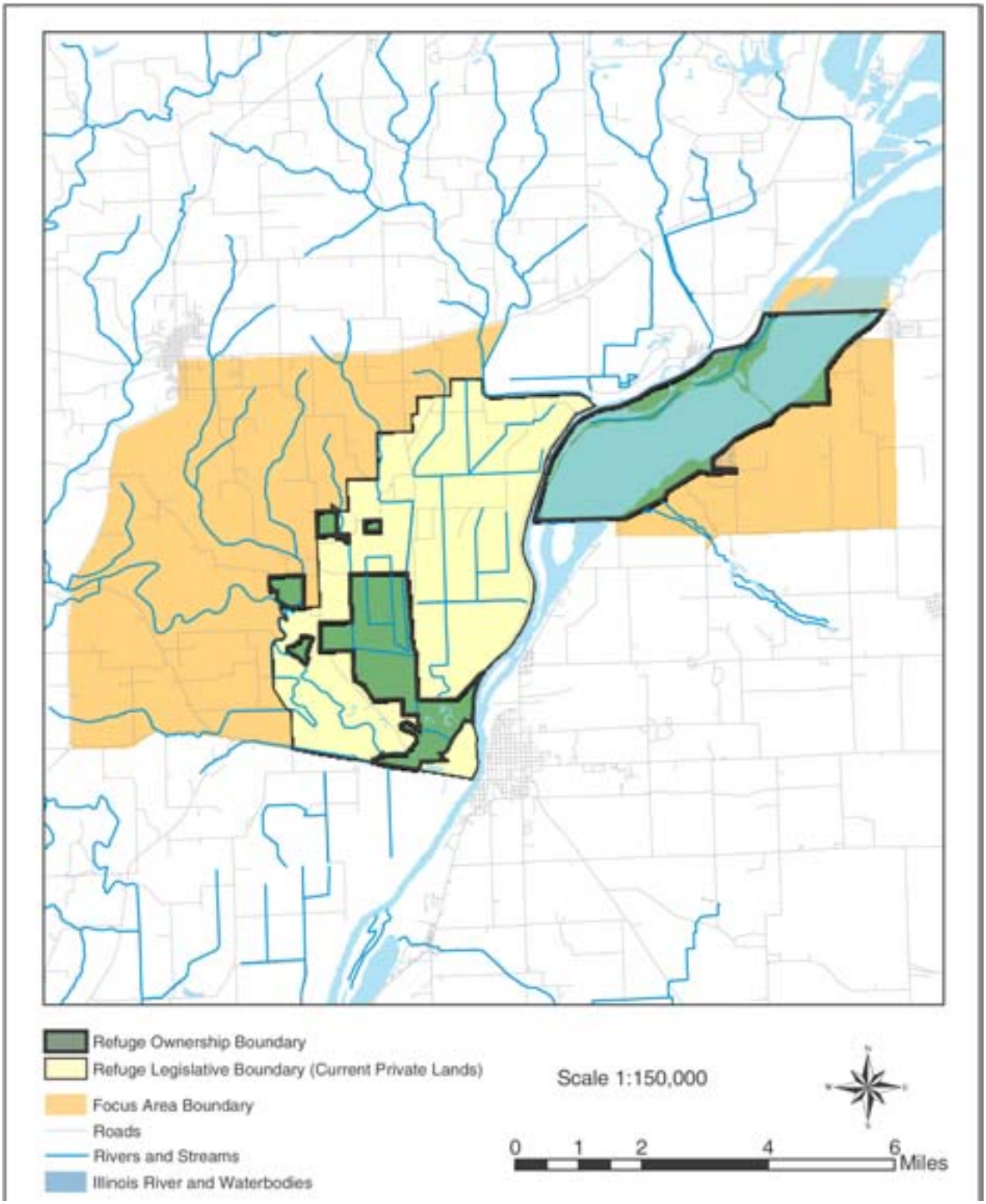


Figure 13: Conservation Focus Areas, Meredosia NWR

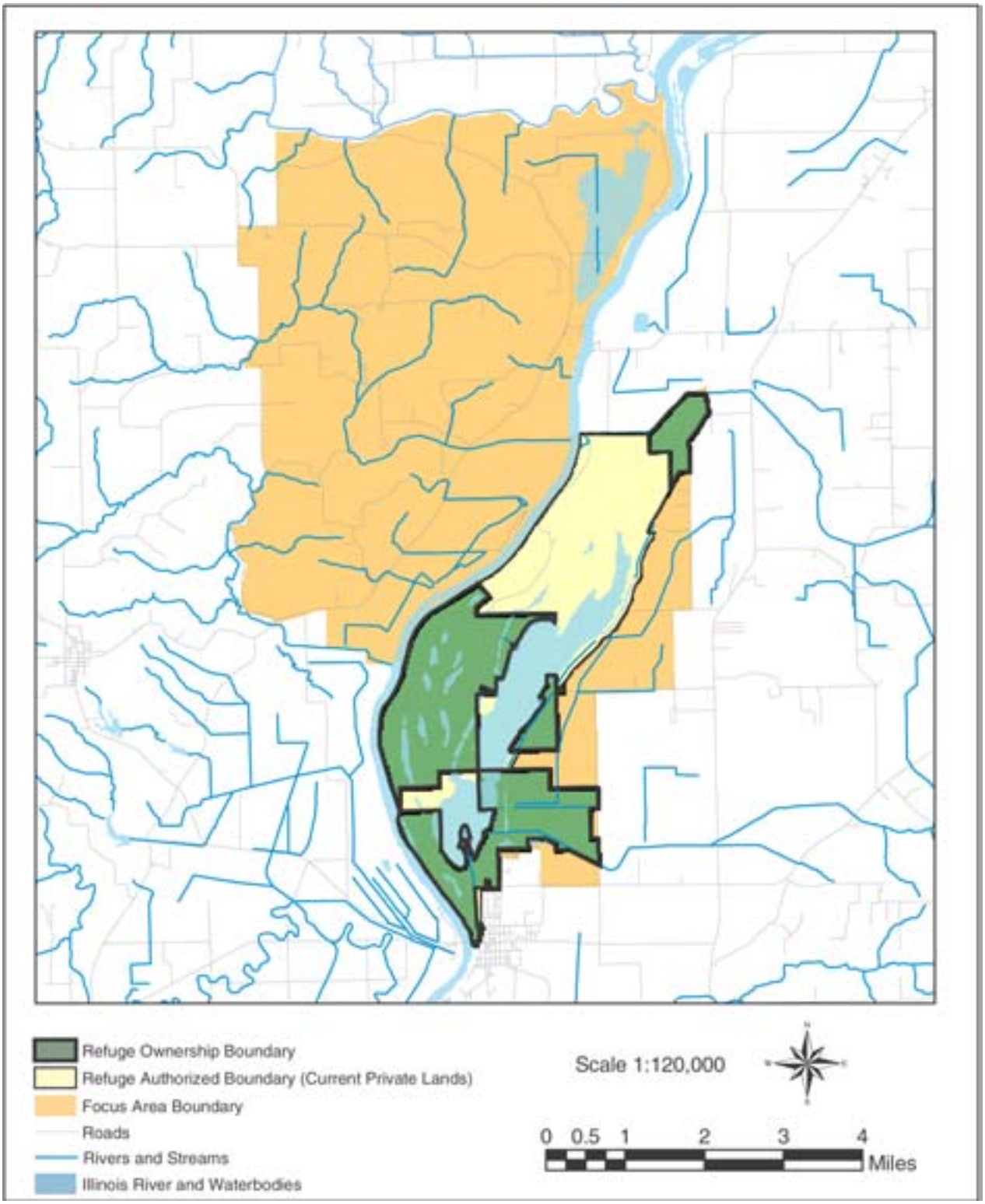


Figure 14: Focus Area Boundaries, Cameron-Billsbach Unit of Chautauqua NWR

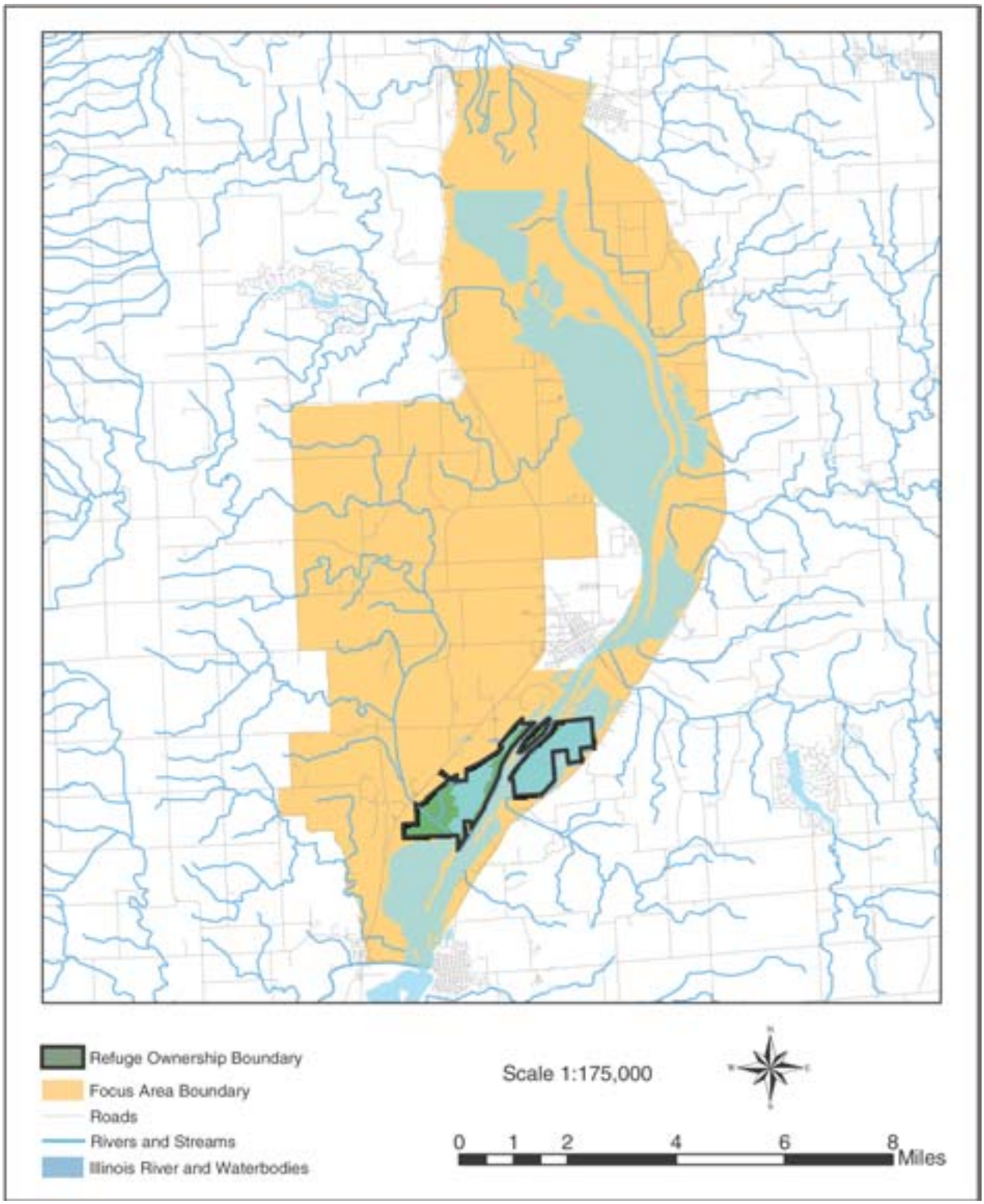


Figure 15: Focus Area Boundaries, Lower Sangamon

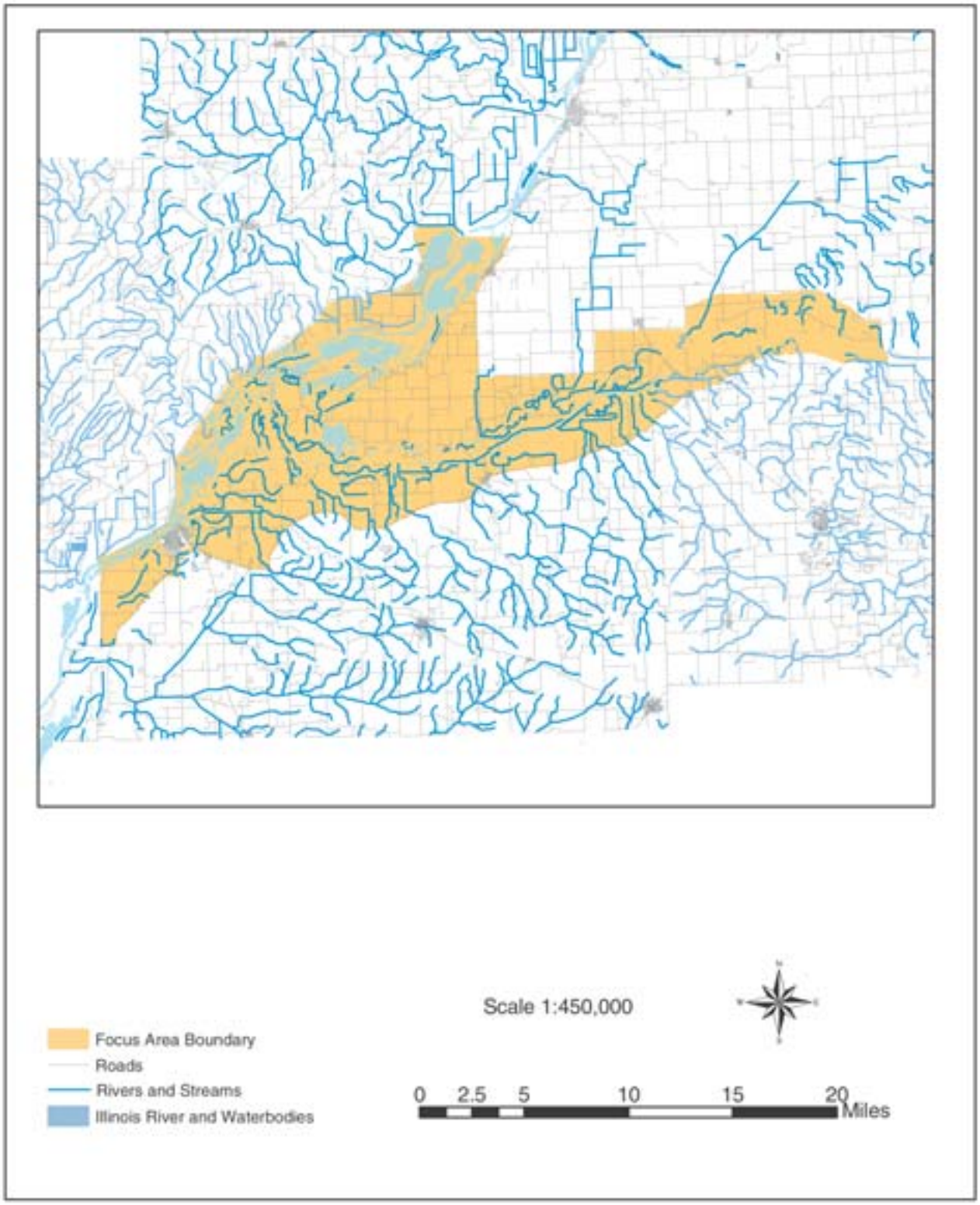


Figure 16: Conservation Boundaries Within Focus Areas, Chautauqua NWR and Emiquon NWR

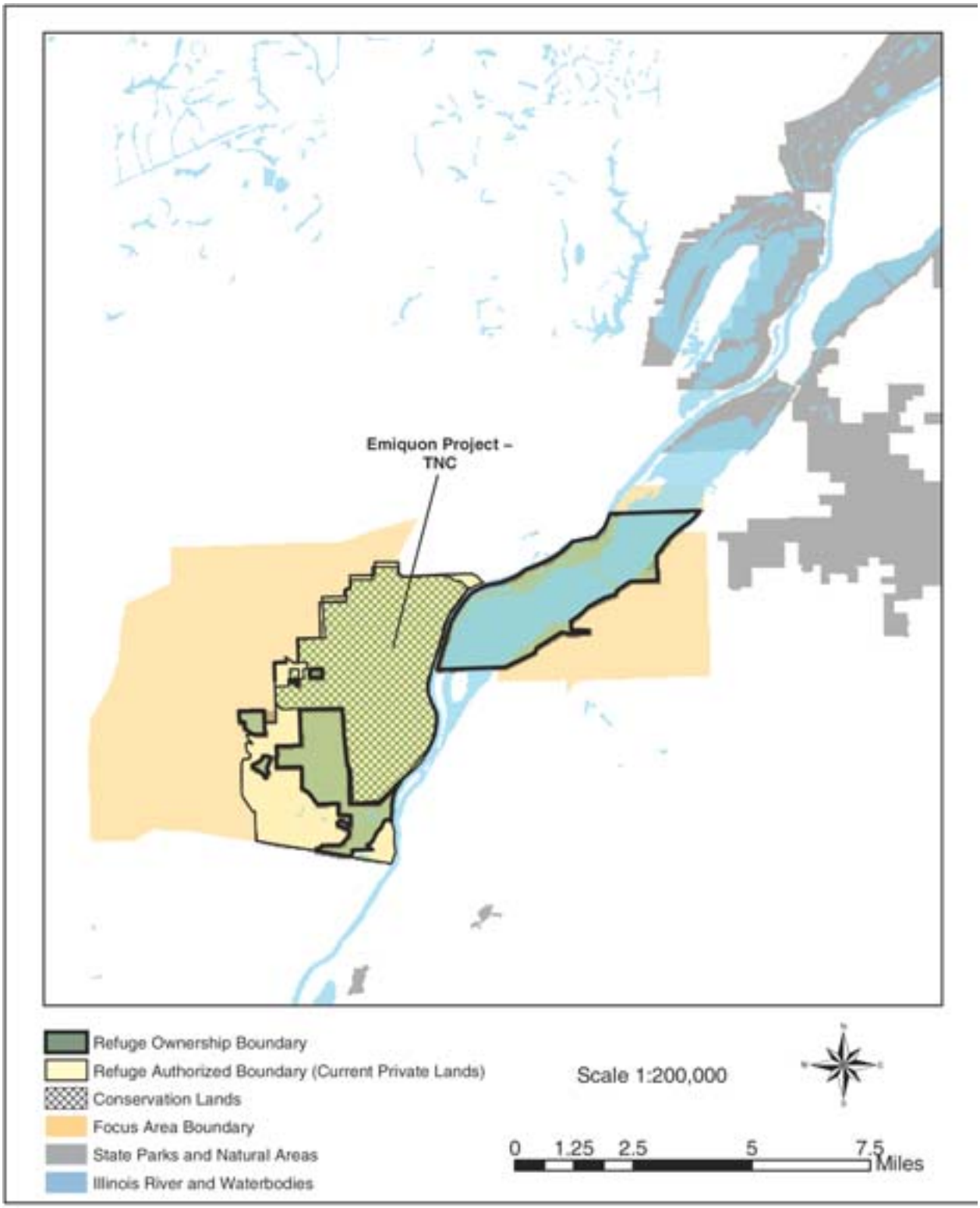
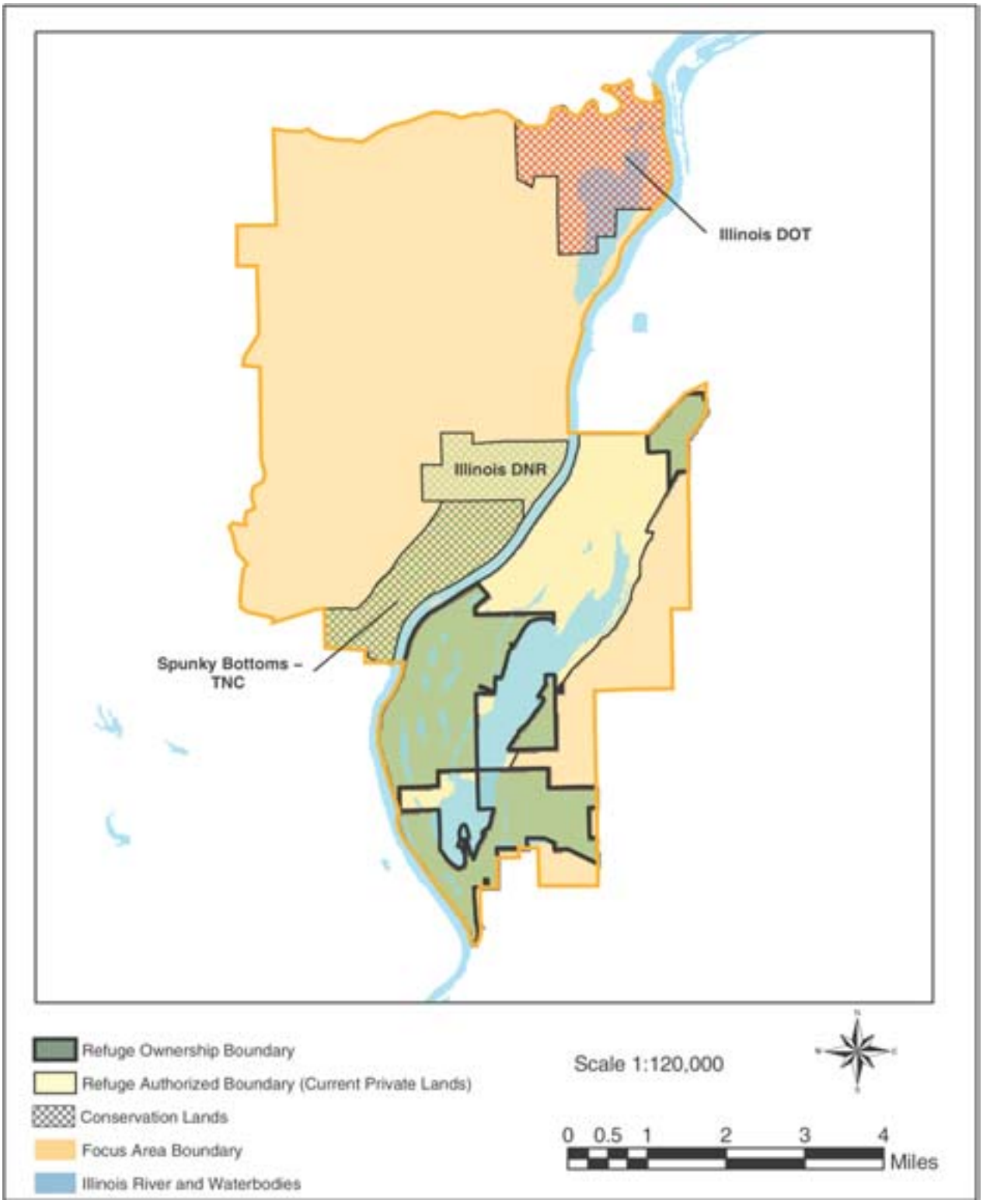


Figure 17: Conservation Boundaries Within Focus Areas, Meredosia NWR



Management guidance for listed species within the Refuge Complex is currently limited. In general, management actions are aimed at protecting all federally listed threatened and endangered species on Refuge Complex land. Current management guidance (goal) for listed species includes protecting and enhancing Refuge habitats to maintain or increase use by endangered or threatened species (the Refuge Complex has an objective level of 3,415 use-days for Bald Eagle and Osprey). However, currently the only efforts being made in this regard is to provide maintenance habitat for Bald Eagles on Refuge Complex land. Bald Eagles use the Refuge Complex from October through March, with peak numbers occurring between November and January. A record 176 eagles were observed on Chautauqua NWR on February 4, 1999, when late winter flood waters topped the north spillway in the South Pool. The most important habitat component provided by the Refuge Complex is sanctuary in the form of mature roost trees protected from human disturbance (primarily Melz Slough and, to a lesser extent, Liverpool Lake). The Refuge Complex also contributes food for eagles in the form of fish and waterfowl. Management actions contributing to Bald Eagle maintenance include assuring an abundance of roost trees for migrating eagles, and providing fish and waterfowl as food sources. Mid-winter Bald Eagle surveys are conducted in January and generally cover all refuges within the Complex. Meredosia NWR and Chautauqua NWR have both supported active Bald Eagle nests in the past. Bald Eagle nests are protected during the nesting season by minimizing all activity around them. For these actions, the Refuge Complex currently follows guidance contained in the Northern States Bald Eagle Recovery Plan.

