Critical Trends in Illinois Ecosystems

Critical Trends Assessment Program
February 2001

Illinois Department of Natural Resources
Office of Realty and Environmental Planning

in collaboration with
Office of Scientific Research and Analysis
Natural History Survey Division

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C H A P T E R O N E

Summary

Ecosystems in Illinois are deteriorating, their natural functions disrupted by fragmentation and stress. So concluded *The Changing Illinois Environment: Critical Trends*, a state-of-the-environment report published in 1994 by the Illinois Department of Energy and Natural Resources (now the Department of Natural Resources). This first "Critical Trends" report recommended that the state begin collecting statewide data on both the extent and condition of its ecosystems in order to determine the most effective and economical natural resources policy. The report quoted Abraham

Lincoln: "If we could first know where we are and whither we are tending, we could better judge what we do and how to do it..."

To learn "where we are and whither we are tending," the Critical Trends Assessment Program (CTAP) at the Illinois Department of Natural Resources has developed the data collection tools and programs needed to monitor trends in Illinois ecosystems. Over the past several years, the CTAP team has completed an atlas of Illinois land cover, an inventory of resource rich areas, 16 regional assessments, and several years of ecosystem monitoring. The team consists of staff from IDNR's Office of Realty and Environmental Planning and Office of Research and Scientific Analysis: the Illinois State Museum, Illinois Waste Management and Research Center, and the Illinois Natural History, State Geological and State Water Surveys.

This report provides an overview of each of the CTAP projects. Chapter 1 summarizes the findings of each program, Chapter 2 describes the land cover of the state, and Chapter 3 provides initial statewide ecosystem monitoring results. Chapters 4 through 13 are reports on each of the ten Illinois watersheds as defined by the Illinois Streams Information System (ISIS). They provide information on land cover and resource rich areas and, if available, ecosystem monitoring results and summaries of regional assessments.

The Department of Natural Resources enlisted dozens of its scientists and researchers, hundreds of volunteers, and numerous data sources and analytical tools to produce the information summarized in this report. This information is vital to protecting, preserving and enhancing Illinois ecosystems.

This information is vital to protecting, preserving and enhancing Illinois ecosystems.

LAND COVER MAPPING

Using satellite imagery (shot between 1991-1995) and spatial databases, CTAP delineated the extent of Illinois ecosystems and published *Illinois Land Cover: An Atlas* in 1996. The resulting statewide land cover database, also available on compact disk, reveals natural features and artificial structures at a level of detail appropriate for regional analyses. It will be updated periodically to detect changes in the extent of the state's ecosystems.

In general, agricultural land dominates the Illinois landscape, covering more than three-fourths — 77.5% — of the state. Specifically:

- row crops constitute the single largest land cover in Illinois with approximately 19.6 million acres, 54.3% of the state's 36,061,727 acres,
- forested and wooded land, primarily deciduous woods, comprises nearly 4.1 million acres or 11.3% of Illinois' surface,
- wetland covers approximately 1.2 million acres or 3.2% of Illinois,

- bottomland forest, spread over 809,000 acres (2.2% of the state's land area), is the most prevalent type of wetland,
- urban and built up land comprises 4.0% of the state, 5.8% when urban grassland is included,
- the remaining 2.1% of the state is open water — lakes, rivers and streams that cover more than 770,000 acres — or barren/exposed land that covers approximately 16,200 acres.

RESOURCE RICH AREAS

CTAP used land cover data and geo-referenced biological data — quantity of forests, wetlands, Illinois Natural Areas Inventory sites, and Biologically Significant Streams — to determine where the most

If degradation is severe, restoration to pre-disturbance condition will likly require intensive vegetation management.

biologically rich areas of the state are located. The 816 Illinois Environmental Protection Agency watersheds were used as the geographic unit for evaluation. Thirty such areas (Fig. 1) were identified and highlighted in an *Inventory of Resource Rich Areas In Illinois*. The Resource Rich Areas:

- cover almost one-fifth of the state, encompassing seven million acres,
- include 45% of the bottomland forest, 34% of the upland forest, and 43% of the nonforested wetland,
- range in size from 15,144 to 626,795 acres,
- are distributed throughout the state and generally occur along stream corridors.

The largest Resource Rich Areas are Big Rivers, the Southern Till Plain and the Middle Illinois River. The smallest ones are Sugar River, Thorn Creek, Des Plaines River, Illinois Beach and the DuPage River, all in the northern part of the state.

The inventory of resource rich areas helped to establish priorities for the state's Conservation 2000 Ecosystems Program — most of the program's Ecosystem Partnerships have at their core a resource-rich area. Ecosystem Partnerships are made up of individuals and interest groups that work together to maintain and enhance ecological and economic conditions within a defined boundary.

REGIONAL ASSESSMENTS

As Ecosystem Partnerships were formed, CTAP prepared regional "Critical Trends" reports for their areas. Usually based on watershed boundaries, the reports describe an area's geology, water resources, living resources, socio-economics, environmental quality, and archaeological resources. They are designed to provide the baseline information the partnerships need to set priorities and develop management plans. Sixteen of the assessments (Fig. 2) are summarized in chapters 4-13; regional assessments for the rest of the state should be completed over the next few years. Some general findings that can be applied statewide include:

- habitat fragmentation is a widespread problem that, in the long term, could limit attempts to maintain and enhance biodiversity,
- habitat degradation is a widespread problem that could be slowed or minimized by simply removing the degradation factors, such as grazing,
- if degradation is severe, restoration to pre-disturbance condition will likely require intensive vegetation management,
- restoring native vegetation along streams would shade the streams, stabilize banks, and filter sediment and chemicals from runoff before they reached the streams, resulting in less siltation and desiccation and lower water temperatures, and
- setting prescribed fires in terrestrial ecosystems, such as prairies, that need regular burning would maintain their characteristics and diversity.

Many of the regions are unique. For example, the Cache River basin contains such exceptionally diverse flora and fauna that two of its wetlands are included in the United Nations list of 15 "Wetlands of International Importance." The Fox River basin is one of the most urban watersheds in the state, yet it has a rich flora including 102 plant species listed

Figure 1. *Resource Rich Areas*

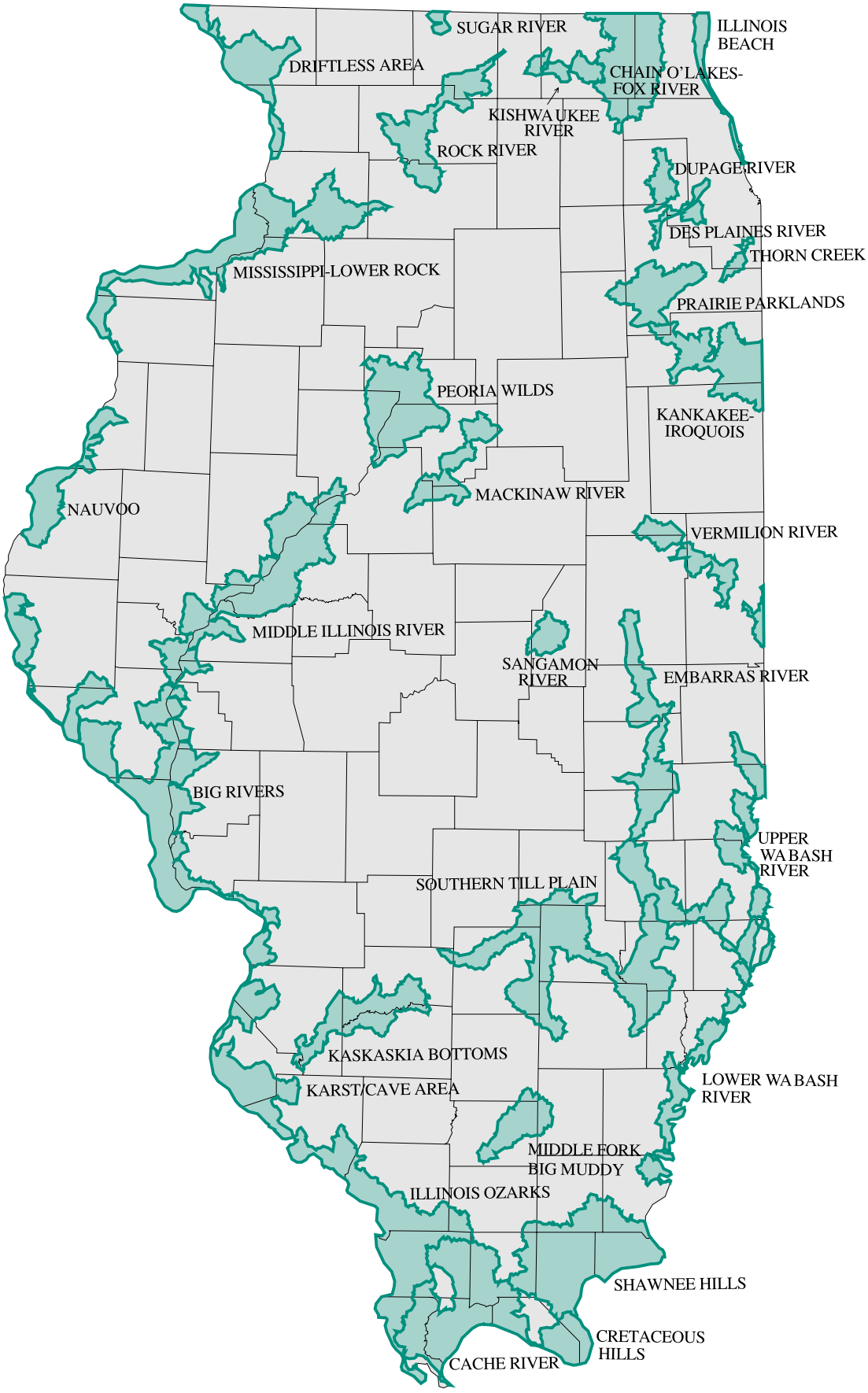
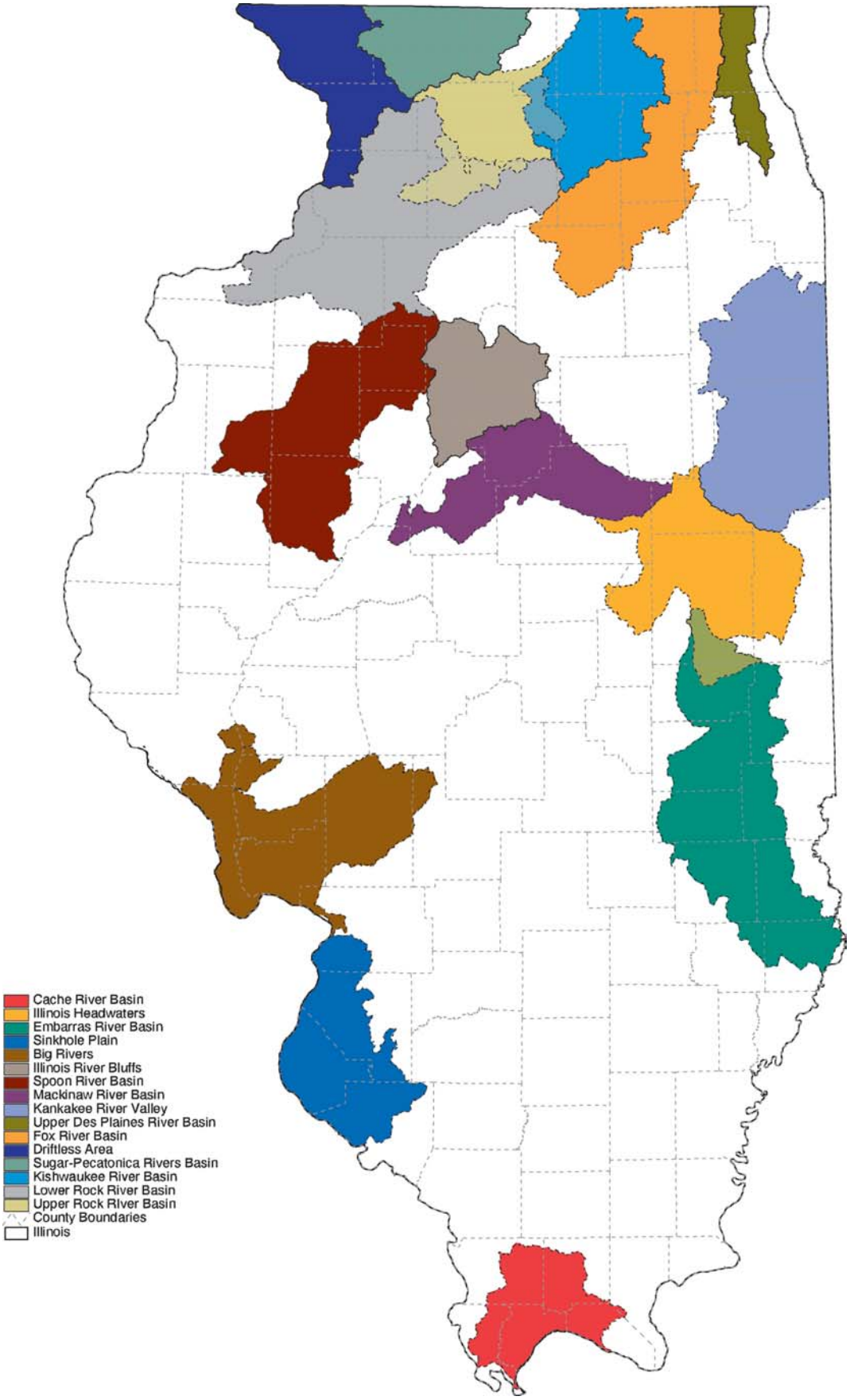


Figure 2. *Assessment Areas Summarized in This Report*



as state endangered or threatened and two listed as federally threatened. Because of glacial topography, the Headwaters area gives rise to six major streams that together drain nearly one-third of Illinois. In southwestern Illinois, the Sinkhole Plain is an area of karst topography characterized by sinkholes and caves and is also one of the fastest growing regions of Illinois.

ECOSYSTEM MONITORING

While these assessments are necessarily based on existing, fragmented data, the Critical Trends program has developed a long-term monitoring network that will provide current information on the condition of the major natural ecosystems. This information will support efforts to preserve, restore, and manage ecosystems across the state. Under the CTAP monitoring plan, CTAP scientists from the Natural History Survey conduct detailed biological inventories of 150 randomly selected sites (30 per year rotating on a five-year cycle) for each of four habitat types — forests, streams, wetlands and grasslands. Trained volunteers in the EcoWatch network carry out less detailed biological surveys at several hundred sites (currently only at forest (ForestWatch) and stream (RiverWatch) sites, but soon at prairie and wetland sites as well). Together the two groups collect a representative set of biological indicators that measure environmental quality. The indicators include information on plants, birds, fishes and aquatic insects that will track changes in the four ecosystems. As data accumulates over the years, regional and statewide trends will become apparent. Even with only five years of data certain patterns are clear.

➢ Streams in Illinois have experienced drastic modification over the past 150 years. Most streams that drain prairie landforms have been straightened, their canopies removed, and the watersheds tiled to drain fields more quickly. The data collected by CTAP scientists and RiverWatch volunteers point out some common problems.

- Illinois streams average only 88.6 out of a possible 180 points on a habitat quality index, indicating fair or poor habitat quality along most Illinois streams. Most streams lack natural habitat features such as wooded riparian corridors, winding stream channels, and stable in-stream habitat such as coarse rocks and wood debris.
- Most sites across Illinois are so degraded from a century of abuse that relatively few sensitive aquatic insects (EPT taxa) remain in the northern 75% of the state. Overall, the average site contains only 7.1 EPT taxa and 8.9 RiverWatch indicator taxa. Three out of five stream samples are dominated by three or fewer macroinvertebrate taxa, further indicating a lack of diversity.
- Indices of organic pollution — the Hilsenhoff Biotic Index (HBI) and the Macroinvertebrate Biotic Index (MBI) — indicate that most streams are at least moderately impaired and characterized by organisms that are moderately tolerant of organic pollution and overall stream disturbance.
- While Illinois streams contain a diversity of fishes — 188 native species — they are often dominated by just two to three fish species, sometimes by one or more of the 15 introduced species found in the state.

➢ CTAP and RiverWatch data clearly suggest that some watersheds are better off than others, but none of the 10 ISIS watersheds ranked high on all stream quality indicators.

- The Spoon River watershed scored high in all measures of macroinvertebrate diversity and pollution intolerance, but showed below average habitat and fish diversity.
- The Embarras/Vermilion S. watershed has both diverse macroinvertebrate and fish communities, but the HBI and MBI indicate the organisms are generally pollution tolerant.
- The Fox/Des Plaines, Rock, and LaMoine watersheds generally scored below average or average on most indicators.
- The lower part of the Big Muddy/Saline/Cache watershed (streams in the Cache Basin or Shawnee Forest) is relatively pristine according to most stream quality indicators, but the upper part (Big Muddy and Saline basins) where farming is the dominant land use has lower stream quality.

The Spoon River watershed scored high in all measures of macroinvertebrate diversity and pollution intolerance, but showed below average habitat and fish diversity.

Forest monitoring data show evidence of disturbance in Illinois forests and woodlands.

- The Kaskaskia watershed scored low on virtually every biological indicator.

➢ Two hundred years ago, 38% of Illinois was forested. Today, 14% of the state's land area remains in forest. Forest cover is now slowly increasing, but the plant species composition of our oak and hickory dominated forests is changing due to fire suppression, habitat fragmentation, and the introduction of non-native species. Forest monitoring data show evidence of disturbance in Illinois forests and woodlands.

- The average CTAP monitoring site contains 58 native plant species and only three introduced species, but where they are found non-natives tend to crowd out native species.
- The most important species in the ground cover layer include Virginia creeper, red maple, sugar maple, grass-leaved sedge, wild geranium, wood nettle, clearweed, mayapple, black snakeroot, and poison ivy. In the shrub layer they include spicebush, Missouri gooseberry, black raspberry, bristly greenbriar, and poison ivy as well as saplings of sugar maple, paw paw, bitternut hickory, rough-leaved dogwood, white ash, green ash, hop hornbeam, black cherry, and American elm.
- The shrub layer is the layer most dominated by introduced plants. More than 70% of shrub stems counted at ForestWatch sites are invasive, generally introduced species. The most dominant are buckthorn and shrub honeysuckle in the north, Japanese honeysuckle in southern and central Illinois, and multi-flora rose throughout the state.
- Invasive ground cover plants, such as garlic mustard and ground ivy, cover more than two and one-half times the area of disturbance-sensitive indicator species such as Dutchman's breeches and white trillium.
- Except for buckthorn and white mulberry, introduced trees are not a problem in the interior of most Illinois forests.
- Northern Illinois forests are the most degraded by invasive plants, while southern Illinois forests are the least affected by introduced species.
- A little over one-third of the oak-hickory forest sites monitored by ForestWatch show evidence of "maple takeover" (because fire has been suppressed, young sugar maples are the dominant saplings instead of oaks and hickories).
- Nearly one out of three sites with flowering dogwoods show signs of anthracnose, a fungal disease that threatens to wipe out flowering dogwoods, much as chestnut blight and Dutch elm disease decimated chestnut and American elm populations in the past.

➢ CTAP bird censusing clearly shows the importance of continuous forest habitat.

- An average of 6.4 bird species considered moderately to highly sensitive to habitat fragmentation were detected at forest sampling sites.
- At isolated sites where there was little additional forest habitat within one kilometer, no area-sensitive birds were found.
- At sites with a high percentage of forest in the surrounding landscape, as many as 15 sensitive species were detected.

➢ About 61% of the pre-European settlement landscape of Illinois was prairie. Nearly 20% of the state is still characterized as grassland, although only 0.01% of the original prairie persists in a high-quality condition. Today's typical grassland is much less diverse than yesterday's prairie.

- CTAP plots contain an average of 20 plant species, 7.5 of them introduced, while a high quality prairie contains as many as 100-140 different plant species.

- The most common native species in Illinois grasslands include red top grass, big bluestem, trumpet creeper, switch grass, beadgrass, and common goldenrod.
- Of the terrestrial habitats, grasslands are the most heavily dominated by introduced species with 60 of 71 monitoring sites dominated by them.
- Meadow fescue and Kentucky and Canadian blue grasses are the most dominant introduced species.
- An average of fewer than two grassland-dependent bird species nest at the sites (a high quality prairie would contain 6-12).
- Except for the eastern meadowlark, brown-headed cowbirds (nest parasites) were detected more often than any grassland-dependent bird species.

➢ Wetlands in Illinois have declined from pre-settlement estimates of 23% of the state to only 3.2%. Of the remaining wetlands, few remain in a high-quality condition, and many are severely degraded due to non-native species invasion, siltation, changes in hydrology, run-off of roadway de-icing salts, drainage activities, and grazing.

- CTAP wetland sites contain an average of 15 plant species, with two of them introduced. Sites containing introduced species have considerably lower biodiversity.
- Reed canary grass, the most commonly encountered introduced species, often completely dominates a site, replacing most native species and almost forming a monoculture. It was the dominant species at 22 of 78 monitoring sites.
- Some monitoring sites were diverse and still contain a high proportion of native species. Southern Illinois wetlands, in particular, seem to be the least affected by introduced species.
- The most common native species include Joe Pye weed, rice-cut grass, tall reed grass, river bulrush, water smartweed, and broad-leaved cattail.
- The number of wetland-dependent bird species found at the typical site is low, 1.3 species on average. A healthy wetland should host 6-10 wetland dependent species.

CTAP wetland sites contain an average of 15 plant species.

PLAN-IT EARTH

After *The Changing Illinois Environment: Critical Trends* was published, the Illinois State Board of Education and Illinois Board of Higher Education asked CTAP staff to help develop a high school science curriculum based on the report. The resulting PLAN-IT EARTH curriculum (Pairing Learners And Nature with Innovative Technology for the Environmental Assessment of Resources Trends and Habitats) integrates state education goals with CTAP findings and data, as well as EcoWatch monitoring procedures. A PLAN-IT partner, Dr. Marylin Lisowski of Eastern Illinois University, received a National Science Foundation grant to train science teachers on using the curriculum and the monitoring procedures. As of 1999, more than three hundred Illinois teachers had been trained.

The curriculum focuses on Illinois ecology and is directed to high school teachers who wish to incorporate environmental science and field work into their classes. Many teachers take their students to a local forest or stream, etc., where the students use EcoWatch procedures to collect data and submit it to IDNR, where it is used for CTAP ecosystem trends analysis.

The curriculum is divided into six ecosystems: rivers and streams, forests, wetlands, prairies, agro-systems and urban. Activities in the curriculum module either provide background information on the biodiversity of Illinois' ecosystems or outline the EcoWatch monitoring procedures for the ecosystem being studied. Each activity was tested in high school science classrooms and re-written as needed.

The curriculum design team included high school science teachers, university education professors, scholastic assessment specialists, Illinois Natural History Survey scientists and IDNR staff.

C H A P T E R T W O

Statewide Land Cover

Illinois' grassland is primarily rural and is concentrated in the northwestern and southwestern areas of the state.

Illinois counties range in size from 110,190 acres in Putnam County to 759,040 in McLean County; the median is 329,377 acres. The typical Illinois county has nearly 190,000 acres of cropland, more than 56,000 acres of rural grassland, approximately 42,000 acres of forested and wooded land, less than 9,000 acres of wetland and approximately 11,000 acres of open water. It also has about 8,000 acres of urban or other built-up land and roughly 50 acres of barren land.

The following provides statewide information on seven land cover categories: cropland, grassland, forest/woodland, wetland, urban/built-up land, open water, and barren/exposed land. Figure 4 illustrates the land cover of the state as a whole.

CROPLAND

- All 102 Illinois counties have cropland; the concentration ranges from 4.0% in Cook County to 85.2% in Piatt County.
  - Eight counties have more than 80% of their acreage in crops.
  - Twenty-two counties have 70-79% of their acreage in crops.
  - Twenty-eight counties are 60-69% crop covered.
- On average, Illinois counties plant 62.6% of their acreage in crops.
- Nearly 91% or 19.6 million acres of the state's cropland is in row crops, primarily corn and soybeans.
  - Small grains account for most of the remaining 9% of cropland.
  - Orchards cover only about 16,000 acres.

GRASSLAND

- Illinois' grassland is primarily rural.
  - About 91% of the state's grasses are rural including pastures, rural roadsides, hay/alfalfa, etc.
  - Only 9% of the grassland is located in urban areas, primarily residential areas, airports, golf courses and other open spaces.

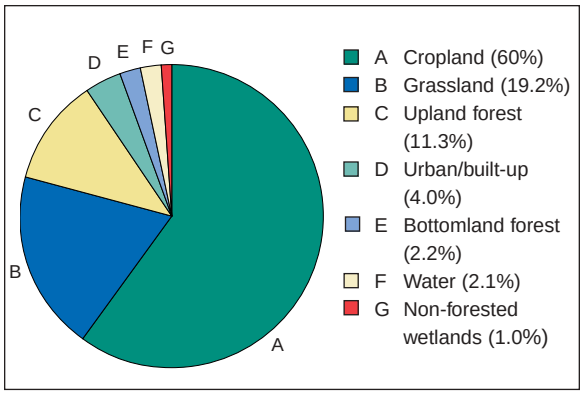


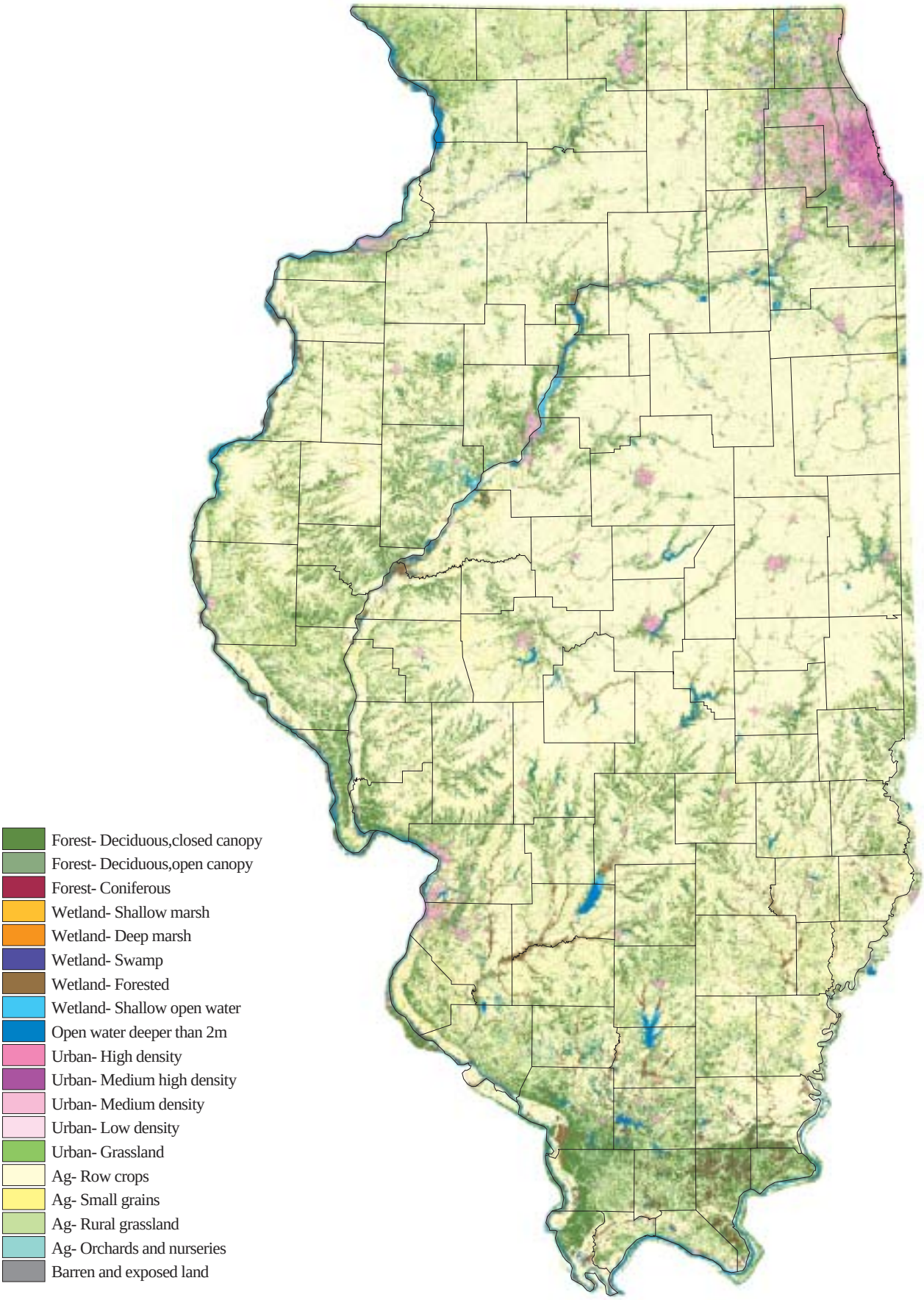
Figure 3. *Statewide land cover percentages*

- Urban grassland is concentrated in or near the Chicago metropolitan area.
  - Sixty percent of the state's urban grassland, or about 240,900 acres, is located in Cook, Lake, DuPage, Will and Kane counties.
  - Cook County alone has more than 75,000 acres of urban grassland.
- Rural grassland is concentrated in the northwestern and southwestern areas of the state.
  - Fifteen counties have more than 25% of their total acreage in rural grasses.

FOREST/WOODLAND

- Illinois has more than 4 million acres of forest and woodland.
- All Illinois counties have forest or woodland; the predominant type is deciduous woods (87.9%, about 3.6 million acres).
  - Open canopy woods — sparsely wooded land in both rural and urban areas — cover more than 400,000 acres.
  - Coniferous woodland is found on only 72,000 acres.

***Figure 4**. Statewide land cover*



- Forested or wooded areas cover an average of 10.8% of each county.

➢ The concentration of forested and wooded land ranges from 0.4% of Ford County to 58.4% of Pope County.
- Two counties, Pope and Hardin, are more than 50% forested or wooded.
- An additional nine counties are 25 to 49% forested or wooded.

WETLAND

Four Illinois counties have more than 10% of their area covered by wetland.

➢ Illinois has nearly 1.2 million acres or 3.2% of its surface in wetland.
- The majority of wetland, 69%, is bottomland forest — approximately 809,000 acres situated along the state's rivers.
- Shallow water wetland comprises 14.9% and shallow marsh/wet meadow comprises 12.0% of all wetland.
- Deep marsh and swamp combined are only 4.0% of the total wetland.

➢ All counties have some bottomland forest, shallow and deep marsh, wet meadow, and shallow water wetland.
- Four Illinois counties have more than 10% of their area covered by wetland (Alexander, Calhoun, Clinton, and Lake); 24 counties have 5 to 10% of their area in wetland.
- Twenty-seven counties have swamp, comprising a total of 11,726 acres, mostly situated near the southern tip of the state.

URBAN/BUILT-UP LAND

➢ Illinois has 10 metropolitan areas.
- The largest, Chicago, encompasses nine counties.
- The second ranked metropolitan area, East St. Louis, covers five counties.
- The Peoria and Rockford metropolitan areas take in three counties each.
- Springfield and Rock Island extend over two counties each.
- There are four single-county metropolitan areas: Bloomington, Champaign, Kankakee and Decatur.

➢ Urban and built-up land constitutes 4.0% of Illinois' surface.
- Low density and medium density land uses, primarily residential, account for 57.5% of urban and built-up land.
- High density development, mostly urban centers, accounts for another 20.9%.
- Transportation, including major roadways and rails, comprises 21.6% of all urban and built-up land.

OPEN WATER

➢ Roughly two-thirds of Illinois' boundary is defined by rivers.
- The Mississippi, Ohio and Wabash rivers border the state.

