CHAPTER 13

Birds

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The Mississippi River, historically, has been a major bird migration corridor within North America. Every spring and fall millions of birds representing almost 300 species migrate through the Mississippi River corridor or remain as year-round residents. The river's north-to-south orientation and nearly contiguous habitat make it critical to the life cycle of many migratory birds. Diving ducks (Figure 13-1), swans, pelicans, and cormorants use the river's large open water pools. Dabbling ducks, geese, herons, egrets, black terns, bitterns, rails, and numerous resident and neotropical songbirds use shallow backwater riverine wetlands. Bottomland forests support migrating and nesting populations of songbirds, bald eagles, ospreys, herons, egrets, hooded mergansers, mallards, and wood ducks.

Riverine wetlands and floodplain habitats play a key role in the life cycles of many migratory birds. The modern landscape along the Mississippi River, having been altered radically by the demand for agriculture, industry, and urbanization that came with the arrival of European settlers, contains far fewer wetlands, forests, and prairies. Concern about the long-term viability of bird populations that require these habitats relates directly to the adverse effects of sedimentation, operation and maintenance of the 9-foot (2.7-m) channel navigation project, navigation-induced developments (including impounding water), industrial and municipal effluent, urban and agricultural runoff, recreation, and other human-induced influences. Migratory birds, once abundant, are virtually absent in areas such as the Illinois River and the Middle and Lower Mississippi River—areas that have been subjected to intense and cumulative impacts.

Figure 13-1. **Several pools of the Upper Mississippi River provide excellent habitat for migrating canvasback ducks (Source: U.S. Fish and Wildlife Service, Onalaska, Wisconsin).**

Waterfowl are the most prominent and economically important group of migratory birds on the Mississippi River. The economic impact attributable to waterfowl

Waterfowl populations on the Mississippi River fluctuate widely year to year, likely as a result of variations in flyway populations, water and food conditions off-river, food resources produced annually within the riverine backwaters, and weather.

hunting nationally in 1991 was $686 million. Fifty-eight percent of waterfowl hunting in the United States occurs in the four U.S. Fish and Wildlife Service (USFWS) management regions that border the Mississippi Flyway. Each region contains states that border the Mississippi or Illinois Rivers but also includes states away from the river (Caithamer and Dubovsky 1996). Researchers estimate by extrapolation that the total economic impact of equipment, boats, trips, and the like for waterfowl hunting on the Mississippi Flyway in 1991 was about $398 million. A significant portion of that impact could be attributed to hunters on the Upper Mississippi River (UMR) and its major tributaries.

Nonconsumptive use of bird resources also is important on the Mississippi River. Birdwatching at developed recreation areas accounted for approximately 15,000 public-use days in 1990 (USACE 1993).

Waterfowl Migration

Four major groups of waterfowl use the Mississippi River during migration. During fall and spring migrations dabbling and diving duck species rely on submersed and emergent aquatic vegetation or seasonally flooded areas with abundant moist-soil plant production. Tundra swans and Canada geese also are common migrants.

Key areas for migrating diving ducks along the Mississippi River corridor have been Navigation Pools 5, 7, 8, 9, 13, and 19 on the Mississippi River. The first four of these pools extend for about 90 miles (150 km). The pools have large open-water areas and shallow marsh zones with luxuriant growths of submersed and emergent aquatic vegetation. Pool 19 extends from Keokuk, Iowa, to Oquawka, Illinois. The most important habitat for diving ducks encompasses the 20-mile (32-km) stretch from Keokuk to Fort Madison, Iowa. The Illinois River (see Chapter 14) and large lakes in Minnesota and Wisconsin were important to diving ducks and other waterfowl species at one time. Now their value to diving ducks is negligible compared to the Mississippi River.

Most numerous among the bay-diving ducks that use riverine and deepwater habitats in the Mississippi Flyway are canvasback (Figure 13-1), lesser scaup, redhead, and ring-necked ducks. Other species of diving ducks, such as the greater scaup, bufflehead, common goldeneye, hooded merganser, common merganser, and ruddy duck also use riverine and deepwater wetlands. Peak numbers of other species during migration, however, are relatively small.

The 1996 breeding population estimate for canvasbacks was 848,000, setting a record for the second year in a row—about 150,000 birds greater than the 1955–96 average (Caithamer and Dubovsky 1996). Scaup numbers have declined steadily since 1985 and the 1996 estimate (4 million birds) is about 2 million below the long-term average (Caithamer and Dubovsky 1996). Most canvasbacks and tundra swans that migrate in the Atlantic and Mississippi flyways now stage on the Mississippi River.

Waterfowl populations on the Mississippi River fluctuate widely year to year, likely as a result of variations in flyway populations, water and food conditions off-river, food resources produced annually within the riverine backwaters, and weather. Because these factors are correlated, it is difficult to discern their individual contributions to changes in populations along the river.

Food Resources On the River

The most spectacular concentrations of several species of waterfowl occur where local areas have an abundance of preferred plant or invertebrate food resources. Canvasback populations fluctuate with