A small population of decurrent false aster (*Boltonia decurrens*), a federally-listed threatened species, has existed on Meredosia NWR since the 1980s. It is a disturbance-dependent species found only at a few sites along the floodplain of the Illinois River. Botanical surveys are currently conducted annually by Dr. Marian Smith of Southern Illinois University-Edwardsville on the Sandy Point population. Small populations are also found on Chautauqua NWR. No protection is currently afforded this plant species on Refuge Complex land.

3.2.2.2 Waterfowl and Other Migratory Birds

The Illinois River Corridor serves as a temporary home to hundreds of thousands of waterfowl that feed and rest on their annual spring and fall migrations. The middle Illinois River valley, stretching from about Hennepin, Illinois, to Beardstown, Illinois, was historically one of the most important areas for migrating waterfowl in all of North America. Although many of the most significant areas have been greatly altered over the years by drainage and cropping of wetlands within the flood plain, shallow bottom land lakes, sloughs, marshes and side channels remain but most are in a degraded state. The Illinois River and associated wetlands provide some of the most significant areas of Wood Duck production and mid-migration mallard habitat in the Mississippi Flyway. The breeding Wood Duck population in the valley is estimated at over 20,000 (North American Waterfowl Management Plan, 1998). Peak Mallard populations have been known to exceed one million ducks.

Twenty-eight species of waterfowl are known to use the Refuge Complex, including Trumpeter and Tundra swans. Two hundred and sixty four species of birds have been documented on Refuge Complex land. The north and south pools of Lake Chautauqua provide a mix of prime habitat for diving ducks and dabbling ducks. Chautauqua NWR in particular provides a haven for more than 40 percent

Table 1: Annual Waterfowl Use Days 1989-1999

Year	Chautauqua NWR		Emiquon NWR		Meredosia NWR		Cameron-Billsbach	
	Ducks	*Geese*	*Ducks*	*Geese*	*Ducks*	*Geese*	*Ducks*	*Geese*
1989	1,152,806	227,483			604,682	44,755	148,225	22,670
1990	1,265,049	479,525			1,717,415	105,858	147,237	36,630
1991	1,670,239	87,236			641,214	7,013	110,571	12,198
1992	3,162,339	73,325			669,645	4,470	152,045	6,215
1993	790,817	233,365	N/S	N/S	467,084	21,578	103,845	10,222
1994	13,411,544	1,400,647	N/S	N/S	579,113	3,000	92,625	8,610
1995	6,756,325	1,948,498	N/S	N/S	584,266	21,189	267,616	1,364
1996*	1,559,586	196,020	34,480	1,750	176,330	3,360	15,770	5,510
1997	2,006,910	545,990	2,957,100	16,850	781,000	2,360	22,095	2,970
1998	9,176,961	348,704	649,602	2,600	956,370	1,675	54,787	4,010
1999	7,057,289	210,230	945,720	2,100	1,752,525	1,435	164,575	3,660

* *January 1-September 30 only.*

of the waterfowl that use the Illinois River segment of the Mississippi River Flyway. Table 1 shows monthly duck use days from the period 1989-1999.

In addition to waterfowl, wetlands along the Illinois River provide habitat for over 30 species of shorebirds and 10 species of gulls and terns. The dense wetland vegetation on Chautauqua NWR provides ideal shelter and feeding habitat for marsh birds such as Sora Rail and Yellow Rail, Great Blue Herons, and Great Egrets. Although they are secretive and seldom seen, American Bitterns and Green Herons feed among the more than 70 plant species found in Lake Chautauqua. The low water of summer and the resulting mud flats produce an abundance of shorebirds, especially sandpipers. August is the time to see the many shorebird species found on the Refuges.

Management guidance for waterfowl and other migratory bird management for the Refuge Complex is aimed at providing high quality resting, nesting, and feeding habitat for waterfowl and other migratory birds. Current management actions are directed toward duck maintenance, goose maintenance, and Wood Duck production.

The Mallard is considered to be the most important of several species of dabbling ducks that use the Refuge Complex in the fall (September through December). The Refuge Complex is generally thought to be less important to waterfowl in the spring, when sheet water is common throughout the area and there is no hunting pressure. In the fall, management is directed to provide shallowly flooded moist soil plants for feeding and open water areas for roosting and sanctuary. Submergent and emergent aquatic vegetation would also be desirable, but these vegetation types are practically non-existent at the present time. Most waterfowl and other migratory bird management occurring on the Refuge Com-

plex is accomplished through habitat management. Criteria used to evaluate duck and goose maintenance success include the number of acres available for moist soil management and to a lesser degree, the number of acres of submergent or emergent aquatic vegetation.

In the past, the Refuge Complex had an extensive Wood Duck nest box program. During this time, approximately 50 nest boxes for Wood Ducks are maintained on the Refuge Complex. Success of the nest box program is monitored by Refuge volunteers.

Current management for Wood Ducks consists primarily of attempting to provide both nesting and brood-rearing habitat. Nesting occurs in both natural cavities and artificial nest boxes. Brood habitat consists of relatively shallow open water interspersed with emergent vegetation, which provides both food and cover. Proximity of brood habitat to nesting habitat is also an important consideration. Criteria used to evaluate Wood Duck success include the number of acres of permanent water with emergent vegetation, proximity of emergent vegetation to main nesting habitats, and availability of trees with natural cavities, primarily in Melz Slough and along South Dike. Due to 1993 and 1995 flooding of the Illinois River and the high tree mortality associated with it, there is an abundance of dead trees with natural cavities but these trees are rapidly disappearing.

Floating goose nesting structures that were placed in Lake Chautauqua by the Quiver Creek hunt clubs in the 1990s have fallen apart and have been removed from the lake. There was no known nesting in any of the structures and because of the litter problem and no identified need to produce local Canada Geese, structures will not be placed in the lake in the future.

The Refuge's prescribed burning program is designed to directly benefit nesting grassland birds in open and semi-open landscapes. These programs also help to increase the amount of suitable waterfowl nesting habitat. The Refuge also attempts to attract waterfowl, shorebirds, and other marsh birds by managing water levels on most of its pools. The purpose of water level manipulation on these pools is to grow food plants and to increase the availability of aquatic invertebrates that are favored by migrating water birds. Wetland restoration and prescribed burning activities have been used to restore and maintain sedge meadows on the Refuge Complex. This provides nesting habitat for birds including Sedge Wrens, sparrows, rails, and warblers.

The annual drawdown of the South Pool of Lake Chautauqua provides excellent foraging opportunities for wading birds, shorebirds and other wildlife. During this drawdown period shorebird surveys are performed by Refuge volunteers.

The Refuge Complex also participates in annual Mourning Dove and Woodcock surveys. Mourning Dove surveys are conducted in Fulton and Cass counties and Woodcock surveys are conducted in Fulton and Mason counties. Results of the nationwide surveys are pooled to determine populations trends for the two species. The population trends are then used to set harvest limits for states where these birds are hunted. Surveys are generally conducted in May or June.

3.2.2.3 Native Fish and Mussels

The Service's fisheries program focuses on a broad variety of federal trust species and the aquatic habitats on which these species depend. For the fisheries program, the term "federal trust species" refers to organisms targeted through the Endangered Species Act, potentially impacted by federal actions under any federal authority within which the Service has formal review or regulatory responsibility; identified within federal mitigation responsibilities assigned to the Service; inhabiting or migrating through interjurisdictional waters; considered nationally significant, rare or declining in range or population size and lacking protection from non-federal authorities; occurring on federal lands; subject to the interests of Native American governments or otherwise aligned with the Service's tribal trust responsibilities; or covered directly or in potential under any of the approximately 29 public laws, or treaties, interstate compacts, Executive Orders, statutes, and agreements pertaining to the Service's mission and natural resource management responsibilities.

The Illinois River was once among the most biologically productive rivers in the nation. As recently as the 1950s, the waters of the Illinois River and its associated tributaries were counted as among the great inland commercial and sport fisheries. Although no longer the case, the state as a whole remains one of the nation's top producers of freshwater fish. The river is home to more than 100 fish species, and its side channels and backwater lakes serve as important nursery areas. Commercial fish yields experienced abrupt declines in the 1920s and by the 1960s the commercial fishery was only 4 percent (1 million pounds) of what it was prior to the establishment of the drainage and levee districts. Since the 1960s the commercial fishery has further eroded and generally remains at about 700,000 pounds per year, a mere 2 percent of the 1908 harvest. Common carp, bighead carp, and silver carp are among the most abundant species, but other species common to the river include gizzard shad, white bass, large mouth bass, bluegill, and black crappie. Channel catfish, buffalo, bullhead, and sauger also inhabit the river. There are approximately 102 species of fish, 37 species of mollusks, and 10 species of crustaceans found in the vicinity of the Refuge Complex (Appendix C).

Within the upper reaches of the river, fish species diversity is somewhat lower. Because water quality is less than ideal and that stretch includes few backwaters needed for breeding and rearing, only the hardiest species can be found. Thus carp are most plentiful throughout the upper river, except around Starved Rock, which offers more habitat diversity. As habitat conditions improve in this area, other species are appearing in substantial numbers, including largemouth bass, bullhead, walleye and white bass.

The middle river has historically been the most productive area of the river because of the availability of habitat, namely backwaters, that support diverse and productive populations. However, as lakes fill with sediment and aquatic vegetation is killed off, native fish populations decline and other more hardy species, such as carp, predominate.

The lower river from Beardstown, Illinois, to Grafton, Illinois, features roughly the same mix of fish species as the middle river but population numbers are smaller. Even though water quality tends to be better in this reach, fish populations suffer because the lower river is channelized, the floodplain is behind levees, and few backwater areas exist.

3.2.2.4 Mammals

The habitats of the Refuge Complex accommodate 45 species of mammals. Foxes and raccoons are the most abundant predators while cottontails and fox squirrels are the most common rodents. Whitetail deer often are seen along the Refuge roads and dikes. Badgers are rarely seen, but their diggings are obvious along the dike areas. Beavers, muskrats, opossums and woodchucks are common but infrequently seen. The squeaking of southern flying squirrels is commonly heard at night.

Small mammals typical of this area include the eastern mole, deer mouse, white-footed mouse, meadow vole, pine vole, southern bog lemming, and plains pocket gopher. Little brown myotis, big brown bat, and hoary bats use the Refuge Complex.

3.2.2.5 Reptiles/Amphibians

Sixty-seven species of reptiles and amphibians have been reported on the Refuge Complex, but little is known about their populations or their limiting factors. Many of these, such as the snapping and painted turtles, are associated with marsh and open waters while others, such as the common garter snake, occur in grasslands and drier areas of the Refuge Complex.

3.2.3 Plant Communities

3.2.3.1 Wetland Resources

In Section 404 of the Clean Water Act, the U.S. Army Corps of Engineers defines wetlands as "areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Wetlands are lands transitional between terrestrial and deepwater habitats where the water table is usually at or near the land surface or the land surface is covered by shallow water (Cowardin et al., 1979). Wetlands are diverse systems that provide the biological interface between the aquatic and terrestrial communities, which multiply their function and contribute to their dynamics. Within wetlands, invertebrates, insects, gastropods, and other organisms living among the vegetation provide an important food source for fish and mammals. Waterbirds and other wildlife rely on wetlands for subsistence, nest sites, and cover, while others utilize fish and invertebrates that inhabit the vegetation. Where natural processes are still occurring, zonation and succession in response to environmental conditions are among the important community processes. Water level fluctuations and the resultant plant and animal response are often the most significant driving force in most wetland communities.

The diverse wetlands of Illinois have resulted from geologic events, human activities, and hydrologic conditions. Prior to European settlement, the Illinois River Corridor was composed of shallow marshes, sloughs, meanders, small ponds, and large backwater lakes that allowed dense stands of submergent pondweeds, coontail, waterlilies and emergent duck potato, smartweed, and river bulrush plants to flourish. Vast tracts of naturally flooded wetlands, bottomland hardwoods, and backwater lake habitat provided resting, nesting, and feeding habitat for migrating ducks, geese, and a variety of other migratory birds and resident wildlife. Foods in the form of mast, natural seeds, and invertebrates were available during the September through March migration. Large expanses of open water and marshes also provided a rich source of other wildlife foods.