➢ Lakes, rivers and perennial streams cover 2.1% of Illinois' surface.
- The Illinois River bisects the state from St. Louis to Chicago.
- Other major rivers include the Rock River in the north, the Kaskaskia in the south and the Mackinaw and Sangamon rivers in the center of the state.

➢ Twenty-four counties contain more than 10,000 acres of lakes, rivers and streams.
- These counties are concentrated along the Mississippi and Illinois rivers.

BARREN/EXPOSED LAND

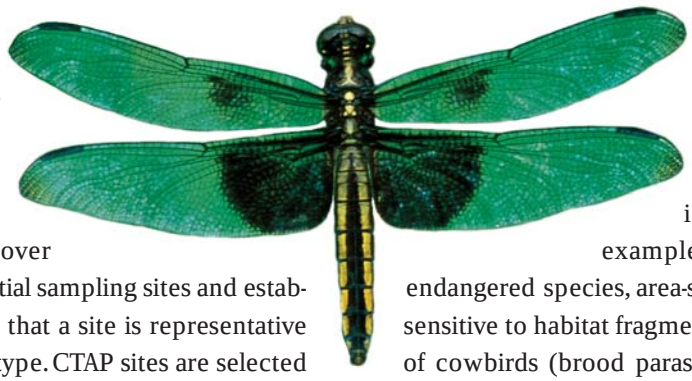
➢ Twenty-five Illinois counties contain barren or exposed land, mostly quarries.
- Acreage of barren/exposed land is small, ranging from one acre in Macon and Williamson counties to 1,823 in LaSalle County.

➢ Only four counties (Cook, LaSalle, McHenry and Will) contain more than 1,000 acres of barren/exposed land.

CHAPTER THREE

Ecosystem Monitoring Results

Are environmental conditions in the state getting better or worse? To answer this question, the Critical Trends Assessment Program has begun implementing its monitoring plan to track statewide trends in forest, wetland, grassland, and stream habitats. CTAP scientists conduct detailed biological inventories of 150 randomly selected sites (30 per year, rotating on a five-year cycle) for each of the four habitat types, while EcoWatch volunteers carry out less detailed biological surveys at several hundred sites each year (currently only at forest and stream sites).



CTAP staff use the statewide GIS land cover database to select potential sampling sites and established criteria to ensure that a site is representative of the intended habitat type. CTAP sites are selected from randomly selected Public Land Survey Townships, while EcoWatch sites are selected from Public Land Survey Sections. In each township or section only one site is sampled. In addition, EcoWatch volunteers may select their own sites (consistent with minimum site criteria).

Since it is not feasible to measure all components of the environment, the monitoring program focuses on a set of representative indicators — data on plants, birds, aquatic insects, and fish — to measure environmental change. Data will be available on terrestrial insects within the next few years.

- **Vascular plants** are being monitored in forest, wetland, and grassland habitats to detect problems of biotic integrity. Encroachment by invasive and/or exotic species, disease, or altered fire regimes can lead to changes in community structure, the loss of sensitive native plant species, and the homogenization of historically diverse plant communities. CTAP indicators for plant communities include the diversity of native plant species and the percent cover of exotic versus native plants. Other indicators are also being investigated. Long-term monitoring of these indicators will reveal spatial as well as temporal patterns of change within these plant communities.
- **Bird populations** are being monitored in forests, wetlands, and grasslands. Indicators include, but are not limited to, the abundance and diversity of habitat specialists (species that can only live in wetlands, for example), threatened and endangered species, area-sensitive species (i.e., sensitive to habitat fragmentation), and the ratio of cowbirds (brood parasites) to host species. Because birds are highly mobile, these indicators can reflect landscape conditions that extend beyond the boundaries of the habitat patches being investigated.
- **Aquatic insects** are used by CTAP scientists to determine the EPT index — the number of species of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) in a sample. EPT species are relatively intolerant of pollution, and the EPT index is one of the most efficient indices of stream health. Because sensitive aquatic insects are less mobile than fish and potentially respond more quickly to changes in stream health, they reflect site-specific impacts better than fish. EPT species are abundant in most streams, while the numbers of fish in the smallest streams may be meager. EcoWatch volunteers collect both aquatic insects and other benthic macroinvertebrates (creatures without a

The monitoring program focuses on a set of representative indicators — data on plants, birds, aquatic insects, and fish — to measure environmental change.

backbone that live on stream bottoms) that are relatively easy to identify and represent a wide range of tolerance to organic pollution. As indicators of stream health they help measure biodiversity (taxa richness and taxa dominance) as well as pollution tolerance (macroinvertebrate biotic index (MBI) and EPT taxa richness).

- **Fish communities** are good indicators of long-term impacts that occur over a broad range of scales — they feed at a range of trophic levels (other fish, insects, plants, etc.), and are consumed by humans for food. Also, they are relatively easy to collect, are directly related to water quality standards used by many government agencies, and account for nearly half of the endangered vertebrate species and subspecies in the U.S. The environmental tolerance, life histories, and geographic distributions are better known for fishes than for any other group of freshwater organisms. Indicators generated from data on fishes include species richness, relative abundance, community structure (ratios of the different types of fishes in the samples), and the diversity and abundance of hybrids and exotic species.

CTAP monitors the biodiversity of forest communities, including changes in the species composition of the plant and bird populations, as well as the status of invasive species.

FORESTS

During the first half of the 19th century forests covered roughly 38% (13.8 million acres) of Illinois. Currently only about 14% (4.9 million acres) of the state remains in forest. Most of the present-day forests have been fragmented into very small parcels of land, and the abundance of species that require large forested tracts to survive, such as the pileated woodpecker and wood thrush, have declined. Small fragmented parcels are also more susceptible to intrusion by invasive species of plants and animals. CTAP monitors the biodiversity of forest communities, including changes in the species composition of the plant and bird populations, as well as the status of invasive species.

Forest Plants

Between 1997 and 1999 CTAP botanists monitored 73 randomly selected forest sites throughout the state (Fig. 5). In addition, EcoWatch volunteers monitored 120 sites in the spring and fall of 1998 and 1999 (Fig. 6). Data on vascular plants were collected from the ground, shrub, and tree layers in the interior of forest patches. The preliminary analysis provides a characterization of the types of forests found in Illinois and some of the threats that they face.

Of the 52 sites monitored by ForestWatch in the fall of 1998, 40 were upland forests and 12 were bottomland forests. Thirty-one of the upland forests were oak-hickory, the most common (about one-half) type of forest in Illinois. The bottomland forests were predominantly ash-elm-maple (Table 1).

***Table 1**. Forest Types Monitored by ForestWatch*

Upland forests:	# of sites:
Oak-hickory	31
Maple-ash-basswood	4
Bur oak	2
Tulip tree	2
Beech-maple	1
Bottomland forests:	
Ash-elm-maple	10
Ash-cottonwood	1
Scrub	1

Figure 5. *CTAP Forest Monitoring Sites, 1997-1999*

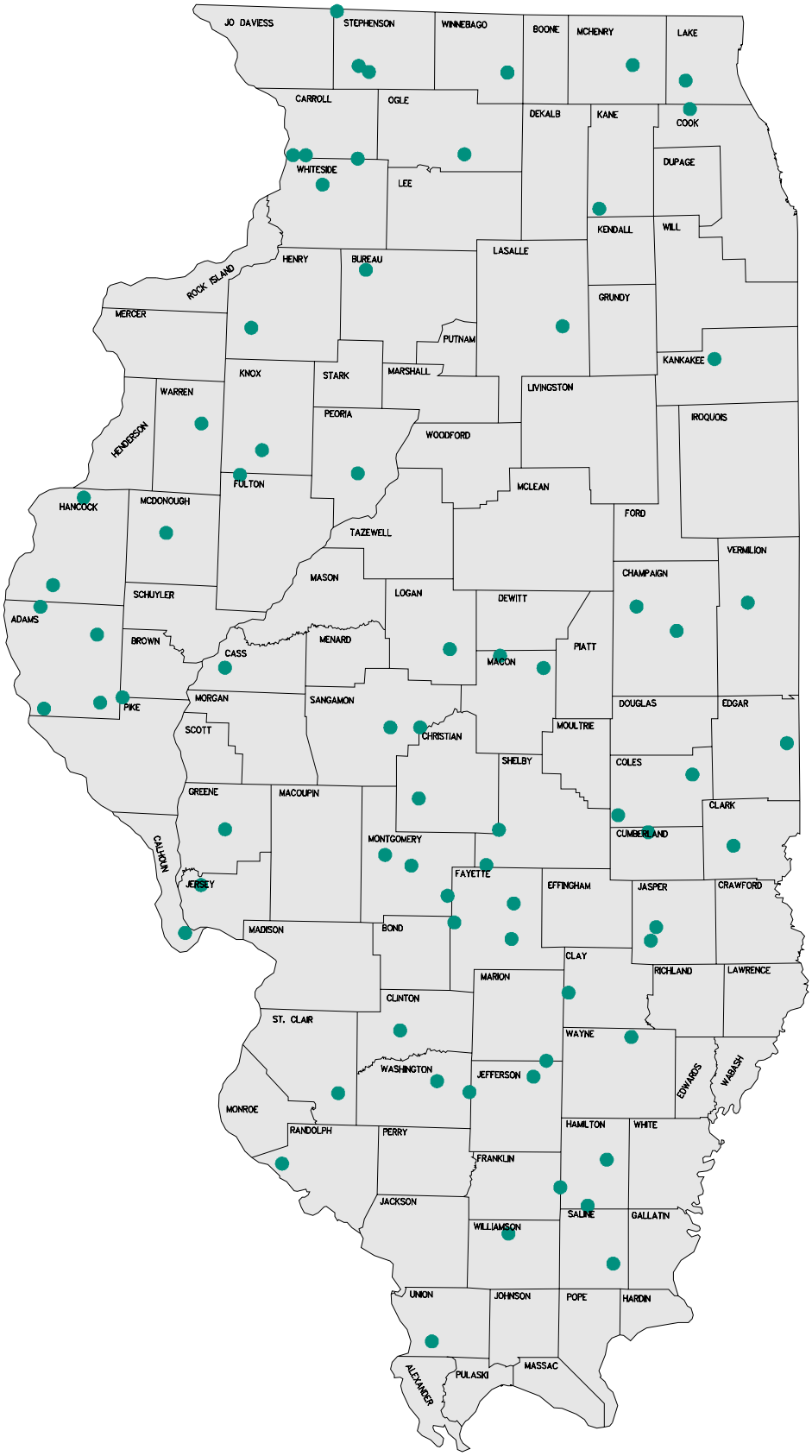
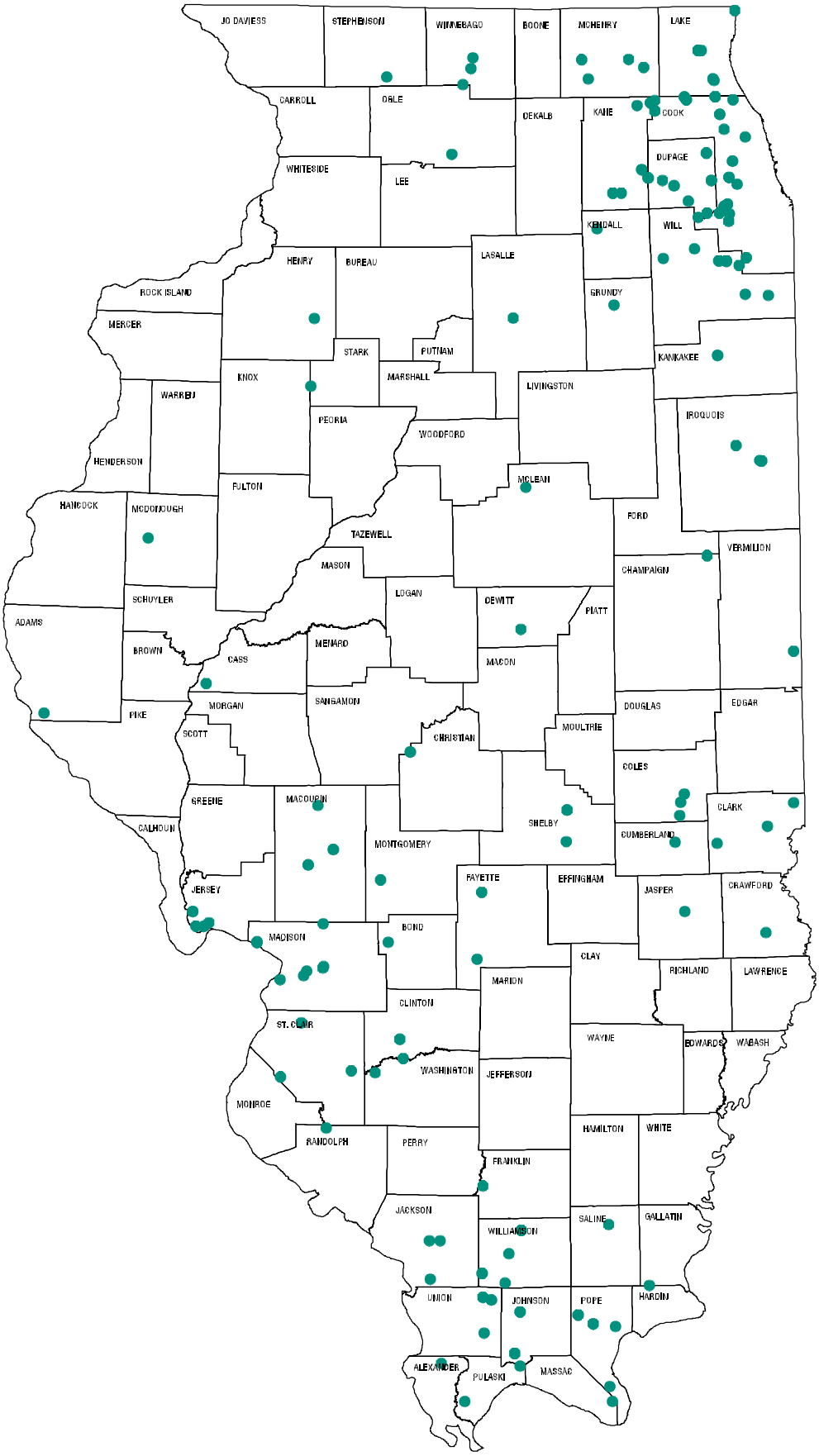


***Figure 6**. ForestWatch Monitoring Sites, 1998-1999*



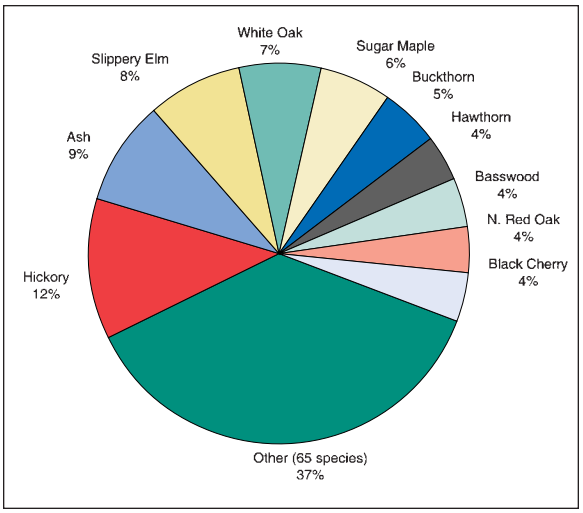


***Figure 7**. Most abundant species, ForestWatch*

The most abundant taxa were hickory and ash, followed by the individual species slippery elm, white oak, sugar maple, and buckthorn (Figure 7). The species with the greatest basal area, which takes into account the size of trees, were white oak followed by hickory, ash, northern red oak, sugar maple and slippery elm (Figure 8). (Note: hickory and ash have higher ranks because they include several species within each genus, while most other taxa listed are individual species.) It is useful to look at abundance and basal area separately, since some species are numerically dominant (i.e. slippery elm) while others are dominant in terms of their size (i.e., white oak). These two measures are used to calculate the importance value of a tree species; the more dominant the species, the greater the importance value. The species with the highest importance value was white oak followed by hickory and ash (Table 2).

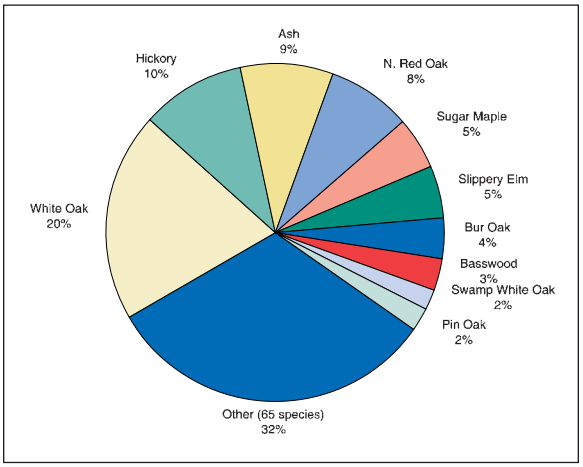


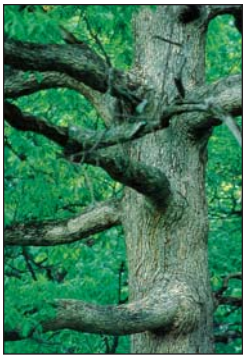
***Figure 8.** Species with the greatest basal area, ForestWatch*

***Table 2.** Species with the Highest Importance Values, ForestWatch*

Species	Importance value
White oak	13.7
Hickory*	11.7
Ash*	8.9
Slippery elm	7.5
Red oak	6.0
Sugar maple	5.3
Basswood	3.3
Hawthorn	2.9
Bur oak	2.8
Hackberry	2.8

** Represents more than one species of hickory and ash trees.*

The total number of vascular plant species detected on the CTAP forest plots (including all trees, shrubs, and ground cover) ranged from 19 to 108 species, with an average of 61 species per site. However, unlike in grasslands and wetlands, the number of species is not necessarily an indication of the quality of the habitat. In general, upland sites tended to be more diverse than bottomlands. The most important native species in the ground cover layer include Virginia creeper (which has the highest importance value at 20 sites), red maple, sugar maple, grass-leaved sedge, wild geranium, wood nettle, clearweed, mayapple, black snakeroot, and poison ivy. In the shrub layer they included spicebush, Missouri gooseberry, black raspberry, bristly greenbriar, and poison ivy as well as saplings of sugar maple, paw paw, bitternut hickory, rough-leaved dogwood, white ash, green ash, hop hornbeam, black cherry, and American elm.



Based on information received from landowners and preliminary analyses of species composition, many forest sites are in the early to intermediate stages of forest succession. That is, they are relatively young forests — often small woodlots — showing evidence of past or present grazing or logging, or the land was farmed at some point during its history. Table 3 compares a typical disturbed site dominated in each stratification layer by sun-loving plants, and an older forest dominated by shade-loving species indicative of the later forest successional stages. CTAP scientists rarely

Table 3. *Dominant Plant Species* in a Recently Disturbed Forest Compared to a Relatively Undisturbed Forest*

Forest with recent disturbance	Forest relatively free of disturbance
Herbaceous ground layer	*Herbaceous ground layer*
Multiflora rose +	Canada wood nettle
White avens	Wild ginger
Clearweed	Common black snakeroot
Understory shrubs and saplings	*Understory shrubs and saplings*
Multiflora Rose +	Paw paw
Amur honeysuckle +	Ohio buckeye
Wild black cherry	Spicebush
Canopy trees	*Canopy trees*
Honeylocust	Basswood
Hackberry	White ash
Wild black cherry	Hackberry

** Based on importance values (IV). IV for ground layer was calculated by adding the relative frequency and percent cover for each species. IV for understory was calculated by adding the relative frequency and density for each species. IV for canopy was calculated by adding the relative frequency and basal area for each species.*
+ Non-native species

encountered older growth forests that were relatively free from disturbance for many decades.

Because of the relatively disturbed nature of most Illinois forests, three common problems exist: 1) they have lost valuable disturbance-sensitive plants, 2) they are being dominated by introduced or invasive species, and 3) because fire has been suppressed, they are being taken over by maple trees.

Disturbance-sensitive species were found at only one-third of ForestWatch sites.

Some native species are very sensitive to disturbances, causing them to be easily extirpated. Such species were found at only one-third of ForestWatch sites (Table 4); their loss provides an opening for weedy, disturbance-tolerant species. While forest sites throughout Illinois generally have a low percentage of introduced plant species compared to wetlands and grasslands — on average only three of the 61 species are introduced — most forests contain some. Even though relatively few introduced species may be detected at a site, their dominance, in terms of relative cover or density, may be disproportionally high and they may totally dominate the understory of the forest.

Table 4. *Detection of ForestWatch Indicator Groundcover Plant Species*

Disturbance-Sensitive Species	Detection (% of sites)	Groundcover (m^2/ha)
Blue cohosh	7%	7.01
White trillium (all species)	7%	0.49
Doll's eyes	6%	2.75
Large-flowered bellwort	12%	2.50
Bleeding hearts (both species)	19%	26.67
Maidenhair fern	4%	1.52
Virginia spiderwort	15%	0.98
Hepatica (both varieties)	6%	0.25
Common Native Species		
Virginia bluebells	na	0.50
Wild columbine	na	0.25
Blue phlox	na	13.28
Red trillium	na	15.17
Blue-eyed Mary	na	0.75
Wild geranium	na	134.43
Swamp buttercup	na	18.96
Sensitive fern	na	2.29
Non-Native Species		
Garlic mustard	31%	105.57
Dame's rocket	1%	0
Moneywort	4%	28.71
Ground ivy	22%	28.86

** na = not available*

Introduced species were found in 58 of the 73 forested sites visited by CTAP botanists (Table 5). At the sites monitored by ForestWatch volunteers, non-native ground cover species were found to cover more than two and one-half times the total area covered by disturbance-sensitive species. In the shrub layer of the forest, invasive taxa averaged 1,210 stems per hectare compared to only 490 for non-invasive shrubs, or more than 70% of all shrub stems counted (Fig. 9). When present, these invasive, introduced species constitute a major form of environmental degradation.

Table 5. *Introduced Species in CTAP Forest Sites, by Region (number of sites monitored is in parentheses)*

	North (18)		Central (35)		South (20)		State (73)
Species	**# sites**	**# sites dominant**	**# sites**	**# sites dominant**	**# sites**	**# sites dominant**	**# sites**
Multiflora rose	9	0	19	4	6	0	34
Honeysuckle shrub	6	1	7	0	0	0	14
Japanese honeysuckle	0	0	4	3	6	1	10
Garlic mustard	5	2	2	0	0	0	7
Buckthorn	4	4	2	0	0	0	6

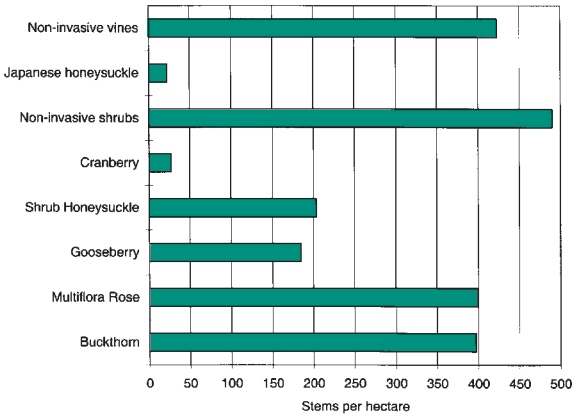


Figure 9. *Number of invasive and non-invasive shrub and vine stems found at 52 ForestWatch sites (a hectare = 2.471 acres)*

A few introduced plant species such as garlic mustard, buckthorn, shrub honeysuckle, Japanese honeysuckle, and multiflora rose have become common invasive plants regionally (Fig. 10). Some native species, such as gooseberry, can also be invasive. Garlic mustard is a serious problem in the Chicago region, but is not widespread in the southern portion of the state. Buckthorn has proliferated in the shrub layer of forests throughout much of northern Illinois, and its abundance in the tree survey further indicates how well-established buckthorn is becoming in northern forests. Honeysuckle shrubs were commonly found in northern and western counties, whereas Japanese honeysuckle was a problem in central and southern counties. Multiflora rose was the most frequently encountered introduced species (detected at 34 sites) and was seen in all regions of the state. Southern Illinois had the fewest sites with dominant introduced species. This could reflect its distance from the ports, horticultural areas, and urban landscapes where introductions usually occur.

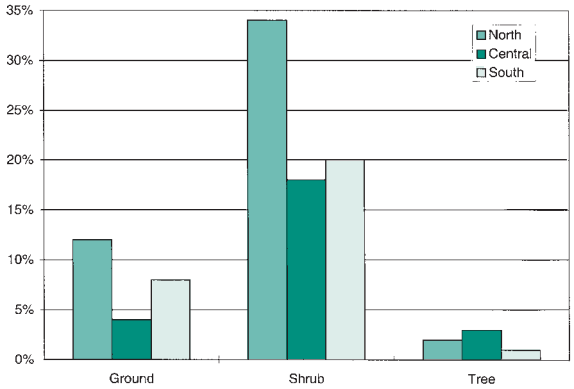


Figure 10. *The percentage of non-native plants* at CTAP forest sites, by layer and region*

** the ground layer is measured by the cover of the plants, the shrub layer by the number of stems, and the tree layer by the basal area*

Multiflora rose was the most frequently encountered introduced species and was seen in all regions of the state.

Evidence of potential maple takeover was present at 11 of the 40 ForestWatch upland sites. Maple takeover refers to a tendency of sugar maples to become established and replace formerly dominant tree species when fire is suppressed. Maple takeover often occurs in concert with a decline in oak species and, to a lesser extent, hickories. *The Changing Illinois Environment: Critical Trends* reported that between 1962 and 1985 maples increased 41-fold while oaks were down 14%. Figure 11 illustrates a ForestWatch site in Pope County that appears to be experiencing maple takeover.

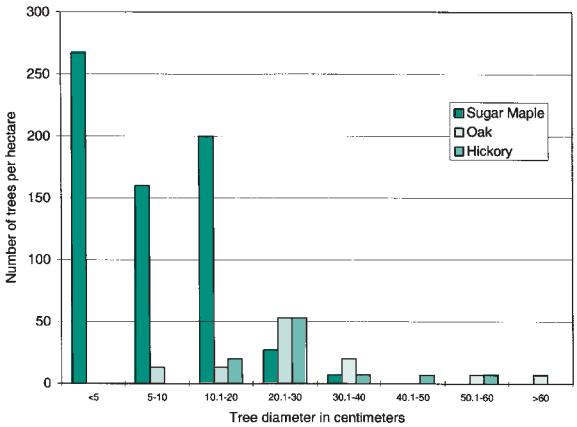


Figure 11. *Maple takeover at Fern Trail Forest*

Finally, ForestWatch volunteers also collected data on the presence of gypsy moth (a pest introduced from Europe) egg masses and signs of dogwood anthracnose. When present in large numbers, gypsy moth caterpillars can defoliate a forest and lead to tree mortality. Currently, they are found primarily in northern Illinois. Anthracnose is a fungal disease introduced from Asia that can decimate flowering dogwoods, which occur primarily in the southern half of Illinois. Anthracnose can be compared to chestnut blight and Dutch elm disease, which have affected chestnut and elm trees across the eastern United States. No gypsy moth egg masses were found at any site, but five of 16 sites with flowering dogwood reported evidence of anthracnose.

Forest Birds

Each species of bird exhibits a different degree of habitat specialization. Some species, such as the introduced European starling, are habitat generalists, which may partially explain why they have successfully spread throughout the country. Other species are highly specific in their habitat requirements, which can include a certain minimum area of habitat as well as a specific type of habitat. The presence or absence of these specialist species can therefore provide information about the quality of a habitat. The 24 species listed in Table 6 are area-sensitive forest-dependent species; their diversity and abundance can serve as indicators of forest conditions in Illinois.

An average of 6.4 forest-dependent bird species was detected at each CTAP site in 1997-1998. These species are expected to decline in abundance as forest habitat is lost or broken into small fragments. Ten of the 24 area-sensitive species are considered

An average of 6.4 forest-dependent bird species was detected at each CTAP site in 1997-1998.

Table 6. *Detection Rates of Area-Sensitive Bird Species, CTAP Forest Sites*

Highly area sensitive	Detection (% sites)	Moderately area sensitive	Detection (% sites)
Pileated woodpecker	16%	White-breasted nuthatch	82%
Ovenbird	16%	Tufted titmouse	78%
Louisiana waterthrush	10%	Yellow-billed cuckoo	66%
Worm-eating warbler (S)	6%	Red-eyed vireo	64%
American redstart	4%	Scarlet tanager	44%
Brown creeper	2%	Wood thrush	42%
Cerulean warbler	2%	Blue-gray gnatcatcher	42%
Veery	0	Acadian flycatcher (As)	40%
Black and white warbler	0	Kentucky warbler (As)	32%
Hooded warbler	0	Yellow-throated vireo	28%
		Hairy woodpecker	22%
Nest parasite		Summer tanager (As)	18%
Brown-headed cowbird	84%	Northern parula	16%
		Yellow-throated warbler (As)	6%

** Species on the edge of their range or those not adequately censused by point counts (e.g. raptors and night birds) are not included*
(S) = predominantly in southern Illinois
(As) = statewide, but predominantly in the south

highly sensitive to fragmentation; an average of only 0.56 of these species were found per site. Although historical data are lacking on the diversity and abundance of these 10 species, the average of less than one species per site clearly reflects the degraded condition of the average forest patch in Illinois.

Partially due to their mobility and the mobility of their predators, birds can respond to disturbance at a regional scale as well as at the local sites where they breed. Because of this, it is useful to monitor bird populations in relation to landscape habitat characteristics. Figure 12 shows that when forest is less abundant at the regional level, bird diversity at randomly selected forest patches is lower than in areas where forest is more widely distributed.

Fragmentation can compound problems caused by the loss of habitat because more fragmentation means more edge habitat. These edges often harbor species that prey on bird nests. Moreover, brown-headed cowbirds, which parasitize the nests of many birds, thrive in open landscapes that have both open habitat for feeding and woodland where they lay their eggs in host nests. Cowbirds were detected from within 84% of the forest patches — a higher detection rate than any of the area sensitive forest species. Because one female cowbird is capable of laying up to 40 or more eggs per year, these figures highlight the impact that cowbirds can have on the reproductive success of forest bird populations in the average forest site.

GRASSLANDS

Prairies once covered 61% of the Illinois landscape. Currently only about 2,300 acres of high quality prairie remain, which is about 0.01% of the presettlement acreage. Although most native prairies have been eliminated, 6,932,409 acres (19.2% of the state) are categorized as "grassland" habitat according to CTAP's land cover database. Most of these areas have been plowed, heavily grazed, or frequently mowed. Often dominated by planted introduced grasses, they do not resemble native prairies. Nonetheless, they may serve as a refuge for some native plant species and provide habitat for grassland-inhabiting animal species whose presence is determined by the extent and structure of the grassland rather than by the plant species in it. CTAP monitoring focuses on the prevalence of introduced species and disturbance-sensitive species. The presence and pervasiveness of these species reflect the ecological condition of the grassland.