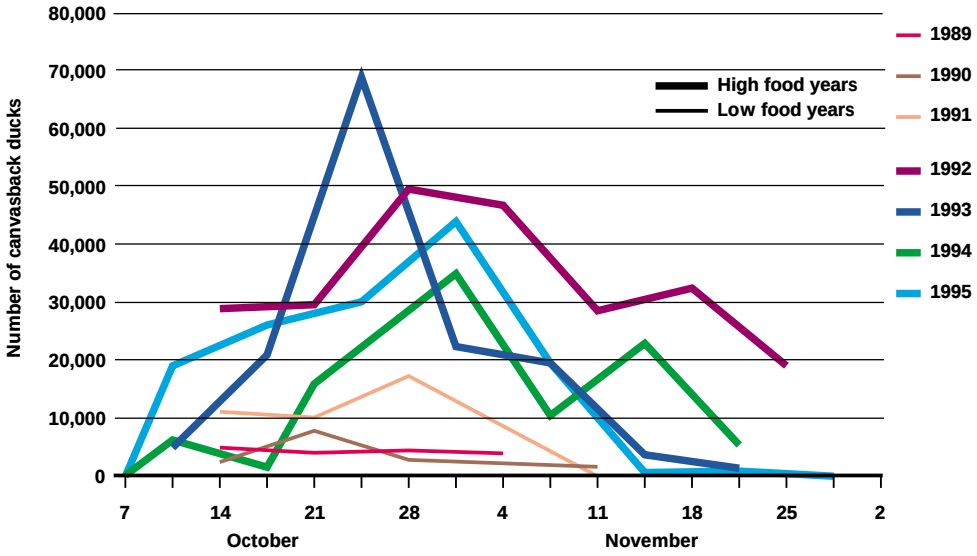

Figure 13-2. **Peak numbers and length of stay of canvasbacks on Lake Onalaska (Pool 7) during fall migration are linked to the abundance of wildcelery plants.**

the availability of wildcelery winterbuds and arrowhead tubers (Korschgen et al. 1988). Several situations suggest that summer floods (1978 on Pool 8) or drought conditions (1987–89 on Pools 5 to 19) cause failure for the winterbud and tuber crop. Figure 13-2 illustrates the impact of the 90 percent loss of wildcelery in Lake Onalaska (Pool 7) on canvasbacks. Research shows that the loss of wildcelery started in 1989. Recovery of this plant species has begun but will take many years to reach the abundance and distribution characteristic of the mid 1980s.

Peak counts of lesser scaup (Figure 13-3), ring-necked ducks, most dabbling ducks, and American coots on Pools 7, 8, and 9 also were depressed during 1989–91 (Figure 13-4, following page). Drought conditions in the late 1980s also appear to have contributed to the decline in numbers of lesser scaup, ring-necked ducks and canvasbacks on Pool 19 (Figure 13-5, following page). Evidently when fingernail clams, the principal food resource for diving ducks on Pool 19 (Thompson 1973), declined because of stress incurred during drought periods (Wilson et al. 1995), the peak number of lesser scaup followed the same trend (Figure 13-6, see page 5).

Figure 13-3. **Lesser scaup are attracted to open water areas where abundant snails, fingernail clams, mayflies, and other invertebrates are found (Source: U.S. Fish and Wildlife Service, Onalaska, Wisconsin).**

River As Nesting Habitat

A few species of waterfowl nest on the Upper Mississippi River System (UMRS). Wood ducks and hooded mergansers are common cavity nesters in bottomland forests. Recent ground surveys in Navigation Pools 7, 8, 11, and 13 indicate high densities of nesting mallards, Canada geese, and the occasional blue-winged teal on islands where nest predators are scarce (John Wetzel, Wisconsin Department of Natural Resources, La Crosse, Wisconsin, unpublished data). Research shows that mallard nesting densities are as high as 172 nests per acre (70 nests per ha) with nest success of 86 percent on islands managed

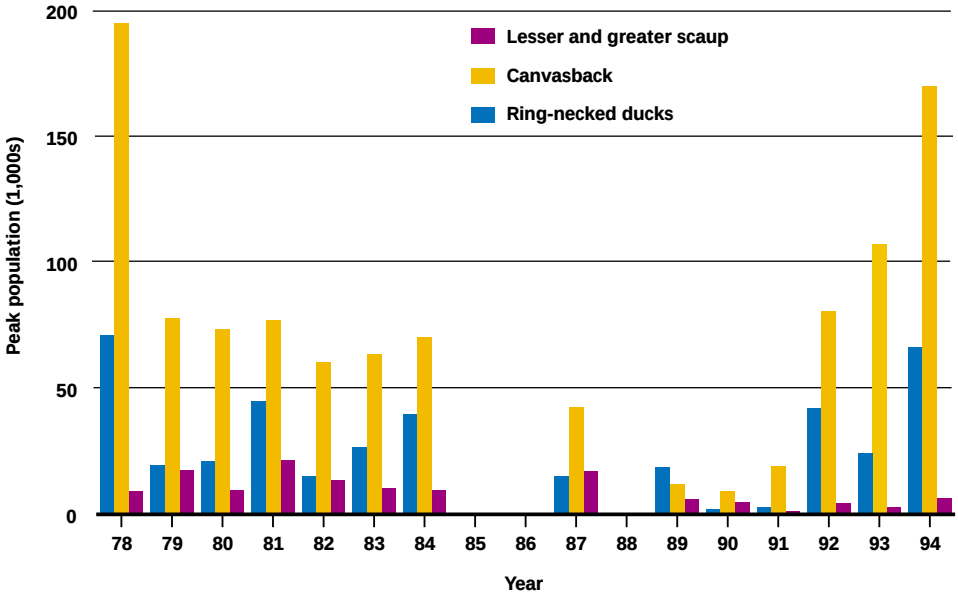

Figure 13-4. **Peak numbers of migrating canvasback, redhead, and lesser scaup ducks during 1978 to 1994 in Pools 7, 8, and 9 of the Upper Mississippi River. Drought conditions are believed to have contributed to a decline in the late 1980s.**