Today only the most hardy varieties are found, such as river bulrush, marsh smartweed, pondweed, wild celery, coontail, and American lotus. These species appear to tolerate the fluctuating water levels, pollution, and turbidity now characteristic of the modern-day river. River bulrush, the most common emergent aquatic plant found in the Illinois River Corridor, provides nesting habitat for some duck species, as well as food and den material for muskrats. Marsh smartweed, also an emergent variety, provides cover for migrating birds and seeds to feed them. It is a preferred habitat for Wood Ducks and Mallards and provides some food and shelter material for muskrats. Sago pondweed, once considered the most important waterfowl food on the continent, is now relatively rare along the river. It was killed off almost entirely in the 1950s and 1960s, although it has been found in isolated locations along the river. Curlyleaf pondweed, a submerged plant, was abundant in nearly all of the backwater lakes as late as the 1950s. But like other varieties, it is currently found in isolated locations. Wild celery, the preferred food of Canvasback and Ring-neck Ducks, also nearly disappeared from the river valley in the 1950s and 1960's.

Moist-soil vegetation grows on mudflats that occur naturally around the shores of backwater areas. The plants, now the most abundant form of vegetation in the Illinois River Corridor, are an essential food source to 35 different species of waterfowl. The seeds most favored are produced by arrowleaf, several species of millet and smartweed, nutgrasses, rice cutgrass, Spanish needles, teal grass, and water hemp. The health and seed productivity of these plants depend on a year-round cycle of specific water levels. The cycle begins in the spring when waterfowl eat the seeds left on the mudflats around backwater areas. With spring rain, the river overflows and the lakes rise and cover their muddy banks. Light summer rain and low water levels from July to October cause the lakes to recede. As the mudflats dry in the sun, the seeds remaining in the mud germinate and grow. With the coming of the early fall rains, the plants produce seeds once again, the lakes rise, and the mudflats are immersed under a shallow cover of water. This is the environment in which dabbling ducks feed during fall migrations.

Another ecologically important aquatic habitat found along the Illinois River are side channels, which are defined as all departures from the main channel in which there is current during normal river stage. These areas are characterized by low current, soft bottom, and reduced turbidity. They provide important food sources of zooplankton, phytoplankton, and benthic organisms for fish, waterfowl, and migratory birds. Side channels often have a greater production and diversity of benthic organisms, phytoplankton, and aquatic macrophytes than the main channel due to their structural diversity, which ranges from fast flowing chutes with high banks to sluggish streams moving through marshy areas.

3.2.3.2 Forest Resources

Bottomland or floodplain forests within the Illinois River Corridor occupy low-lying areas along the river in relationship to their elevation and distance from water. While once rich in forests, the river's forests today consist of a little more than narrow strips along the edges of the riverbanks. The most densely forested bottomland areas today are located around LaSalle and Starved Rock and in the Alton Pool, the river's southernmost section. Floodplain forests are characterized by poor drainage and slow permeability. In general, flooding regimes, including depth and duration, are major forces in determining species composition

and richness and in determining growth. Floodplain forests in Illinois include wet, wet-mesic, and mesic floodplain forests. Vegetation diversity tends to increase from wet to mesic floodplain forests.

Wet floodplain forests occur in the floodplain bordering the river and include the riverbank. In general, trees and shrubs found in the wet floodplain forest zone are those species most tolerant of flooding. Thus, compared with other floodplain forests, wet floodplain forests contain fewer trees since flood frequency and duration tend to be limiting factors for this community. Wet floodplain forests are often seasonally flooded and/or have perched water tables during a portion of the year, often in late winter and spring. Canopy species in this community include silver maple, hackberry, green ash, honey locus, sycamore, and cottonwood. Sub-canopy species include box elder, Kentucky coffeetree, river birch, and black willow. Shrubs and woody vines include elderberry, bristly catbrier, trumpet creeper, poison ivy, and riverbank grape. Ground cover includes ragweed, panicled aster, a variety of nettles, blue lobelia, honewort, Virginia wild rye, annual bedstraw, and an assortment of others.

Wet-mesic forests typically occur on low terraces along the river and tend to be intermediate in flood duration. Typical canopy species include silver maple, bitternut hickory, hackberry, honey locust, green ash, black walnut, pin oak, and American elm. Sub-canopy species include box elder, sugarberry, red haw, red mulberry, persimmon, Kentucky coffeetree, and slippery elm. Shrubs and vines include paw paw, Missouri gooseberry, common blackberry, elderberry, bristly catbrier, poison ivy, and riverbank grape. Groundcover species include ragweed, false nettle, a variety of sedges, wild chervil, enchanter's nightshade, honeywort, Aunt Lucy, Virginia wild rye, annual bedstraw, white avens, cow parsnip, Virginia waterleaf, wood nettle, Virginia blue bells, woodland phlox, and others. Very few, if any, high quality wet-mesic floodplain forests occur today within the Illinois River Corridor.

Mesic floodplain forests typically occur along high terraces and have relatively brief flooding duration and lower flooding frequency. Common canopy species include sugar maple, black walnut, red oak, bur oak, chinquapin oak, basswood, and American elm. Sub-canopy species include Ohio buckeye, red mulberry, persimmon, and slippery elm. Shrubs and vines include paw paw, redbud, Missouri gooseberry, bladdernut prickly ash, Virginia creeper, bristly greenbrier, poison ivy, and riverbank grape. Ground cover species include many species found in mesic upland forests: doll's eye, wild ginger, Jack-in-the-pulput, spring beauty, enchanter's nightshade, leather flower, hairy and smooth sweet, and a variety of others.

Ecological concerns associated with floodplain forests include flooding, hydrologic cycle maintenance, fire suppression, timber harvest, fragmentation, siltation, and exotic and invasive species. For instance, considerable tree mortality occurred along the Illinois River following the severe flooding in 1993. In general, trees and shrubs found in wet floodplain forests fared much better in 1993 than those found in mesic floodplain forests. Historically, floodplain forests within the Illinois River Corridor were comprised of a diversity of tree species. However, those communities that remain are often dominated by silt and flood-tolerant species (e.g., silver maple).

Farther upland from the river the forest communities are dominated by mixed softwoods, including silver maple, American elm, swamp privet, red mulberry,

box elder, green ash, sycamore, and river birch. Still higher up in elevation, the forest community includes sugarberry, hackberry, hawthorn, honey locust, bur oak, and dogwood. Grading into the blufftops and at some distance from the river, the forest community is characteristic of a diverse mix of softwoods and hardwoods, including oak and hickory, red and sugar maples, and black walnuts.

Upland forest communities can be classified by soil-moisture characteristics as tree species tend to respond in predictable ways along soil-moisture gradients. For the Illinois River Corridor, these would include dry, dry-mesic, mesic, and wet-mesic upland forests.

Dry upland forests are found on ridge crests and slopes with south and south-western exposures. Major canopy species include white oak and black oak. Subcanopy species include shadbush, flowering dogwood, hop hornbeam, redbud, and red cedar. Shrubs include roughleafed dogwood, aromatic sumac, smooth sumac, pasture rose, nannyberry, and hazelnut. Woody vine include Virginia creeper and poison ivy. Garlic mustard, an extremely invasive species, has become locally abundant in many areas and has replaced many native species. Ground cover species include pussy toes, sedges, poverty oats, soft agrimony, hog peanut, tall anemone, shooting star, and a host of others. Several prairie species are often found in forest openings including big bluestem, little bluestem, yellow stargrass, and flowering spurge.

Dry-mesic upland forests, the most prevalent forest community type in Illinois, are found along the upper to middle slopes and ridges of the dissected terrain bordering the Illinois River and on the slopes and sides of ravines. Major canopy species include white oak, black oak, shagbark hickory, and white ash. Subcanopy species include sugar maple, sassafras, shadbush, blue beech, hop hornbeam, redbud, red mulberry, black cherry, and slippery elm. Typical shrubs include rough-leafed dogwood, hazelnut, Iowa crabapple, Missouri gooseberry, black raspberry, aromatic sumac, black haw, and nannyberry. Woody vines include Virginia creeper, poison ivy, bittersweet, bristly greenbrier, riverbank grape, and summer grape. Groundcover includes pussy toes, Virginia snaketoes, whorled milkweed, ebony spleenwort, blue aster, rattlesnake fern, soft agrimony, sicklepod, sedges, and others.

Mesic upland forests occur on sites where available soil moisture is greater than that in dry-mesic sites. These forests are found on the lower-to-middle slopes of the dissected terrain associated with major streams and tributaries. They are characteristic of dense canopies, an understory of shade tolerant woody species, and a variety of woodland wildflowers. Canopy cover includes sugar maple, red oak, bur oak, and basswood. Subcanopy species include Ohio buckeye, shadbush, red mulberry, paw paw, blue beech, and hop hornbeam. Typical shrubs include elderberry, redbud, alternate-leafed dogwood, wahoo, black haw, bladdernut, wild hydrangea, buckbrush, prickly-ash, wafer-ash, common chokeberry, black current, and gooseberry. Woody vines include poison ivy, Virginia creeper, grape honeysuckle, and riverbank grape. Groundcover includes spikenard, yellow bellwort, black snakeroot, bloodroot, blue cohosh, broadleaf goldenrod, fern, and a rich assortment of others.

Wet-mesic upland forest occur where drainage is limited, either by soil characteristics or where depressions occur within the upland forest. While such conditions exist within the Illinois River Corridor, few examples of this community exist.

Typical canopy species would include swamp white oak. Subcanopy is often absent. Groundcover species probably include wetland sedges and shrub species.

Ecological concerns with upland forests include loss and degradation from agricultural development and urban sprawl, timber harvest, grazing, exotic and invasive species, over-browsing by deer, fire suppression, and habitat fragmentation. For instance, over grazing often produces major changes to a forest's structure and composition. As such, many grazing-sensitive species have probably been eliminated from many forest remnants along the Illinois River, while those more tolerant (e.g., thorn-bearing taxa such as red haw, honey locust, gooseberry, blackberry) have probably become more abundant. Non-native species also tend to increase from over-grazing, such as garlic mustard, buckbrush, and poison ivy. Fire suppression typically results in compositional changes in mesic forests (an increase in sugar maples) and primarily structural changes in drier sites (such as an increase in stem density of woody plants and shade). The result is often a reduction in cover and diversity of the ground flora, often the most diverse stratum in Illinois woodlands (Taft et al. 1995).

3.2.3.4 Grassland Resources

The Great Plains, once the continent's largest biome, has become functionally non-existent over the last 150 years. The original tallgrass prairie, which extended from western Indiana to the eastern part of Kansas, Nebraska, and North and South Dakota and south to Oklahoma and Texas, has been virtually eliminated throughout its historic range. Recent surveys suggest that 82.6 to 99.9 percent declines in the acreage of tallgrass prairie have occurred in 12 states and one Canadian province since European settlement. Prior to human-induced alteration, the lower Illinois River floodplain was roughly 40 percent prairie. Today few remain. Loss and fragmentation of prairie landscapes combined with changes in natural processes have had negative consequences for many grassland plants and associated animals

Historically, prairies were an important component of Illinois River ecosystem structure and function. Prairies are plant communities dominated by herbaceous plant species (mainly grasses) and where trees are either absent or widely scattered across the landscape. Illinois lies within an area called the "prairie peninsula," an eastward extension of prairies that borders deciduous forests and woodlands to the north, east, and south. Prairies of this region were maintained under the influence of three major stresses: climate, grazing, and fire. Prairies in this region are subject to extreme temperature fluctuations, with hot summers and cold winters. Rainfall and growing seasons vary from year to year, with prolonged droughts lasting for several years. Prairie fires, started by Native Americans and lightening, were probably common prior to European settlement. As fire moved across the landscape, it killed-off most saplings of woody species, removing thatch that aided in nutrient cycling, and promoting flowering of many species. A portion of the above-ground prairie was consumed each year by grazing animals, such as bison, elk, deer, and rabbits. Grazing was an integral part of the ecosystem performing many functions important for diversity and maintenance.