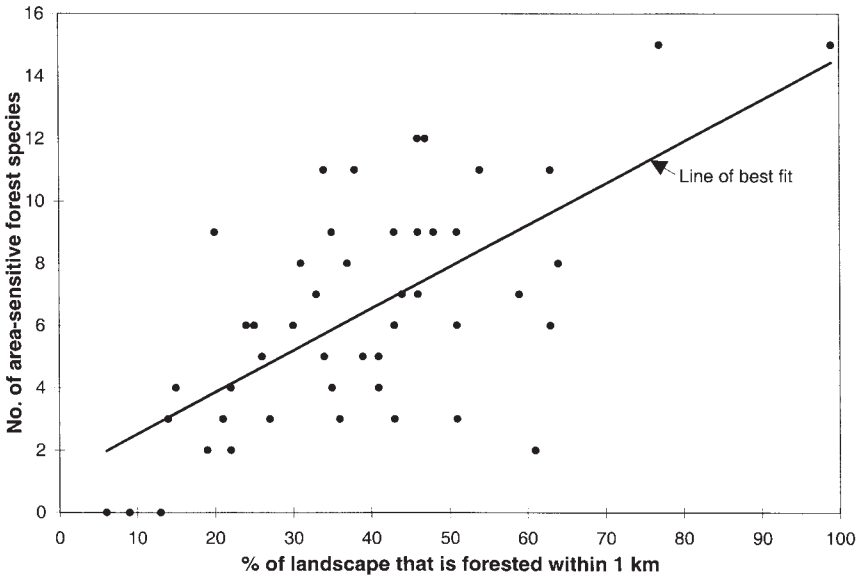


Figure 12. *The relationship between forest bird diversity and the amount of forest in the surrounding landscape*

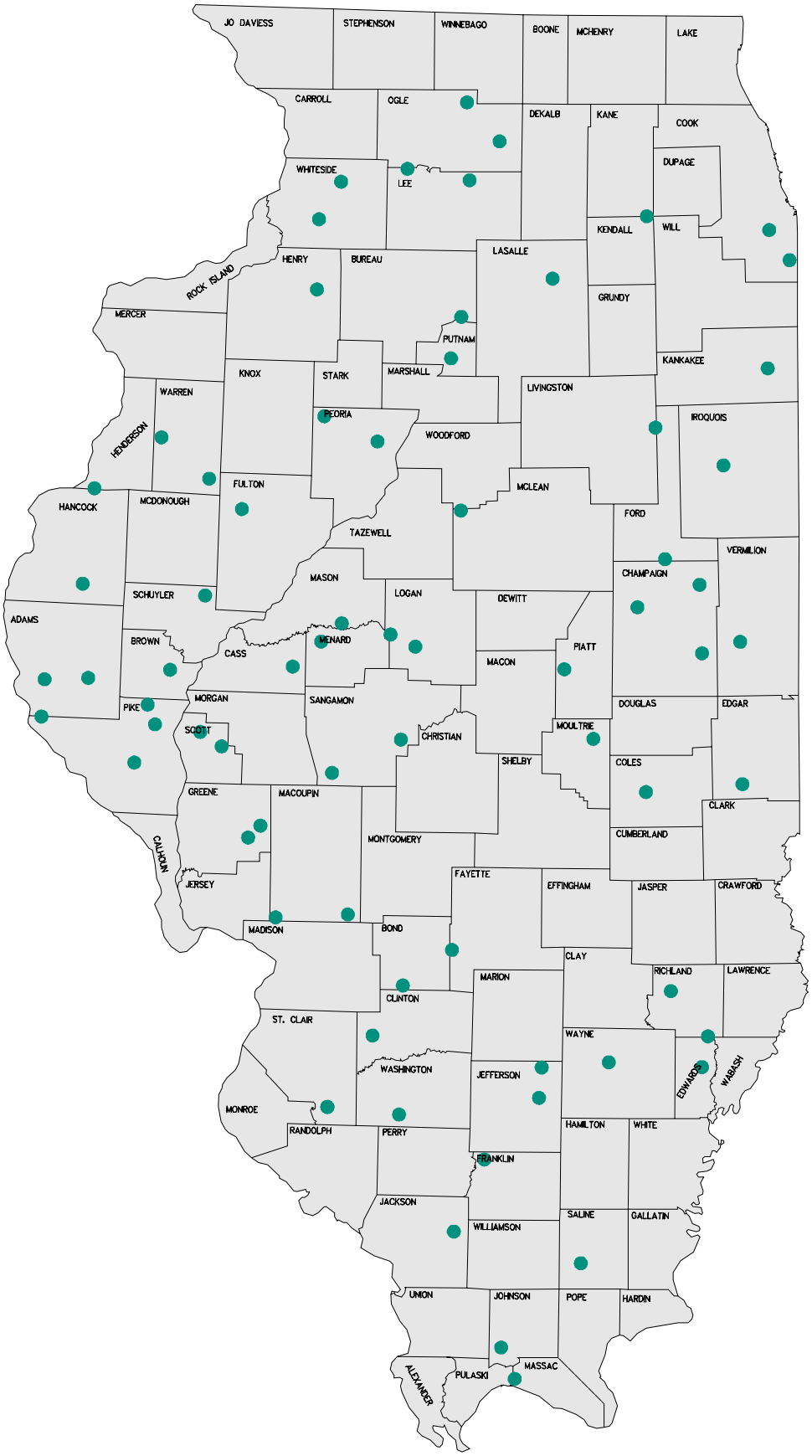
Grassland Plants

From 1997 to 1999 CTAP botanists monitored 71 randomly selected grassland sites (Fig. 13). On average, 8.6 randomly selected potential sites were visited before a grassland site was found that met minimum CTAP criteria for sampling. Many potential sites were rejected because they were planted in monocultures or were otherwise highly manicured. The high rejection rate means that far less than the 19.2% of the state's land cover that is classified as grassland habitat is actually functioning as a natural grassland ecosystem.

Currently only about 2,300 acres of high quality prairie remain, which is about 0.01% of the presettlement acreage.

The monitored sites ranged from planted waterways and roadsides with low species diversity to medium-quality prairies with higher diversity (Table 7). Important indicators of habitat conditions within grasslands include vascular plant species richness and the presence of introduced species. Statewide, the plots at these grassland sites contain an average of 20 plant species; lowest diversity sites averaged six species per site and highest diversity sites (prairie remnants) averaged 33 species per site. By comparison, high quality prairies may contain 100-140 species in only a few acres.

Figure 13. *CTAP Grassland Monitoring Sites, 1997-1999*



Important native species in Illinois grasslands include red top grass, big bluestem, trumpet creeper, switch grass, beadgrass, and common goldenrod.

Table 7. *CTAP Grassland Sites*

Grassland type	% of sites	Average # of plant species per site
Successional field	33%	24
Mowed pasture	14%	16
Lightly grazed pasture	12%	21
Prairie remnant	12%	33
Right-of-way	10%	11
Heavily grazed pasture	7%	15
Utility planted field	7%	9
Within-crop utility strip	5%	6

The grassland sites also averaged seven and one-half non-native species, or 38% of the species detected per site. The number of introduced species was fairly constant across most sites. Of the terrestrial habitats, grasslands were the most heavily dominated by introduced species, with 60 of the 71 sites dominated by them. The grassland layer with the greatest coverage of introduced species was the ground layer (Fig. 14). Introduced shrubs appear to be encroaching upon the state's grasslands, although no one species is dominant. Introduced trees appeared to be a problem only in central Illinois, probably because white mulberry seeds are scattered by birds and species such as osage orange used to be planted as fencerows.

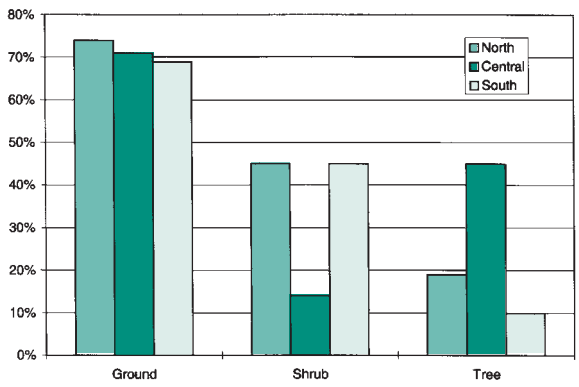


Figure 14. *The percentage of non-native plants* at CTAP grasslands sites, by layer and region*

** the ground layer is measured by the cover of the plants, the shrub layer by the number of stems, and the tree layer by the basal area*

Meadow fescue and Kentucky and Canadian blue grasses, all common pasture mixes, were the dominant introduced species across the state (Table 8). They are prevalent because most Illinois grasslands are no longer native prairie habitats, but instead have been planted or altered with introduced grass mixtures for uses such as pastures and roadsides. Over time, these areas gradually become repopulated with pioneer plant species, with the result that most current grassland habitat contains a mixture of introduced and native plant species.

Grassland Birds

To assure that sample sites are at least marginally suitable for grassland birds, CTAP ornithologists census birds in grassland patches of at least 10

Table 8. *Introduced Species in CTAP Grassland Sites, by Region (number of sites monitored is in parentheses)*

	Northern (14)		Central (41)		Southern (16)		State (71)
Species	# sites	# sites dominant	# sites	# sites dominant	# sites	# sites dominant	# sites
Hungarian brome	9	3	18	5	1	1	28
Meadow fescue	8	1	25	14	10	9	43
Tall fescue	0	0	0	0	3	3	3
Kentucky bluegrass	6	5	22	6	11	0	39
Canadian bluegrass	5	1	7	4	3	0	15
Orchard grass	4	1	11	4	4	0	19

Historically, wetlands covered at least 23% of Illinois. The remaining natural wetlands now occupy only 3.2% of Illinois.

acres. The 12 species listed in Table 9 are highly dependent on grasslands and their presence is an indicator of grassland quality. CTAP detected an average of only 1.8 of these bird species per site in the 45 grasslands censused in 1997-1998. While some of the 12 species do not occur statewide, and high quality sites in southern Illinois might not be expected to have more than about six species, all 12 could occur in high quality grasslands in northern Illinois. Nonetheless, in comparison to historical information, a statewide average of 1.8 species per site is very low. Moreover, the most commonly detected grassland species exhibit only low to moderate sensitivity to grassland fragmentation (i.e. dickcissel, eastern meadowlark). Brown-headed cowbirds were detected at 62% of the sites. This species occasionally parasitizes grassland bird nests and their abundance suggests that reproductive success among grassland birds may be low. In other words, conditions may be worse than what might be inferred based only on census data.

Table 9. *Detection Rates for Grassland Birds*

Bird Species	Sensitivity	Detection rate (% of sites)
Northern harrier*	High	2.2%
Upland sandpiper*	High	not detected
Short-eared owl*	High	not detected
Henslow's sparrow*	High	11.1%
Savannah sparrow	High	2.2%
Bobolink	High	6.7%
Sedge wren	Medium	11/1%
Grasshopper sparrow	Medium	22.2%
Eastern meadowlark	Medium	68.9%
Western meadowlark	Medium	not detected
Dickcissel	Low	51.1%
Vesper sparrow	Low	2.2%
(Brown-headed cowbird)	(Nest parasite)	(62.2%)

** State endangered species*

WETLANDS

Historically, wetlands covered at least 23% of Illinois. In the last two hundred years, Illinois has lost approximately 90% of its wetlands as a result of draining, filling, clearing, and urban development. The remaining natural wetlands now occupy only 3.2% of Illinois, and habitat loss continues.

Furthermore, most remaining wetlands are becoming degraded due to fragmentation, siltation, altered hydrological conditions, and the invasion of introduced species. Highly invasive, introduced plant species such as reed canary grass, the common reed, and purple loosestrife can dominate disturbed wetlands and exclude native plant species, resulting in a loss of biodiversity. Wetland bird and insect communities are especially sensitive to changes in hydrology, plant species composition, and habitat loss. To assess the biodiversity of palustrine emergent wetlands, CTAP scientists monitor changes in species composition, including the prevalence of introduced species and their effects on wetland communities.

Wetland Plants

In comparison to disturbed wetlands, high quality sites are relatively diverse and free from introduced species. Therefore, species richness and the presence of introduced plant species are indicators of habitat quality. CTAP collected plant data in 78 randomly selected sites from 1997 to 1999 (Fig. 15). Species information was recorded from the ground cover, shrub layer, and tree layer (when present). The types of palustrine emergent wetlands monitored ranged from marshes with open water to sedge meadows to wet depressions in fallow agriculture fields. Plant diversity within the sample plots averaged 15 species per site, but ranged from one to 39 species. The most important native species include Joe Pye weed, rice-cut grass, tall reed grass, river bulrush, water smartweed, and broad-leaved cattail.

The average number of introduced species per

Figure 15. *CTAP Wetland Monitoring Sites, 1997-1999*

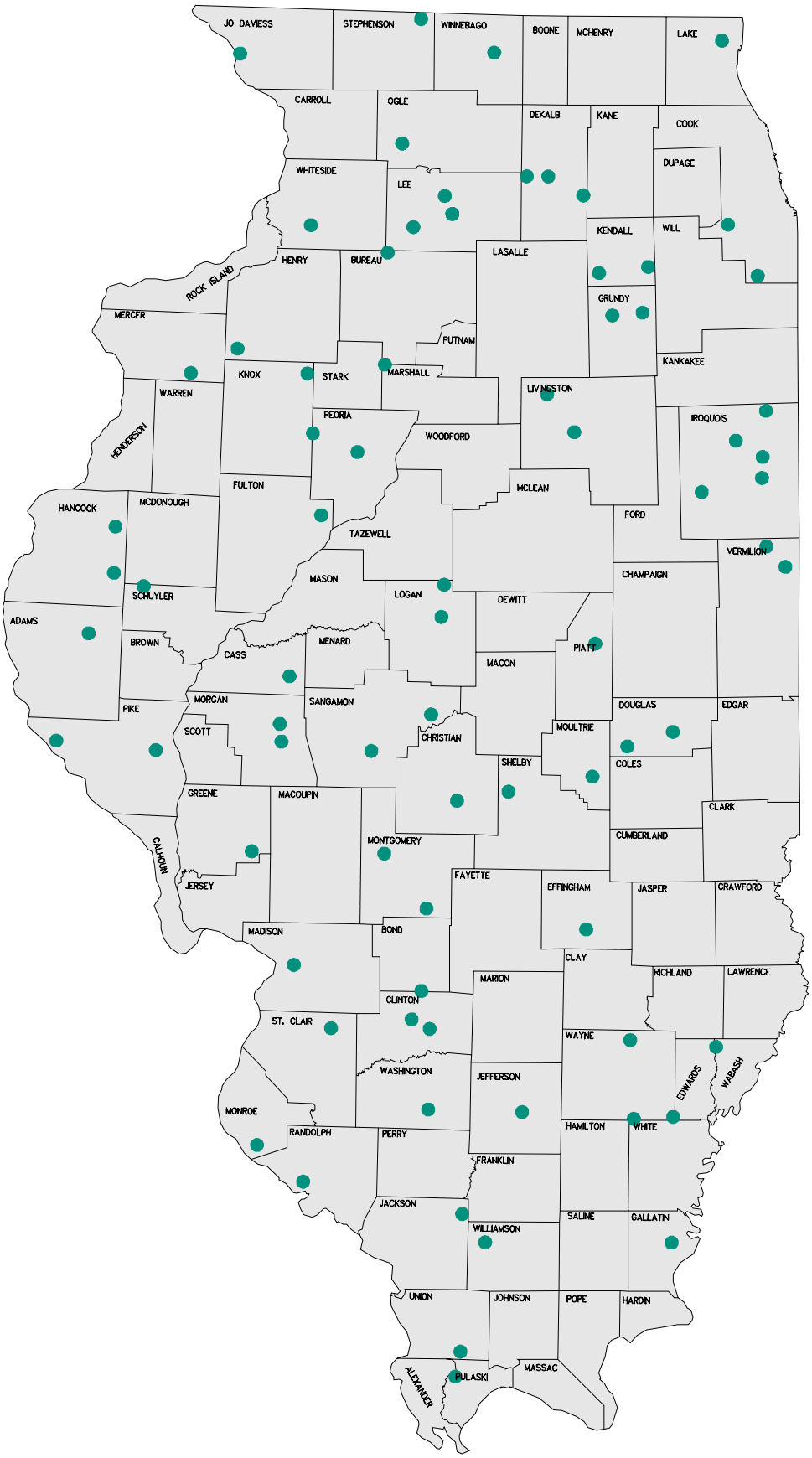


Table 10. *Introduced Species in CTAP Wetland Sites, by Region (number of sites monitored is in parentheses)*

	Northern (22)		Central (37)		Southern (19)		State (78)
Species	**# sites**	**# sites dominant**	**# sites**	**# sites dominant**	**# sites**	**# sites dominant**	**# sites**
Meadow fescue	1	0	6	4	2	0	9
Narrow-leaved cattail	2	1	0	0	5	0	7
Reed canary grass	13	6	20	16	5	2	38
Barnyard grass	2	0	7	1	6	0	15
Common reed*	1	0	0	0	5	5	6

** Species locally native in Illinois, but becoming invasive out of its original range*

site was two; those of greatest concern were several grasses and the narrow-leaved cattail (Table 10). Northern and central Illinois wetlands were most heavily dominated by reed canary grass and meadow fescue, while southern Illinois wetlands most often contained the common reed — an invasive native species.

A higher percentage of introduced species were generally found at lower diversity sites. Where reed canary grass — the most commonly encountered introduced species — was found it had replaced most native species, often nearly forming a monoculture. Reed canary grass was, in fact, the dominant species at 22 of the 78 sites sampled. While most Illinois wetlands have been altered, some monitored sites are still diverse and contain a high proportion of native species, particularly in Southern Illinois (Fig. 16).

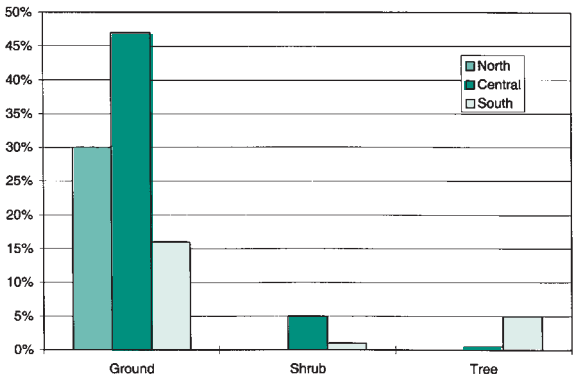


Figure 16. *The percentage of non-native plants* at CTAP wetland sites, by layer and region*

** the ground layer is measured by the cover of the plants, the shrub layer by the number of stems, and the tree layer by the basal area*

Wetland Birds

While many of the bird species that use wetlands are able to live in other habitats as well (e.g. red-winged blackbird), the 31 species listed in Table 11 are dependent on wetlands and their presence serves as an indicator of wetland conditions.

Although at least 15 wetland-dependent species occur in southern Illinois and at least 27 species occur in the north, a statewide average of only 1.3 wetland-dependent species per site was detected at the 50 sites censused in 1997 and 1998. No wetland-dependent species were detected at half the sites, and only 16 of the 31 wetland-dependent species were detected; only six species were found in at least 10 sites. Twelve of 35 state threatened or endangered bird species are wetland-dependent, yet only three were detected, at one site each. Their rarity further reveals the degraded condition of the average wetland in Illinois.

Table 11. *Detection Rates for Wetland Birds*

Bird Species*	Illinois Status	Detection Rate (% of Sites)	Geographic Distribution
Pied-billed grebe	Threatened	2%	Statewide
Double-crested cormorant		2%	Statewide
American bittern	Endangered	not detected	Mostly northern IL
Least bittern	Threatened	2%	Mostly northern IL
Great blue heron		24%	Statewide
Great egret		6%	Statewide
Snowy egret	Endangered	not detected	Southern IL only
Little blue heron	Endangered	not detected	Southern IL only
Cattle egret		2%	Southern IL only
Green heron		4%	Statewide
Black-crowned night-heron	Endangered	not detected	Statewide
Yellow-crowned night-heron	Endangered	not detected	Southern IL only
Mute swan		not detected	Northern IL only
Canada goose		10%	Statewide
Wood duck		16%	Statewide
Mallard		16%	Statewide
Blue-winged teal		8%	Statewide
Hooded merganser		not detected	Statewide
King rail	Endangered	2%	Mostly northern IL
Virginia rail		not detected	Mostly northern IL
Sora		not detected	Mostly northern IL
Common moorhen	Threatened	not detected	Mostly northern IL
American coot		not detected	Mostly northern IL
Sandhill crane	Threatened	not detected	Northern IL only
Spotted sandpiper		4%	Statewide
Common snipe		not detected	Northern IL only
Black tern	Endangered	not detected	Northern IL only
Willow flycatcher		16%	Statewide
Marsh wren		4%	Northern IL only
Swamp sparrow		10%	Northern IL only
Yellow-headed blackbird	Endangered	not detected	Northern IL only

** An additional three wetland-dependent species (Forster's tern, black rail, and Wilson's phalarope) are on the state's threatened and endangered species list, but they are excluded from this analysis because Illinois is on the edge of their range and their occurrence in the state is extremely rare and sporadic.*

STREAMS

EPT taxa richness measures the number of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) found.

The rivers and streams within and bordering Illinois, totaling approximately 87,000 river miles, once supported a highly diverse community of plants and animals. At the dawn of the 20th century, most Illinois streams had sinuous courses with associated rich marshes and swamps. The stream banks were lined with protective vegetation that reduced the likelihood of bank failures and heavy erosion. Since then agriculture and development have drastically reduced the health of our streams — marshes and swamps have disappeared, streams have become turbid, and their channels have been straightened and levied. Some species of freshwater mussels, environmentally sensitive aquatic insects, and fish that were once common to Illinois waters have been extirpated from the state. Nonetheless, it appears that Illinois streams have survived the worst period of degradation. Improvements in municipal sewage treatment and better agricultural practices have dramatically improved the health of Illinois streams in the past three decades.

To assess current stream quality, CTAP scientists use environmental indicators that change predictably with watershed disturbances such as organic enrichment, stream channelization, or removal of natural riparian vegetation.

- Water chemistry — conductivity, dissolved oxygen, pH, and water temperature
- Habitat quality index — 12 parameters are scored during stream visits
- Aquatic insects
  - EPT taxa richness — measures the number of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) found
  - Hilsenhoff's Biotic Index (HBI) — measures organic enrichment in streams as well as a wide range of watershed disturbances
- Fishes
  - fish species richness and dominance
  - diversity and abundance of hybrid and exotic species

RiverWatch volunteers collect 33 taxa of benthic macroinvertebrates — nine EPT taxa as well as snails, mussels, aquatic worms, and crayfish — and calculate a set of stream quality indicators similar to those used by CTAP scientists.

- EPT taxa richness
- total taxa richness
- macroinvertebrate taxa dominance
- Macroinvertebrate Biotic Index (MBI), an index similar to the HBI, based on the pollution tolerance values for the 33 taxa sampled

Between 1997 and 1999, CTAP scientists sampled 89 stream sites (Fig 17). Between 1995 and 1999 RiverWatch volunteers monitored 580 stream sites along 447 streams (Fig. 18). Volunteers collected more than 1,300 samples of macroinvertebrates. In the following discussion, data for both programs are presented as averages for the state as a whole and for the 10 ISIS watersheds (Fig. 19).

Table 12. *Number of Streams and Sites Monitored by RiverWatch*

Watershed	Streams in watershed*	1995 Streams/Sites	1996 Streams/Sites	1997 Streams/Sites	1998 Streams/Sites	1999 Streams/Sites	Total Streams/Sites
Rock	190	9/10	29/35	34/40	36/47	32/47	50/75
Fox/Des Plaines	135	9/9	30/42	39/64	61/110	55/88	74/139
Kankakee/Vermilion/ Mackinaw	174	8/11	17/21	9/10	8/9	14/20	28/40
Spoon	133	10/10	15/16	13/16	15/17	14/15	29/34
Sangamon	136	2/2	20/21	11/11	3/3	10/10	28/30
LaMoine	191	16/18	22/23	29/37	32/38	35/41	53/64
Kaskaskia	195	4/4	29/30	43/48	41/43	40/42	61/69
Embarras/Vermilion	153	19/23	17/21	10/14	10/11	14/17	32/43
Little Wabash	120	4/4	4/4	3/3	4/4	5/5	7/7
Big Muddy/Saline/Cache	160	15/16	33/36	43/45	49/55	51/56	68/79
TOTAL	1587	96/107	216/249	234/288	259/337	270/341	447/580

** Number of streams is based on the ISIS database, which includes all streams that drain at least 10 square miles. RiverWatch volunteers sometimes monitor streams with smaller drainage areas.*

Figure 17. *CTAP Stream Monitoring Sites, 1997-1999*

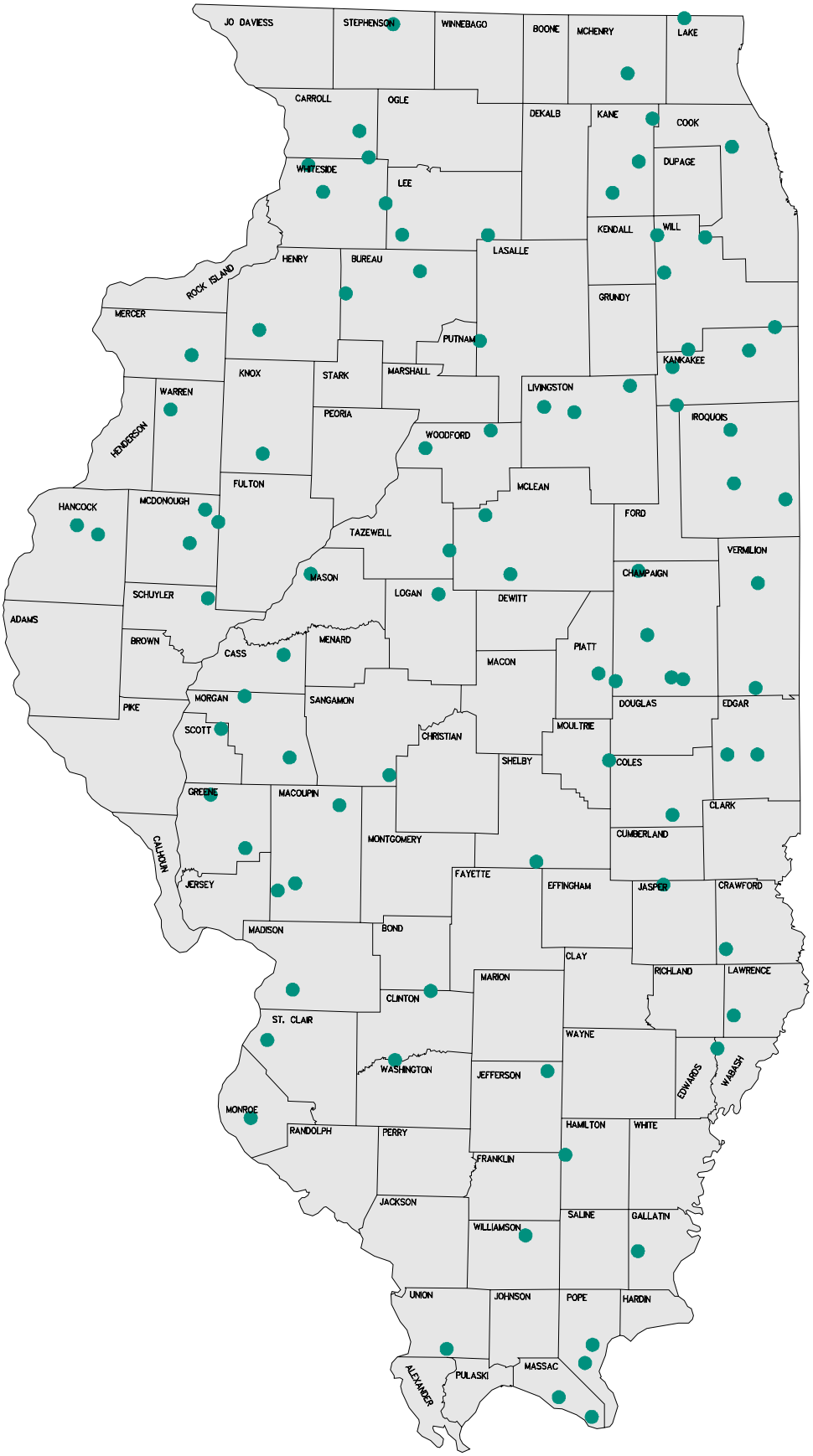


Figure 18. *RiverWatch Monitoring Sites, 1995-1999*

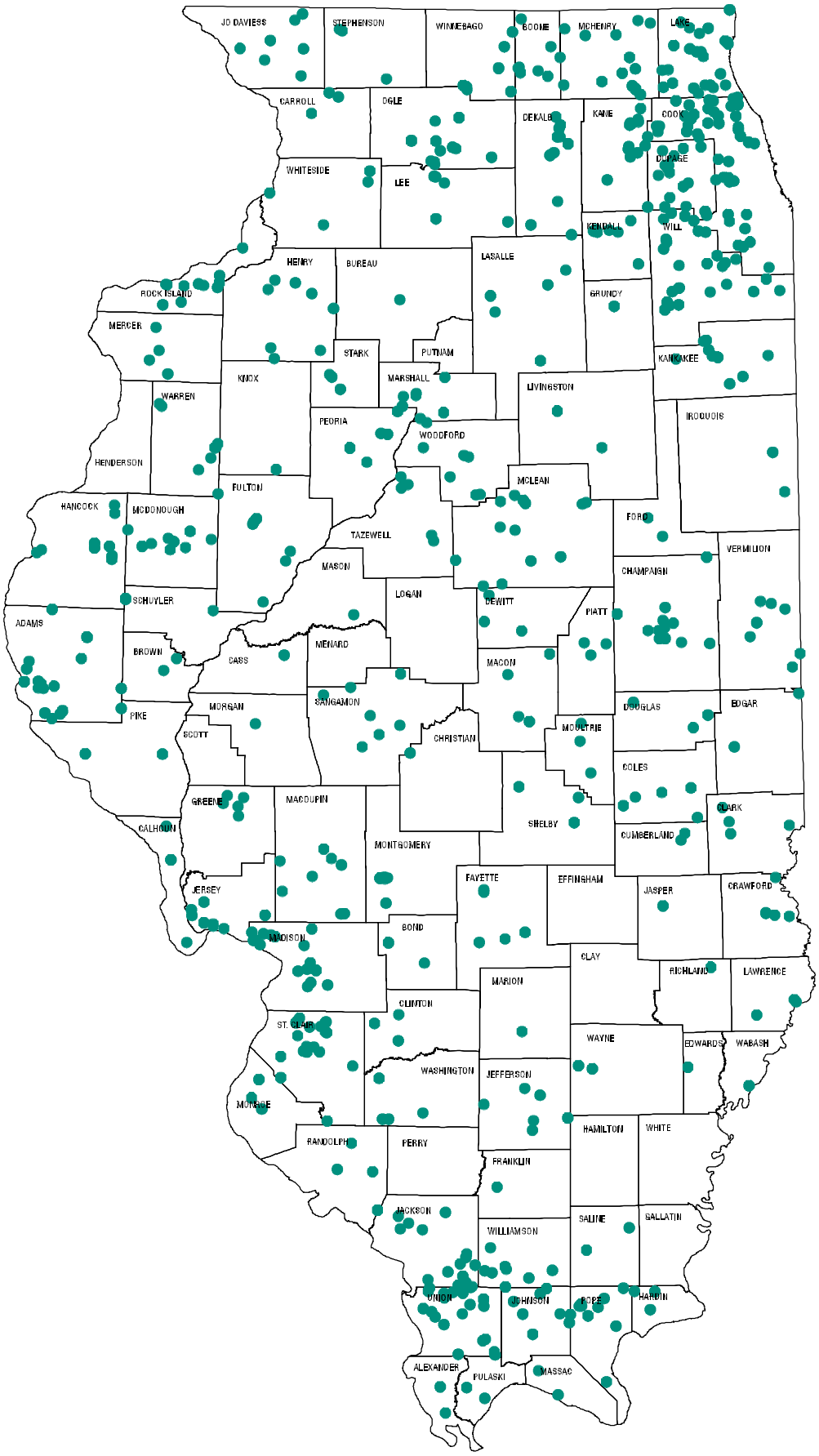
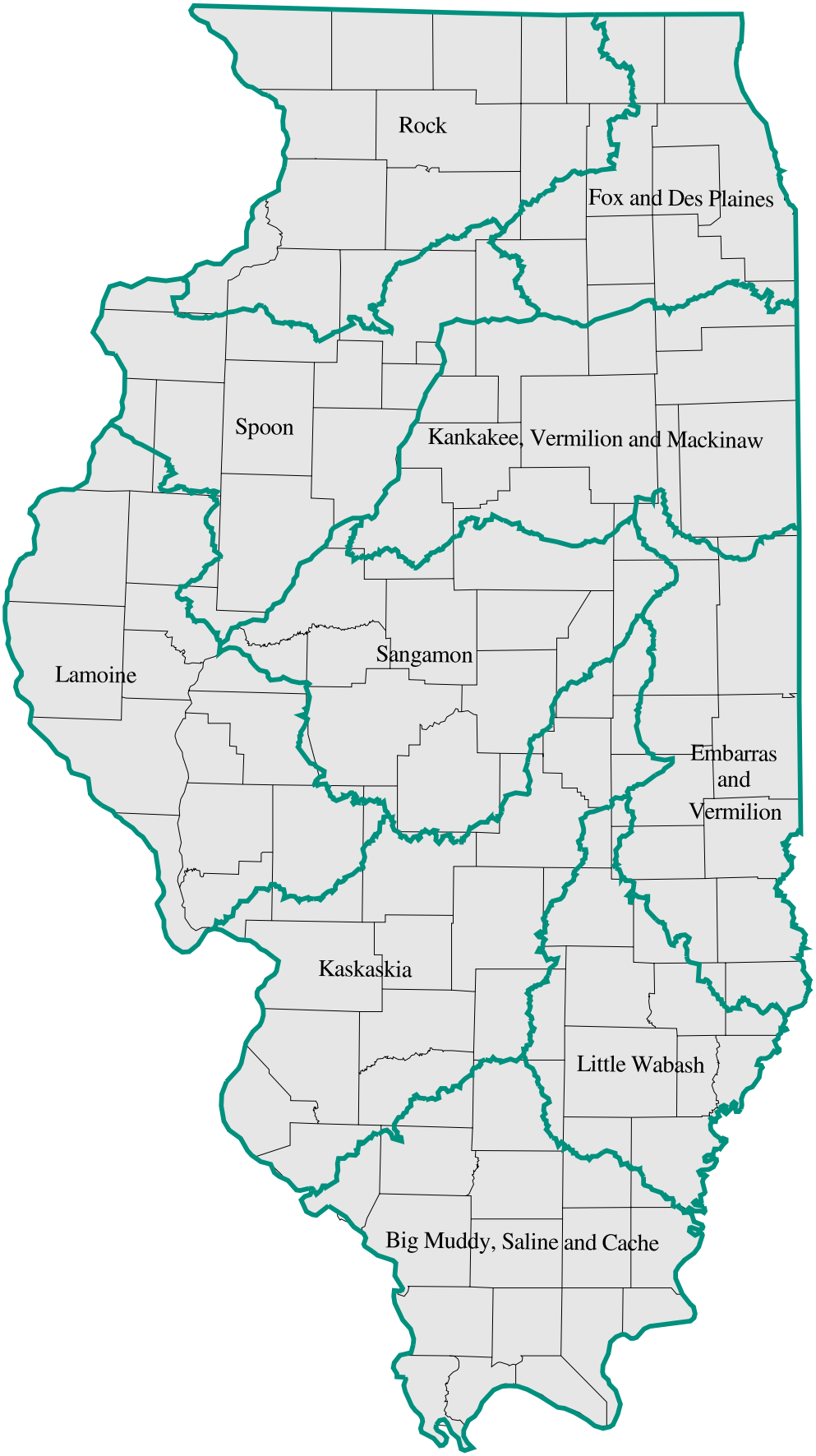


Figure 19. *Illinois Streams Inventory System (ISIS) Watersheds*



Water Chemistry and Temperature

Water chemistry can give important clues as to the types of environmental stressors that are affecting a watershed. For example, conductivity increases with greater concentrations of dissolved particles, particularly charged ions, in water. Because it generally increases with greater human population densities, it has been used as an index of urbanization. (Conductivity can also be higher in streams

The average stream in Illinois displayed only fair habitat quality.

that drain areas with certain types of bedrock.) Dissolved oxygen concentration fluctuates with temperature, organic pollution load, and exposure to sunshine. Hydrogen ion concentration, expressed as pH, usually increases with urbanization and increasing rates of photosynthesis caused by loss of stream canopy. Water temperatures also tend to be higher in urban and agricultural areas.