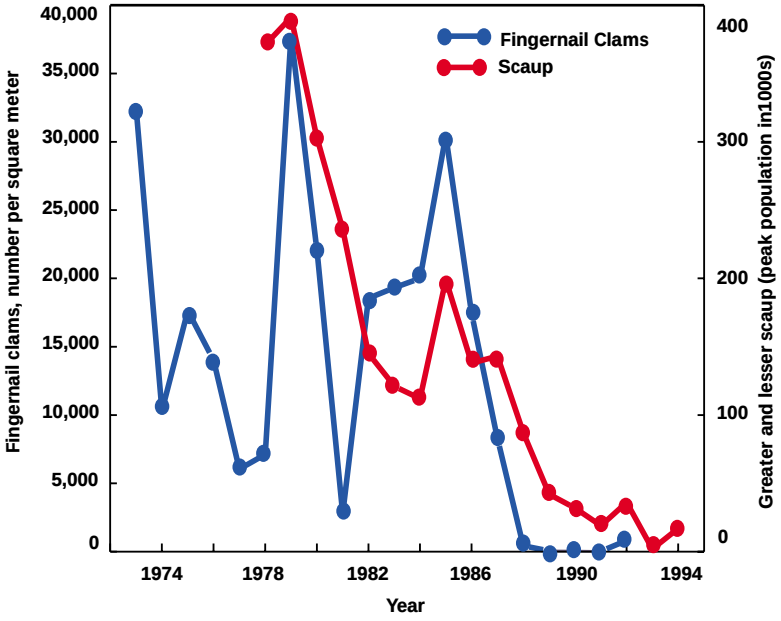

Figure 13-5. **Peak numbers of migrating lesser and greater scaup on Pool 19 in the fall are linked to the abundance of fingernail clams (numbers per square meter), small mollusks important in the scaup diet.**

for ground-nesting birds. In a given year 10 to 50 percent of mallard ducklings survive the period from hatch to fledgling depending on weather conditions, availability of brood-rearing habitat, and predator populations. Causes of mallard duckling mortality are consistent with those reported for other species, including predation, adverse weather conditions, lack of food, and disease.

Other Bird Species On the UMR

We have little information on the numbers and distribution of birds other than waterfowl that use the Mississippi River. The only long-term data set for assessing population trends of breeding birds (migratory songbirds as well as certain other migrant birds and residents) along the Mississippi River corridor is the Breeding Bird Survey (Peterjohn 1994). Estimating trends specific to the river is difficult because many survey routes exclude the Mississippi River floodplain.

Habitat-specific data on the occurrence and relative abundance of most nonwaterfowl bird species are not yet available for most areas along the Mississippi River. Furthermore, the breeding success of most

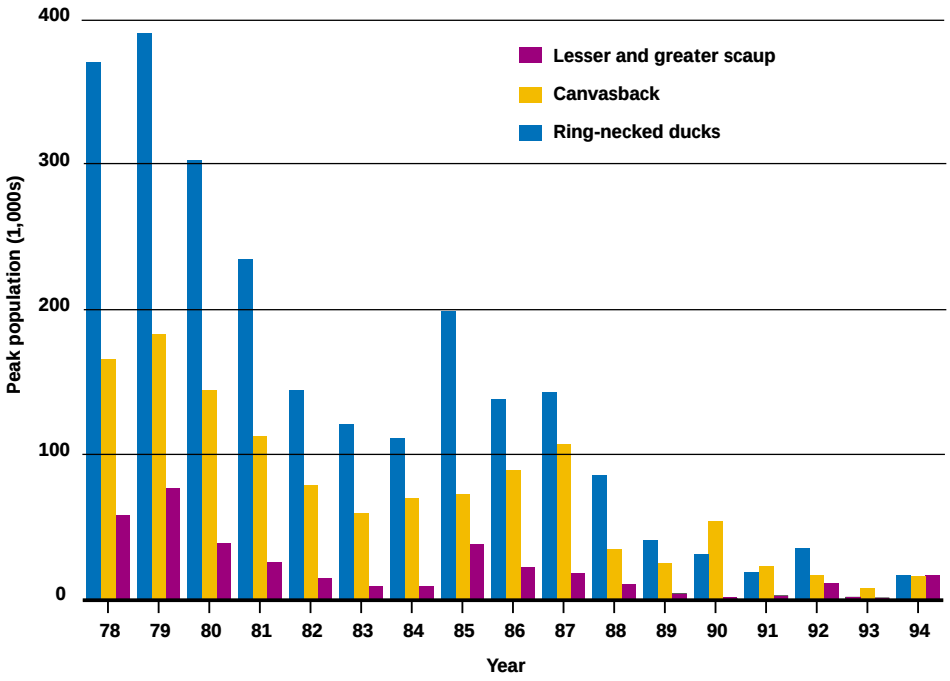

Figure 13-6. **Peak numbers of migrating canvasback, redhead, and lesser scaup ducks during 1978 to 1994 in Pool 19 of the Upper Mississippi River. Steady decline in numbers is attributed to a consistent decline in fingernail clam populations.**

species along the Mississippi River is unknown and little information exists about songbird use of the river corridor during migration.

Species lists and preliminary counts of birds are available for the breeding and migration seasons on a few areas within U.S. Fish and Wildlife Service refuges. In addition, point count surveys of breeding birds in various habitats were conducted in key pools of the UMR for 1994, 1995, and 1996. Preliminary analysis of 1995 data for forest habitat indicates distinct differences in bird community composition between the upper pools (4, 8, and 13) and Pool 26. Fewer total birds were detected in Pool 26 forests than in upper pool forests in 1995, perhaps due in part to extensive flooding that year. Results also identified differences in bird communities among various riverine habitats such as forests and marshes (see Figure 9-1). Species that benefit from the UMR ecosystem include the American redstart (Figure 13-7). Although American redstarts and the prothonetary warbler (Figure 13-8, following page) have declined throughout much of their range, our data show that they are abundant in forests of Pools 4, 8, and 13.