Three main types of prairie historically occurred in the Illinois River Corridor. They are 1) prairie (black soil, silt-loam prairies, including dry-mesic prairie, mesic prairie, wet mesic prairie, and wet prairie), 2) sand prairie, and 3) hill prairie.

Dry-mesic prairies are typically found on slopes or on soil that is fairly well drained. Common grasses, forbs, and shrubs include little bluestem, big bluestem, prairie dropseed, prairie panic grass, switch grass, Indian grass, side-oats gama, porcupine grass, prairie sedge, Mead's stiff sedge, plains oval sedge, bird's foot violet, black-eyed Susan, compass grass, blazing star, leadplant, New Jersey tea, prairie willow, smooth sumac, and pasture rose (Illinois DNR, 2001). Ecological concerns associated with dry-mesic prairies include the absence of fire and other natural disturbances, wood plant encroachment, and exotic species invasion. Common exotic species include Kentucky bluegrass, Canada bluegrass, sweet clovers, Queen Anne's lace, parsnip, and asparagus (Solecki 1995, 1997).

Mesic prairies are among the most species rich plant communities in North America. Typical remnants contain from 15 to 30 species in a half-meter square sampling quadrat (Illinois DNR, 2001). Most of the plant species found in dry-mesic prairies also occur in mesic prairies. Common grasses and forbs include little bluestem, big bluestem, prairie dropseed, switch grass, Indian grass, compass plant, and prairie dock. Ecological concerns for mesic prairie are similar to those in dry-mesic prairies. No remnant of this prairie type occurs on the Refuge.

Wet-mesic prairies are transitional between mesic and wet prairies and can include plant species from each. Typical grasses, forbs, and shrubs include big bluestem, prairie cordgrass, blue joint grass, awl-fruited oval sedge, brown fox sedge, closed gentian, Culver's root, golden Alexanders, marsh blazing star, swamp rose, prairie willow, and sometimes pussy willows. Ecological concerns for this prairie type are similar to those for dry-mesic and mesic prairie, with the addition of hydrologic cycle maintenance. No remnant of this prairie type occurs on the Refuge.

Wet prairie is a community type where surface water is present during winter and spring and the soil is almost saturated. Typical grasses, forbs, and shrubs include: prairie cord grass, blue joint grass, big bluestem, blue flag, common boneset, panicled aster, prairie Indian plantain, meadow sweet, swamp rose, and sometimes pussy willows. Ecological concerns for this prairie type are similar to those for dry-mesic and mesic prairie, with the addition of hydrologic cycle maintenance. No remnant of this prairie type occurs on the Refuge.

Sand prairies occur where the soil is composed predominantly of sand or sandy loam. White and Madany (1978) recognized five sand prairie community types, based on soil moisture, from dry to wet. Numerous rare and declining plant species occur in sand prairies in this region. These include bog clubmoss, broom-rape, dwarf grape fern, ear-leafed foxglove, false heather, and kitten tails, to name a few. Prairie fameflower, a species that has been considered for listing at the federal level, is also found in sand prairies.

Hill prairies are grassland communities that occur on slopes typically with exposure to the south and/or southwest. Soils moisture conditions are very dry. Substrate, which is also used to differentiate this type of prairie, include loess, glacial drift, gravel, and sand. The floristic composition of hill prairies is a combination of species that also occupy other prairie types (e.g., dry, black soil, sand, and gravel prairies). Because of their inaccessibility, hill prairies have survived as a greater proportion than other prairie types, leaving hill prairies as some of the last remnants of the prairie biome that dominated Illinois for 8,000 years prior to European settlement. Ecological concerns for this prairie type are

similar to those for other prairie types, with the addition of the diminution of grazing, which results in the conversion of hill prairies to forest. For this reason, hill prairies remain severely threatened within the Illinois River Corridor.

Photograph by Bernie Angus

Ecological concerns associated with native grasslands include loss, fragmentation, fire suppression, hydrologic cycle maintenance, exotic and invasive species, and development. For years following the initial conversion of native Midwestern prairies, many prairie-dependent wildlife species remained relatively stable through their ability to colonize agricultural grasslands. However, 20th century agricultural grassland loss has followed a similar path of decline as native prairie loss in the 19th century.

Until the 1950s, many remnant prairie tracts were surrounded by agricultural grasslands (haylands/pasture), which helped support their natural structure and function. Today, few of these agricultural grasslands remain, causing many prairie remnants to become islands surrounded by row-crop fields and other development. Further, much of the remaining tallgrass prairie habitat in the area is highly fragmented and dominated by human activity. Habitat fragmentation diminishes habitat suitable for area-sensitive species. Habitat size, shape, and amount and type of edge are important factors in the reproductive success of many grassland birds. Without proper management, many remaining areas will continue to degrade due to their size, isolation, absence of natural processes such as fire and hydrologic cycle maintenance, and inadequate buffers protecting them from surrounding agricultural and urban land uses. Fire absence can lead to woody vegetation encroachment and severe invasion of non-native grasses, which can eliminate many prairie plants. Moisture regimes of many remaining mesic, wet-mesic, and wet prairies have been altered by drainage tile/and or ditches. Many of the ground nesting birds that utilize remaining prairies must concentrate their nesting effort in small scattered parcels of habitat with large amounts of linear edge, where predators such as red fox, striped skunk, and raccoon easily forage. Large native predators (wolves, cougar and bear) which historically preyed on bison, deer, and livestock, have been eliminated from the area and naturally replaced by medium-sized predators (fox, skunk, raccoon) that prey extensively on birds, their eggs, and their young.

3.2.3.5 Savanna Resources

Prior to European settlement, oak savanna covered approximately 27-32 million acres of the Midwest (Nuzzo 1986). This same author indicates that in 1985, only 113 sites (2,607 acres) of high-quality oak savanna remained. More than 99 percent of the original savanna has been lost, and Midwestern oak savanna is among the rarest ecosystems in the world. Development has destroyed, fragmented, and disrupted natural processes needed to maintain quality oak savanna ecosystems.

Savanna are characterized by scattered, open-grown trees, with or without shrubs, and a continuous herbaceous ground cover typically dominated by grasses, sedges, and forbs. Density and percent of tree cover varies from little to none, and is intermediate between open prairie and closed woodland and forest.

Savanna is defined as having at least one tree per acre, but less than 50 percent cover. In the dissected terrain of the major river valleys, such as the Illinois River, savannas often occurred associated with a mixture of vegetation types including prairie, woodland-barrens, and forest (Zawacki and Hausfater, 1969; Nelson et al. 1994). Midwestern savanna-like habitats have several unifying characteristics including:

- open canopy structure;
- canopy dominance by a few species of oaks;
- ground cover usually rich in species associated with tallgrass prairie;
- a majority of floristic diversity contained in the ground cover;
- dependence on fire and other disturbances for maintenance of diversity and stability.

Three savanna sub-classes are recognized in Illinois: savanna (generally on fine-textured soils), sand savanna, and barrens (local inclusions of a prairie flora within an otherwise forested landscape) (White and Madany 1978, Madany 1981). However, only the silt-loam savannas are known to occur within the reach of the river occupied by the Illinois River Refuge Complex. Prior to European settlement, savanna was a likely feature of the Illinois River landscape (Nuzzo, 1986). Today, few remain.

Dry-mesic savanna are natural communities where the tree layer is comparable to dry-mesic upland forests and the understory is similar to dry-mesic prairie. Dry-mesic savanna historically occurred within the Illinois River Corridor on the upper slopes and ridge tops of areas dissected by the Illinois River and major tributaries (Illinois DNR, 2001). It is characteristic of a woodland/hill prairie complex and were ecotonal between upland prairies and upland forests. However, in the absence of fire, these areas rapidly developed into closed woodlands. Most of the remaining dry-mesic savannas within the Illinois River Corridor have been degraded and/or undergone substantial vegetational changes. Tree species in these communities primarily include white oak and black oak. Shrubs usually include hazelnut, common blackberry, rough-leafed dogwood, leadplant, and willow. Grasses and forbs include big bluestem, oat grass, white-haired panic grass, little bluestem, Indian grass, bird's foot violet, Canadian milk vetch, common carrion flower, Culver's root, hog peanut, purple coneflower, and shooting star. Within the Illinois River Corridor, less than 10 acres remain (Illinois DNR, 2001).

Mesic savanna typically were associated with prairie groves on level to slightly rolling terrain, at the base of moraine ridges, or as islands surrounded by wetland vegetation (Illinois DNR, 2001). Mesic savannas may also have occurred as ecotonal areas between upland prairies and bottomland forest communities. Vegetational characteristic for mesic savannas is not entirely known, since few remain. Tree species probably included bur oak, black oak, and white oak. Shrubs were probably similar to dry-mesic savannas and include leadplant, New Jersey tea, gray dogwood, and hazelnut. Grasses included big bluestem, little bluestem, and Indian grass. Mesic savannas are among the rarest communities in the Midwest.

Wet-mesic and wet savanna, like mesic savanna, are so rare that little information is available on these natural communities. Nelson et al. (1994) infers their possible occurrence along the lower Illinois River prior to European settlement.

He concluded that since roughly 56 percent of floodplain along the lower Illinois River was forested in the early 1800s and, based on stem-density data calculated from Government Land Office (GLO) records, at least some of this forest could have been wet to wet-mesic savanna. While no detailed descriptions are available, the following is an account compiled by Nelson et al. (1994). Tree species probably included hackberry, pecan, American elm, cottonwood, pin oak, bur oak, black walnut, and willows. Shrub layers probably were not well established, but may have included box elder and elderberry. Groundcover may have included prairie cord grass, Virginia wild rye, stout wood reed, giant ragweed, sawtooth sunflower, Jurusalem artichoke, and goldenglow.

Ecological concerns associated with savanna are similar to that of prairie and include flooding, timber harvest, fragmentation, siltation, exotic and invasive species, and development. Of late, a new round of human-induced change threatens many remaining savanna ecosystems. In a trend called "rurbanization," rural areas are being converted to a more densely developed state. As a result, many remaining and restorable savannas are being fragmented through housing development, roads, etc., which diminishe the value of these areas for area-sensitive wildlife. Habitat size, shape, and amount and type of edge are important factors in the reproductive success of many wildlife species. Without management, most areas will degrade due to their size, isolation, and absence of natural processes (such as fire) and inadequate buffers protecting them from surrounding land uses.

3.2.3.6 Biological Integrity, Diversity, and Environmental Health

The Service defines biological integrity as "biotic composition, structure, and functioning at genetic, organism, and community levels comparable with historic conditions, including the natural biological processes that shape genomes, organisms, and communities." As such, biological integrity can be evaluated by examining the extent to which biological composition, structure, and function has been altered from historic conditions. Biological composition refers to biological components such as genes, populations, species, and communities. Biological structure refers to the organization of biological components, such as gene frequencies, social structures of populations, food webs of species, and niche partitioning within communities. Biological function refers to the processes undergone by biological components, such as genetic recombination, population migration, the evolution of species, and community succession.

Biological integrity lies along a continuum from a biological system extensively altered by significant human impacts to the landscape to a completely natural system. No landscape retains absolute biological integrity, diversity, and environmental health. However, the Service strives to prevent the further loss of natural biological features and processes; i.e., biological integrity.

Currently, there is no written guidance for managing biological integrity, diversity, and environmental health specific to the Refuge Complex. Current management intent is to restore and maintain high quality ecosystems within the approved boundaries of the Refuge Complex primarily for the benefit of waterfowl and other migratory birds. While there has been no direct effort to manage Refuge Complex land for the benefit of biological integrity, diversity, and environment health, management's recent focus on landscape and ecosystem-level processes and functions and the species they serve certainly has contributed in this regard.

Table 2: Total Number of Visitors to Illinois River NWR Complex in 2002

	Chautauqua	Meredosia	Emiquon
Total Number of Visitors	27,950	16,082	8,455
Interpretation & Observation	24,090	9,050	6,200
Environmental Education	1,605	352	120
Hunting	60	0	455
Fishing	2,500	5,000	1,200
Outreach Audience	1,200	220	530

3.2.4 Visitor Services

Providing recreational opportunities and interpreting the unique natural features of the Refuge Complex for visitors are important elements of the Service's mission and the mission of the Refuge Complex. Six primary wildlife-dependent recreational uses were identified by the National Wildlife Refuge Improvement Act of 1997: hunting, fishing, wildlife observation and photography, environmental education and interpretation. These uses, when compatible with the Refuge purposes, are the focus of the Refuge Complex's visitor services activities. The public use for fiscal year 2002 is displayed in Table 2. Current visitor services facilities are depicted in figures 18-20.