Streams in the Big Muddy/Cache/Saline and Little Wabash watersheds displayed relatively low conductivity because they drain low nutrient soils, sandy soils, or sandstone bedrock areas. The Fox/Des Plaines and Rock River watersheds had the highest average conductivity; in the former it was largely due to high population densities and associated organic wastes while in the latter high conductivity was due to dissolved ions from dolomite bedrock.

Dissolved oxygen was generally high and fully saturated throughout the state. Three of 10 basins demonstrated supersaturated conditions (having more oxygen than predicted for their temperature). This is usually due to high photosynthetic rates fostered by an open canopy. Only the Kaskaskia River basin demonstrated any appreciable reduction from full saturation. Several streams in that watershed were exceedingly slow flowing, heavily canopied, and received organic wastes from grazing cattle. These conditions reduced oxygen saturation. The pH of streams statewide was slightly alkaline; only the Little Wabash basin scored close to neutral. Stream temperature averaged near 17˚C statewide, with the Big Muddy/Cache/Saline and Sangamon river basins providing the highest average temperatures.

Habitat Quality Assessment

The habitat quality index, modified from the United States Environmental Protection Agency, provides a numerical measure of human induced physical disturbance as well as the ability of the stream to provide hiding and feeding places for aquatic organisms. CTAP scientists score 12 habitat parameters that relate to the quality and width of shoreline vegetation, quantity and quality of in-stream cover (e.g. coarse mineral and organic substrates and undercut banks), the condition of banks, and relative straightness of the stream course. The index provides a numerical score, ranging from zero to 180 points, that increases with stream quality. Actual scores ranged from 25, indicating severe landscape and drainage alterations, to 146, indicating an aquatic and riparian resource of the highest quality. The statewide average was 88.6, indicating that the average stream in Illinois displayed only fair habitat quality.

Most Illinois streams lack natural habitat features such as wooded riparian (streamside) corridors, winding stream channels (many are channelized), and stable in-stream habitat such as coarse rocks and wood debris (often removed to improve drainage). Highly agricultural ISIS basins, including the Kankakee/Vermilion N./Mackinaw, the Kaskaskia, Rock, Spoon, and Embarras/Vermilion S. watersheds, scored below the statewide average for habitat quality (Fig. 20). Streams in these areas have been modified to drain row crop fields rapidly. The Sangamon and Little Wabash basins, on the other hand, scored higher than the statewide average because more of their streams are larger and flood-prone, discouraging row crop agriculture close to the streams.

Aquatic Insects/Benthic Macroinvertebrates

Taxa Richness: The EPT taxa richness index measures the number of EPT taxa (species relatively

intolerant of pollution) present in a sample — higher index values indicate less organic pollution. EPT are most diverse in natural streams and decline with increasing watershed disturbance. EPT richness ranged from zero to 17, suggesting that stream health ran the gamut from poor to excellent across the 59 sites sampled by CTAP scientists. Statewide, the average was 7.1 EPT taxa per stream, indicating that most streams were in only fair condition.

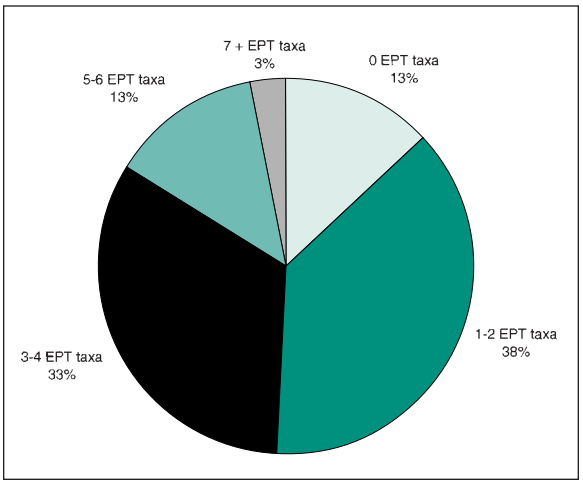


Figure 22. *Distribution of EPT taxa richness, RiverWatch*

ISIS basins with the lowest EPT score (implying poorest condition) were the Kaskaskia and Kankakee/Vermilion N./Mackinaw watersheds. These are highly agricultural areas that offer extremely monotonous habitat for EPT species. Alternatively, the Embarras/Vermilion S., Spoon, and Sangamon watersheds had the highest EPT richness (Fig. 21). The Rock River watershed was historically one of the richest for EPT species in the state. Currently, it supports less than the statewide average.

The average EPT taxa richness at RiverWatch sites was 2.6, much lower than the CTAP average because RiverWatch collects only nine EPT taxa. RiverWatch EPT taxa richness reached a high of 2.9 in 1999, although this followed a low of 2.3 in 1998; no clear trend is discernible. The Spoon, Big Muddy/Saline/Cache, Kankakee/Vermilion/Mackinaw, and Embarras/Vermilion watersheds fared better than the average. At the opposite end of the spectrum were the Kaskaskia, Little Wabash, and Fox/Des Plaines watersheds. Figure 22 shows the distribution of EPT taxa richness for all RiverWatch samples.

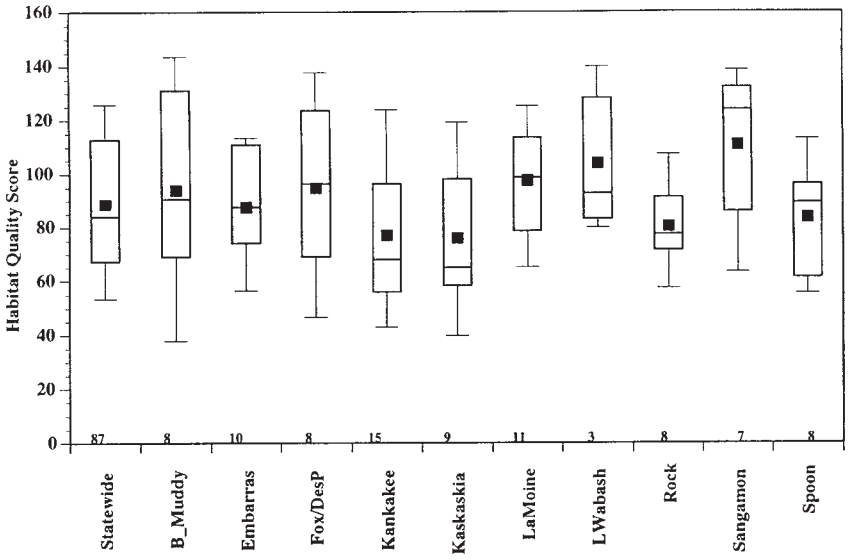


Figure 20. *Distribution of average habitat quality scores statewide and for 10 ISIS watersheds*

Note: squares indicate the mean, the horizontal line in the box indicates the median, box denotes 25-75 percentiles, while vertical lines denote 10-90 percentiles. Number of observations are indicated above category labels.

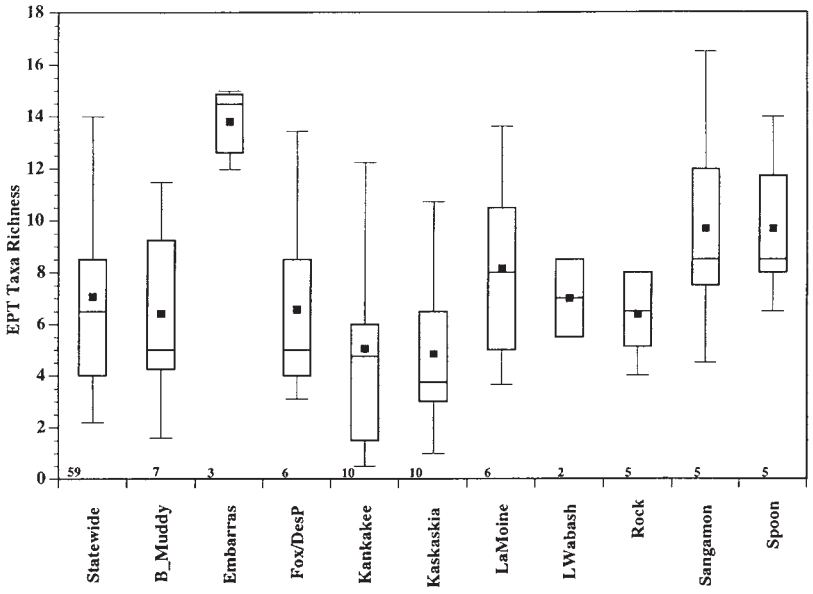


Figure 21. *Distribution of average EPT taxa richness statewide and for 10 ISIS watersheds*

Note: squares indicate the mean, the horizontal line in the box indicates the median, the box denotes 25-75 percentiles, while vertical lines denote 10-90 percentiles. Number of observations are indicated above category labels.

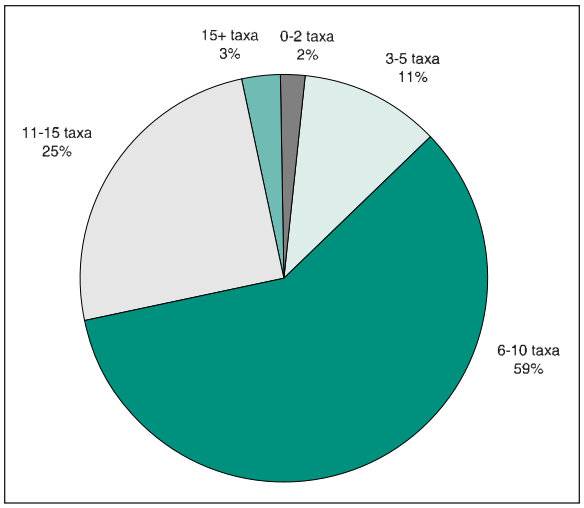


Figure 23. *Distribution of total taxa richness, RiverWatch*

Total taxa richness, calculated for RiverWatch sites, specifies the number of distinct taxa identified at a stream site — a more diverse array of taxa indicates better stream health. Taxa richness averaged 8.9 taxa per sample overall. More than one-fourth of samples had 11 or more taxa, nearly three-fifths had from six to ten taxa, and one-eighth had fewer than six taxa. The highest taxa richness was found in the Spoon, Big Muddy/Saline/Cache, and the Embarras/Vermilion watersheds. The lowest average taxa richness was recorded for the Kaskaskia and Little Wabash watersheds.

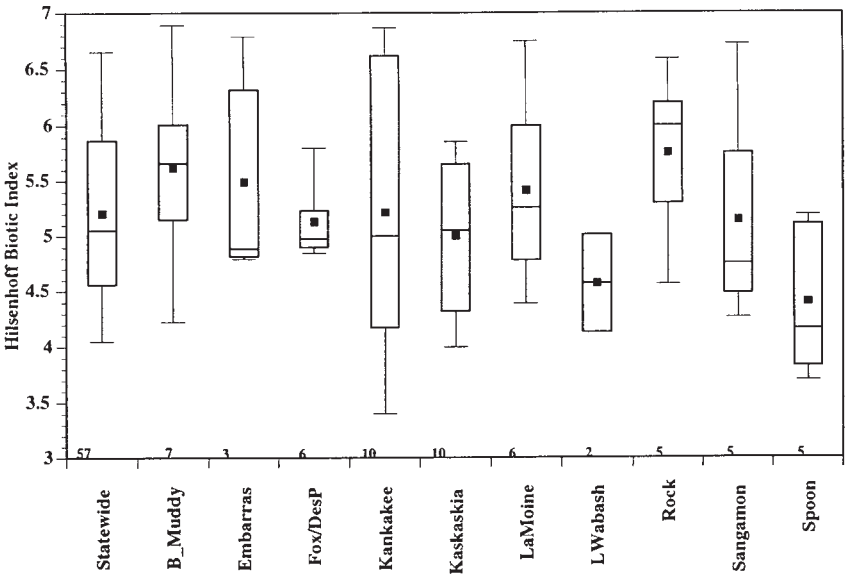


Figure 24. *Distribution of average HBI scores statewide and for 10 ISIS watersheds*

Note: squares indicate the mean, the horizontal line in the box indicates the median, the box denotes 25-75 percentiles, while vertical lines denote 10-90 percentiles. Number of observations are indicated above category labels.

Indices of Organic Pollution: The Hilsenhoff Biotic Index (HBI), developed by aquatic biologists in Wisconsin, provides an overall index of pollution tolerance for an EPT sample. Developed as an index of organic enrichment (livestock and human wastes entering streams), it also detects multiple forms of watershed disturbance. Individual species tolerances range from zero to 10, with higher numbers indicating greater tolerance to disturbance. The index measures the weighted-average pollution tolerance value for all EPT taxa in a sample — a lower score indicates better stream quality. HBI scores at CTAP sites ranged from 3.1, indicative of a healthy stream, to 7.1, which suggested moderate-to-severe organic enrichment and disturbance (Fig. 24). Statewide, the average score was 5.2, demonstrating that streams were moderately impaired and had EPT fauna that were moderately tolerant of organic pollution and overall stream disturbance. Relatively few streams had taxa intolerant of these conditions. Streams that displayed the lowest scores were in the Spoon River basin and those with the highest HBI scores were in the Rock River basin.

The Macroinvertebrate Biotic Index (MBI), modified from Wisconsin's family level HBI tolerances, provides a weighted-average of the pollution tolerance of organisms in a RiverWatch sample. If pollution-intolerant taxa such as stoneflies are found in a stream, it indicates that organic pollution is low or modest. On the other hand, if the stream is dominated by pollution-tolerant taxa such as aquatic worms, the stream is probably polluted.

RiverWatch MBI values averaged 5.7 over the four-year period 1995 to 1999 (Table 13). Values declined from 6.3 to 5.5 during this time, suggesting improved quality, but the decline may have been an artifact of improved training. Southern Illinois has some of Illinois' least disturbed habitats, so it is not surprising that the Big Muddy/Cache/Saline watershed had one of the lowest five-year averages, as did the Spoon. The Sangamon, Kankakee/Vermilion N./Mackinaw, and Rock watersheds also had better-than-average MBIs. The Little Wabash basin had the worst MBI, followed by the Embarras/Vermilion S., Kaskaskia, and Fox/Des Plaines watersheds.

Table 13. *MBI: Mean, Standard Deviation, and Range*

	Mean	Standard Deviation	High	Low
1995	6.3	1.7	10.8	2.7
1996	5.7	1.0	9.9	1.3
1997	5.8	1.2	11.0	2.4
1998	5.6	1.1	11.0	1.7
1999	5.5	1.0	9.7	2.0
Overall	5.7	1.2	11.0	1.3

Taxa Dominance: Taxa dominance, calculated for RiverWatch, measures the percentage of the three most common taxa compared to the rest of the sample. Dominance by just a few taxa indicates lower stream quality. Taxa dominance averaged 80.4% statewide, with ISIS watershed averages ranging from 77.2 to 85.9%. The Spoon and the Big Muddy/Cache/Saline watersheds had the lowest taxa dominance, demonstrating better health. The Kaskaskia, Little Wabash, and LaMoine showed the biggest problems with taxa dominance, indicating that they were the least healthy. Six taxa are most often associated with taxa dominance in Illinois streams — sowbugs, caddisflies, midges, scuds, black flies and mayflies (Fig. 25).

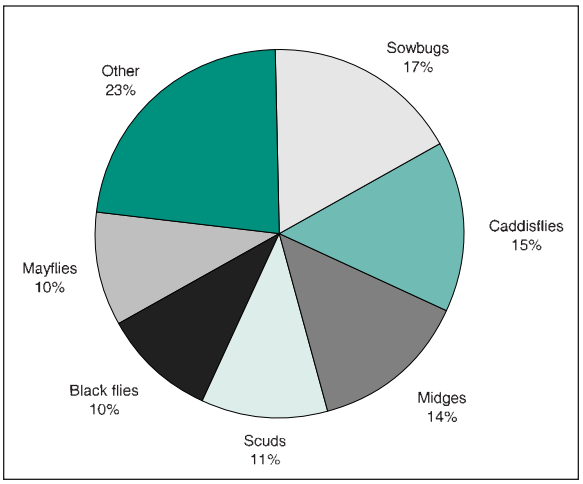


Figure 25. *Most common macroinvertebrates sampled by RiverWatch*

Fishes

Fish species, due to their greater mobility, tend to indicate environmental changes on a watershed scale. Total native fish species richness, fish species dominance, and the number of exotic and hybrid species are used as indicators of watershed disturbance.

CTAP scientists sample fishes in randomly selected small streams — 30 CTAP sites are sampled each year with a total of 150 sites sampled over a five-year period. They also obtain samples from IDNR fisheries biologists who focus on larger streams. The IDNR fisheries samples are gathered from 514 stations in all 33 hydrologic units in Illinois over a five-year period. Approximately 160 IDNR fisheries sites are sampled every year.

Eleven native fish species have been extirpated from the state since the turn of the century.

Fish Species Richness: Illinois has a rich diversity of fishes: 188 native species that include colorful darters and the unique ancient fishes — sturgeon, paddlefish, and gars. Each species differs in its sensitivity to various types of environmental disturbance, and some species are quickly lost when ecosystems are disturbed. From earlier studies, we know that 11 native fish species have been extirpated from the state since the turn of the century; currently there are 31 species on the state's list of threatened and endangered species.

The statewide average for native fish richness is 13.6 species at the 58 CTAP fish sites sampled in 1998 and 1999. The Embarras basin is by far the richest, while basins that supported the fewest species are the LaMoine and the Spoon (Fig. 26).

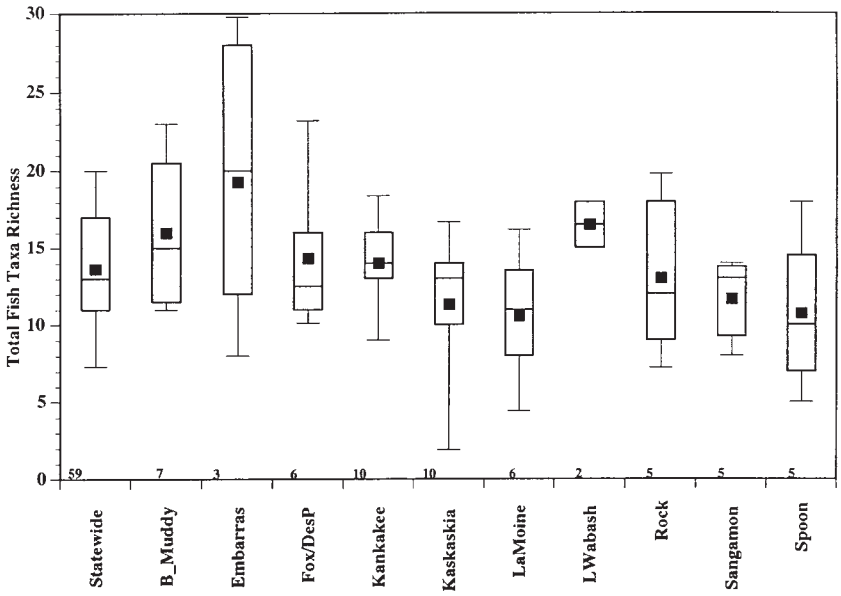


Figure 26. *Distribution of average native fish species richness statewide and for 10 ISIS basins*

Note: squares indicate the mean, the horizontal line in the box indicates the median, the box denotes 25-75 percentiles, while vertical lines denote 10-90 percentiles. Number of observations are indicated above category labels.

Fish Species Dominance: Streams that support large numbers of a relatively few species, as opposed to those with low-to-moderate numbers of many species, are generally thought of as being degraded. Moreover, in cases where one or a few species are abnormally dominant, those species are usually disturbance-tolerant. When the number and quality of microhabitats (pools, riffles, undercut banks, stable sand bars) are reduced it tends to eliminate habitat specialists, leaving behind mostly habitat generalists. For instance, when sedimentation becomes severe the variability of pool depth decreases while the expanse of shifting sand bottom with shallow water overhead increases. Species such as the sand shiner and bluntnose minnow, habitat generalists, often become dominant in this situation.

Of the seven IDNR basins surveyed, Salt Creek — a large tributary of the Sangamon River — has the largest percentage of the three most abundant fish species (Fig. 27). This basin receives tremendous quantities of water because much of the watershed is tiled. The increased runoff has eaten away at banks, making the streambed wider, and deposited tremendous quantities of sand and silt, promoting extremely high numbers of red and sand shiners and bluntnose minnows, all habitat generalists. The Vermilion River watershed in eastern Illinois also shows high dominance, despite the Middle Fork being a designated National Scenic River. The western drainage is highly agricultural and has been degraded due to sedimentation, sewage discharge and cattle grazing in the early 20th century. The drainage is dominated by a relatively few species including bluntnose minnows, striped shiners, and longear sunfish, all habitat generalists. Although one might consider the Vermilion River and Salt Creek to be in better condition based on their higher species richness, this pattern of abundance suggests the communities are out of balance.

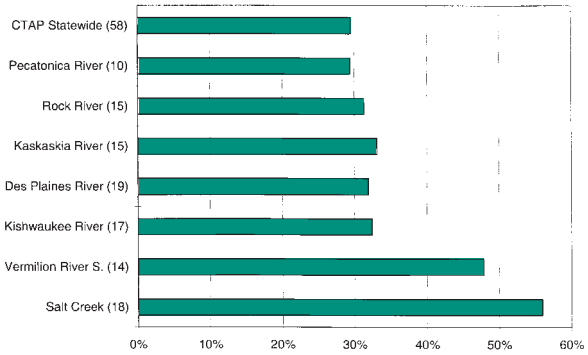


Figure 27. *The relative proportion of the three most abundant species sampled in each of seven IDNR Fisheries watersheds and the CTAP statewide average*

Note: the number of samples are in parentheses

Diversity and abundance of hybrids and exotic species: Many exotic (non-native) fish species and hybrids (crosses between different species) have been released or escaped into Illinois streams. Since the 1880s, 15 exotics have been recorded in the state. Occasionally these taxa thrive and become dominant components of fish communities, often at the expense of native species. Moreover, many exotics and hybrids thrive under disturbed conditions and their presence can be an indicator of stress. While hybrids are few in number across the IDNR fisheries basins as well as CTAP sites, exotics are relatively abundant in the Des Plaines and Pecatonica basins (Fig. 28). The Des Plaines watershed is highly urbanized, while a large

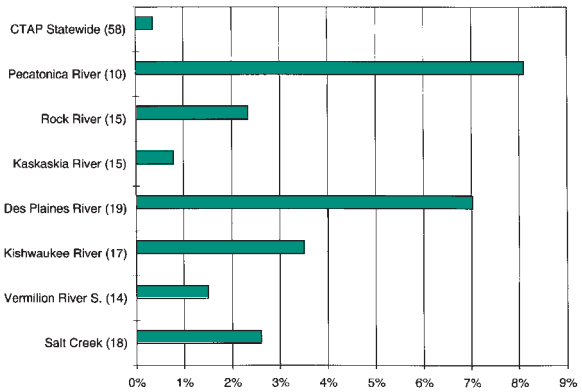


Figure 28. *Percentage of exotic species at seven IDNR Fisheries basins and the CTAP statewide average.*

Note: the number of samples are in parentheses

dairy industry is located in the Pecatonica watershed. The Kaskaskia basin, on the other hand, supported the fewest exotics even though it is a highly modified, agricultural basin. CTAP monitoring suggests that exotics are of relatively minor importance, but this may be a consequence of the program's random sampling design and its focus on smaller streams than those sampled by IDNR Fisheries. Small streams often have fewer exotic species than large ones.

Although water quality is likely to improve, the abundance of exotic species is unlikely to decrease soon. For example, grass, bighead, and silver carps have been recently introduced; all have the capacity to outcompete many of our native fish species and to alter habitat by uprooting aquatic plants, thereby increasing turbidity.

Conclusion

Streams in Illinois have experienced drastic modification over the past 150 years. Most streams that drain prairie landforms have been straightened, their canopies removed, and their watersheds tiled to drain fields more rapidly. Historical data confirms the loss of several fish, mussel, and aquatic insect species from what was a very diverse aquatic setting. Habitat quality scores most readily confirm this degradation. Water chemistry "snap shots" demonstrate that centers of high human population density and agriculture have changed the chemical signature of streams through the release of effluents and the loss of riparian vegetation. EPT and fish community characteristics demonstrate some drastic differences across ISIS basins in the state.

Table 14 summarizes the picture presented by CTAP scientist and RiverWatch volunteer data. It shows the importance of using multiple measures of stream quality — no watersheds scored high on all of them. The Spoon River, for example, scored high in all measures of macroinvertebrate diversity and pollution tolerance — its streams have a diverse macroinvertebrate community that is generally intolerant of pollution. On the other hand, the watershed has only average habitat quality and below-average fish diversity. The Embarras/Vermilion S. watershed has both diverse macroinvertebrate and fish communities, but poor HBI and MBI indices — the organisms are tolerant of pollution. Several watersheds scored near average or below average on most indicators, including the Rock, Fox/Des Plaines, and LaMoine. The Kaskaskia watershed scored consistently low on virtually every indicator.

In a couple of instances, the volunteer and professional data seem contradictory. In the case of the Little Wabash watershed very few sites were monitored, so more data is needed before stream quality can be judged. In the Big Muddy/Saline/Cache, CTAP scientists found the quality to be below average, reflecting that several of their randomly selected sites were in the intensively farmed Big Muddy and Saline basins. RiverWatch volunteers mostly monitored streams in the Cache basin or Shawnee Forest, and the stream quality indicators illustrate the relatively pristine nature of this area.

Table 14. *Basins with Notably Better or Worse Indicator Values Relative to the Average*

	HBI	MBI	EPT Richness	EPT Taxa(RW)	Taxa Richness	Taxa Dominance	Native Fish	Darter Richness	Exotic Species	Habitat Score
Rock	–	+							–	–
Fox/Des Plaines		–			–				–	+
Kankakee/Vermilion/ Mackinaw		+	–	+	+	+			–	–
Spoon	+	+	+	+	+	+	–		+	
Sangamon		+	+				–	+	+	+
LaMoine						–	–	–	+	+
Kaskaskia		–	–	–	–	–	–	–	–	–
Embarras/Vermilion	–	–	+	+	+		+	+	+	
Little Wabash	+	–		–	–	–	+	+	+	+
Big Muddy/Saline/ Cache	–	+		+	+	+	+		–	

Note: Blank cells indicate values near the average, '+' indicates greater than 1/2 standard deviation above the average, '-' indicates more than 1/2 standard deviation below the average.

Most streams that drain prairie landforms have been straightened, their canopies removed, and their watersheds tiled to drain fields more rapidly.

CORRELATING AQUATIC INDICATORS

CTAP uses several aquatic indicators to monitor stream quality. The most valuable indicators are those that contribute unique information about stream quality and are also correlated with other indicators. The table below shows where relationships between indicators are strongest. For example, EPT richness is significantly correlated, in a negative fashion, with the HBI; RiverWatch EPT taxa richness is similarly correlated with the MBI. This fits the hypothesis that when water quality is good, the number of EPT taxa should be higher and the HBI and MBI should be lower since many organisms are present that are less tolerant of pollution.

While the correlations confirmed this relationship, sampling results did not always fit this model. A sampling site may have high EPT richness, indicating species diversity, while the HBI value reflects a large number of pollution tolerant organisms. One explanation is that Illinois streams are so degraded from a century of abuse that relatively few sensitive EPT taxa remain, particularly in the northern three quarters of the state. In the future, any increase in EPT richness will most likely result from the homogenization of moderately tolerant taxa across the state, not from colonization of sensitive taxa from distant "islands" of high quality habitat.