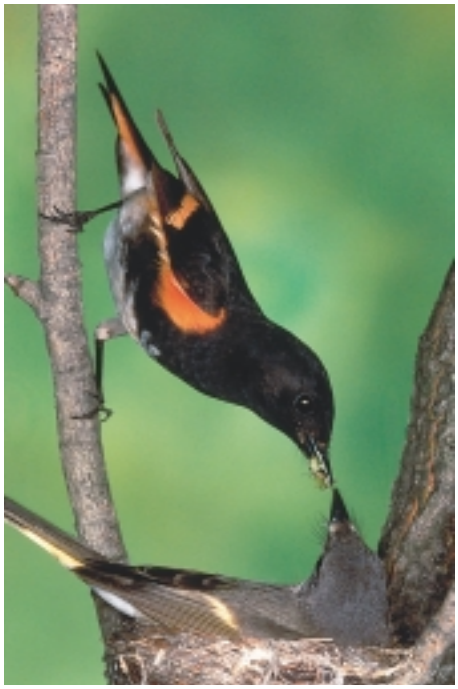

Figure 13-7. **The American redstart, a neotropical migrant, is one of the most abundant forest birds on the upper reaches of the Upper Mississippi River (Source: Photo by Isidor Jeklin for the Cornell Laboratory of Ornithology).**

A few data sets exist for nongame birds classified as endangered, threatened, or of special concern to Federal or State agencies or individual resource managers. These are the raptors such as the bald eagle and red-shouldered hawk and colonial waterbirds such as the great blue herons and great egrets.

Figure 13-8. **The prothonetary warbler is another migrant closely linked to the Upper Mississippi River floodplain forests (Source: Brian Collins, Minneapolis, Minnesota).**

The UMRS is a major migration route and wintering area for bald eagles. Depending on ice conditions on the river, groups of 100 or more eagles may roost at sites near dams. Numbers of breeding bald eagles along the Upper Mississippi River have increased over the past two decades.

The red-shouldered hawk is listed as endangered in Iowa and Illinois, threatened in Wisconsin, and of special concern in Minnesota. The UMR floodplain contains much of the forested habitat in Iowa and Illinois. Consequently, the floodplain is important for maintaining red-shouldered hawk populations in these states and providing a link for the habitats of northern and southern populations. The ecology of red-shouldered hawks has been studied along the Upper Mississippi River since 1983 and recent surveys have been expanded to cover more of the river (Pools 9–11 and 16–19). Thirty-two breeding territories were confirmed in 1992 and 37 territories in 1993 (Jon Stravers, Midwest Raptor Research Fund, Pella, Iowa, unpublished data).

The UMR is an important nesting and feeding area for great blue herons and great egrets because extensive bottomland forests and diverse aquatic areas provide suitable nesting and foraging habitats (Thompson 1978). Eight species of colonial water birds nest or breed within Mississippi River habitats (Thompson 1977; U.S. Fish and Wildlife Service, Winona, Minnesota, unpublished data).

Tracking Population Changes Over Time

Most continental populations of diving ducks depend on large lakes and riverine impoundments in the upper portions of the Mississippi Flyway to feed and rest during fall migration (Korschgen 1989). At one time the wetlands area of Minnesota, Wisconsin, Iowa, and Illinois totaled many millions of acres. Since European settlement and subsequent agricultural expansion, wetland losses have reduced this area by as much as 15.8 million acres (6.4-million ha) (Tiner 1984). Although a large proportion of riverine and deep-water wetlands remain, few are important to waterfowl because of changes brought on by both anthropogenic and natural causes. Efforts to conserve and restore riverine wetlands have been under way for many years and some areas of the UMRS may have future management potential.

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Waterfowl population survey data in the upper Midwest have been collected most consistently by the U.S. Fish and Wildlife Service and the Illinois Natural History Survey. On Pool 19, fall waterfowl censuses 1948 through 1984 by Frank Bellrose and Robert Crompton revealed a yearly mean peak number of 345,000 diving ducks (Illinois Natural History Survey, Havana, Illinois, unpublished data). The percent composition of peak numbers was lesser scaup, 71 percent, canvasback, 18 percent, and ring-necked ducks, 10 percent. Peak population counts of these three species on Pool 19 have been much lower during the past 10 years (Steve Havera and Michelle Georgi, Illinois Natural History Survey, Havana, Illinois, unpublished data).

Serie et al. (1983) compiled 1961 through 1977 data for canvasbacks on Mississippi River Pools 7 and 8 (combined) and Pool 19. Peak estimates of 147,000 canvasbacks occurred on Pools 7 and 8 in 1975 and 169,000 on Pool 19 in 1970. During 1978 through 1994 a peak of

195,000 canvasbacks was observed on Navigation Pools 7, 8, and 9 (Korschgen et al. 1989). Significant numbers of ring-necked ducks and lesser scaup used these pools during this time period (Figure 13-4). A maximum count of 875,000 divers was estimated on Pool 19 in 1969.

The population of swans on the UMR has increased in recent years, principally on Pools 7, 8, and 9. In those areas swan use during 1992 and 1993 was higher than that observed in the early 1980s.

Changes on the Illinois River illustrate the potential severity of human modifications to the river-floodplain ecosystem (Mills et al. 1966; Havera and Bellrose 1985; see Chapter 14). Dabbling duck populations (Figure 13-9) have declined steadily since the late 1940s, when annual fall surveys were initiated in Illinois. Peak mallard numbers during these early migration counts exceeded 1.5 million birds on the Illinois River alone. Environmental degradation on the Illinois River (Bellrose et al. 1983) caused a shift in migration routes of both dabblers and divers from the Illinois River to the central portion of the Upper Mississippi (Pools 19–26).

The shift is evident because the populations on the two rivers converge after 1960 when mallard use of Mississippi River habitats increased concurrent with declining use of Illinois River habitats (see Figure 14-8). Diving ducks also shifted from the Illinois to the Mississippi River (see Figure 14-7). Today, the combined populations of dabblers and divers barely exceed 500,000 birds, a full two-thirds reduction from pre-1950 populations.