3.2.4.1 Potential Refuge Visitors

In order to estimate the potential market for visitors to the Refuge, we looked at 1998 consumer behavior data for an area within an approximate 50-mile radius of the Refuge Complex and focus areas. We used a 50-mile radius because we thought this was an approximation of a reasonable drive to a refuge for an outing. The consumer behavior data that we used in the analysis is derived from Mediamark Research Inc. data. The company collects and analyzes data on consumer demographics, product and brand usage, and exposure to all forms of advertising media. The consumer behavior data were projected by Tetrad Computer Applications Inc. to new populations using Mosaic data. Mosaic is a methodology that classifies neighborhoods into segments based on their demographic and socioeconomic composition. The basic assumption in the analysis is that people in demographically similar neighborhoods will tend to have similar consumption, ownership, and lifestyle preferences. Because of the assumptions made in the analysis, the data should be considered as relative indicators of potential, not actual participation.

We looked at potential participants in birdwatching, freshwater fishing and hunting. In order to estimate the general environmental orientation of the population we also looked at the number of people who potentially might hold a membership in an environmental organization. The consumer behavior data apply to persons greater than 18 years old. For the area that we included in our analysis, the population of persons greater than 18 years old was 1,113,185. The estimated maximum participants in the 50-mile radius for each activity are: 90,090 for birdwatching; 86,994 for hunting and 189,103 for freshwater fishing. The number of persons who might hold a membership in an environmental

Figure 18: Visitor Services Facilities, 2003, Emiquon NWR

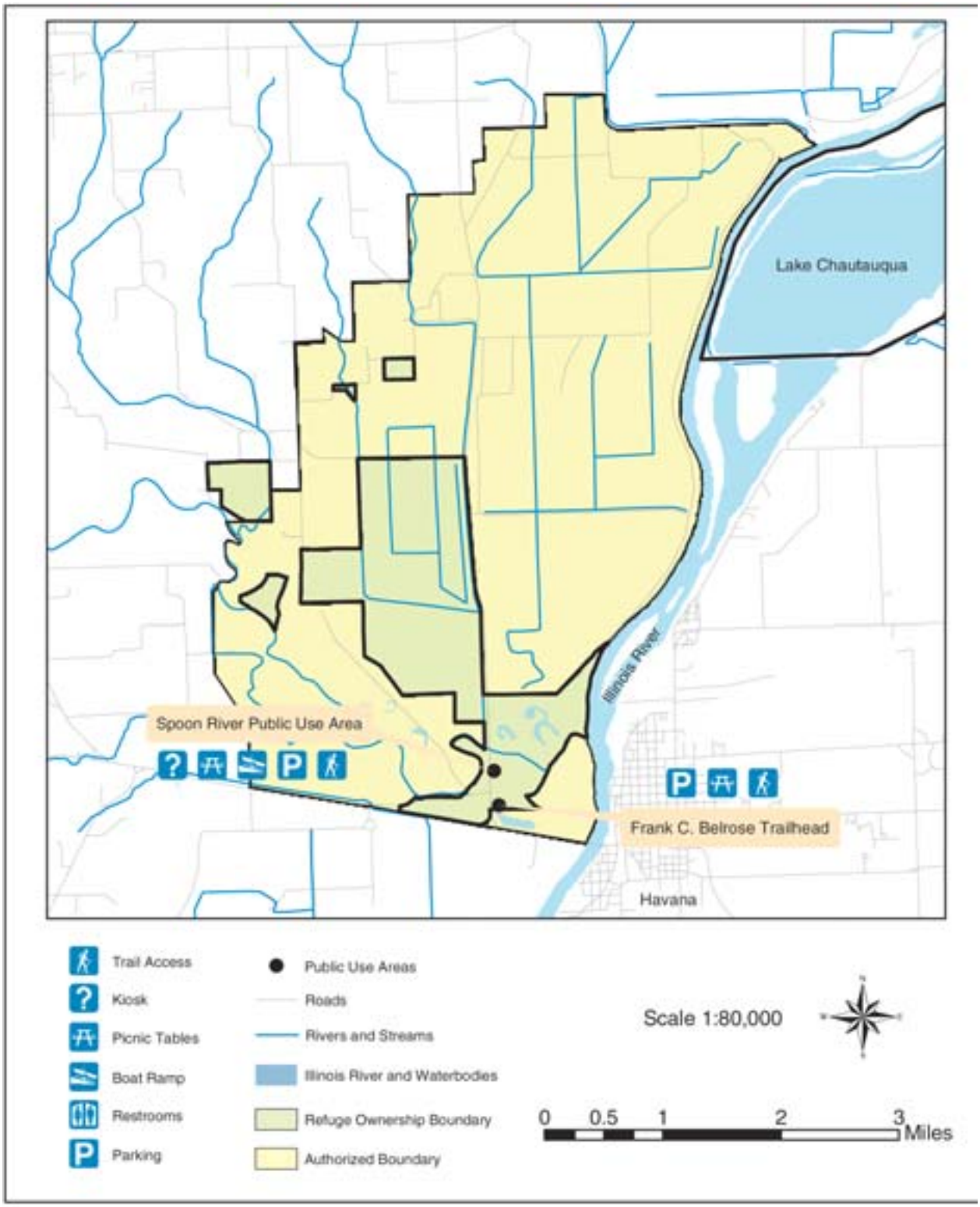


Figure 19: Visitor Services Facilities, 2003, Chautauqua NWR

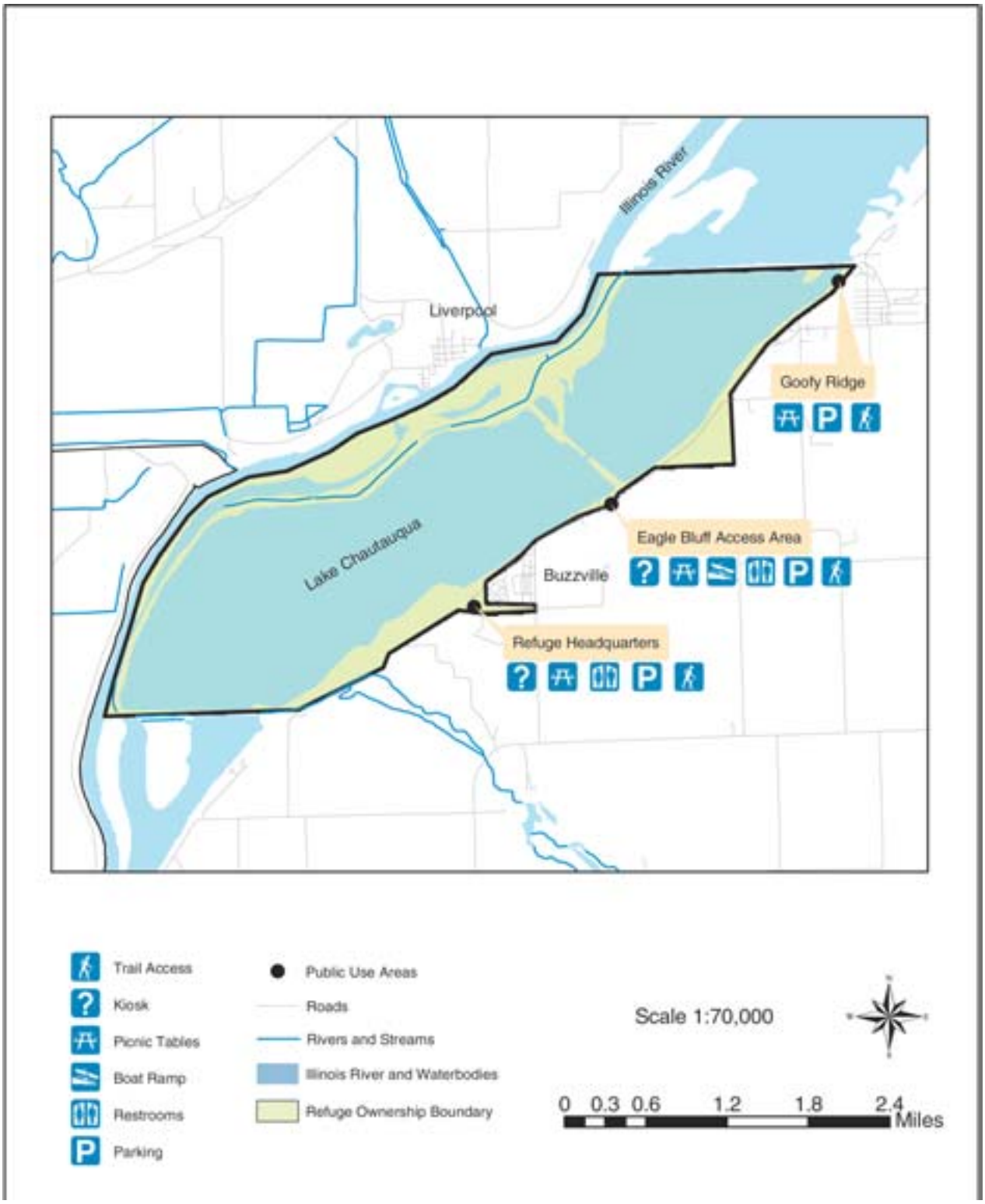
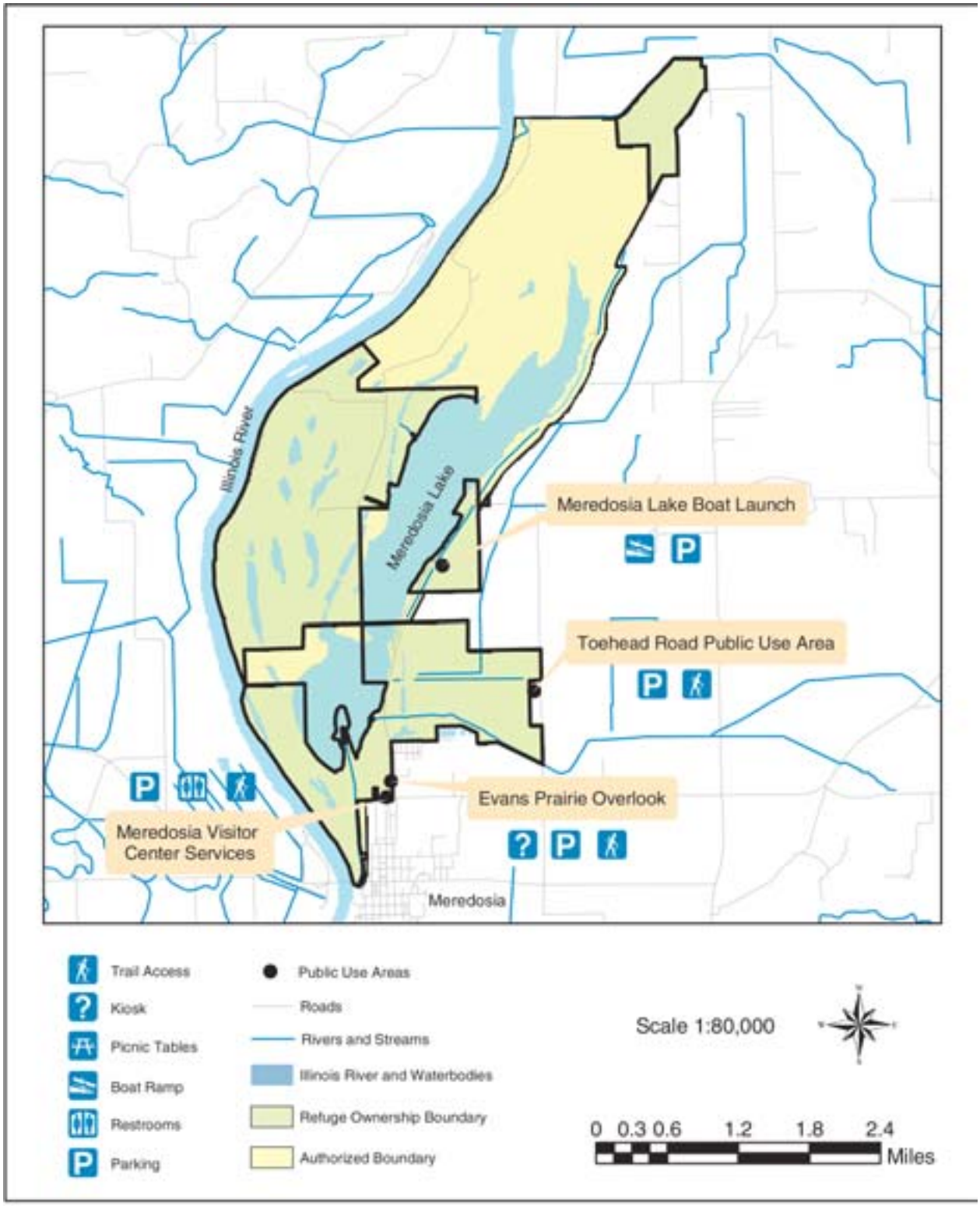


Figure 20: Visitor Services Facilities, 2003, Meredosia NWR



organization is 28,908. The projections represent the core audience for repeated trips to the Refuge. On days with special events and when large numbers of birds are at the Refuge, visitors can be expected to travel longer distances.