Several indicators are correlated with habitat quality, which is surprising since other attempts at this have been difficult — the paucity of "pristine" habitat has left only a partial range of habitat quality from which to detect relationships. EPT richness and darter richness are both positively related to the habitat score, indicating that better habitat supports greater biodiversity. The number of exotic fish species is negatively correlated with habitat, since the number of exotic species are expected to be higher when habitat is poor.

Several of the other RiverWatch indicators also show significant correlation. EPT taxa richness is correlated with total taxa richness and taxa dominance, and taxa dominance and taxa richness are also correlated with one another. More than half (53%) of the variation in taxa

Significant Relationships Among Aquatic Indicators

Comparison	Correlation	p	# of observations
HBI vs. EPT richness	-0.33	0.01	57
MBI vs. EPT taxa (RW)	-0.42	<0.01	1178
Habitat score vs. EPT richness	0.28	0.04	57
Habitat score vs. Darter richness	0.35	<0.01	58
Habitat score vs. Exotic species	-0.28	0.04	58
EPT taxa (RW) vs. Taxa richness	0.68	<0.01	1178
EPT taxa (RW) vs. Taxa dominance	-0.53	<0.01	1178
Taxa dominance vs. Taxa richness	-0.73	<0.01	1178
Native fish vs. Stream width	0.48	<0.01	58
Native fish vs. Darter richness	0.57	<0.01	58
pH vs. Conductivity	0.28	0.02	68
pH vs. Dissolved oxygen	0.47	<0.01	68

Note: The closer the correlation coefficient is to one, the stronger the relationship. A negative sign indicates that as one variable increases the other decreases. p is the probability the relationship is due to chance.

dominance is explained by variation in taxa richness (and vice-versa). Thus, when a stream suffers from taxa dominance (that is dominance by just a few taxa), it generally has a lower overall taxa richness. It is not clear whether the RiverWatch indicators are correlated with habitat quality because the volunteers have not calculated a habitat score. A habitat index is being developed and its relationship to other indicators will be explored in the future.

Native fish species richness is positively correlated with all other fish richness measures, as well as fish abundance and stream width. Thus, larger samples and larger streams generally yield more species of fish (natives, minnows, and darters). The latter suggests that stream biological criteria may have to be scaled for stream size.

Water chemistry parameters do not seem to be significantly correlated to most biological indicators, although some water chemistry indicators are correlated among themselves. Conductivity is positively correlated with pH, since greater dissolved ions in water from human or bedrock sources usually leads to a higher pH. Dissolved oxygen is also strongly correlated with pH. Streams receiving an abnormally high amount of sunshine develop algal growth and increased photosynthesis, which leads to an increase in pH by removal of hydrogen ions from the water. This seems innocuous, but the increased photosynthesis is a telling feature of streams that have had their tree canopy removed, a condition that leads to increases in maximum water temperature and to drastic changes in the food quality and quantity available to aquatic organisms. Streams shift from a food economy based on tree leaves, to one where filter-feeding on small particles and grazing on algae predominates.

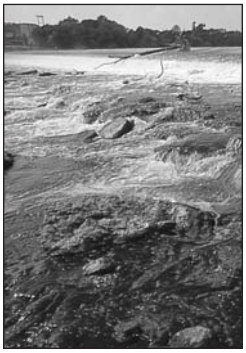
CHAPTER FOUR

Rock River Watershed

Illinois' third largest ISIS watershed is located in the northwestern part of the state. It has the most grassland acreage in the state, as well as the highest percentage of land in grasses. The Rock is the third most urbanized watershed (in both acreage and percentage of land), with only the Fox/Des Plaines and Kaskaskia watersheds being more urbanized. (See page 103 for a color map of the watershed's land cover.)

Five sites within the watershed have been designated as Resource Rich Areas (RRA) — the Driftless Area, Kishwaukee River, Rock River, Sugar River, and Mississippi-Lower Rock River.

- The 300-square-mile Driftless Area RRA is a unique part of the state because it escaped Pleistocene glaciation. The area is characterized by rolling hills and wooded ridges and includes canyons, ravines, bluffs and palisades. Some of the flora and fauna are distinctive and unique in the state, including several plant species which are northern species or preglacial and interglacial relicts.
- The Sugar River RRA is characterized by a wide, wooded riparian corridor of floodplain forest and upland woods. The smallest RRA at 23.7 square miles, the area is along an important bird migration route and provides habitat for several unusual amphibians and reptiles.
- The natural resources of the 101-square-mile Kishwaukee River RRA are concentrated along the wooded corridor of the river. Originally the area was savanna with many sloughs and marshes, but is now primarily agricultural.
- The Mississippi-Lower Rock River RRA encompasses 715 square miles — 81% in the Rock River watershed and 19% in the Spoon River watershed. It includes major rivers, bottomlands, upland forests, prairies and river bluffs. The area has a relatively high total acreage of natural areas because of the Mississippi River sites.
- The ecological core of the 322-square-mile Rock River RRA is the river corridor from Rockford to Dixon. Significant features include upland and floodplain forests, seeps, springs, prairies, aquatic systems, cliffs and bedrock outcroppings. Some of the habitats support relict boreal plants which are more normally found farther north in Wisconsin and Minnesota and in the Appalachian Mountains.



Significant features include upland and floodplain forests, seeps, springs, prairies, aquatic systems, cliffs and bedrock outcroppings.

Table 15. *Watershed Land Cover*

Land Cover	Acres	Percent of Watershed	Statewide Percentage*
Upland forest	297,383	7.3% (8)	7.2% (5)
Grassland	1,073,788	26.2% (1)	16.7% (1)
Non-forested wetlands	37,092	0.9% (5)	10.5% (5)
Bottomland forest	49,663	1.2% (8)	5. 7% (8)
Water	63,506	1.6% (4)	12.7% (4)
Urban/built-up	175,492	4.3% (3)	9.4% (3)
Cropland	2,398,071	58.6% (8)	11.1% (5)
Total acreage	4,094,998	100.0%	11.3% (3)

** The watershed's percentage of the land cover type statewide, e.g. 7.2% of the state's upland forests are located in this watershed. Note: the watershed's rank (1st-10th) is shown in parentheses.*

ECOSYSTEM MONITORING

CTAP biologists assessed eight streams in this watershed. The region had the worst average HBI score of all watersheds, indicating that its streams were the most organically enriched. Since the watershed is heavily grazed by livestock, the HBI average is not surprising. The Rock also had lower than average EPT richness, fish richness, and habitat quality. While historically it was one of the richest watersheds in EPT and native fish species, the loss of vegetated riparian zones, stream channelization, siltation, and livestock grazing have taken their toll.

The best stream sampled was Elkhorn Creek near Milledgeville. It had a habitat score well above the state and basin average, but it also had a relatively low native fish richness. The worst site was Coal Creek near Mineral in Bureau County. It had recently been dredged, so the bottom was mostly clay overlain by loose sand and silt. It yielded just two EPT taxa and habitat quality was very poor due to channelization, lack of variation in depth, and lack of canopy. However, native fish richness was relatively high for such a monotonous habitat.

RiverWatch collected 179 samples at 75 sites on 50 streams between 1995 and 1999. Its biological indicator data also suggest that the Rock River watershed is of slightly below-average ecological quality (Table 16). The watershed ranked near the median in MBI and EPT taxa, both indicators of organic pollution. Taxa richness and taxa dominance are also slightly below average, showing lower diversity in macroinvertebrates than other watersheds. Midge larvae, scuds, and hydropsychid caddisfly larvae were the three most dominant taxa overall. Each is among the state's most common macroinvertebrates.

Table 16. *Watershed Indicator Scorecard*

Indicator	Watershed Value	Statewide Value	Watershed Ranking
Macroinvertebrates			
HBI	5.8	5.2	10
MBI	5.5	5.7	4
EPT richness	6.4	7.1	7
EPT taxa (RW)	2.7	2.6	6
Taxa richness	8.8	8.9	7
Taxa dominance	80.2%	80.4%	6
Fish			
Native fish	13.0	13.6	6
Darter richness	1.7	1.9	8
Exotic species	0.5	0.2	10
Habitat			
Habitat score	80.5	88.6	8

Table 17. *MBI Values*

Statistic	1995	1996	1997	1998	1999	Overall
Average	6.07	5.52	5.60	5.41	5.24	5.46
Standard deviation	1.19	0.65	0.97	0.82	0.89	0.89
Minimum	4.10	4.34	4.20	4.30	3.09	3.09
Maximum	7.63	6.81	8.87	7.67	7.68	8.87
Number of sites*	9	28	41	49	46	173

** Only samples with at least 25 organisms were included in the analysis.*

Statistical analysis did not detect any major trends in MBI (Table 17). Values decreased over the five years, suggesting improved stream quality, but the change is not statistically significant and was probably exaggerated by blood worm identification errors in 1995.

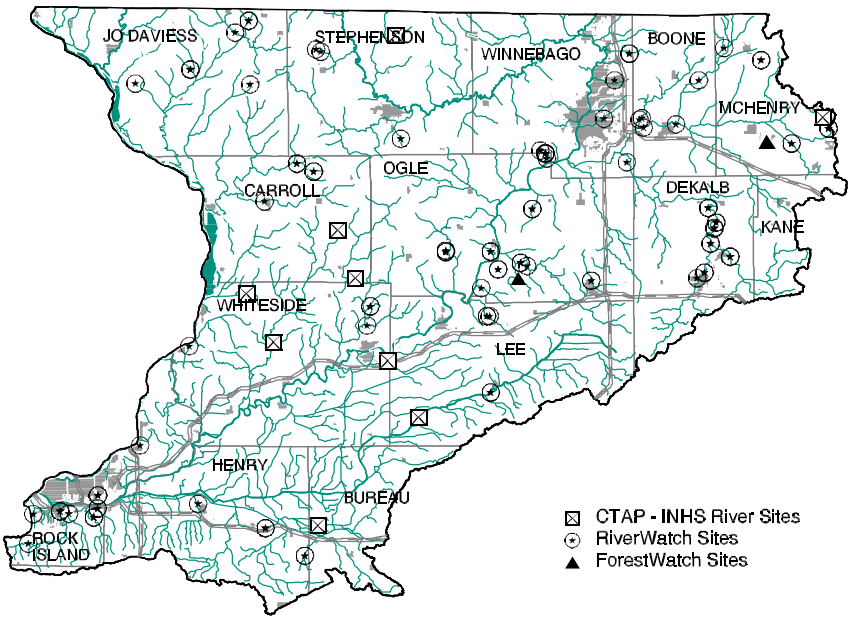


Figure 29. *Monitoring sites*

REGIONAL ASSESSMENTS

Five regional assessments have been completed for the Rock River Watershed — for the Upper Rock River Basin, Lower Rock River Basin, Kishwaukee River Basin, Sugar-Pecatonica Rivers Basin, and the Driftless Area.

Upper Rock River Basin

The Upper Rock River covers nearly 640,000 acres (999 square miles) in north central Illinois. It consists of eighteen sub-basins between Rockford and Sterling that drain into the Rock River. It is typical of agricultural Illinois — rolling, rural, prosperous — except for the rocks. Bedrock has been pushed to the surface here. Exposed rock forms canyons, bluffs, and ravines. Where it has been crumbled by weather it creates unusual soils, which foster the development of equally unusual natural communities.

The basin supports nearly 800 native plant species, or 38% of the species native to Illinois.

Agriculture is the dominant land use in the area, as it is across most of the state. Sixty-one percent of the area's acreage is devoted to croplands, slightly above the state average. Grasslands (mostly pasture, but also prairie, rights-of-way, and such) account for 23%, compared to 18% for Illinois. Forests and woodlands are the next-largest category with 8%, which is below the state average of 11%. Forests are concentrated on the uplands along the Rock River and its major tributaries. Urban and built-up coverage matches the state share of 6%.

Wetlands and open water combine for less than 3% of the area, compared to about 5.5% for the state. The distinctive landscape provides an array of natural habitats:

- several of the 33 Illinois Natural Area Inventory sites contain ecosystems of statewide significance — cliffs, bluffs, soils, and plant life associated with St. Peter's sandstone bedrock that are unique to this part of the state,
- 17 miles of streams (segments of the Kishwaukee and Rock rivers) have been designated as Biologically Significant,
- 206,215 acres have been designated a state Resource Rich Area,
- the Castle Rock State Park/Lowden-Miller State Forest complex is home to more breeding pairs of forest bird species (85) than any other part of Illinois.

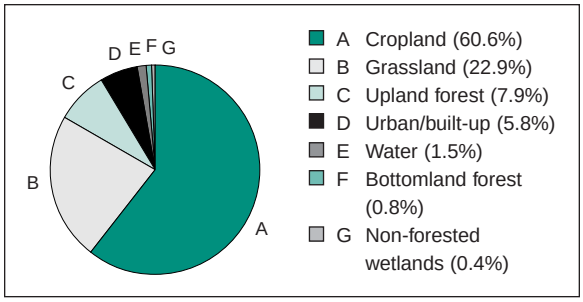


Figure 30. *Upper Rock River basin land cover*

Plant and animal life

The basin supports nearly 800 native plant species, or 38% of the species native to Illinois. Thirty-eight plants are listed by the state as threatened or endangered. The prairie bush clover is also on the federal list of threatened species. Over half of the area's threatened or endangered species are associated with the St. Peter's sandstone bedrock and its derivative soils.

Basin acreage - 639,479 acres
State land* - 5,303 acres
Total natural areas - 6,020 acres
High-quality natural areas - 200 acres
Nature preserves - 1,050 acres

** Does not include natural areas or nature preserves that may be state owned.*

The area has high terrestrial species diversity due to the range and extent of habitats. Birds account for the vast majority of state threatened and endangered species (T&E); the river otter is the sole T&E mammal. Among reptiles and amphibians, the four-toed salamander, western hognose snake, and Blanding's turtle are listed as T&E species. Nearly all reptiles and amphibians that existed in the area before European settlement are still present. Three T&E fish species and five mussels have been recorded in the area, but their continuing presence is unlikely.

Local economy and outdoor recreation

The three main counties in the Upper Rock River basin — Winnebago, Lee and Ogle — account for 3% of Illinois' population and 2.5% of its personal income. Winnebago County accounts for 80% of the area's economic activity. Following national and state trends, the area economy has shifted towards the service sector — between 1969 and 1993, employment in the services sector grew from 14% to 29% of total employment, while employment fell from 39% to 24% in the manufacturing sector. Thanks to higher wages, however, manufacturing remains the largest sector in terms of earnings.

Outdoor recreation opportunities in the area are driven largely by the Rock River itself. The Rock is among Illinois' finest fishing streams — especially for walleye and catfish — and boat access is offered at 39 points. Nearly 9,200 acres are publicly owned, accounting for about 1.5% of the total area. Lowden-Miller State Forest is the largest state site, closely followed by the adjoining Castle Rock State Park. The area's five major state sites attracted nearly 1 million visitors in 1994 and created 250-300 jobs.

Threats

While the Upper Rock River area's ecology is impressively diverse, it nonetheless faces threats common to Illinois including habitat fragmentation and degradation, stream alteration, and erosion.

Habitat degradation and fragmentation - Before settlement, more than one-third of the land was prairie and the remainder was forest. Today, 48 acres (0.02%) of presettlement prairie remains, and 9% of the area remains forested, with 114 acres considered high quality. Remaining habitats are often carved up into habitat "islands", which may not be able to sustain healthy ecosystems over the long run. Large mammals and other far-ranging species lack adequate habitat, and the small populations of plant and animal species that do live here are vulnerable to disease, drought, and a lack of genetic diversity.

Most of the original habitat was displaced by agriculture, but urbanization is now a noticeable trend. In some former agricultural regions in Illinois, such as the Fox and DuPage river valleys, subdivisions, malls, and office parks have largely replaced farms as the dominant features in the landscape. The same economic and social forces are now pressing on the Upper Rock River area, accelerating fragmentation.

In some former agricultural regions in Illinois, subdivisions, malls, and office parks have largely replaced farms as the dominant features in the landscape.

Stream alteration - Dams and levees have been built along the Rock River for flood control and electricity generation. Unfortunately, they also raised water temperature, slowed the current, isolated fish and mussel populations, and generally disrupted wildlife that had adapted to the natural cycles of the river.

Erosion - The hilly, heavily farmed Rock River basin has been subject to erosion, which costs farmers valuable soil and leads to increased siltation in streams and rivers. This in turn can choke off vegetation and fish nests, impede fish that depend on their sight for survival, and carry pesticides and fertilizer into streams. During the 1930s and 1970s, erosion in the form of gullying was particularly severe. Today, however, only 25% of the land is considered "moderately" eroded, and siltation has decreased since the early 1980s. The change may be due in part to more farmers using conservation tillage and setting aside erodible land in response to federal incentives.

Opportunities

Many of the changes that humans have made are reversible. For example, controlled burns can kill off tree seedlings sprouting in prairie sod the way that lightning fires used to, and dismantling drainage structures can put the "wet" back into wetlands. If the dams cannot be removed along the Rock River, they should at least be modified to include chutes that both fish and canoeists can use to move up and down the river.

The basin has several large, contiguous habitats that serve to mitigate the problems of

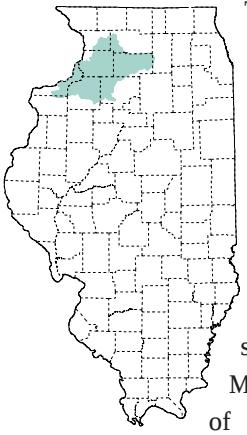
The amount of potentially restorable natural land in the area is sizable.

fragmentation. The most significant is the Castle Rock State Park/Lowden-Miller State Forest complex. Most of the 4,225 acres are forested, providing one of the finest bird habitats in Illinois. Large tracts like this offer certain birds protection from competitors and predators that frequent the forest edge, such as the cowbirds that parasitize native songbird nests.

The amount of potentially restorable natural land in the area is sizable. For example, several dozen acres of restorable prairie persist within a golf course maintained by the Byron Forest Preserve District.

The Nachusa Grasslands offer similar potential as a large prairie. The Nature Conservancy site now includes more than 1,000 acres. The Conservancy intends to protect the existing patches of prairie and restore as fully as possible the fields separating them. Ultimately, the plan is to connect Nachusa to Franklin Creek State Park, maximizing the amount of contiguous wildlife habitat.

Lower Rock River Basin



The Lower Rock River Basin encompasses 2,543 square miles (1.6 million acres) in northwestern Illinois, including substantial parts of Bureau, Carroll, Henry, Lee, Ogle, Rock Island, and Whiteside counties and slivers of DeKalb and Mercer counties. The bulk of the area consists of that portion of the Rock River's drainage area that lies between the DeKalb/Lee county line and the river's confluence with the Mississippi River near Moline.

Agriculture is the dominant land use with 87.5% of the land cover — high even by Illinois standards. More than 75% of the agricultural land (68% of the total) is dedicated to crop land (mostly row crops, but also small grains and orchards). The remainder consists of rural grasslands, which include pastures, alfalfa and other hay, roadsides, remnant prairies, and other grassland cover in rural areas.

Little of the area's presettlement natural habitats remain. Less than 0.001% of the area's ecosystems are considered high quality, compared to 0.07% statewide. Most of the native prairie was plowed; only 0.002% of presettlement prairie survives. Channel dams have converted the Rock River into a series of lakes, and the rich complex of wetlands, once the area's most distinctive ecological asset, has long since been drained and converted to crop land.

Basin land - 1,627,442 acres
State land* - 10,012 acres
Federal land - 675 acres
Total natural areas - 9,255 acres
High-quality natural areas – 154 acres
Nature preserves - 445 acres

** Does not include natural areas or nature preserves that may be state owned.*

Even so, the area's varied topography supports a wide range of ecological communities, which in turn support an impressive variety of species, and largely compensates for the relative scarcity of high-quality habitat. Key features include:

- 44 miles of streams that have been designated Biologically Significant because of their fish or mussel diversity;
- 43 Illinois Natural Areas Inventory sites that include marshes, seeps, two types of forest, and eight types of prairie; and
- Nachusa Grasslands, a 1,000-acre prairie restoration owned by The Nature Conservancy.

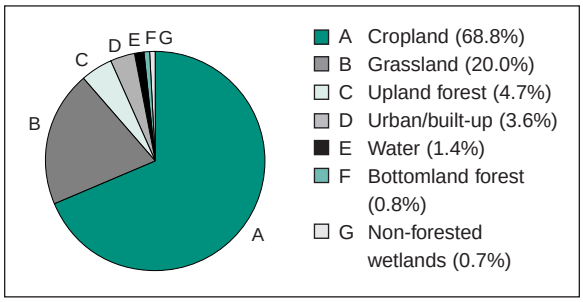


Figure 31. *Lower Rock River basin land cover*

Plant and animal life

An estimated 1,180 plant species can be found in the Lower Rock River area, roughly 80% of which are native to Illinois. Overall, 39% of Illinois' plants

can be found here, a high percentage for an area that encompasses only 4.5% of the state. A more thorough survey would probably uncover more species. While high-quality habitat acreage is low, the variety of habitat has nonetheless promoted a good diversity of plant species. Twenty-nine state threatened or endangered plant species are known from the area. Most are restricted to high-quality natural communities, and more than half can be found in sand prairies.

More than three-fourths of Illinois' mammal species live in the area, including the state threatened river otter. Fifteen amphibian and 27 reptile species are thought to exist here, including the endangered mud turtle, the threatened western hognose snake, and perhaps the threatened timber rattlesnake. Although the area supports a large diversity of aquatic species, some species have disappeared from the drainage in recent decades. With improvements in water quality, extirpated species could conceivably return.

Local economy and outdoor recreation

Between 1870 and 1990 the population of the five main counties in the basin grew 117% to 330,000, or 2.9% of the state total. By 1994, the area supported nearly 176,000 jobs and generated $4.6 billion in personal income. Rock Island County accounted for more than 50% of the employment and 60% of the income. Since 1970, employment has grown slowly, at 0.4% annually compared to 1.1% statewide. Meanwhile, the economy has shifted towards the service sector, which accounted for 23% of all jobs in 1994 (up from 14% in 1970) while manufacturing slipped from 26% to 17%.

Recreational opportunities abound in the Lower Rock River area as evidenced by six major state parks and fish and wildlife areas. The 1.5 million visitors at the state sites generate $16.5 million in economic output and 260 jobs each year. More than 800,000 people visit the Hennepin Canal Parkway State Park each year to fish, boat, canoe, hunt, hike, bike, ride horses, snowmobile, and picnic along the old canal. Part of the Upper Mississippi National Wildlife and Fish Refuge is also located in the area.

Threats

While the area contains diverse habitat, its ecology nonetheless faces threats common to Illinois: notably habitat fragmentation and degradation, stream alteration, and degraded water quality.

Habitat fragmentation and degradation - Fragmentation, the carving of once-extensive forests, wetlands, and prairies into small habitat "islands" by roads, subdivisions, and farm fields shrinks and modifies habitat. Smaller tracts may not support wide-ranging species, or may support only small populations that are more vulnerable to stress, in-breeding, and local extinction. Significant fragmentation has occurred across Illinois, but is particularly problematic in the Lower Rock area. For example, the area's 1,113 parcels of forested wetlands average only 8.2 acres. Few forest tracts are as large as the 500 acres required by many songbirds. Except for the Nachusa Grasslands, most prairie remnants are also too small to support anything approaching the complexity of the original tallgrass prairie.

More than 800,000 people visit the Hennepin Canal Parkway State Park each year.

Stream alteration - Apart from the clearing of the prairies, no change to the Lower Rock area has had a more profound ecological impact than attempts to alter the flow of water through it. The draining of area wetlands and the tiling of farm fields increases the amount of arable land, but it also speeds the flow of water into area streams, which then rise to flood stage faster, crest higher, and run faster (and thus do more damage to streambanks). In an attempt to reduce flooding, all but 27 miles of the Green River has been dredged and straightened to increase its water-carrying capacity.

Erosion and sedimentation - The area's loess soils are vulnerable to the forces of wind and water. Erosion accelerated beginning in the 1920s when area farmers, like their colleagues across Illinois, converted from small grains to row crops, which expose more soil. Much of this valuable soil was washed from fields and became sediment in streams, dramatically affecting stream ecology. Fortunately, erosion has been much reduced since the 1980s. Row crop acreage has declined, with most of the region's hilliest, most erodible land taken out of production through the U.S. Department of Agriculture's Conservation Reserve Program. Also, more farmers are using soil-saving

tillage methods. Today, three-fourths of basin farmland loses soil no faster than natural processes can replenish it.

Water pollution - Two-thirds of the Rock River is now clean enough for the uses to which it is put, according to EPA standards, as is half the Green River. Most remaining pollution can be attributed to excess nutrients from partially treated sewage and runoff from farm fields, both of which promote the growth of bacteria that deplete water of oxygen. About 58% of the area is deemed at least "moderately" vulnerable to aquifer contamination, due to geological factors. However, such pollution is usually local.

Many steps can be taken to increase local biodiversity.

Opportunities

While pristine examples of original habitats either do not exist or are quite small in the Lower Rock River basin, many acres of degraded natural communities persist. These remnants need to be identified, in particular those restorable bits of floodplain forest, mesic (moist) prairie, and savanna of which few or no high-quality examples remain. If they were restored, they could prove crucial to maintaining the biodiversity of the region.

Many other steps can be taken to increase local biodiversity; the following are just a few of several recommendations.

- Restore grassy and sedge-dominated wetlands to attract threatened and endangered species such as the least and American bitterns, green heron, king rail, and marsh wrens. The Green River Conservation Area in particular would be a likely area for trumpeter swans to begin nesting again in Illinois. While there is a paucity of public sites large enough to attract breeding birds, the smaller areas could be managed as stopover sites to attract migrating species such as warblers and vireos.
- Leave unmowed strips around ponds to provide refuge for reptiles and amphibians and nesting sites for birds, and delay mowing hayfields in which bobolinks nest to spare young birds, since mowing kills as many as 94% of nestlings.
- Reestablish streamside grasses, shrubs, and trees to restore the ecological richness of streams. For example, in spite of being surrounded by farmland, Fairfield Ditch #1 has clear water because its banks are protected by a sediment-catching buffer of small trees and grasses some ten feet wide.

Kishwaukee River Basin

The Kishwaukee River originates just south of Woodstock in McHenry County and flows into the Rock River just south of Rockford. The basin covers approximately 1,218 square miles in parts of seven counties. Much of the land is used for agricultural purposes; only 7% is forest or wetland.

Glaciation, however, has left moraines, sub-glacial channels, terraces, out-wash fans, valley train deposits, and bedrock highs in the area. The Marengo Moraine is the oldest moraine in the area and is one of the most striking glacial landforms in Illinois.

Though much of the land has been altered for agriculture, unique natural communities remain:

- parts of three streams, totaling about 64 miles, are recognized as Biologically Significant because they support a high level of mussel and fish diversity,
- 64,386 acres have been designated a state Resource Rich Area,
- 30 acres of wetland and 22 acres of prairie are classified as high quality,
- the Illinois Water Quality Report rated 86.5% of the Kishwaukee sub-basin as "full support,"
- the Biological Stream Characterization rated the Kishwaukee River upstream from the South Branch as an "A" stream.

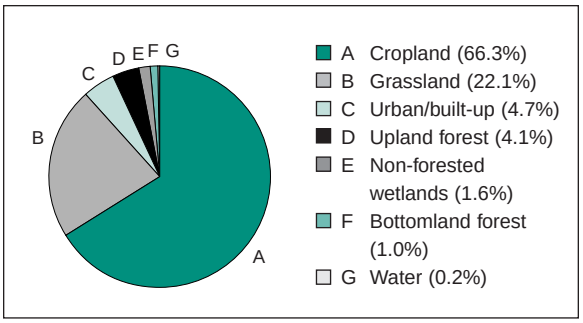


Figure 32. *Kishwaukee River basin land cover*

Plant and animal species

Thirty-five percent of the state's native and naturalized vascular plants are found in the basin. Of these, 14 are listed as state endangered and 14 as state threatened. Of these 28 T&E species, 17 occur in wetlands. Not all plants found here are wanted or appreciated — 21% of the plants have been introduced from other geographical areas.

At least 262 of the 299 bird species that regularly occur in the state can be found in the area. Of these 262, 135 breed or formerly bred here, including 14 of the 34 T&E bird species. The area's wetlands represent the most significant avian area where species such as the state threatened least bittern and sandhill crane breed.

Seventy-five percent of the state's mammal species are likely to occur in the Kishwaukee area, and the state threatened river otter has recently been sighted along the south branch of the Kishwaukee River. The basin also supports a diversity of aquatic species and state endangered fishes include the blacknose shiner and the Iowa darter.

Local economy and outdoor recreation

The area is home to nearly 5% of the state's population and is highly urban, with nearly four-fifths of its residents living in urban areas. Since 1870 the population in the Kishwaukee River area has grown fivefold; growth has been particularly high in Winnebago and McHenry counties.

The local economy grew nearly twice as fast as in the rest of the state between 1970 and 1994. It generates 4.7% of the state's employment and personal income. In 1994 it employed more than 314,000 people and generated $13 billion in income.

There are no major state-owned recreation areas in the basin, but conservation districts offer several forest preserves and trails. There are also limited activities including hiking and natural history discovery at the undeveloped nature preserves and natural areas.

Threats

Today's Kishwaukee River basin is much changed from the presettlement era. Forests, wetlands and prairies have given way to agriculture, artificial water drainage, and urbanization. Today's landscape is 85% agricultural and urban.

Basin acreage - 779,744
Total natural areas - 3,379.1 acres
High-quality natural areas - 52 acres
Nature preserves - 247.4 acres

Flooding - One of the greatest concerns for area residents is flooding. Average annual flow in the basin has jumped more than 50% since 1970. Although average precipitation has increased, other explanations for the increased flow include the drainage and removal of wetland areas and the discharge of treated waste water into the river basin.

Erosion - Field drainage has played an important role in increasing the volume and rate of runoff from cultivated fields. With the majority of the soils in the watershed having loess as their uppermost parent material, the potential for soil erosion is moderate to high and the increased discharge is causing erosion problems along the Kishwaukee River and its drainage. Channel widening and bank failures are two major erosion problems.

Habitat loss - The loss of natural habitat in the basin has been severe. Prior to European settlement in 1820, the area was a montage of different forest types, savannas, blacksoil and gravel prairies, and a variety of wetlands from marshes to fens. For example, wetlands covered as much as 31% of McHenry County, 21% of Boone, and 14% of Winnebago. Today, McHenry County still has the highest percentage of wetlands — 6%. Overall, only 2.6% of the area's land is wetland. There has also been a similar decline in prairie, savanna and forest. Altogether only 52 acres (0.006% of total area) remain in a high quality, undegraded condition, all of it wetland and prairie. No pristine forest or savanna remains.

At least 262 of the 299 bird species that regularly occur in the state can be found in the area.

This is even more severe than statewide levels, where only 0.07% of the total area remains in a high quality undegraded condition.

Opportunities

To address area flooding and habitat loss, a critical element is to protect and restore wetlands. Wetlands mitigate the effects of storm flow in streams by retaining excess rainwater and delaying delivery of water to the main stream. Reduced stream flow will not only reduce flooding and erosion, but will also enhance the quality of the stream by limiting channeling and bank failure. Maintaining even small, temporary wetlands would benefit almost all of the reptiles and amphibians in the area; the American toad, western chorus frog, and bullfrog do well in small patches of cattail marsh, even when the marsh is completely surrounded by developed land. Additionally, wetlands are important stopover sites for migrating birds and are heavily used by nesting birds.