Population trends for most songbird species in UMR stratum 17 of the Breeding Bird Survey match continental trends (stratum 17 encompasses portions of Minnesota, Wisconsin, Illinois, and Iowa from near St. Croix Falls, Wisconsin, to Clinton, Iowa, as well as up the Wisconsin River to Stevens Point, Wisconsin). Trends could be calculated for 119 species, of which, 35 showed significant change from 1966 to 1994. Twenty-one (60 percent) of the significant trends were positive, indicating an increased population, and 14 (40 percent) trends were negative, signifying a drop in population. Continental trends for 28 of these species (80 percent) were moving in the same direction and also judged significant. This may indicate that habitat conditions in this stratum do not influence populations of these bird species differently than elsewhere in North America.

Figure 13-9. **Mallard ducks nest and migrate along the Upper Mississippi and Illinois Rivers.**

Environmental degradation on the Illinois River caused a shift in migration routes of both dabblers and divers from the Illinois River to the central portion of the Upper Mississippi.

Continental trends were not significant for six species with significant trends within the Upper Mississippi—five positive and one negative. For these six species, factors that influence populations may differ between the UMR stratum and the rest of the continent.

In the Lower Mississippi River Valley stratum (stratum 5, Cairo, Illinois, to the Gulf of Mexico) 47 of 105 species for which population trends could be calculated had significant trends from 1966 through 1994. Thirteen of these trends were positive (population increases) and 34 were negative (population decreases). Continental trends for 22 of these species were significant and in the same direction as in stratum 5. As in the Upper Mississippi River, this may show that habitat conditions in the Middle and

Numbers of breeding bald eagles nesting along the UMR have increased from 2 to 5 pairs in the 1970s to 43 to 44 pairs in 1993 and 1994.

Lower Mississippi do not affect these bird populations differently than they do in other parts of North America.

Continental trends for five species were significant and contrary to trends in the Lower Mississippi River Valley. Continental trends were not significant for 18 species with significant trends on the Lower Mississippi River, two positive and 16 negative. For these 23 species, factors that influence populations may differ between the river stratum and the rest of the continent. That 16 of these species show a decrease in population, suggests widespread habitat degradation in the Lower Mississippi River Valley stratum.

The only other nationwide long-term survey of birds is the Christmas Bird Count. The survey method is far less standardized than the Breeding Bird Survey, although certain methods of analysis can be used to assess trends for wintering and resident bird species. The methods of Morrison and Morrison (1983) were used to determine population trends for the ruffed grouse, red-bellied woodpecker, pileated woodpecker, downy woodpecker, hairy woodpecker, house finch, northern cardinal, great horned owl, and barred owl from data gathered at 12 Christmas Bird Count locations centered on the UMRS. The only trend detected was a positive trend for the house finch, a species that has been expanding its range throughout the Midwest.

Figure 13-10. **Large numbers of bald eagles can be seen roosting and feeding near open water areas during winter (Source: U.S. Fish and Wildlife Service, Onalaska, Wisconsin).**

Bald eagle numbers (Figure 13-10) were declining nationally because of loss of prey and habitat prior to 1940, when the Bald Eagle Protection Act was passed (USFWS 1996). Although the bald eagle population was recovering before World War II, populations declined again because of reproduction failure. The lowered reproduction rates were caused by ingestion of DDE. The DDE—which caused egg shell thinning by inhibiting calcium release—was a breakdown product of DDT, a widely used insecticide from the 1940s until it was banned in the early 1970s. After 1973, bald eagle population numbers began to recover (USFWS 1996).

Numbers of breeding bald eagles nesting along the UMR have increased from 2 to 5 pairs in the 1970s to 43 to 44 pairs in 1993 and 1994 (Figure 13-11). Productivity per nest has varied little between 1986 and 1993, with 0.95 to 1.5 young per nest (U.S. Fish and Wildlife Service, Winona, Minnesota, unpublished data). Bald eagles wintering from Cairo, Illinois, to Minneapolis, Minnesota, were surveyed annually from aircraft during two consecutive days in late January or early February 1963 through 1967. The minimum number counted on these surveys was 397 in 1964 and the maximum was 885 in 1965. Peak numbers of bald eagles seen on informal roadside surveys between Winona and Red Wing, Minnesota, exceeded 200 birds during the winters of 1990 through 1995 (Upper Mississippi River National Wildlife and Fish Refuge, unpublished data).

Populations of great blue herons (Figure 13-12), great egrets and double-crested cormorants appear to have declined on the UMR (Graber et al. 1978; Thompson 1977, 1978; Upper Mississippi River National Wildlife and Fish Refuge, Onalaska, Wisconsin, unpublished data;