3.2.4.2 Administrative Facilities

Most administrative facilities for the Refuge Complex are located at Chautauqua NWR. The Refuge Complex office has an attached garage that is used as a shop. Other facilities include a garage, which is used for storage, a flammable storage building, and two pole barns where large equipment is stored. A refuge house is occupied by the Refuge Manager. A pole building at Meredosia NWR includes office, shop and storage areas.

3.3 Current Management

Habitat management on the Illinois River Complex entails a combination of active and passive management. Management seeks to mimic natural processes where possible in this greatly modified ecosystem. Drainage, diversion of Great Lakes water, elimination of natural cover, and artificial structures such as locks and dams on the river have all contributed to the challenges to maintain natural functioning processes within the ecosystem. Due to the loss of much of the historical riparian, wetland, and upland habitats, management intensity must be increased to meet the fish and wildlife needs within the areas remaining to support them. This is particularly true in the wetland habitats where dikes, water pumps, and water control structures play an integral role in restoration of wetland habitats. Reconnection of habitats to the river is an integral part of the management but it must be regulated to control unnaturally frequent or severe flood events and excessive siltation. In uplands, habitats may be restored passively by allowing succession to occur or they may require active planting and management, such as with the restoration of native grasslands where planting and controlled burning are key management tools.

Photograph by Bernie Angus

3.3.1 Wetland Management

Current management of wetlands within the Refuge Complex (e.g., floodplain forests, marsh, fen, sedge meadow) is to provide high quality resting, nesting, and feeding habitat for waterfowl and other migratory birds; spawning, nursery, and overwintering habitat for native fish and mussels; and contribute to the native biological diversity of the Illinois River System. Currently the Refuge Complex manages roughly 6,000 acres of wetland habitat.

In most cases, current wetland management on the Refuge Complex involves the manipulation of water to achieve the desired successional stage of wetland plant communities. Hydrologic cycle maintenance plays an important role in the life cycle of wetlands. As wetland soils go through the drying process, nutrients are released and made available for plant growth. Upon re-flooding, the wetland is rejuvenated and results in an area thriving with insect life and aquatic vegetation. Forested wetlands are managed primarily by limiting human influence to maintain natural levels of hydrologic change. Sedge meadows are managed in this way and are also managed with prescribed fires to help maintain their open character.

Chautauqua NWR, Emiquon NWR, and Meredosia NWR and the Cameron Unit all have water control structures and dikes that require regular maintenance and operation to achieve the desired habitat for fish and wildlife resources. The Billsbach Unit has no structures or facilities. The following summarizes the degree of management required on the refuge units to achieve wildlife and habitat objectives.

Chautauqua NWR water management facilities were reconstructed within the last 10 years through the Refuge force account and contracting projects that cost an estimated $5 million and through a Habitat Restoration and Enhancement Project funded and contracted through the Corps of Engineers, which cost about $14 million. The Corps constructed a 40,000-gallon-per-minute pump station capable of pumping from the river into either unit, from either unit out to the river, or from one unit to the other. These projects restored water management capability to the 1,100 acre North Pool and to the 2,100-acre South Pool. The Refuge entered 2003 with the water management infrastructure in prime condition. The pools are managed as follows:

Lake Chautauqua is divided into the North Pool (1,100 acres) and the South Pool (2,000 acres). The North Pool is managed to provide deep stable water habitat (4 to 5 feet) for fish, invertebrate and aquatic plant populations to provide food and cover for Ruddy Ducks and other diving ducks, eagles (the North Pool supports an active eagle nest), pelicans, cormorants, gulls, and other wildlife in need of deep water habitat. The North Pool is protected by a 10-year flood event levee. Refuge staff in cooperation with the Corps of Engineers monitor river levels closely. When the river crest is predicted to top the North Pool levee, Refuge staff open the flood gates in the water control structure to equalize pool water with river water to prevent excessive damage to the levee. The Long Term Resource Monitoring Station in Havana has been monitoring aquatic vegetation, invertebrates, and fish populations since completion of the Habitat Restoration Project. They are presently working with Refuge staff and Americorps volunteers to reestablish wild celery and pond weed in the North Pool. The pool was drawn down for construction in 1998 with a near total fish kill, thus eliminating some carp without using chemicals. The pool will be managed with permanent water for aquatic communities to support migratory birds.

The South Pool of Lake Chautauqua is managed to provide shore bird habitat in their southward migration and to provide moist soil plant seeds, tubers, and invertebrates for waterfowl and other wildlife during fall and spring migration. The South Pool is protected by a 2-year flood event levee that keeps the small summer fluctuations out of the pool to allow the moist soil plants to mature and produce seed. The dewatering is accomplished by removing stop logs from the south water control structure and slowly draining water beginning in about mid June if river levels permit. Water can be pumped off to facilitate dewatering in some circumstances if needed. The South Pool is slowly reflooded by placing stop logs in the Quiver Creek weir and diverting water into the South Pool through a 3X3 foot water control structure or by pumping. Gravity flow is preferred over pumping because of the savings in fuel consumption. The reflooding usually begins in early September to make the food available to waterfowl during their migration. Shallow water is maintained in the South Pool through the spring waterfowl migration.

Approximately 1,500 acres of exposed mudflats for moist soil plant germination is provided by drawing the pool down to 432.0 M.S.L. This provides excellent

foraging habitat for shorebirds and moist soil plant production for migratory birds. Throughout the fall and beginning around October 15, water is slowly added to the pool, which allows gradual flooding of food reserves produced by the moist soil plants. Water levels are increased or decreased according to the annual Water Management Plan. The South Pool of Lake Chautauqua provides excellent spring spawning and nursery habitat for young fish in late winter and spring. It was estimated by the Illinois Natural History Survey that in 1996 over 39 million larval and juvenile fish escaped from the lake to the Illinois River.

Management of Refuge wetlands for moist soil plant production is a major tool used to achieve migratory bird objectives. Moist soil habitats provide shallowly flooded food resources (seeds, invertebrates) for migrating dabbling ducks, shorebirds, other marsh birds, and Canada geese. The greatest use by all waterbirds occurs in the fall, but moist soil units provide a variety of resources for waterbirds and other wildlife species throughout the year. Moist soil units may remain flooded for 2 years and are drawn down during the spring of the third year to make conditions suitable for germination of native moist soil plant species such as smartweed, millet, beggars tick, rice cutgrass and chufa. Drained pools are partially re-flooded in September to a depth of 4 to 18 inches to provide optimum foraging conditions for dabbling ducks. Mud flats and shallow pool edges enhance food availability for shorebirds and other marsh birds. From that point, flooding continues at 6-inch increments making additional food available as the earlier flooded food is consumed. By the end of migration, water levels are brought up to full pool elevation. Other pools may be partially drained in October to concentrate and expose invertebrates, insect larvae, and minnows as an additional food source for shorebirds, ducks, and geese.

The Refuge plans to restore Liverpool Lake on Liverpool Island. This will require restoration of a low level dike at the south end of the island and plugging three or four ditches eroded through the natural berm from flood waters. At least one water control structure will be placed in a ditch to catch and hold flood waters.

Liverpool Side Channel is badly silted in and restoration may be accomplished through Refuge force account, Habitat Restoration and Enhancement Project, or as an Illinois 2020 project.

The Cameron Unit now has water control structures constructed in partnership with Ducks Unlimited to facilitate management of habitat on Weis Lake. This lake is badly degraded and waterfowl use declined precipitously in the mid 1970s because of sedimentation and loss of aquatic vegetation. The water control structures will keep out most of the summer fluctuations in river levels and allow moist soil plants to grow and mature. The structures have stop logs with flap gates that can be reversed to allow water in or out depending on the season and water conditions.

The **Billsbach Unit** has no facilities. Most of this unit is open water with full time connection to the Illinois River and therefore management to provide other habitats for migratory birds and other wildlife is not an option.

Emiquon NWR requires active management in the form of restoring crop fields to forests, prairie, savanna, or wetland habitat. The 536-acre North Globe will be restored and managed as a hemi-marsh with roughly 40 percent open water and the remainder in aquatic and emergent vegetation. The restoration will require a dike across the north end of the unit to keep water off the state highway. The pump station will be restored to dewater or flood by pumping or by gravity flow to maintain desired water levels. The Oxbow Unit and the Wilder Units will be managed as moist soil units. Until neighboring property within the authorized boundaries is purchased, care will be used to avoid causing wet conditions through subsurface hydraulics in these two units. Higher ground will be planted to mast producing bottomland hardwoods, prairie, or savanna. The Nature Conservancy owns about 7,000 acres of cropland within the approved Emiquon NWR acquisition boundary. The organization plans to restore Thompson and Flag lakes and associated upland habitat beginning in 2005.

Emiquon NWR currently has three areas where moist soil management occurs. They are the Wilder Unit (387 acres), Bellrose Unit (40 acres), and the Spoon River Oxbows (80 acres). Presently the Wilder Unit cannot be pumped in the fall to provide waterfowl habitat due to the lack of a water source. Flooding of this area may be achieved when the Illinois River exceeds flood stage in the spring and occasionally in the fall, as in 2001. This unit receives excellent duck use when food resources are covered with shallow water.

The Bellrose Unit can be pumped from the adjacent Spoon River but will not hold water once pumping has stopped. The water immediately begins to percolate down through the sandy soil and enter the Spoon River. No pumping is performed during the fall for this reason. During the spring it is flooded when Illinois River flood waters backed into the unit. When flood waters begin to recede, stoplogs are placed in the water control structure to try and hold water for the spring migration. Water seeped out quickly, resulting in rapid drying of the soils and extensive germination of cocklebur. During October, stoplogs are inserted in the Spoon River oxbow water control structure to hold water for the fall and spring migration. Water levels rise in this unit from one of two ways: heavy precipitation coming through the oxbow or as the Illinois River rises, water backs into them. All stoplogs are removed in early summer as flood waters recede to allow water levels to drop and moist soil plant development to begin.

The Service purchased the 712-acre South Globe Drainage District from The Nature Conservancy in 2001. This unit is surrounded by an agriculture levee on four sides with no means of bringing water into the unit. The Service will install a water control structure to take in water during river flooding and hold water to encourage development of an open marsh type habitat.

Meredosia NWR has two moist soil units inside the Willow Creek and Meredosia Drainage districts. When the river reaches flood stage, Refuge staff open a screw gate on a water control structure allowing river water into the moist soil units. The gate is closed when water reaches the desired level and water is held to provide habitat for migratory birds and other wildlife. There is no dependable source of water to flood the area for fall migration. Refuge staff place a portable pump in the Illinois River each fall to flood seven small wetlands on Meredosia Island. These wetlands all have low level dikes and water control structures which are manipulated to provide brood habitat, to allow production of moist soil

plants, and to provide food for migratory birds and other wildlife in the fall. The Refuge is in the process of converting old fields to bottomland forests on Meredosia Island.