Remnants of other ecosystems can play a key role in preserving the ecology of the area; small pieces of natural communities can still harbor diversity. For example, an unknown quantity of degraded prairie most likely remains, particularly along railroad rights-of-way. Some of this degraded prairie has high restoration potential.

Maintaining even small, temporary wetlands would benefit almost all of the reptiles and amphibians in the area.

Sugar-Pecatonica Rivers Basin

The Sugar-Pecatonica Rivers basin encompasses approximately 796.2 square miles in north central Illinois. The Pecatonica is the dominant stream, accounting for two-thirds of the drainage area. It originates in Iowa County, Wisconsin, crosses the Illinois border near the town of Winslow, flows south to Freeport, then heads east-by northeast towards its confluence with the Rock River near Rockton. In Illinois the length of the Pecatonica River is 92.4 miles.

Basin acreage - 509,679 acres
State land* -701 acres
County land - 3,334 acres
Total natural areas - 3,647 acres
High-quality natural areas - 85.7 acres
Nature preserves - 672 acres

** Does not include natural areas or nature preserves that may be state owned.*

Much of the land in the basin is used for agriculture — 53% in cropland and 36% in grassland, most of which is non-native forage grasses such as hayfields and pastures. Only 8% of the area is forest or wetland.

The area has a number of natural community remnants that are otherwise rare or absent in the rest of Illinois, especially prairie, wetland, and sand communities. The Sugar and Pecatonica river corridors have some of the most extensive riparian wetland communities left in northern Illinois. The sand area between the Sugar and Raccoon Creek supports several rare sand communities, and the eastern portion supports some of the best examples of dolomite prairie left in the state. Other significant features:

- high quality natural areas include 60 acres of upland forest, almost eight acres of prairie, six acres of shrub swamp, eight acres of sedge meadow, and three acres of pond;

- the Winnebago County Forest Preserve District is acquiring many other native habitats, including several high quality wetland sites and a number of prairie and wetland restoration projects;
- the Biological Stream Characterization rated much of the Sugar River as a Class "A" stream (unique aquatic resource) and rated the Pecatonica and several of its tributaries as a Class "C" stream (moderate aquatic resource);
- two segments of area streams, for a total of 10.1 miles, are recognized as Biologically Significant because they support a high level of mussel and fish diversity;
- 15,144 acres have been designated a Resource Rich Area.

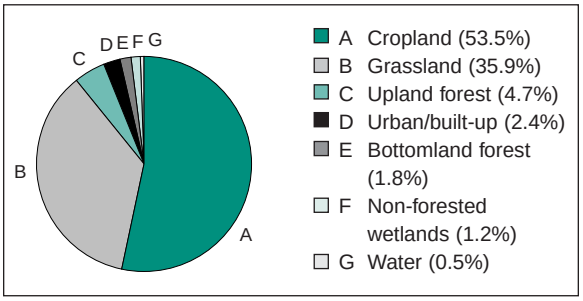


Figure 33. *Sugar-Pecatonica rivers basin land cover*

Plant and animal life

Thirty-three percent (850) of the state's native plant species occur in the area. Of these, 26 are state endangered (the eastern prairie fringed orchid is also federally threatened) and six are state threatened. Most of these rare species occur in the prairie and wetland communities, particularly the sand communities in the Sugar River drainage and the wetland habitats associated with the bog area in the Raccoon Creek drainage.

At least 261 of the 299 bird species that regularly occur in the state can be found here. Because of the geographical position of the area and the rather diverse array of habitats, several species of birds either reach or are near the northern (e.g., yellow-throated warbler, white-eyed vireo, northern mockingbird, and acadian flycatcher), or southern (e.g., sandhill crane, common snipe, least flycatcher, and clay-colored sparrow) limits of their range.

Seventy-six percent of the state's mammal species are likely to occur in the Sugar-Pecatonica area. The state threatened river otter has been observed here, and five T&E species of fish are found here — the blackchin, blacknose, and weed shiners, and the western sand and Iowa darters.

The state threatened river otter has been observed here, and five T&E species of fish are found here.

Local economy and outdoor recreation

The two main counties in the basin, Stephenson and Winnebago, account for 2.6% of the state's population. Since 1870 their combined population has quadrupled, compared to a 350% increase statewide. Most of this growth was in Winnebago County, where Rockford, the largest city of the area, is located.

Between 1970 and 1994, the local economy grew nearly 25% faster than the rest of the state. In 1994, the area supported 190,000 jobs and generated $6.7 billion in personal income. The area is a net importer of workers, suggesting that Rockford is a key employment region for outlying areas.

Outdoor activities are popular. Lake Le-Aqua-Na State Park provides opportunities for fishing, boating, hiking, picnicking, camping, and other activities. The park attracts about 270,000 visitors a year, generating about $3.2 million in economic output and 50 jobs a year. The Winnebago County Forest Preserve District also operates twelve sites that provide an array of activities.

Threats

Agriculture and urbanization have changed the mosaic of forests, wetlands, savannas, and prairies that existed before European settlement. A few of the resulting ecological threats:

Habitat loss - Very few natural communities remain in the area. For example, in 1820 wetlands covered as much as 6% of Stephenson County and 14% of Winnebago County. Only 2.9% of the area remains in wetland today. Furthermore, only 0.01% of the total area remains as high-quality habitat, which is even more severe than the statewide level of 0.07%.

Habitat fragmentation - The lack of habitat leads to several other common ecological problems, particularly habitat fragmentation. Habitat fragmentation interrupts biological

interactions, ecological processes, and species migrations, and reduces habitat heterogeneity. The outcome typically is loss of species diversity.

Exotic species - Degraded natural communities are particularly vulnerable to being invaded by exotic species, which can overrun native plant communities and reduce biodiversity. Garlic mustard and reed canary grass are two exotic species known in the area; many of the remaining marshes and sedge meadows are threatened by these non-native species.

Impaired water quality - Only 12.4% of the Pecatonica River was rated as "full support" (water quality meets the needs of all designated uses protected by applicable water quality standards), and the remainder was rated as "Partial Support/Minor Impairment" (water quality has been impaired to a minor degree). Major water quality problems include municipal wastewater discharges, and phosphorous and siltation from agricultural runoff. However, of the 40 tributaries to the Pecatonica, 34 were rated as "full support" along their entire length.

Only 12.4% of the Pecatonica River was rated as "full support" and the remainder was rated as "Partial Support/Minor Impairment".

Opportunities

A large amount of wetland habitat in the area could be restored. This is especially true along the major stream and river corridors where restoring natural riparian vegetation and connecting existing wetland communities would increase habitat, as well as provide additional wetland functions — store floodwater and reduce siltation and nutrient loading. Reducing silt and chemical runoff will improve the water quality of the streams, thereby enhancing their ability to support fish, as well as minks and river otters. Restoring riparian zones will renew their ability to act as dispersal corridors for many animals, such as the gray fox and bobcat, thus reducing the effects of habitat fragmentation.

The continued acquisition of larger quality wetlands that remain in the area would allow the bird population to become more successful and self-sustaining, and provide large home ranges necessary to support bobcats and river otters. However, maintaining even small, temporary wetlands would benefit many animals, especially reptiles and amphibians. More information is needed on habitat remnants, particularly about the distribution, abundance, qualitative condition, and ecological trends among remnants.

Prairie restoration, coupled with the preservation of native prairie and other grassland habitats, would provide additional habitat for animals such as badger and red fox, and provide valuable sites for reintroducing Franklin's ground squirrel. Larger grassland areas of at least 100 acres would benefit grassland birds most sensitive to grassland fragmentation. Exotic plant invasion can be addressed by restoring habitat with native plants, conducting controlled burns, treating them directly or using biological controls.

Driftless Area

The Driftless Area encompasses approximately 996 square miles in extreme northwestern Illinois. Bordered by Wisconsin to the north and the Mississippi River to the west, the area includes nearly all of Jo Daviess County, most of western and northern Carroll County, the northwestern corner of Whiteside County, and small segments of western Stephenson County.

The Driftless area is so named because it has little or no "drift" — the sediments deposited across the remainder of northern and central Illinois by glaciers that bypassed this corner of the state. The rough, unglaciated terrain features wooded uplands, rolling hills, narrow valleys, numerous streams, springs, and even cliffs and bluffs.

Basin acreage - 637,115 acres
State land* - 4,880 acres area
Federal land - 40,929 acres
Total natural areas - 33,311 acres
High-quality natural areas - 48.3 acres
Nature preserves - 723 acres

** Does not include natural areas or nature preserves that may be state owned.*

Agriculture is the dominant land use with croplands and grasslands (which are mostly pasture) combining for almost three-fourths of the land. Farm lands in this area are not as concentrated in row crops, which account for only 32% of agricultural land compared to 70% statewide. This is partly due to the difficulty of cultivating some of

the area's more rugged terrain. Forests account for one-fifth of the area's land cover, well above the statewide average of 11.3%. Most of the forested areas are found on the slopes along rivers and streams. Key features include:

- 70 miles of streams have been designated Biologically Significant because of their fish and mussel diversity,
- 30 acres of dry sand prairie and four acres of dry-mesic sand prairie are designated as high-quality ecological communities, accounting for 7.5% and 4.2% of the state acreage, respectively,
- diverse cliff communities provide an array of unique habitats, depending on orientation to sun and wind; the most unusual are a handful of algific slopes which retain subsurface ice through most of the year and harbor northern and relict species,
- 191,814 acres have been designated a state Resource Rich Area.

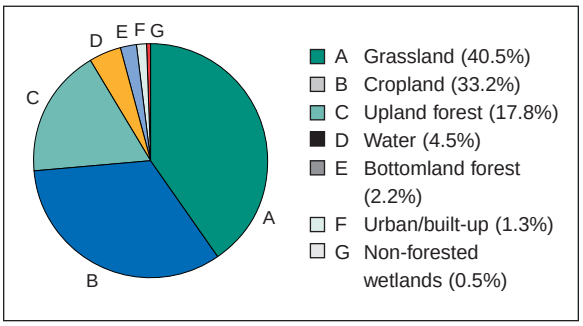


Figure 34. *Driftless Area land cover*

Plant and animal life

The area supports communities that are rare or nonexistent elsewhere in the state, notably sand prairies and cliff communities. Habitat is particularly good for birds. Of the approximately 271 species found here, 138 breed or formerly bred here, and 18 — 43% of the state total — are listed as state threatened or endangered. Other threatened or endangered species include the river otter and timber rattlesnake.

Approximately 42% (915 species) of Illinois' native flora occurs here, an area that comprises only 1.7% of the state's total land area. Fifty-five plants are state-endangered and 11 are state-threatened. Of these, 17 species are found in Illinois only within the Driftless Area, mostly on algific (cold-producing) slopes, sand prairies, and dolomite cliffs.

Local economy and outdoor recreation

In 1990, the population of Carrol and Jo Daviess counties, the two main counties in the area, stood at 38,600, 10% below that of 120 years ago. The area is rural, with only one-quarter of the population living in urban areas. In 1994 the area economy supported nearly 21,000 jobs and generated $541 million in personal income. The services sector almost doubled in size, growing from 11% of employment in 1970 to its present share of 23%. Unlike many other parts of the state, manufacturing employment also grew, by about 1.5% annually. Although farming employment has declined it continues to be an important part of the local economy, with 10-12% of workers employed on area farms.

Although farming employment has declined it continues to be an important part of the local economy.

Outdoor recreation opportunities are largely shaped by the area's rough terrain and its major streams, especially the Mississippi River. The river, its floodplain, and diverse habitats attract a variety of wildlife and provide ample opportunities for boating, hunting, and fishing. Two major state parks, Mississippi Palisades and Apple River Canyon, collectively attract 840,000 visitors annually, generating $8.6 million in economic output and 130 jobs. The Upper Mississippi National Wildlife and Fish Refuge also stretches along the river, providing habitat for fish and waterfowl. Much of the 14,000-acre Savanna Army Depot will eventually be transferred to the refuge.

Threats

While the Driftless Area's topographical complexity and array of habitats are unique, its ecological threats are familiar: erosion, water contamination,

and fragmentation and degradation of habitat.

Erosion - Soils here are relatively thin, and steep slopes promote soil erosion and sedimentation in streams and rivers. One study found that more than half of Jo Daviess County has a slope of more than 7%, and nearly one-third exceeds 18%. Careless management in the 1930s led to the creation of large gullies, with associated problems of soil loss, flooding, and sedimentation. Since then, farmers have increasingly used conservation tillage, vegetation has been planted on some of the more sensitive slopes, and gullies have been repaired by installing retaining structures and by adding fill. Some evidence suggests that improved land management practices have helped to reduce flooding as well as soil loss.

While the Driftless Area is blessed with a variety of habitats, they are often separated by agricultural or developed land.

Water quality - Sections of the Apple and Mississippi rivers, and most of the Galena River, were rated by the Illinois Water Quality Report as "Full Support," indicating that water quality meets the needs of all designated uses. The Plum River and Carroll Creek were downgraded slightly for phosphorous contamination from municipal wastewater discharges.

There is some concern that large-scale livestock operations may threaten groundwater and surface water in the area. Two hog facilities with 4,000 animals each are located near the headwaters of the Apple River and neighbors and health officials are concerned about the potential impact of large volumes of animal waste. Local geology adds to the concern — most of the area lacks the thick layer of glacially deposited till that filters out most contaminants. Nearly 60% of the area is highly or excessively vulnerable to aquifer contamination, and another 8% is moderately vulnerable.

Habitat degradation and fragmentation - Almost all of the original prairie has been destroyed and many of the area's wetlands have been drained for agriculture or flooded for navigation. Fire suppression has fostered maple invasion of oak forests, and subdivisions are carving up ecosystems to provide homes for people drawn, in part, by the area's scenic beauty.

Opportunities

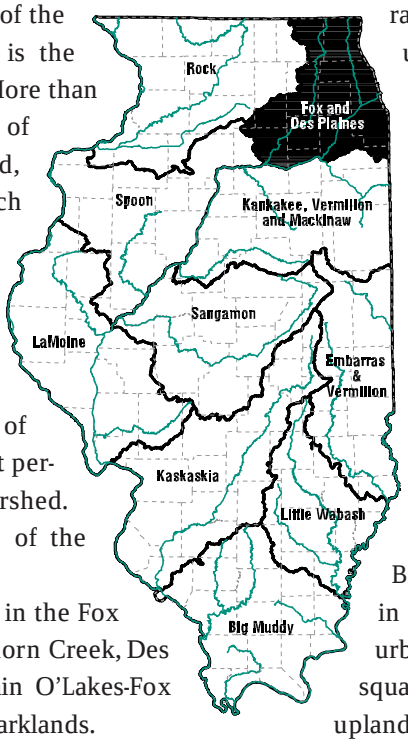
Vast potential exists for prairie restoration, especially sand prairies and various hill prairies. The few remaining large expanses of prairie, including the sand prairies at the Savanna Army Depot, should be protected — fragmented plots tend to support only small populations of species that are vulnerable to local extinction. Actively managing prairies, including prescribed burning, will limit encroachment by invasive species such as woody plants.

Reestablishing native vegetation along river corridors could bring significant benefits. Siltation, desiccation, and higher than normal temperatures would all be reduced to acceptable levels if streams were lined with native plants that shaded the stream, stabilized the banks, and filtered sediment and chemicals from runoff before they reached the stream.

Measures to improve the integrity of rivers and their banks would do more than improve habitat for aquatic wildlife; they can also serve to improve the corridors between diverse habitat, mitigating the threat of fragmentation. While the Driftless Area is blessed with a variety of habitats, they are often separated by agricultural or developed land. This is problematic for species such as amphibians, which often travel long distances between breeding and non-breeding habitat. Two of the area's most notable species, the timber rattlesnake and the bobcat, also demand a variety of habitats for foraging, breeding, and resting.

C H A P T E R F I V E

Fox and Des Plaines Rivers Watershed



Located in the northeastern part of the state, the Fox and Des Plaines is the most urbanized ISIS watershed. More than one-third of the area consists of urbanized and developed land, accounting for one-half of such land cover in the state. The watershed has the most non-forested wetland acres in the state as well as the highest percentage of wetland in a watershed. It also has the least amount of cropland acreage and the smallest percentage of cropland in a watershed. (See page 104 for a color map of the watershed's land cover.)

Five Resource Rich Areas are in the Fox and Des Plaines watershed — Thorn Creek, Des Plaines River, DuPage River, Chain O'Lakes-Fox River, Illinois Beach and Prairie Parklands.

- Thorn Creek is a relatively small area — 32 square miles in a heavily urbanized area. Natural resources are confined along streams and in forest preserves. The Thorn Creek Nature Preserve has narrow ridges and deep ravines, shallow depressions, broad uplands and the stream valley.
- The Des Plaines River RRA is a small — 68 square miles — highly urbanized site which forms a narrow corridor along the river from just west of Chicago to Joliet. Relatively high percentages of upland woods and non-forested wetlands occur at this site. Important natural features include prairie, savanna, river bluffs, cliffs, wetland, floodplain and upland forest.
- The DuPage River RRA, comprised of the watershed of the East Branch of the Du Page River, is located in the highly urbanized western suburbs of Chicago. With its small size (81 square miles) it has a high percentage of upland forest (19%) and non-forested wetlands (3%).
- The Chain O'Lakes-Fox River RRA (447 square miles) encompasses the area of most recent glaciation in Illinois. Significant natural features include glacial landforms, natural lakes, and

The watershed has the most non-forested wetland acres in the state as well as the highest percentage of wetland in a watershed.

Table 18. *Watershed Land Cover*

Land Cover	Acres	Percent of Watershed		Statewide Percentage*	
Upland forest	290,149	11.3%	(4)	7.0%	(7)
Grassland	326,288	12.7%	(8)	5.1%	(10)
Non-forested wetlands	78,237	3.1%	(1)	22.0%	(1)
Bottomland forest	26,448	1.0%	(9)	3.0%	(10)
Water	36,275	1.4%	(5)	7.3%	(7)
Urban/built-up	931,664	36.3%	(1)	49.8%	(1)
Cropland	877,925	34.2%	(10)	4.1%	(10)
Total acreage	2,566,987	100.0%		7.1%	(9)

** The watershed's percentage of the land cover type statewide, e.g., 7% of the state's upland forests are located in this watershed. Note: the watershed's rank (1st-10th) is shown in parentheses.*

many types of wetland — bogs, fens, seeps, and shallow and deep marshes. Some rare species and community types are limited in their distribution to this area of the state. Urban expansion from the Chicago metropolitan region continues to put severe pressure on the natural resources here.

- Even though its boundaries include urbanized areas of the Chicago metropolitan region, the Illinois Beach RRA (77 square miles) is one of the most ecologically rich and unique areas in Illinois. Its location on the shores of Lake Michigan provides a diversity of habitats that support a wide variety of plants and animals. Significant and unusual topographic features include beaches, ridges and swales, and dunes. The area is an important migratory route for birds.
- The dominant feature of the Prairie Parklands RRA is the recently created Midewin National Tallgrass Prairie, the nation's first federally designated tallgrass prairie, at the former Joliet Arsenal. Significant natural resources include prairies, wetlands and streams. The largest concentration of upland sandpipers in the state is in the Prairie Parklands area. The RRA takes in 239 square miles — 41% in this watershed and 59% in the Kankakee/Vermilion/Mackinaw watershed.

Most fish richness measures were also close to statewide averages and habitat quality was slightly higher than the statewide average.

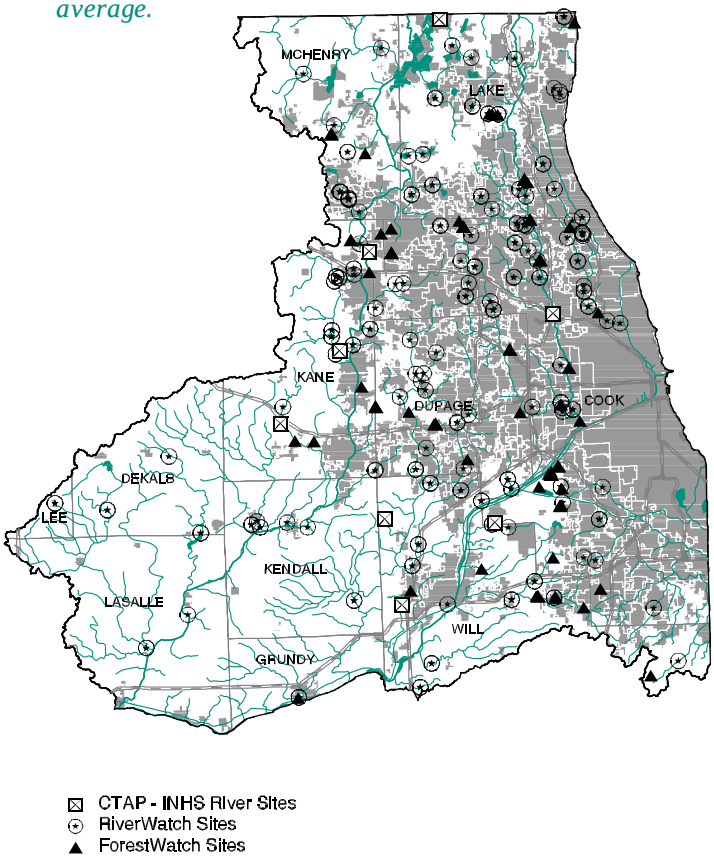


Figure 35. *Monitoring sites*

ECOSYSTEM MONITORING

HBI values at the eight sites sampled by CTAP biologists indicate moderate organic enrichment, while EPT richness was slightly below the statewide average. Most fish richness measures were also close to statewide averages and habitat quality was slightly higher than the statewide average. One high quality stream was Ferson Creek below Kane County's Leroy Oaks Forest Preserve; it had high habitat quality, good EPT and HBI scores, and high fish richness. The lowest quality site was Willow Creek at Rosemont. It supported no EPT species, relatively low fish richness, and had a very low habitat quality score.

RiverWatch volunteers collected 313 samples at 139 sites on 91 streams. Most RiverWatch biological indicator data also suggest the watershed is below-average in ecological quality. It ranked seventh and eighth among the ten watersheds in MBI and EPT taxa, suggesting that organic pollution has disturbed sensitive taxa. It ranked fifth in taxa richness — with 9.1 taxa per site, slightly above the state average of 8.9 — but seventh in taxa dominance. Sowbugs and hydropsychid caddisfly are the most common taxa.

Table 19. *Watershed Indicator Scorecard*

Indicator	Watershed Value	Statewide Value	Watershed Ranking
Macroinvertebrates			
HBI	5.1	5.2	5
MBI	6.0	5.7	7
EPT richness	6.6	7.1	6
EPT taxa (RW)	2.2	2.6	8
Taxa richness	9.1	8.9	5
Taxa dominance	80.4%	80.4%	7
Fish			
Native fish	14.3	13.6	4
Darter richness	1.8	1.9	5
Exotic species	0.3	0.2	6
Habitat			
Habitat score	94.9	88.6	4

Table 20. *MBI Values*

Statistic	1995	1996	1997	1998	1999	Overall
Mean	6.65	5.91	6.11	5.95	5.81	6.02
Standard deviation	1.78	0.92	0.98	1.02	0.97	1.02
Minimum	4.23	4.84	4.52	3.63	3.47	3.47
Maximum	9.44	9.97	9.50	11.00	8.80	11.00
Number of sites*	10	40	63	110	83	306

* *Only samples with at least 25 organisms were included in the analysis.*

ForestWatch volunteers monitored 14 sites in the Fox and Des Plaines Rivers watershed in the fall of 1998. Ten were upland forests (4 oak-hickory, 4 maple-ash-basswood, 2 bur oak) and four were bottomland forests (2 ash-elm-maple, 1 ash-cottonwood, 1 scrub). Tree species richness ranged from four to 16 species per site, averaging 10.2 per site, slightly below the statewide average of 11.8 species per site. The site with only four species was dominated by hawthorn trees and was characterized as scrub. Thirty-eight tree taxa were recorded in the watershed (75 taxa statewide).

The great abundance of buckthorn recorded here is alarming. This non-native invasive woody plant is particularly abundant in northeastern Illinois and seems to be a problem throughout the watershed. It grows in both shrub and tree form, spreads rapidly and crowds out native vegetation, reducing the diversity of the forest and the ability of native plants and animals to survive.

In general, the trees that were most abundant also had the highest basal areas and importance values (Table 21). Buckthorn is an exception. Since it is an understory tree it does not grow very large and is only ninth in basal area and seventh in importance value. In contrast, white oak trees grow very large. Despite being seventh in abundance, they have the greatest basal area and are third in importance.

Two upland sites showed some signs of maple takeover. The site graphed in Figure 36 shows that sugar maples dominate the smallest size class, indicating poor regeneration by oaks and hickories and the possible future dominance of maples. This likely reflects changes in the fire regime in the area.

Table 21. *Tree Species with the Highest Importance Values*

Importance Value	Species	% of total trees counted (n=1,943)	% of total basal area ($22.1m^2$/ha)
30.6	Ash	14%	16%
22.9	Basswood	11%	11%
20.7	White oak	6%	19%
15.5	Hawthorn	9%	3%
15.4	Bur oak	3%	11%
13.7	Slippery elm	7%	5%
13.5	Buckthorn	14%	3%
9.0	Black cherry	6%	3%
7.2	Sugar maple	3%	4%
6.7	Red oak group	3%	4%

There were no signs of gypsy moths or dogwood anthracnose at any site. Anthracnose has not been a problem in northern Illinois but gypsy moths have been entering northeastern Illinois, primarily from Wisconsin, and pose a major threat to forest health.

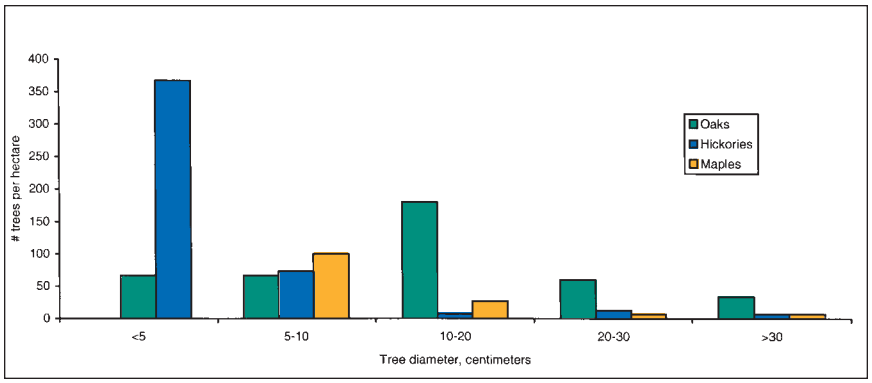


Figure 36. *Maple take-over in an oak-hickory forest*

Abundance of invasive shrubs (primarily non-native) was rather high, comprising 74% of the 1,340 total shrub stems recorded. Honeysuckle shrubs, buckthorn, and European highbush cranberry reached high densities here compared to the statewide average (Fig. 37). Ninety-eight percent of the buckthorn, 60% of the honeysuckle shrubs, 22% of the multiflora rose, and 100% of the cranberry recorded across the state were recorded in this watershed. Buckthorns were found on nine of 14 sites. Two sites were particularly dominated by buckthorn and contributed most of the

buckthorn stems for the watershed and for the state. These numbers are not surprising since this is one of the most populated areas in the state and a major port-of-entry, both of which increase the odds that non-native plants will be introduced.

Spring monitoring also recorded numerous non-natives among the ground cover — ground ivy and garlic mustard were common, with one or both widespread at 10 of the 12 sites monitored. At three of these sites, disturbance-sensitive species were also recorded — blue cohosh and bleeding hearts at one site, and white trillium at two sites. Future monitoring should determine if the disturbance-sensitive species are being replaced by the non-native invasive species.

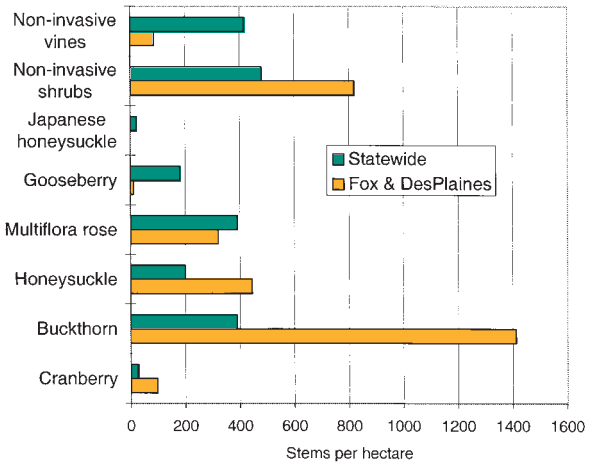


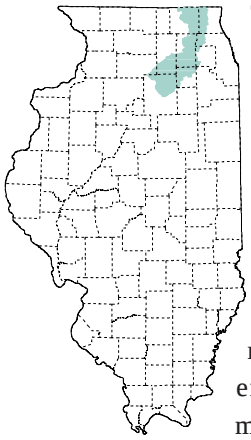
Figure 37. *Number of invasive and non-invasive shrub and vine stems*

Spring monitoring also recorded numerous non-natives among the ground cover.

REGIONAL ASSESSMENTS

Two regional assessments have been completed for this watershed — the Fox River Basin and the Upper Des Plaines River Basin.

Fox River Basin



The Fox River, the third largest tributary of the Illinois River, enters Illinois in the northwest corner of Lake County and flows 115 miles south, emptying into the Illinois River at Ottawa. Its basin is about 130 miles long and rarely exceeds 25 miles in width. The basin encompasses 1,720 square miles and includes portions of eleven counties: McHenry, Lake, DeKalb, Kane, Cook, DuPage, LaSalle, Lee, Kendall, Will, and Grundy. The portion of each county within the basin varies from less than 1% (Grundy County) to 74% (Kane County).

Within these counties is a diverse land cover; 19 of the 20 major state land cover categories are represented (only swamps are not found here). At one extreme are DeKalb, Kendall, and LaSalle counties which have 89-94% of their land in agricultural uses and 4-6% in urban uses. At the other extreme is Lake County, where agriculture takes up less than 25% of the land and urban development encompasses 42%. Despite its urban character, Lake County has more wetland acreage than all but three counties in Illinois.

Compared to the rest of the state, the Fox River area has less forest and agricultural land and more wetland. Seventy-two percent of the state's graminoid bog communities and all of the low shrub bogs and forested bogs occur here, as well as four of the state's five fen community types. Geological landforms such as kames, eskers and moraines have also contributed to the area's natural communities — 65% of Illinois' dry gravel prairies and 86% of the gravel hill prairies are found here. Other significant features:

- the 5,506 acres of high quality sites represents 0.5% of the land in the basin and 21% of the total undegraded natural communities in Illinois,
- the watershed has 63 miles of Biologically Significant Streams and 2,204 acres of Biologically Significant Lakes,

- 285,844 acres have been designated a state Resource Rich Area,
- all of the state's undegraded natural lakes are found along the Fox River.

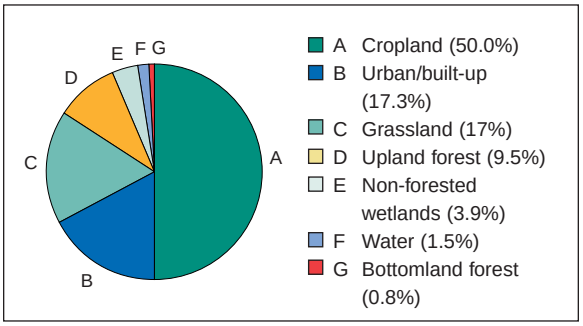


Figure 38. *Fox River basin land cover*

Plant and animal life

Due to the area's unique ecological diversity, many of the state's plants and animals are found in the basin; some are found nowhere else. From carnivorous pitcher plants and sundews to the diminutive white and yellow lady's slipper orchids, the area has a rich flora, with 102 species listed as state endangered or threatened, and two as federally threatened.