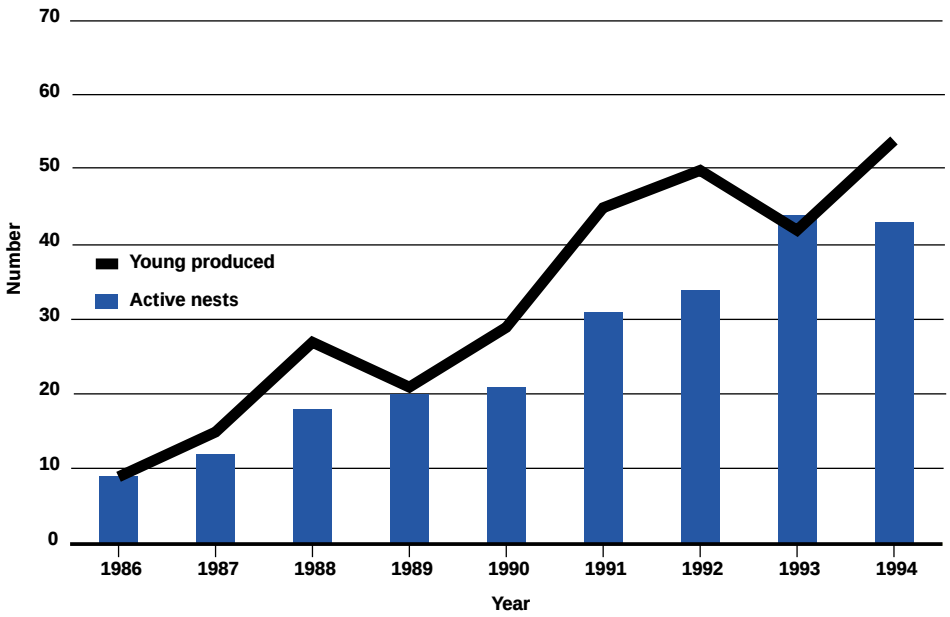

Figure 13-11. **Numbers of active bald eagle nests and young eagles between Pools 4 and 14 of the Upper Mississippi River from 1986 to 1994. Their numbers are increasing steadily throughout the Upper Mississippi River System.**

Kirsch 1997). Thompson (1977) reported 31 heron and egret colonies (18 colonies contained both species) within the UMR. By 1978 the number of colonies decreased to 27, again with 18 containing both species (Thompson 1978). Recent data on the cattle egret show that its range has expanded to include areas in and near the Mississippi River floodplain as far north as Pool 13 (Upper Mississippi River National Wildlife and Fish Refuge, Onalaska, Wisconsin, unpublished data).

Possible causes for apparent population declines in great blue herons and great egrets include poor water quality, loss of nesting trees (Figure 13-13, following page) and foraging areas, and toxic contaminants (Thompson 1978). Several State and Federal agencies have censused colonies since Thompson's study, but the years, methods, and reaches examined differed among surveys. The Upper Mississippi River National Wildlife and Fish Refuge began standardized surveys of great blue herons and great egrets in the refuge in 1993, although the Flood of 1993 hampered the initial survey. Refuge personnel reported that 6 of 18 colony sites active in 1992 were abandoned after nest initiation or were not colonized in 1993.

Figure 13-12. **Herons and egrets feed on fishes, amphibians, and invertebrates common in shallow waters throughout the Upper Mississippi River System (Source: U.S. Fish and Wildlife Service, Onalaska, Wisconsin).**

The Illinois Department of Natural Resources has conducted aerial surveys of rookeries since 1983. Other states along the UMRS survey heron and egret colonies intermittently. The Illinois surveys revealed a substantial increase in the number of active heron nests on the Mississippi River where it borders Illinois; the 2,111 nests in 21 colonies counted in 1987 multiplied to 5,045 nests in 20 colonies in 1991. Active egret nests also increased from 351 nests in

Figure 13-13.
Herons and egrets nest in colonies widely distributed along the Upper Mississippi River System (Source: U.S. Fish and Wildlife Service, Onalaska, Wisconsin).

Because of their economic importance relative to recreational hunting, waterfowl continue to be the most closely tracked bird species in the UMRS.

14 colonies in 1987 to 1,099 nests in 18 colonies in 1991. Ground surveys of colonies in Pool 26 indicate that both species occur mostly in tall living cottonwood and sycamore trees on river islands (Browning-Hayden et al. 1994). Future bird populations in the lower reaches of the UMRS may be affected as a result of high tree mortality that resulted from the extreme flood in 1993 (see Chapters 9 and 15).

Little reliable data on heron and egret productivity has been obtained since Thompson's 1977 study where the reported average nesting success was 3.0 young herons per nest out of 518 nests examined, and 2.5 young egrets per nest out of 73 nests examined.

Populations of endangered least terns, which occur mostly on the lower portion of the Mississippi River, appear to be increasing (Smith and Renken 1993; Woodry and Szell 1997; Rumancik 1985, 1986, 1987, 1988, 1989, 1990, 1991). Estimates however, indicate that local productivity is not great enough to support such large increases in the population (Kirsch *in press*).

Double-crested cormorants were common breeders and abundant migrants on the UMR from St. Paul, Minnesota, to St. Louis, Missouri, during the 1940s and 1950s. Their numbers declined over the next two decades because of the effects of contaminants and human disturbance on productivity. Numbers remained low for several years then slowly began to increase in the late 1980s. Current numbers of breeding and migrating cormorants remain much lower than historical levels (Figure 13-14). A minimum of 418 cormorant pairs nested in four colonies in 1992 and 504 pairs nested in nine colonies in 1993 (Kirsch 1997). Only 500 to 2,000 cormorants were seen during spring 1992 and 1993, whereas 5,000 to 7,000 were seen during the fall migration of 1991 and 1992. Both numbers were much lower than counts of 20,000 to 40,000 cormorants in the 1940s (Kirsch 1997; Figure13-14).

Information is not sufficient to estimate trends of black terns specific to the river, although Breeding Bird Survey data (1966–1987) indicate a 4 percent annual decline of black terns in Iowa, Minnesota, and Wisconsin (Hands et al. 1991). Data are not sufficient to examine trends in abundance of the Forster's tern, black crowned night heron, and yellow-crowned night heron.

Discussion

Because of their economic importance relative to recreational hunting, waterfowl continue to be the most closely tracked bird species in the UMRS. Changes in the distribution of migrating diving ducks and the reduced abundance of dabbling ducks in the Upper Midwest over the past several decades largely are attributable to habitat alteration caused by changes in land and water use. Loss of invertebrate and wetland plant foods on the Mississippi River between 1946 and 1964 seriously affected the numbers and distribution of lesser scaup, ring-necked ducks, and canvasbacks.