The Shearl and Skinner wetlands on Meredosia NWR are the two primary areas where limited water level management occurs. Moist soil vegetation in these wetlands is flooded during spring migration when the Illinois River water levels rise and back into the units. Spring waterfowl use is excellent in these units, however fall use is minimal because there is typically little if any available water. This spring habitat is important to waterfowl to build up their energy stores to arrive on the nesting grounds in good condition to lay eggs and produce young.

Prior to the fall of 2000, water control structures on Meredosia Island were nonfunctional because of lack of maintenance for many years and, therefore, no water management has been accomplished on Twin Ponds, North Pond, Moss and Briar Pond, Alice's Pond and others. During the fall of 2000, rehabilitation work was completed on the island's water control structures, ditches and levees. In October of 2000, pumping of water from the Illinois River into the island's ditches, sloughs and ponds was restored. This habitat will be maintained and managed to enhance biological diversity on the Refuge.

3.3.2 Forest Management

Current management of native upland and bottomland forests within the Refuge Complex is to provide high quality breeding and foraging habitat for migratory birds (e.g. Cerulean Warbler, Red-shouldered Hawk, Yellow-billed Cuckoo), forest nesting waterfowl (e.g. Wood Ducks), an assortment of upland game species (e.g., Wild Turkey), and contributing to the native biological diversity within the Illinois River Corridor. Management focus is to eliminate non-native species and replace them with native hardwood species, to maintain uneven aged stands, to maintain soil productivity, and to reduce fuel loads. No commercial timber harvest currently takes place on Refuge Complex land. The Refuge Complex currently protects and manages roughly 4,500 acres of forest habitat within the Illinois River System.

Photograph by Bernie Angus

3.3.3 Grassland Management

Currently there is very little written guidance for managing Refuge Complex grasslands. Early guidance included managing "small waste areas to encourage their reversion to sand prairie vegetation rather than to woody type vegetation." Currently the Refuge Complex protects and manages roughly 200 acres of high quality native grassland habitat. The most recent guidance states that Refuge Complex grasslands should provide habitat for grassland bird species, provide nesting habitat for waterfowl and resident game birds, improve habitat diversity on the Refuge, protect water quality and soils from erosion, and provide public use and environmental education opportunities to create an awareness and knowledge of grasslands and their uses by wildlife.

Refuge Complex grassland management actions focus primarily on mowing and prescribed burning. During the summer, the cool season grasses on the setback, north, and south levees on Chautauqua NWR are mowed to prevent woody vegetation from becoming established on the slopes. Approximate levee acreage currently mowed is 72 acres.

The Refuge Complex's Cooperative Farming Program is used as a habitat management tool to address specific management problems. Examples include preventing undesirable woody species from invading an area that will be planted to native grasses, or to control invasive plant species (i.e. reed canary grass, cottonwoods, maples). Several cooperative farmers from the local community currently utilize Refuge Complex land on a two-thirds/one-third crop-share lease, with one-third of the harvest being allocated to the Refuge Complex . The cropland provides food and loafing areas for migrating waterfowl and food, cover and edge for other species. Crops grown include corn, soybeans and winter wheat. Crop fields are restored to native vegetation once control of invasive species is achieved.

3.3.4 Savanna Management

Currently the Refuge Complex does not protect or manage any native savanna habitat within the Illinois River System, nor is there any written guidance on management intent. There are limited opportunities to restore and maintain savanna habitat on Chautauqua NWR near the Refuge Complex Headquarters.

3.3.5 Fish and Mussel

Current management for native fish and mussels on Refuge Complex land is aimed at restoring, protecting, and managing backwater lake and side channel habitat to create and maintain high quality fisheries habitat capable of supporting a self-sustaining, balanced fish community in support of the Illinois River fisheries resource. Two primary objectives provide guidance for fishery-related actions on the Refuge Complex:

1) maintain and improve the quality of aquatic habitats for a well-balanced community of fish and other water-oriented wildlife species; and
2) provide quality recreational fishing opportunities that are compatible with the primary Refuge objectives (Chautauqua Refuge Fishery Management Plan, 1988).

Active management of Refuge Complex land for fish populations is currently limited due to shallow water and periodic draw-downs in most impoundments. During the 1990s, Chautauqua NWR was rehabilitated to a functioning backwater lake, bottomland forest, and floodplain wetland complex through efforts of the Fish and Wildlife Service and the Environmental Management Program of the Corps of Engineers. The water management system now allows Refuge Complex staff to mitigate the human induced impacts associated with navigation, the diversion of Lake Michigan water down the Illinois River, and conversion of the tallgrass prairie and wetlands to cropland production and other uses. Refuge Complex personnel approximate the historic hydrograph using a series of low level levees, spillways, and water control structures to mimic the historical flood cycle, especially during spring fish migration and the summer dry period.

In 1995, fish were stocked in the North Pool of Lake Chautauqua. The Refuge Complex stocked 200 pounds of fathead minnows and the Illinois DNR stocked 400 pounds of breeder bluegill and 100 pounds of breeder crappie from Spring Lake, and 120,000 fingerling bass from the Jake Wolf Hatchery. Forty breeder bass were stocked during the formal dedication ceremony held in July of 1999. Anglers were beginning to catch crappie, catfish, and largemouth bass just before the flood of 2002 when the river over-topped levees and contaminated the north pool with exotic and invasive fish species (e.g., carp species). Refuge impoundments are periodically sampled to determine which fish species are present.

Invasive species (e.g., carp) are controlled by lowering pool levels in the winter, which freezes the fish out, or pumping the pools down for construction purposes, which greatly reduced invasive species. During summer draw-downs of the south pool, most fish escape to the river. Some fish survive the summer in deep water found in borrow areas. The Illinois Natural History Survey estimated that 39 million fish that hatched and grew in the South Pool of Lake Chautauqua escaped to the river.

Two aspects of wetland management are problematic with respect to managing the Refuge Complex for maximum fisheries benefits. First, managing high quality, open wetland systems is difficult because technology is currently limited to effectively control nuisance exotic and invasive species and encourage desirable fish utilization. Secondly, many controlled high quality wetlands are regulated following water management regimes that tend to limit fish use and production.

3.3.6 Wildlife Monitoring

Bird banding has been used for decades by wildlife managers and scientists across North America to understand and track the movements of migratory birds. Illinois River staff cooperate with Illinois Department of Natural Resources by providing assistance with the banding of Canada Geese during the summer. The Refuge also has its own banding program for Wood Ducks and has a yearly quota to band 300 birds.

Aeriel waterfowl surveys are conducted weekly from September through April during the spring and fall migrations by the Illinois Natural History Survey. Ground surveys are performed by Refuge staff and Refuge volunteers throughout the year. These surveys allow Refuge Complex staff to determine migratory bird populations on the Refuge Complex and waterfowl use days, as well as to determine the success of habitat management techniques. Results of the surveys are posted on the Illinois River Refuges and Illinois Natural History web sites.

3.3.7 Visitor Services

Management intent for conducting high quality public wildlife-dependent recreation programs on Refuge Complex land is to enhance the public's understanding and appreciation of the natural world. To this end, the Refuge Complex seeks to provide a wide variety of wildlife-dependent recreation opportunities for the public to enjoy.

3.3.7.1 Environmental Education and Interpretation

Wildlife observation, including the observation of plants and other natural features, is the single most popular recreational use of the Refuge Complex attracting over 30,000 visits annually. The Refuge Complex has constructed several interpretive trails with wildlife viewing platforms situated along the trail edges. All three of the Complex's refuges have trails. Maintenance of existing trail facilities will require adequate funding to keep the facilities safe for public use. Photography is another popular public use related to wildlife observation. Visitors to the Refuge Complex take advantage of the trails and observation platforms to capture special moments of nature's beauty.

Currently, waterfowl hunting only is allowed on Chautauqua NWR. The Liverpool Lake Public Hunting Area is located on the west side of the Refuge between the west levee and the Illinois River. Regulations require either boat blinds or blinds made from existing dead material. The hunting area is available on a first-come first-served basis. Although duck use on Lake Chautauqua is excellent, duck use of the public hunting area has been poor, resulting in a poor hunting season with very few ducks or geese being taken.

Hunting of migratory game birds, upland game birds, and big game hunting is currently permitted on Emiquon NWR in designated areas. Areas open to hunting are north of the Spoon River to the Wilder Farms levee on the east side of Route 78/97 and north of the Spoon River west of Route 78/97 as posted. Hunters using the area are primarily seeking white-tailed deer and waterfowl. Overall, hunter use of these areas was low, but provided a quality hunt for those taking advantage of the opportunity. Parking on the east side of Route 78/97 is a problem because of the lack of a parking area for hunters. Future plans call for the construction of a parking area east of route 78/97 and north of the Spoon River.

Hunting is not allowed on Meredosia NWR because of deed restrictions that were acquired with the land.

A new boat ramp and parking lot on the North Pool of Chautauqua NWR was opened in July 1999 and receives moderate use by local anglers. The pool was stocked by the Illinois Department of Natural Resources during the spring and summer of 1999 with largemouth bass, crappie, bluegill, and catfish. All Refuge Complex and state regulations must be followed.

Fishing opportunities are limited to the Spoon River and the Oxbow area on Emiquon NWR. The Refuge provides a boat ramp and parking lot to local anglers. The Refuge receives moderate use from anglers. All Refuge and state regulations must be followed.

Fishing opportunities on Meredosia NWR are seasonal due to the Meredosia Lake silting in. The best opportunities for fishing occur in the spring as spring flood waters are receding. Meredosia Lake receives good use from local anglers as well as local commercial fisherman in state waters. State regulations apply.

Environmental education and interpretation are important tools that the Refuge staff use to inform the public about special topics, such as the Illinois River ecosystem, or to call attention to Refuge resources such as prairies or moist soil management.

Environmental education currently takes place both on- and off-Refuge. Refuge Complex staff give slide shows, lead interpretive tours and hikes, create educational exhibits, conduct activities that offer hands-on learning opportunities, provide demonstrations and workshops and write educational articles. Activities are presently geared toward structured educational experiences in which Refuge Complex land and facilities provide a place for students to actively study and learn about ecology and environmental relationships, as presented by their own school teaching staff. Refuge Complex programs follow a style of teaching and a method of learning involving real experiences.

3.3.7.2 Outreach

Outreach activities on the Refuge Complex are consistent with a small-staffed refuge with no one staff person dedicated to visitor services and outreach activities (such as an outreach specialist or outdoor recreation planner). The Refuge Complex headquarters does not have a visitor center or visitor contact station. Outreach activities include staff-conducted talks and tours, on- and off-refuge, with local school groups, local conservation groups and Refuge visitors. The Refuge Complex also participates in staffing of exhibits at sportsmen shows such as Havana Octoberfest, Midwest Waterfowl, Deer and Turkey Expo (Peoria), and Conservation World at the Illinois State Fair. The Refuge Complex participates in local Conservation Day events sponsored by the local Natural Resource Conservation Service.

The Refuge Complex generally holds at least two special events each year for Migratory Bird Week (May) and National Wildlife Refuge Week (October). During these events the auto tour route is open and there are numerous stops along the way for visitors to view wildlife and learn about the National Wildlife Refuge System. On Meredosia NWR there is also an annual Earth Day Event in which all of the Meredosia school district participates in assisting the Refuge with various projects such as planting trees, prairie forbs, and picking up litter. In addition, the Refuge Complex issues roughly 10 to 12 news releases each year and participates in two to three television/radio spots.

3.3.7.3 Law Enforcement

Enforcement of federal wildlife laws, as well as regulations specific to the Refuge System, is an integral part of Refuge Complex operations. Law enforcement plays a crucial role in ensuring that natural and cultural resources are protected and that visitors encounter a safe environment. The Refuge currently has no employees with a law enforcement commission. However, federal law enforcement is a cooperative effort by many agencies in the area. Cooperative relationships and strategies have been developed with state conservation officers and all county sheriff departments in the area. The special agents in Springfield are helpful and supportive in addressing specific law enforcement issues.

3.4 Wilderness Review

As part of the CCP process, we reviewed lands within the legislative boundaries of the Refuge Complex for wilderness suitability. No lands were found suitable for designation as Wilderness as defined in the Wilderness Act of 1964. The Refuge does not contain 5,000 contiguous roadless acres nor does it have any units of sufficient size to make their preservation practicable as Wilderness. Lands acquired for the Refuge have been substantially affected by humans, particularly through agriculture and transportation infrastructure.