The diverse wetland habitats harbor a rich bird community — herons, waterfowl and geese provide common sightings. This is one of the major areas in Illinois for rare wetland species such as the pied-billed grebe, great egret, king rail, common moorhen, least bittern, yellow-headed blackbird, sandhill crane, and red shouldered hawk.

Basin acreage - 1,092,871 acres
State land*- 8,331 acres
County land - 17,270
Total natural areas - 16,125 acres
High-quality natural areas - 5,506 acres
Nature preserves - 4,425 acres

** Does not include natural areas or nature preserves that may be state owned.*

While most mammal species are fairly common, the pigmy shrew, one of the smallest and rarest shrews in Illinois, has been collected only in the Fox River area.

Local economy and outdoor recreation

The six main counties through which the Fox River and its tributaries flow — Lake, McHenry, Kane, Kendall, DeKalb, and LaSalle — form one of the most dynamic areas in the state. It is home to 11% of the state's population and is highly urban — only 15% of the residents live in rural areas. Between 1969 and 1994, the Fox River economy grew twice as fast as the rest of the state, supporting 12% of the state's employment and 13% of its personal income. Four of the six counties rank among the top ten in the state in per capita income.

The state operates five major sites in the area: Chain O' Lakes, Shabbona Lake, Silver Springs, and Moraine Hills state parks and Volo Bog Natural Area. Hunting, fishing, boating and nature activities are all popular pursuits here.

Threats

Prior to European settlement (1820), prairie occupied 31% of the Fox River area and forest 68%. Up until World War II settlements were still rural in character; woodlands, fields, and farms still occupied large areas. The post World War II period, with its flight to the suburbs, changed the composition of the area. With population explosion came habitat loss, degradation, and fragmentation, along with the accompanying invasive and exotic flora and fauna. Trends in the terrestrial community classes of forest, savanna and prairie indicate habitat loss equals or exceeds statewide rates, although the rate of loss for wetlands and natural lakes and ponds is substantially less than statewide.

The watershed can be divided into three distinct segments. The upper Fox, with its many lakes and wetlands, is the most pristine and rich in natural ecosystems, yet is experiencing the greatest population pressure from growth in the northwest Chicago suburbs. The middle Fox is very much an urban river, flowing through six Kane County cities with populations of 15,000-100,000. The challenges in the area include flood control, pollution prevention, and recreation oriented toward the river. Finally, the lower Fox flows through a primarily

Due to the area's unique ecological diversity, many of the state's plants and animals are found in the basin; some are found nowhere else.

agricultural landscape and is threatened by soil erosion and chemical runoff from farms.

Urbanization - Urban expansion from the Chicago metropolitan region is putting severe pressure on the natural ecosystems of the region. During the last 20 years, nearly 1,100 miles of new roads have been built in the area, population has grown 30%, and employment and vehicle miles traveled have grown 75%. Urbanized acreage has expanded by 25% in just the last 10 years.

Although many of the area's natural communities are degraded, they retain relatively high levels of ecological integrity.

Water pollution - Wastewater treatment standards have greatly improved the quality of the river since the early 1960s, reducing phosphorous concentrations and fecal coliform counts. However, excessive algal blooms are still a concern. If wastewater treatment is not changed in the upcoming decades, it is likely that the growing amount of effluents may halt or reverse the declining trends in phosphorous and fecal coliform bacteria.

Habitat loss and fragmentation - Natural habitats in the area are typically found in small patches separated from each other by agricultural or developed land and this will continue as development pressure mounts. Stream habitat fragmentation has caused the extirpation or declines in fish species.

Flooding - The loss of natural habitats has reduced the water storage and retention abilities in the basin. Urban settings increase runoff and quickly move water into the river through ditches and tributaries. Similarly, intense cultivation lessens the capacity of water to infiltrate the soil and increases the rate of flow into tributaries and, ultimately, the river. Flooding is now a major problem in the area.

Opportunities

Although many of the area's natural communities are degraded, they retain relatively high levels of ecological integrity and have potential for improvement. For example, forests could be restored in areas where they could potentially have at least a 500-acre core; this would improve habitat for breeding birds. In smaller upland forests, native plant communities could be restored, with shrubby areas and oak trees provided for migrant birds. Managing forests to maintain large snags with exfoliating bark or cavities would provide roosting habitat for forest-dwelling bats and den sites for other mammals, including the southern flying squirrel.

Wetland conservation should also be a high priority because of the relatively large population of threatened and endangered species. Grassland restoration around existing wetlands would provide habitat for declining grassland birds, help buffer wetlands from surrounding development, and provide nesting habitat for many wetland species.

Prairie restoration, coupled with the preservation of native prairie and other grassland habitats, would provide additional habitat for badger and red fox. Restoring native vegetation in the riparian zone along creeks and rivers will not only help wildlife but will also reduce siltation, desiccation, and higher than normal temperatures in the stream. Vegetation will shade the stream, stabilize the banks and filter sediment and chemicals from runoff before they reach the stream.

Upper Des Plaines River Basin

The upper Des Plaines River Basin includes the river basin from the Wisconsin border to the Chicago Sanitary and Ship Canal in Cook County. It drains approximately 346 square miles and includes central Lake, north central Cook and a small portion of DuPage counties. No other natural Illinois river runs through such an urbanized watershed, and yet no other urban river still has so much nature left in and around it.

Scientists estimate that prior to settlement the landscape was 60% forest and savanna and 40% prairie. Wetlands made up a little more than one-quarter of the basin, mostly wet prairie, prairie pothole marsh, sedge meadow, peatland and floodplain forest. Today, urban land takes up more than 40% of Lake County and 75% of Cook County, yet pockets and pieces of natural lands still exist.

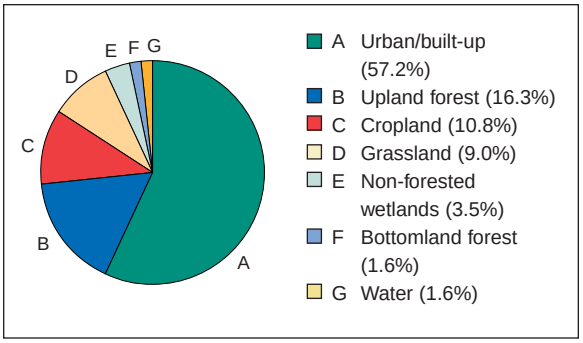


Figure 39. *Upper Des Plaines River basin land cover*

Eighteen percent of the upper Des Plaines basin is woodland. Marshes, wet meadows, and ponds cover 3.5% of the surface with 167 pothole lakes still surviving. The basin contains 63% of the statewide total of northern flatwoods (open woodlands that occur on claypan soil), 10% of the state's calcareous floating mat community (floating mat of sedge peat over a lake or pond), and 7.3% of the state's sedge meadow community. Other significant features:

- the combination of different moisture, terrain, and soil types produce 16 distinct habitat types in the basin; several — bogs, fens, marl flats — are more typical of Canada than Chicago's collar counties;
- high quality natural areas make up 0.2% of the basin; and
- nine nature preserves offer wet prairies, fens, sedge meadows, marsh, oak savanna, and oak woods.

Plant and animal life

The Upper Des Plaines area has distinctive flora, with some plants such as northern cranesbill and hairy white violet more typical of Canada. Only 662 species of plants have been recorded in the area. Of these, 24 species are listed as state threatened or endangered; the prairie white fringed orchid is also listed as federally threatened.

With its large amount of urban land, the area does not figure importantly as wildlife habitat, although at least 270 of the 300 bird species that occur in Illinois can be found here, as well as 43 species of mammal. Twenty-three species of reptiles and 16 species of amphibians are found here, with the state endangered eastern massasauga occurring in pockets of habitat provided by the many forest preserves and conservation areas. Butterflies and skippers are well known with 109 species documented. Scattered pockets of lupine in the upper Des Plaines area provide food for the federally endangered Karner blue butterfly.

Local economy and outdoor recreation

The Des Plaines River runs through the heart of Illinois' most urbanized region. Cook and Lake counties encompass merely 2.5% of Illinois' land area, but account for 31% of its urban land and 50% of its population. In the last 120 years, the population of the area grew fourteen-fold. Nearly 99% of residents live in urban areas, and urban land takes up more than 40% of Lake County and nearly three-quarters of Cook County, compared to only 6% for the rest of Illinois.

The Upper Des Plaines area has distinctive flora, with some plants such as northern cranesbill and hairy white violet more typical of Canada.

The area employs nearly 3.5 million people with a total income of $150 billion — over half of the jobs and income in Illinois. Most agriculture, which plays only a small part in the economy and land cover, is in specialty crops, commodities that have a high cash value in a region of high land values.

Basin acreage - 221,637
Total natural areas - 2,259 acres
High quality natural areas - 440 acres
Nature preserves - 1,476 acres

The region does not include any state outdoor recreation sites, but it does contain county forest preserves and interpretive centers. The urban character of the area deters hunting; firearm deer hunting is not allowed.

Threats

Pollution - While surface water pollution has been reduced, water quality is still compromised by hard-to-regulate nonpoint sources such as soils washed into streams from fields and building sites, and de-icing salts from roads. The Illinois Environmental Protection Agency has assessed about a quarter of the upper Des Plaines basin and rates water quality as fair. Mussel diversity, an indicator of water

quality, is also low. Although 18 native species have been reported from the region, only three common species have been found alive since 1963.

Emissions of federally regulated pollutants have also been reduced, although locally produced air pollution (i.e. engine exhaust) is still a problem. Cook and Lake counties are crisscrossed with 10% of the state's roads and they carry 40% of the vehicle-miles traveled in the state.

Modification - Humans have long pre-empted nature as engineers of the watershed — fields have been tiled and wetlands drained. Impounding structures have been installed on natural lakes to stabilize their levels and the lakes now function like artificial impoundments. Low-head dams alter both water level and the movement of sediments, nutrients, and plants and animals in the river channel. Average flows in the Des Plaines are 80% higher today than in the 1940s and 1950s.

The basin has become an outdoor laboratory for experiments in the restoration and reconstruction of habitats.

Exotic species - An arkful of non-native animals and plants have been introduced into the basin, often with unintended ecological effects. The rusty crayfish (used as bait) has been dumped into the water and its survivors outcompete the native clearwater crayfish. Ten percent of the vascular plant species now found in the basin are not native to it. Several species of exotic turtles as well as two caimans have been reported in the Des Plaines River — probably discarded pets.

Fragmentation - Construction of roads, fields, and houses divides forests, wetlands, or prairies into small habitat "islands." Forested wetlands in the basin consists of 390 separate tracts, the mean size of which is 7.5 acres. Research suggests that many forest birds need the protection of at least 500 acres of woods to breed successfully. The two largest contiguous forested tracts on the Des Plaines River (near Gurnee and near Libertyville) measure 239 and 106 acres respectively. The largest emergent wetland in the basin covers 355 acres — massive by Illinois standards — but the average is 3.7 acres.

Fire - The extent of savanna in the presettlement basin is thought to be explained in part by the occasional fires that swept the area, recycling nutrients, clearing the ground for new growth, and killing all but the fire-resistant oak species. Without fire to stem plant invaders, savanna becomes dense woods. In deep woods, young maples untouched by fire survive to shade the forest floor. Plants that thrive in the sun — including oak seedlings — languish. As a result, the old oaks in the woods of the upper Des Plaines basin are not reproducing themselves. Mid- and late-summer wildflowers also struggle to bloom after the leafed-out trees block the sun. These effects can be reversed for some flowering plants, such as the state endangered northern cranesbill that occurs in one dryish forest in the basin. Its numbers increase after ground fires are deliberately set to burn off competing plants.

Opportunities

The basin has become an outdoor laboratory for experiments in the restoration and reconstruction of habitats. For example, the Des Plaines River Wetlands Demonstration Project consists of 450 marshy acres along the river in northern Lake County that have been reconfigured and replanted. The site quickly attracted waterfowl and tests have shown that water quality improved as it progressed through the wetland. Also in Lake County, a damaged savanna is regenerating at Reed-Turner Woodland Nature Preserve. Cutting brush and burning periodically are restoring savanna-like growing conditions in other areas, and plans are underway to link public stream margins, forest preserves, and roadsides with appropriately managed private and commercial sites to create corridors of protected land.

C H A P T E R S I X

Kankakee, Vermilion and Mackinaw Rivers Watershed

Although only the fourth largest ISIS watershed, the Kankakee/Vermilion/Mackinaw watershed has the most acres of cropland, which covers more than three-fourths of the land. It has the smallest percentage (5.6%) of forest among the 10 watersheds. (See page 105 for a color map of the watershed's land cover.)

Four Resource Rich Areas are in this watershed — the Mackinaw River, Kankakee-Iroquois, Peoria Wilds, and Prairie Parklands.

- The most significant features of the 195-square-mile Mackinaw River RRA are the river and its tributary, Panther Creek. The waters flow clear in a series of pools and riffles over a sand-gravel-silt substrate. The banks are generally forested and the surrounding area is agricultural.
- The Kankakee-Iroquois RRA takes in 361 square miles and is relatively flat with low sandy ridges. Aquatic systems and savannas are important remaining natural resources of the area. The Kankakee River, which forms the core of the RRA, is unusual in Illinois because it flows on or near bedrock.
- The Peoria Wilds RRA is 434 square miles that encompass the floodplain of the Illinois River, deeply dissected bluffs and hills bordering the floodplain, and relatively flat agricultural areas. A large tract of forest runs along the bluff to the west of the river, and non-forested wetlands are concentrated along the river. One of the largest remaining oak woodland areas in Illinois is found here. Almost three-fifths of the RRA lies in this watershed and the remainder lies in the Spoon River watershed.
- The dominant feature of the Prairie Parklands RRA is the recently created Midewin National Tallgrass Prairie, the nation's first federally designated tallgrass prairie, at the former Joliet Arsenal. Significant natural resources include prairies, wetlands and streams. The largest concentration of upland sandpipers in the state is in the Prairie Parklands area. The RRA takes in 239 square miles — 59% in this watershed and 41% in the Fox and Des Plaines Rivers Watershed.

The banks in the Mackinaw RRA are generally forested and the surrounding area is agricultural.

ECOSYSTEM MONITORING

Fifteen CTAP sites were assessed in this basin, which had HBI scores near the statewide average. The watershed had exceedingly low EPT richness and had the second lowest average habitat quality score. Total native fish richness, however, was slightly above average with more than half being minnows. This region is highly agricultural and most streams do not have a vegetated riparian zone.

Two of the monitored streams, Sugar Creek near Stockland and Terry Creek near Custer Park, are high quality. Sugar Creek had a tree-shaded riparian zone where it was sampled and fish richness was exceedingly high. However, major channelization, levee formation, and a treeless riparian zone just one kilometer upstream will degrade this site over time. Terry Creek, a small sandy stream, produced a large number of EPT taxa and had good habitat quality, but relatively few fish

Table 22. *Watershed Land Cover*

Land Cover	Acres	Percent of Watershed		Statewide Percentage*	
Upland forest	180,296	4.6%	(9)	4.4%	(9)
Grassland	573,891	14.6%	(7)	9.0%	(6)
Non-forested wetlands	29,806	0.8%	(6)	8.4%	(6)
Bottomland forest	38,138	1.0%	(10)	4.4%	(9)
Water	41,048	1.0%	(7)	8.2%	(6)
Urban/built-up	101,313	2.6%	(6)	5.4%	(5)
Cropland	2,972,847	75.5%	(2)	13.8%	(1)
Total acreage	3,937,343	100.0%		11.0%	(4)

** The watershed's percentage of the land cover type statewide, e.g., 4.4% of the state's upland forests are located in this watershed. Note: the watershed rank (1st-10th) is shown in parentheses.*

species. The worst stream was Rock Creek near Carlock. It provided no EPT taxa, had low dissolved oxygen, and scored poorly for habitat quality.

RiverWatch volunteers collected 71 macroinvertebrate samples at 40 sites on 28 streams between 1995 and 1999. The sites selected by volunteers were of a higher quality than those randomly selected by CTAP scientists. Overall, the RiverWatch data showed better-than-average ecosystem health; the watershed fared particularly well in measures of taxa tolerance, suggesting that organic pollution is relatively minor. The watershed ranked second in number of EPT taxa and third in average MBI.

Statistical analysis indicates improving stream quality with the MBI falling from 6.2 to 4.9.

With respect to macroinvertebrate diversity, the three most common species accounted for an average of 78.4% of the sample. The watershed's average of 9.2 taxa per sample ranked fourth among the 10 watersheds. The three most dominant taxa collected were midge larvae, scud, and hydropsychid caddisfly larvae (an EPT species, albeit a common and moderately pollution-tolerant example). Each of these taxa were common across the state. Although the value was up and down over the five year period, statistical analysis indicates improving stream quality with the MBI falling from 6.2 to 4.9.

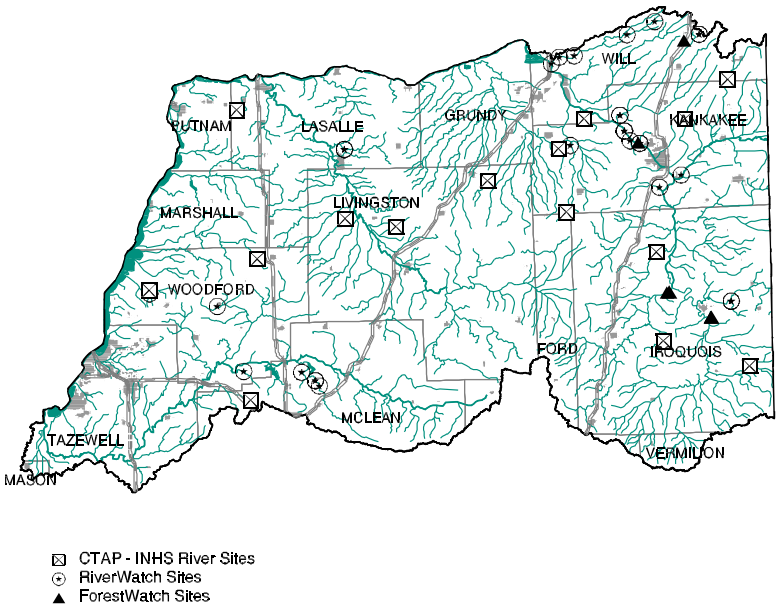


Figure 40. *Monitoring sites*

Table 23. *Watershed Indicator Scorecard*

Indicator	Watershed Value	Statewide Value	Watershed Ranking
Macroinvertebrates			
HBI	5.2	5.2	6
MBI	5.4	5.7	3
EPT richness	5.0	7.1	9
EPT taxa (RW)	3.4	2.6	2
Taxa richness	9.2	8.9	4
Taxa dominance	78.4%	80.4%	3
Fish			
Native fish	14.0	13.6	5
Darter richness	2.1	1.9	4
Exotic species	0.3	0.2	6
Habitat			
Habitat score	77.1	88.6	9

Table 24. *MBI Values*

Statistic	1995	1996	1997	1998	1999	Overall
Average	6.20	5.46	5.32	5.85	4.98	5.43
Standard deviation	1.80	0.76	0.96	1.30	1.25	1.23
Minimum	4.71	3.79	4.01	4.39	2.03	2.03
Maximum	10.77	6.49	7.02	7.95	7.74	10.77
Number of sites*	9	17	10	7	20	63

** Only samples with at least 25 organisms were included in the analysis.*

ForestWatch volunteers monitored two sites in the fall of 1998, an oak-hickory upland forest and an ash-elm-maple bottomland forest. Species richness was 12 species at one site and 15 at the other. The average of 13.5 species for these two sites is above the statewide average of 11.8 species per site. A total of 21 tree taxa were recorded. In general, the trees that were most abundant also had the highest basal areas and importance values (Table 25). The exception is oak trees which were fewer in number but had a larger basal area than most species.

Table 25. *Tree Species with the Highest Importance Values*

Importance Value	Species	% of total trees counted (n=156)	% of total basal area ($19.8m^2$/ha)
63.7	White oak	6%	47%
30.9	Hawthorn	31%	7%
19.9	American elm	19%	7%
17.0	Swamp white oak	3%	17%
11.9	Ash	8%	2%
11.0	Hackberry	8%	3%
6.2	Shingle oak	4%	2%
6.2	Swamp chestnut oak*	2%	5%
5.3	Black locust	2%	1%
4.9	Honey locust	3%	4%

** Because swamp chestnut oak is found mainly in southern Illinois, this was likely misidentified and should be either white oak or swamp white oak.*

Neither of the two sites showed signs of maple takeover, gypsy moths or dogwood anthracnose. However, more sites need to be monitored to determine if these threats are present in the watershed. Of the 420 shrub and vine stems recorded, 89% belonged to two invasive shrub species — the native Missouri gooseberry and the non-native multiflora rose, which was especially abundant. These two sites contributed nearly 50% of the total multiflora rose recorded across the state.

These two sites contributed nearly 50% of the total multiflora rose recorded across the state.

Spring monitoring at one site recorded two disturbance-sensitive species — white trillium and large-flowered bellwort — and one non-native invasive species — ground ivy. None of these three plants were widespread within the site.

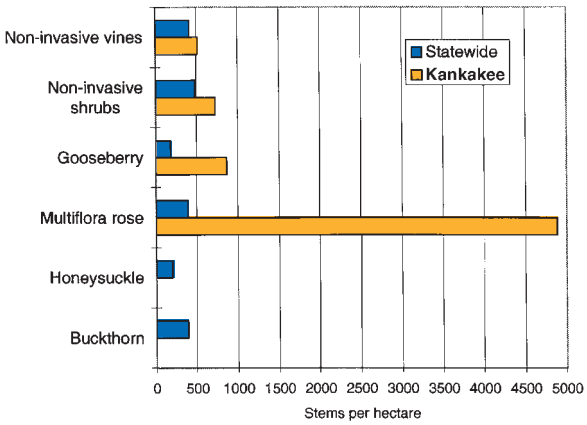
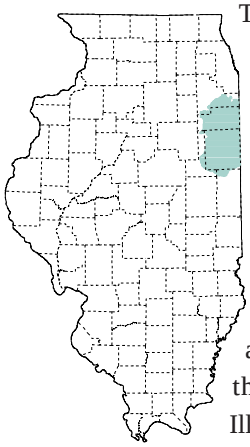


Figure 41. *Number of invasive and non-invasive shrub and vine stems*

REGIONAL ASSESSMENTS

Two regional assessments have been conducted in this watershed — for the Kankakee River valley and the Mackinaw River basin.

Kankakee River Valley



The Kankakee River valley takes in 2,169 square miles, including nearly all of Kankakee and Iroquois counties plus parts of four adjacent counties in northeast Illinois. Two "mainstem" rivers dominate — the Kankakee, which flows west across the valley until it joins the Des Plaines to form the Illinois River, and the Kankakee's principal tributary, the Iroquois. More than three-fourths of the land area is cropland and nearly 16% is grassland — pastures and hayfields, idle fields, remnant prairies, and grassy strips along roads and railroad tracks. Forest covers 3.1% of the land and non-forested wetlands cover another 0.5%. Forests and wetlands, along with the open water of the river systems, are the refuges where much of the region's plant and animal life persists.

In general, relative losses of presettlement habitat in the Kankakee exceed statewide averages.

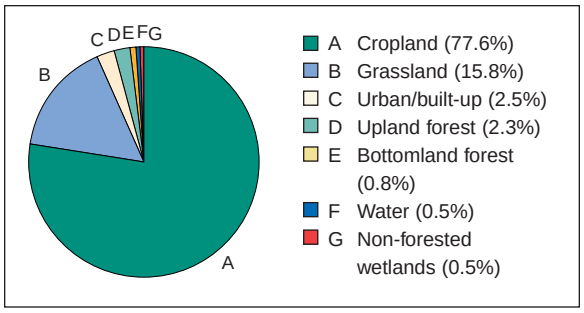


Figure 42. *Kankakee River valley land cover*

In general, relative losses of presettlement habitat in the Kankakee exceed statewide averages. And except for forest and savanna, the ecological quality of what does survive is lower in the Kankakee valley than in the rest of the state. More than 90% of the valley was prairie (including savannas) when Euro-American travelers first saw it. Today about 56 acres of prairie survive in the region, or 0.005% of the original.

Conservative calculations suggest that the presettlement Kankakee valley included 375,000 acres of wetlands of various types. An estimated 96% of them are gone. Only about 236 acres of the remaining wetlands (not counting forests along streams) persist in their presettlement state, and of these, only six acres remain of the highest quality. More than 10,000 acres of floodplain forest persist, the biggest chunk being in the Momence wetlands. There, 1,600 acres of sloughs and swamps remain largely as observers saw them 70 years ago. Other significant features:

- biologists rank most of the Kankakee and Iroquois rivers, along with nine of their tributaries, as "highly valued aquatic resources,"
- five branches of the Kankakee-Iroquois drainage, totaling 74.7 miles, have been designated as Biologically Significant Streams because of the diverse life they support,
- nearly 88% of the sampled stream miles in the Kankakee drainage "fully support" appropriate uses as determined by the Illinois Environmental Protection Agency,
- 231,005 acres have been designated a resource rich area,
- eight state-recognized nature preserves and 33 state-designated natural areas offer savannas, dunes, sandy uplands, and bottomland forest of various types.

Plant and animal life

While the number of species in the valley remains high, recent records reveal that the number of individuals of many species is dwindling. The decline in presettlement habitat is presumed to be the cause of this shrinkage, as farm fields, home sites, and roads replace more ecologically complex environments.

Basin acreage - 1,292,227
State land* - 6,658 acres
Total natural areas - 6,900 acres
High quality natural areas - 1,228 acres
Nature preserves - 845.5 acres

** Does not include natural areas or nature preserves that may be state owned.*

The area is home to at least 249 of the estimated 299 bird species that regularly occur in Illinois. Of these, 143 are known to breed or used to breed in the area and 19 of these are listed as threatened or endangered in Illinois.

Six species of fish known from the region are listed by state authorities as being endangered or threatened. One of them, the weed shiner, is among the rarest fishes in Illinois and the only large population of the species is found in the Kankakee valley. Smaller populations are known in only two other localities in the state.

Of the more than 1,000 species of native plants known in the area, 75 are species whose survival in Illinois is considered uncertain, and two — Mead's milkweed and the eastern prairie fringed orchid — are rare in the nation as a whole.

Local economy and outdoor recreation

Over the past century the combined populations of Kankakee and Iroquois counties more than doubled, with most of the growth occurring in Kankakee County. Kankakee County is highly urbanized, with almost seven out of ten people living in urban areas. Iroquois County is more rural with fewer than one out of five residents living in urban areas.

During the past decade the area has lost population as it has lost some of its industrial base. Manufacturing employment fell 32% in the last 25 years, while service sector employment rose 120%. Manufacturing is still the largest source of earnings in Kankakee County, however, reflecting its higher wages. Services and trade provide the most jobs. In predominantly rural Iroquois County farming is the third largest employment sector, after services and trade.

Outdoor recreation opportunities in the Kankakee River valley are shaped largely by the river itself. Kankakee River State Park is visited by approximately 1.2 million people annually who come to hike, camp, hunt, fish, ride horses, watch wildlife, and go boating. The smaller Iroquois County Conservation Area is known for its sand dune and prairie marsh habitats and its excellent pheasant hunting. Visitors to these sites generate about $14 million in output and 220 jobs for the local economy.

Threats

Habitat loss and fragmentation - Construction of roads, fields, and houses divides once-intact forests, wetlands, or prairies into small habitat "islands." The entire local populations of some plant and animal species in these splintered tracts may include only a few individuals. The smaller such local populations are, the more vulnerable they usually are to disease and in-breeding stress. Fragmented habitats also are often too small for species that need far-flung home ranges. For example, gray squirrels are rare or absent in the area because the extensive tracts of forest they need are rare here.

The minimum forested acreage thought necessary to shelter populations of breeding songbirds is 500 acres. None of the three largest tracts of savanna — found upstream of Momence on the Kankakee and along Spring Creek between Gilman and Crescent City — is bigger than 428 acres.

Grassland and wetland birds also lack sufficient breeding space within the Kankakee valley. Fortunately, planned restoration of large tracts just outside the region — at the Midewin National Tall Grass Prairie near Joliet and the Grand Kankakee Marsh across the state line in Indiana — should help replenish those populations locally.

Fragmentation also severs the natural landscape links that connect disparate habitats. Each spring, amphibians like the American toad migrate to lowland areas from upland forests to breed, while reptiles move to upland retreats to hibernate each fall; fragmentation blocks these natural movements.

Grassland and wetland birds also lack sufficient breeding space within the Kankakee valley.

Prairie remnants in restorable condition may persist along railroad rights-of-way.

Stream alternation - The most direct way to disturb ecosystems is to modify the way they work. Construction of artificial drainage systems is (apart from the plowing of the prairie) the most widespread form of ecosystem modification in the Kankakee valley.

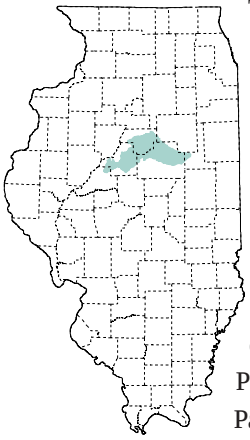
Absence of fire - Oak-hickory forests are not reproducing themselves because the understories are not allowed to burn, resulting in forest floors too shady for sun-loving oak seedlings to flourish. Shade-tolerant maples thrive, however. This has implications for wildlife; squirrels and chipmunks tend to be most abundant in forests heavy with nut-producing trees like oaks and hickories.

Opportunities

Sensible restoration could enhance and expand three large islands of habitat types that have become scarce in most of the rest of Illinois — the upland forests of the Kankakee River State Park, the forested wetlands of the Momence Wetlands and the savannas and grasslands of the Iroquois County Conservation Area. (Extensive savannas also persist on private lands in the Kankakee Sands area.) This would again make the Kankakee host to large breeding populations of birds of the savanna, forested wetland, and emergent wetland. Other opportunities exist to enhance ecosystems.

- Stream corridors, even drainage ditches, can serve as dispersal corridors for plants and animals. Restored riparian zones, for example, enable amphibian and reptiles like the American toad to move safely from the uplands of the Kankakee where it spends most of its life to lowlands where it breeds. Hedgerows in fields offer similar connecting havens for mammals.
- Prairie remnants in restorable condition may persist along railroad rights-of-way; these have been cataloged by local conservation groups such as the Grand Prairie Friends.
- Shrubs planted alongside drainage ditches provide shelter for birds, shade water for fishes, and hold ditch banks against erosion.

Mackinaw River Basin



The Mackinaw River originates in Ford County near Sibley and winds approximately 130 miles in a westerly direction before joining the Illinois River near Pekin. The basin encompasses 1,138 square miles in central Illinois and covers parts of six counties. Principal tributaries are Panther, Walnut and Money creeks. The river basin bisects a highly productive agricultural landscape and is bounded by two metropolitan areas, Bloomington-Normal on the southeast and Peoria on the northwest. More than three-fourths of the land is in cropland; corn and soybeans are the predominant crop with yields above the state average. McLean County contains more farmland — nearly 700,000 acres — and produces more corn and soybeans than any other county in the state.

Habitat loss rates in the basin seem to exceed rates for the state as a whole. Prairie accounted for almost three-fourths of the presettlement landscape; today the only representative of the prairie ecosystem is 1.5 acres of high quality hill prairie. Wetlands have largely disappeared and occupy only 0.3% of the basin. Forest has declined to 5% of the land area, but much of the riparian zone throughout the basin retains at least a narrow forested strip. This buffer stabilizes the river banks and is considered a primary reason for the relatively good health of the Mackinaw River. Other significant features:

- natural communities represented in high quality natural areas include glacial drift hill

prairie, loess hill prairie, dry-mesic barrens, mesic upland forest, and wet floodplain forest;

- the Mackinaw is considered one of the finest examples of a prairie stream left in Illinois and 136.4 miles have been designated as Biologically Significant;
- Panther Creek and the portion of the Mackinaw River north and east of the Mackinaw River Fish and Wildlife Area are both designated as "Class A" streams, indicating that they are high-quality habitats for a rich variety of plants and animals;
- 125,008 acres have been designated a state Resource Rich Area.