Four factors had a direct impact on species composition and the abundance of wetland plants: (1) fluctuating water levels, (2) water turbidity, (3) water depth, and (4) competition among plant species. The primary food item for diving ducks on Pool 19 has been fingernail clams (Thompson 1973) but, as on the Illinois River, this essential food base also may be in decline on the Mississippi River (see Chapter 10).

Other bird species of special importance discussed here (i.e., bald eagles, red-shouldered hawks, great blue herons, common egrets) also received attention over the past half century. But the majority of species have not been studied exclusively within the river-floodplain environment.

Initial surveys of a few selected pools have provided baseline data for analysis to determine community habitat associations and distribution throughout the UMRS, and serve as a guide to more detailed studies. Repeated surveys on 3- to 5-year cycles would help track trends in populations and community composition.

During the past 5 years, Long Term Resource Monitoring Program staff members have been building and analyzing geographic information systems (GIS) land-use coverages for the river and collecting data on aquatic resources. Staff members at the Upper Mississippi Science Center have been collecting data on breeding-bird communities and habitat characteristics in several habitats, such as bottomland forest, shrub carr, wet meadow, upland grass-shrub, cattail-emergent wetlands, and emergent wetlands that do not contain cattail.

Terrestrial and wetland habitats continue to change along the UMR. The next step is to build spatial bird habitat models that make it possible to forecast potential future conditions under different flow and habitat management regimes. The goal is to provide information to river managers on management options and potential consequences to the habitats and the bird communities that rely on them.

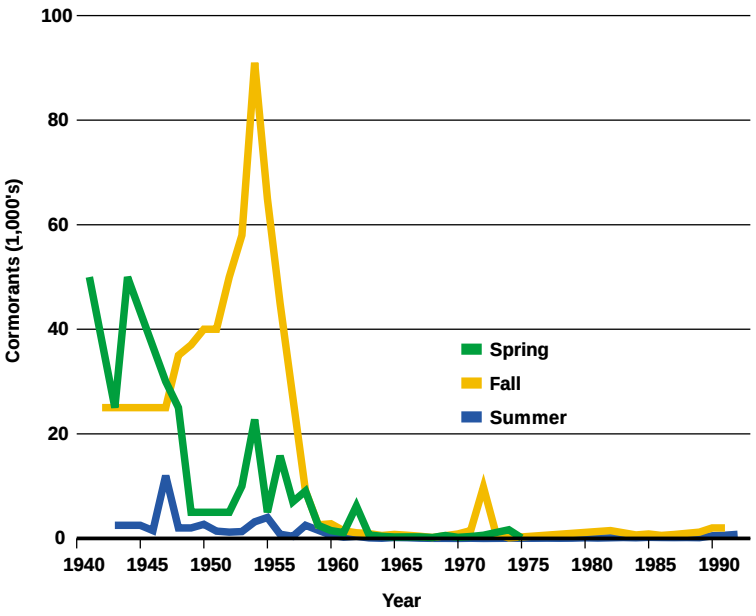

Figure 13-14. **Abundance of double-crested cormorants during the migration and breeding season on the Upper Mississippi River National Wildlife and Fish Refuge declined precipitously in the late 1950s. Similar to other fish-eating birds, cormorant nesting success was inhibited by chemicals developed for agriculture after World War II. Slight improvements in cormorant populations have been detected in the 1990s.**

We need more detailed information on several aspects of UMRS habitats to build the basic model of spatial and temporal changes in vegetation communities. Understory vegetation, for example, cannot be seen on aerial photographs and is missing from the current GIS coverages. The structure of habitats and species dominance and not just the plant species seen in the canopy may prove important for predicting bird communities. Spatial and temporal environmental determinants of emergent wetland and wet meadow communities also need to be better understood.

We need to assess the quality of habitats for supporting bird populations, especially foraging success and productivity. Further research should identify limiting factors and use gap analyses and UMRS GIS to estimate the carrying capacity of the UMR for bird species or groups. Gap analysis is conducted by overlaying vegetation and species richness maps with public ownership and management maps so gaps in the management of biodiversity can be identified. Survey sites should be distributed both

inside and outside of the floodplain (10 miles [16 km] on both sides of the river) to identify species using floodplain habitats for part or all of their life.

Information dissemination and agency cooperation are important aspects to migratory bird conservation and management. Because birds do not recognize political boundaries, resource managers typically must consider factors on an international as well as a local scale. Given adequate species or community level information from all areas a bird visits in its lifetime, managers can work more effectively and distribute resources to the most critical areas.

Carl Korschgen is a supervisory wildlife biologist, and both Eileen Kirsch and Kevin Kenow are research wildlife biolgists, all located at the USGS Upper Mississippi Science Center, La Crosse, Wisconsin.

References

Bellrose, F. C., S. P. Havera, F. L. Paveglio, Jr., and D. W. Steffeck. 1983. The fate of lakes in the Illinois River Valley. Illinois Natural History Survey Biological Notes 119, Illinois Natural History Survey, Champaign, Illinois. 27 pp.

Browning-Hayden, L. L., R. V. Anderson, M. A. Romano, and F. A. Cronin. 1994. Characterization of Great Blue Heron and Great Egret Nest Sites in Pools 20 and 26, Mississippi River. Paper presentation and Abstract *in* the Proceedings of the 26th Annual Meeting of the Mississippi River Research Consortium, La Crosse, Wisconsin, April 29, 1994.

Caithamer, D. F., and J. A. Dubovsky. 1996. Reports, Waterfowl population status, 1996. U.S. Fish and Wildlife Service, Office of Migratory Bird Management, Branch of Surveys and Assessment. Web Site: http://www/fws.gov/r9mbmo/reports/status

Graber, J. W., R. R. Graber, and E. L. Kirk. 1978. Illinois birds: Ciconiiformes. Illinois Natural History Survey, Urbana. Biological Notes 109:1–80.

Hands, H. M., M. R. Ryan, and J. W. Smaith. 1991. Migrant shorebird use of marsh, moist soil and wooded agriculture habitats. Wildlife Society Bulletin 19:457–465.

Havera, S. P., and F. C. Bellrose. 1985. The Illinois River: A lesson to be learned. Wetlands 4:29–41.

Kirsch, E. M. 1997. Numbers and distribution of Double-crested Cormorants on the Upper Mississippi River. Colonial Waterbirds 20:177–184.

Korschgen, C. E. 1989. Riverine and deepwater habitats for diving ducks. Pages 157–180 *in* L. M. Smith, R. L. Pederson, and R. M. Kaminski, editors. Habitat management for migrating and wintering waterfowl in North America. Texas Tech University Press, Lubbock. 560 pp.

Korschgen, C. E., L. S. George, and W. L. Green. 1988. Feeding ecology of canvasbacks staging on Pool 7 of the Upper Mississippi River. Pages 237–250 *in* M. W. Weller, editor. Waterfowl in winter. University of Minnesota Press, Minneapolis.

Mills, H. B., W. C. Starrett, and F. C. Bellrose. 1966. Man's effect on the fish and wildlife of the Illinois River. Illinois Natural History Survey, Urbana. Biological Notes. 57:1–24.

Morrison, M. L. and S. W. Morrison. 1983. Population trends of woodpeckers in the Pacific coast region of the United States. American Birds 37:361–363.

Peterjohn, B. G. 1994. The north American breeding bird survey. Birding 26:386–398.

Rumancik, J. P., Jr. 1985. Survey of the interior least tern on the Mississippi River from Cape Girardeau, Missouri, to Greenville, Mississippi, 1985. U.S. Army Corps of Engineers, Memphis, Tennessee. 25 pp.

Rumancik, J. P., Jr. 1986. Population survey of the interior least tern on the Mississippi River from Cape Girardeau, Missouri, to Greenville, Mississippi, 1985. U.S. Army Corps of Engineers, Memphis, Tennessee. 25 pp.

Rumancik, J. P., Jr. 1987. Population survey of the interior least tern on the Mississippi River from Cape Girardeau, Missouri, to Greenville, Mississippi, 1987. U.S. Army Corps of Engineers, Memphis, Tennessee. 25 pp.

Rumancik, J. P., Jr. 1988. Population survey of the interior least tern on the Mississippi River from Cape Girardeau, Missouri, to Greenville, Mississippi, 1988. U.S. Army Corps of Engineers, Memphis, Tennessee. 25 pp.

Rumancik, J. P., Jr. 1989. Population survey of the interior least tern on the Mississippi River from Cape Girardeau, Missouri, to Vicksburg, Mississippi, 1989. U.S. Army Corps of Engineers, Memphis, Tennessee. 25 pp.

Rumancik, J. P., Jr. 1990. Population survey of the interior least tern on the Mississippi River from Cape Girardeau, Missouri, to Vicksburg, Mississippi, 1990. U.S. Army Corps of Engineers, Memphis, Tennessee. 25 pp.

Rumancik, J. P., Jr. 1991. Population survey of the interior least tern on the Mississippi River from Cape Girardeau, Missouri, to Vicksburg, Mississippi, 1991. U.S. Army Corps of Engineers, Memphis, Tennessee. 25 pp.

Serie, J. R., D. L. Trauger, and D. E. Sharp. 1983. Migration and winter distributions of canvasbacks staging on the Upper Mississippi River. Journal of Wildlife Management 47:741–753.

Smith, J. W., and R. B. Renken. 1993. Reproductive success of least terns (*sterna antillarum*) in the Mississippi River Valley. Colonial Waterbirds 16:39–44.

Thompson, D. 1973. Feeding ecology of diving ducks on Keokuk Pool, Mississippi River. Journal of Wildlife Management 14:203–205.

Thompson, D. H. 1977. Declines in the populations of colonial waterbirds nesting within the floodplain of the Upper Mississippi River. Pages 26–37 *in* Proceedings, 1977 Conference of the Colonial Waterbird Group. Northern Illinois University, DeKalb, Illinois.

Thompson, D. H. 1978. Declines in the populations of great blue herons and great egrets in five Midwestern states. Pages 114–127 *in* Proceedings, 1978 Conference of the Colonial Waterbird Group. Northern Illinois University, DeKalb.

Tiner, R. W. 1984. Wetlands of the United States: Current status and trends. National Wetlands Inventory, Newton Corner, Massachusetts. 59 pp.

USACE (U.S. Army Corp of Engineers). 1993. Economic impacts of recreation on the Upper Mississippi River System: Economic impacts report. Final Version, March 1993, U.S. Army Corps of Engineers, St. Paul District, Planning Division. 31 pp. + Appendixes.

USFWS (U.S. Fish and Wildlife Service). 1996. Bald eagle species account. U.S. Fish and Wildlife Service, Division of Endangered Species. Web Site: http://www/fws.gov/~r9endspp/i/b/msab0h.html

Wilson, D. M., T. J. Naimo, J. G. Wiener, R. V. Anderson, M. B. Sandheinrich, and R. E. Sparks. 1995. Declining populations of the fingernail clam *Musculium transversum* in the Upper Mississippi River. Hydrobiologia 304:209–220.

Woodry, M. S., and C. C. Szell. 1997. Reproductive success of the interior least tern (Sterna antillarum) nesting on the Mississippi River from Memphis, Tennessee, to Rosedale, Mississippi: Year two. Report for U.S. Fish and Wildlife Service, Project No. E–1, Segment 11.