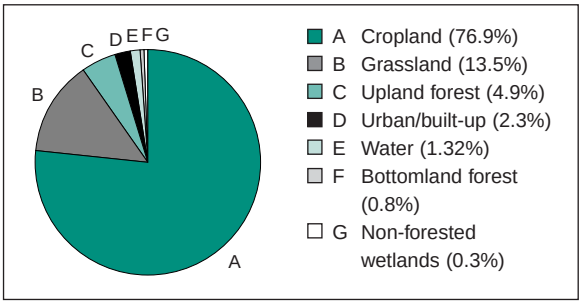


Figure 43. *Mackinaw River basin land cover*

Plant and animal life

The Mackinaw is the only central Illinois site for a unique, stream-dwelling plant, the state-endangered heart-leaved plantain. Here you can also find the black-winged damselfly and the ruby-spot damselfly — both are indicators of good water quality. The macroinvertebrates found in a recent survey appear to be more diverse than those of many other watersheds in Illinois, another indication of good water quality.

Basin acreage - 728,495 acres
State land* - 1,248 acres
Total natural areas - 3,182.6 acres
High quality natural areas - 43 acres
Nature preserves - 84.3 acres
** Does not include natural areas or nature preserves that may be state owned.*

While only 9% of the plant species found in Illinois can be found in the Mackinaw basin, almost three-fourths of the mammals occurring in the state live here. At least seven state T&E species occur in the basin: the Illinois chorus frog, western hognose snake and Illinois mud turtle (all limited to the sand areas in the southwest corner of the basin), the short-eared owl and loggerhead shrike, as well as the heart-leaved plantain and tall sunflower.

Local economy and outdoor recreation

The three main counties through which the Mackinaw flows — McLean, Tazewell and Woodford — have all grown in population by 60-70% since the late 1940s. In the past decade, however, Woodford and Tazewell counties have lost population as manufacturing jobs declined in the Peoria Metropolitan Statistical Area. McLean County has continued to grow with an economy built around insurance, higher education, and, most recently, automobile manufacturing. While farming may be ubiquitous in the Mackinaw River area, agriculture produces only 2% of the area's income and this percentage has declined over time.

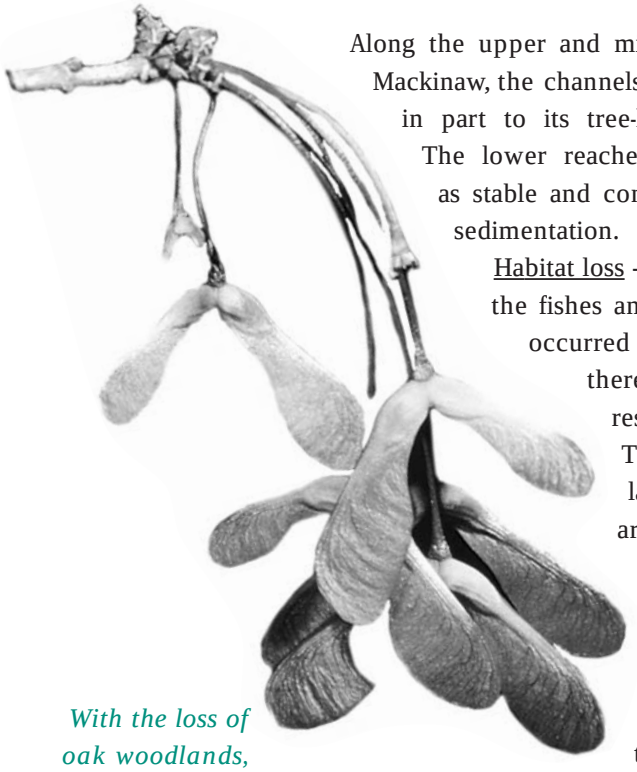
The area does not have any high profile outdoor recreation areas, but the streams and surrounding areas offer an array of outdoor activities, from fishing and hunting to canoeing.

Water pollution from built-up and agricultural lands has led to a decline in the aquatic life of the Mackinaw since the 1950s.

Threats

Pollution - Water pollution from built-up and agricultural lands has led to a decline in the aquatic life of the Mackinaw since the 1950s, particularly the mussels and fishes of the lower drainage. Clean water mussels such as the slippershell and spike have been replaced by species that are tolerant of lower water quality, such as the white heelsplitter and three ridge.

Sedimentation - Compared to the other major tributaries of the Illinois River, the Mackinaw River basin has one of the highest sediment yield rates in the Illinois River basin. Excess sediment comes from increased erosion due to urban and agricultural land use patterns. In urban landscapes the velocity of runoff during storms increases, causing high levels of soil erosion. In agricultural landscapes on flat uplands, most streams have been ditched and the fields tiled to promote drainage, causing water to speed off areas where it was once retained.



With the loss of oak woodlands, the plant and wildlife species that depend upon them are also gone.

Along the upper and middle reaches of the Mackinaw, the channels are very stable, due in part to its tree-lined riparian zone. The lower reaches, however, are not as stable and contribute to increased sedimentation.

Habitat loss - Nearly one-fourth of the fishes and mussels that once occurred in the Mackinaw live there no more, a direct result of habitat loss. The draining of wetlands and removal of areas of clear, slow water (because of sedimentation, channelization, increased water velocity) has caused the golden shiner and the brown bullhead to disappear. Unstable bottom conditions, caused by sedimentation, have extirpated certain species of mussels. This loss of habitat has been highest in smaller tributaries that pass through upland areas.

The absence of fire also contributes to habitat loss. When fire is suppressed, changes occur in forest structure, composition, and diversity, for example, the invasion of sugar maples into oak-hickory forests. With the loss of oak woodlands, the plant and wildlife species that depend upon them are also gone.

Habitat fragmentation - Notable examples of problems caused by fragmentation are increased songbird nest parasitism by cowbirds, interruption of migration patterns, and, ultimately, loss of songbird species diversity. Similarly, habitat connectedness is important for species such as amphibians, which often travel long distances between breeding and non-breeding habitats.

Many habitats have been degraded by grazing. The palatable and often showy species such as trilliums, ferns, orchids, and bellflowers are gone. The unpalatable species (those that are thorn-bearing or have bristly fruits) are left to flourish. Many woodlands in the basin now have a ground cover of undesirable species like buckbrush, common snakeroot, brambles, and garlic mustard.

Opportunities

To create stable banks and thus reduce soil erosion, a wide band of vegetation should be planted along streams and rivers — natural vegetation deflects water from the bank, absorbs energy from the moving water, and results in a slower flow. Maintaining these forested riparian zones could enhance the suitability of the area as habitat for bobcats and gray foxes, and reducing silt and chemical run-off will improve the ability to attract and support river otters.

Restoring prairie and prairie wetlands would benefit a variety of amphibians and reptiles and enhance the suitability of the area as habitat for Kirtland's snake, the smooth green snake and the tiger salamander. Restoring native forests, wetlands, sand prairie and sand ponds in the sandy southwest area would benefit two of the basin's T & E species — the Illinois chorus frog and Illinois mud turtle. Maintaining small temporary fishless ponds in forests — particularly upland forests which are among the rarest in the basin — would benefit almost all reptiles and amphibians, as well as other species that depend on them for food.

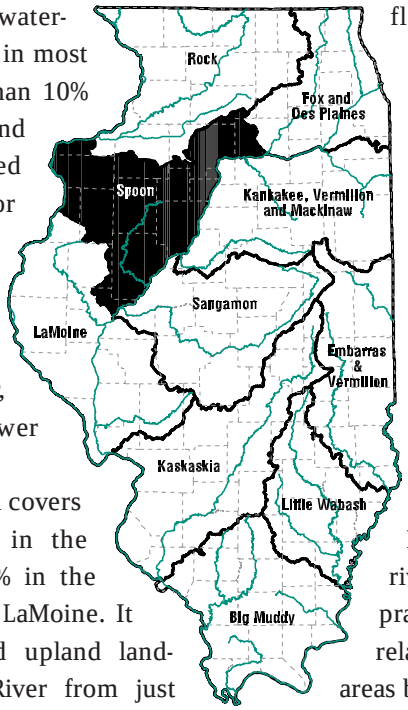
Habitat loss has also been a major problem for birds in the basin; the area has few high quality areas for breeding birds. The Parklands natural area in the middle Mackinaw River sub-basin has the best potential for creating a large, forest-interior tract of 500 acres or better. This site already has veeries, northern paula, Louisiana water thrush and ovenbird. It is large enough to contain significant areas of grassland and shrubland habitat.

Restoring grasslands would bring back populations of many threatened and endangered bird species. Sites should be relatively large (more than 100 acres) and dedicated to grassland management. Woody vegetation removal (except in areas that are too wet to burn) may be necessary to attract some birds and increase their nesting success. Rotational mowing, burning or grazing may maximize the number of grassland birds that can nest in an area.

C H A P T E R S E V E N

Spoon River Watershed

The seventh largest of the 10 watersheds, the Spoon is fairly average in most respects. It accounts for more than 10% of the statewide acreage of upland forest, grassland and non-forested wetlands. (See page 106 for a color map of the watershed's land cover.)



Portions of three Resource Rich areas lie within this watershed — the Middle Illinois River, Peoria Wilds and Mississippi-Lower Rock.

- The Middle Illinois River RRA covers 899 square miles — 24% in the Spoon River watershed, 41% in the Sangamon and 35% in the LaMoine. It incorporates floodplain and upland landscapes along the Illinois River from just below Peoria to Florence. The third largest RRA, the site includes sand prairies, which have a mix of native tallgrass and plants more commonly associated with the western U.S., such as the prickly pear cactus.
- The Peoria Wilds RRA is 434 square miles — 42% in the Spoon River watershed and 59% in the Kankakee — that encompass the floodplain of the Illinois River, deeply dissected bluffs and hills bordering the floodplain, and relatively flat agricultural areas away from the river. A large tract of forest runs along the bluff to the west of the river, and non-forested wetlands are concentrated along the river. One of the largest remaining oak woodland areas in Illinois is found here.
- The Mississippi-Lower Rock River RRA encompasses 715 square miles — 81% in the Rock River watershed and 19% in the Spoon River watershed. It includes major rivers, bottomlands, upland forests, prairies and river bluffs. The area has a relatively high total acreage of natural areas because of the Mississippi River sites.

One of the largest remaining oak woodland areas in Illinois is found here.

ECOSYSTEM MONITORING

Based on the eight CTAP sites that were assessed, the Spoon watershed had the best average HBI scores of all ISIS basins and above average EPT richness. Conversely, native fish richness and habitat quality were below average. Most streams

Table 26. *Watershed Land Cover*

Land Cover	Acres	Percent of Watershed		Statewide Percentage*	
Upland forest	449,073	12.9%	(3)	10.9%	(4)
Grassland	668,468	19.1%	(3)	10.4%	(5)
Non-forested wetland	38,883	1.1%	(3)	11.0%	(4)
Bottomland forest	53,777	1.5%	(7)	6.1%	(6)
Water	47,706	1.4%	(6)	9.5%	(5)
Urban/built-up	91,772	2.6%	(5)	4.9%	(6)
Cropland	2,146,345	61.4%	(5)	10.0%	(7)
Total acreage	3,496,028	100.0%		10.0%	(7)

** The watershed's percentage of the land cover type statewide, e.g. 10.9% of the state's upland forests are located in this watershed. Note: the watershed's rank (1st-10th) is shown in parentheses.*

sampled had severe erosion and sand deposition. Only one monitored stream had good habitat quality, David's Creek near Monmouth in Warren County. While the Edwards River had great EPT richness, the stream suffered from sand deposition to the extent that pools were relegated to narrow areas along banks.

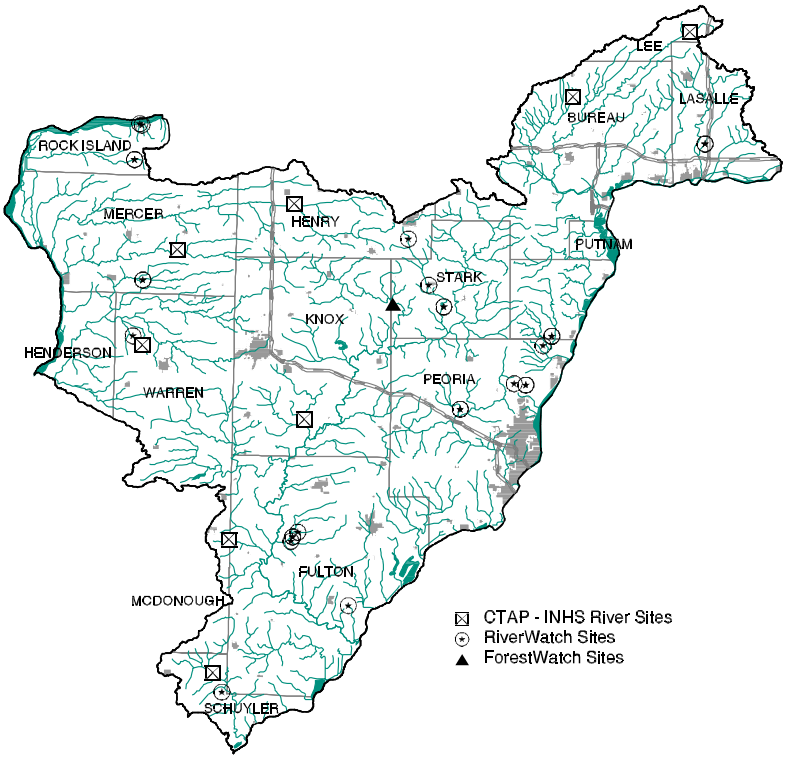


Figure 44. *Monitoring sites*

RiverWatch volunteers collected 74 samples at 34 sites on 29 streams. RiverWatch indicators suggest that the watershed's streams are among the best in the state. However, it should be noted that most of the sites monitored were located on streams that flow into the Mississippi or Illinois rivers rather than into the Spoon River itself.

The watershed ranked either first or second among the ten watersheds in all four indicators.

The watershed ranked either first or second among the ten watersheds in all four indicators. Overall, the values reflect high macroinvertebrate biodiversity and only modest organic pollution. The average MBI value has decreased over the five-year period, indicating an improvement in stream quality. However, the changes are not statistically significant.

Table 27. *Watershed Indicator Scorecard*

Indicator	Watershed Value	Statewide Value	Watershed Ranking
Macroinvertebrates			
HBI	4.4	5.2	1
MBI	5.3	5.7	2
EPT richness	9.7	7.1	2
EPT taxa (RW)	3.4	2.6	1
Taxa richness	9.5	8.9	2
Taxa dominance	77.5%	80.4%	2
Fish			
Native fish	10.8	13.6	9
Darter richness	1.8	1.9	5
Exotic species	0.0	0.2	1
Habitat			
Habitat score	83.8	88.6	7

Table 28. *MBI Values*

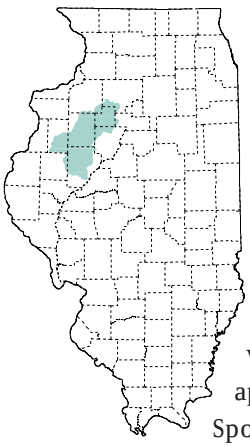
Statistic	1995	1996	1997	1998	1999	Overall
Average	5.92	5.25	5.38	5.15	4.97	5.29
Standard deviation	1.36	0.81	0.98	0.63	0.82	0.93
Minimum	4.71	2.69	3.41	4.38	3.18	2.69
Maximum	9.03	5.93	7.28	6.37	6.61	9.03
Number of sites	9	14	16	13	16	68

** Only samples with at least 25 organisms were included in the analysis.*

REGIONAL ASSESSMENTS

Two regional assessments have been conducted in this watershed — for the Spoon River basin and the Illinois River Bluffs.

Spoon River Basin



The Spoon River rises in west-central Illinois near the small town of Neponset in southwestern Bureau County. For approximately the first 100 miles of its course, the Spoon parallels the Illinois River, then abruptly turns southwestward in Fulton County. Within approximately 25 miles, the Spoon joins the Illinois River opposite the town of Havana.

The river basin encompasses a surface area of approximately 1,845 square miles and includes portions of nine counties. Most of the land is used for agricultural purposes, ranging from 97% in the upper reaches of the watershed to 55% in the lower Spoon.

Prior to European settlement approximately 67% of the Spoon River area was prairie and the remaining 33% was timber. Only 112 acres of prairie, 0.01%, remain in an undegraded, high-quality ecological condition. The 2.4 acres of high quality dry-mesic prairie found in the area accounts for 16.7% of such prairie remaining in Illinois. The basin's wet-mesic upland forest accounts for 18% of the total remaining in the state. While the original savanna acreage for the area is unknown, the area has a notable small remnant (0.7 acre) that accounts for 7.6% of all the high quality savanna in Illinois. It is the only remnant of a Grade A savanna in the state. Other significant features:

- underground the region is literally a "coal mine" and 7.5% of the area contains contiguous areas of surface-mined land;
- only 21 stream-miles of the Spoon have been channelized, making it one of the least channelized watersheds in Illinois;
- the area is rich in archaeological resources, with more than 2,600 sites recorded; a major archaeological museum, Dickson Mounds State Museum, presents the world of native Americans through 12,000 years in the Illinois River Valley.

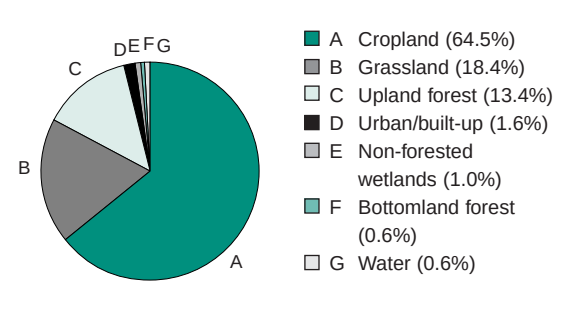


Figure 45. *Spoon River basin land cover*

Plant and animal species

Twenty-eight percent of the state's plants grow in the Spoon River basin, including the state-threatened bunch-flower, a lily found in wet to mesic prairies that occurs in Massasauga Prairie Nature Preserve.

Illinois endangered bird species that live in the area include the black-crowned night heron, northern harrier, upland sandpiper and Henslow's sparrow. Threatened species include the red shouldered hawk, brown creeper, least bittern, and loggerhead shrike. While several bird species have disappeared from the area, the wild turkey has been re-established.

Basin acreage - 1,180,951 acres
State land*- 2,399 acres
Federal land - 1,671 acres
Total natural areas - 217.5 acres
High-quality natural areas - 111.3 acres
Nature preserves - 84 acres
** Does not include natural areas or nature preserves that may be state owned.*

More than three-fourths of Illinois' mammal species are known or likely to occur in the Spoon river area. The river otter, once locally extinct, was reintroduced in 1996. One endangered reptile, the massasauga rattlesnake, is known to exist in the basin, but the state-threatened timber rattlesnake has been extirpated.

Local economy and outdoor recreation

Except for Peoria County, the area is mostly rural. Between 1870 and 1990 the combined populations of Peoria, Fulton, Knox, Stark and Warren counties grew only 90%, compared to statewide growth of 350%. Not surprisingly, urbanized Peoria County had the greatest population increase, up 285%.

Since the early 1970s, the area economy has changed steadily from a manufacturing base to a more service-related economy. In 1970, the service sector accounted for 19% of the area's jobs; by 1994, it accounted for more than one-third. Although manufacturing employment fell to 12% of area employment, it still accounts for more than 20% of all income, and Caterpillar in Peoria remains the largest employer.

The area has one state-owned outdoor recreation site, Snakeden Hollow State Fish and Wildlife Area. Restored from a Midland Coal Company surface mine, the site encompasses 2,500 acres near Victoria in Knox County. Emiquon National Wildlife Refuge is a federally-owned site with 1,671 acres near the confluence of the Spoon and Illinois

The area is rich in archaeological resources, with more than 2,600 sites recorded.

rivers in Fulton County. When land acquisition is complete, the refuge will encompass approximately 11,000 acres.

Threats

Habitat loss and fragmentation - Habitat losses for prairies and wetlands (only 1% of the land is in wetlands) have exceeded the rates for the state as a whole, while forest habitat loss has occurred at a lower rate. In addition to habitat loss through conversion to cropland, most remnant plant communities in the Spoon River basin have experienced changes because of fragmentation, the absence of fire, and exotic species introduction.

Tiling and flooding - Tiling agricultural land to improve drainage has a negative impact on streams. The rapid drainage increases the pulse of floods as well as the intensity and duration of low-flow once the water has moved downstream. Also, stream organisms are not adapted to these extreme water level fluctuations and whole populations can be extirpated.

Sedimentation - The Spoon River watershed is the largest contributor of siltation to the Illinois River. Because of this siltation, no parts of the Spoon are rated as high quality or as a Biologically Significant Stream.

Maintaining the forested riparian zone along the Spoon River will enhance the suitability of habitat for the gray fox, bobcat, river otter, and amphibians and reptiles.

Opportunities

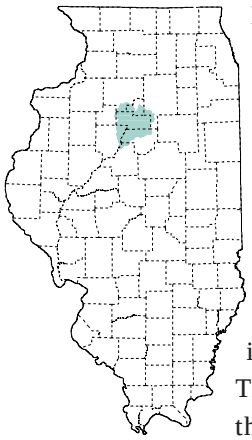
To improve bird management in the area, large tracts of forest are needed to offset fragmentation. One candidate is the Emiquon National Wildlife Refuge in Fulton County. Restoring grassland tracts of more than 100 acres would also improve prospects for re-introducing Franklin's ground squirrels and provide additional habitat for badgers and red fox.

Restoring wet prairie, especially at the Massasauga Prairie Nature Preserve, would help birds as well as amphibians and reptiles. Restoring natural vegetation and maintaining riparian zones will improve water quality.

Other recommendations for the basin include:

- protect both upland and floodplain forested tracts and maintain dispersal corridors such as the forested riparian zone along the Spoon River to enhance the suitability of habitat for the gray fox, bobcat, river otter, and amphibians and reptiles;
- manage developed areas, especially urban forests and parks, to improve bird habitat by encouraging oaks and leaving shrubby areas for migrants;
- in agricultural areas, provide increased cover for wildlife with shrub-lined drainage ditches and unmowed roadsides.

Illinois River Bluffs



Located in west-central Illinois, the Illinois River Bluffs begin near Hennepin, where the Illinois River makes its 'big bend' toward the south, and ends at the southern end of Peoria Lake at East Peoria, taking in nearly 561,000 acres. This part of Illinois marks the furthest reach of the massive glaciers that crept from the north and east during the most recent ice age.

As the ice walls melted, rock rubble piled up along their edges. The resulting moraines snake across today's landscape, running roughly north to south for dozens of miles. Streams sliced their way through these moraines on their way from the uplands to the Illinois River below, creating a picturesque terrain.

The mix of woodland, savanna, and prairie found in the bluffs along the Illinois River is one of the largest remnant forest ecosystems left in Illinois. The Illinois River Bluffs has more forest than most parts of the state — more than one-half of its presettlement forest area remains wooded today, compared to 31% statewide, and more of the forests retain their original ecological integrity, 0.2% compared to 0.08% statewide.

Other significant features include:

- the Illinois River was one of three river-floodplain ecosystems in the U.S. given priority for restoration by the National Academy of Science National Research Council;
- 277,847 acres have been designated a state Resource Rich Area;

- a number of natural communities that are rare or absent in the rest of the state occur here — more than half of the good-quality glacial drift hill prairie, almost half of the seeps, and all of the tall shrub fen.

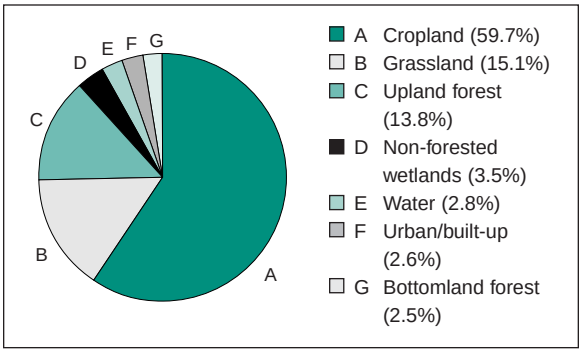


Figure 46. *Illinois River Bluffs land cover*

Plant and animal life

Overall, the area is not a haven for rare species. Only 1.3% of Illinois' officially endangered species and 10.5% of its threatened species are found here. However, the valley does harbor rare plant species such as the decurrent false aster, which exists only in the Illinois River Valley, and Schreber's aster, found in Illinois only in and around the river bluffs. A little more than a thousand species of vascular plants (four of five of them are native) are known in the area, but only 10 appear on the T&E list.

Basin acreage - 560,874 acres
State land*- 9,475 acres
Federal land - 1,622 acres
Total natural areas - 2,459 acres
High-quality natural areas - 501 acres
Nature preserves - 1,300 acres
** Does not include natural areas or nature preserves that may be state owned.*

Some three dozen species of wetland birds are known to inhabit the region, including 16 species, such as the black-crowned night-heron and the king rail, whose survival in Illinois is recognized as threatened or endangered. The double-crested cormorant has begun to recolonize former breeding areas around the edges of some of the region's larger backwater lakes, and the wild turkey again roams area woods.

The valley serves as an essential corridor for transient species, including the federally-threatened bald eagle, the bobcat, and many migratory bird species.

Local economy and outdoor recreation

Since 1870 the population in the Illinois River Bluffs has grown 174% and in 1990 the area was home to 2% of the state's population. Peoria County nearly quadrupled in population during that time period, while Woodford County grew only after World War II (by about 70%) as the suburbs of Peoria extended into this largely rural county. Marshall County has remained rural and actually lost one-fourth of its population.

In 1994, the area supported nearly 136,000 jobs and generated $5.0 billion total personal income. Peoria County accounted for more than 80% of both. In 1970, manufacturing provided 21% of the region's jobs; by 1994 it provided only 12% while the service sector provided 37%. In rural Marshall County, the farm sector led the economy in 1970; by 1994 it was fourth in both employment and earnings.

Recreational opportunities abound in and around the backwater lakes of the Illinois River. The state owns two major recreation areas — Marshall State Fish and Wildlife Area and Woodford County Conservation Area — which together cover nearly 9,000 acres. Both sites offer ample opportunities for fishing, boating, hunting, hiking, camping, picnicking, and viewing wildlife. Together they generate an estimated $1.3 million in total economic output for the area.

Threats

Habitat loss and fragmentation - Local wetlands and prairies disappeared here at about the same rate as in the rest of Illinois and of the estimated 107,000 acres of presettlement wetlands, about 33,000 acres are left. Forest and savanna, however, disappeared at rates faster than the statewide averages. The losses continue as once-remote farms have acquired new value as building sites. Urban development has already impacted some of the best remaining natural areas and threatens others as it sprawls north of Peoria.

The valley serves as an essential corridor for transient species, including the federally-threatened bald eagle, the bobcat, and many migratory bird species.

The area has more than 700 separate emergent wetlands, land covered with water shallow enough that plants rooted in the water grow mainly above it. The largest such wetland (in the Marshall County Conservation Area) is 74 acres, but the average wetland is 3.1 acres. Forested wetlands are split into more than 800 separate parcels with a mean size of 13.8 acres — considerably smaller than the 500 acres thought necessary to provide safe breeding habitat for many forest birds.

Pollution - A century ago Chicago decided to eliminate its water pollution problem by flushing it down the Illinois River. By 1922 the Illinois River at Chillicothe was ecologically dead. Improved sewage treatment upstream has restored that part of the river to life but not yet to health; the pondweeds, coontail, and wild celery that once sustained flocks of hungry waterfowl on Peoria Lake, for example, never came back.

Altered hydrology - Draining chronically wet soils makes them farmable, but it destroys some kinds of habitat and alters the way others function. While some amphibians adapt well to humanized environments — the bullfrog can use drainage ditches, flooded fields, even livestock watering troughs as breeding habitat — most species are not so opportunistic. The wet prairies preferred by the eastern massasauga snake have been dramatically reduced in extent since settlement, resulting in the snake's extirpation from the Illinois River Bluffs.

In general backwater lakes in the area have lost 70% of their capacity to sedimentation since settlement.

Sedimentation - Siltation, increased water temperatures, and desiccation all follow when riparian vegetation is removed and fields are tiled for agricultural production. Excessive siltation is among the most damaging forms of stream pollution. In general backwater lakes in the area have lost 70% of their capacity to sedimentation since settlement.

Opportunities

To enhance habitat for breeding birds, existing large forest sites should be conserved. The Peoria Wilds Resource Rich Area, combined with wetlands in Marshall County, could turn the Illinois River Bluffs into a breeding source for other parts of Illinois. Studies suggest that prescribed fires can benefit bird species such as the northern oriole, summer tanager, rose-breasted grosbeak, and great crested flycatcher. The red-headed woodpecker, whose presence in the Midwest has declined nearly 2% a year since 1966, has also shown higher reproductive success in burned woods.

The region could be made more welcoming to migrant birds that seek open woods by restoring degraded but still viable savanna. Small sites could be restored with native plant communities, keeping in mind the needs of migrant birds. Protecting both upland and floodplain forested tracts and maintaining dispersal corridors such as the forested riparian zone along the Illinois River could enhance the suitability of the area as habitat for gray fox and bobcats. Remaining forests could be managed to maintain large snags for forest-dwelling bats and den sites for other mammals such as the southern flying squirrel.

Existing wetlands should be preserved and they should be buffered by wooded and grassland strips. Wetlands or riparian forest restoration could attract river otters, and maintaining small wetlands would benefit almost all amphibian and reptile species. Also, maintaining small, temporary, fishless ponds in large forest tracts would benefit many of these species. For most amphibians, however, agricultural fields and vacant lots are barriers to dispersal. For these species to persist in the landscape, small wetlands must be connected to other wetlands by corridors of natural vegetation.

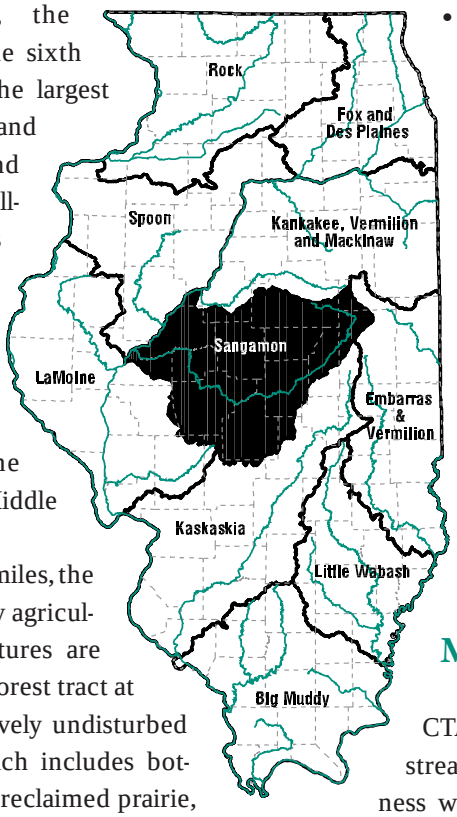
To provide valuable grassland habitat for birds, sites should be at least 100 acres, and be burned or mowed on a schedule that leaves some areas unmanaged for at least three years. Preserving native prairie and other grassland habitats would provide additional habitat for badger and red fox.

Siltation, desiccation, and higher than normal temperature would all be reduced to acceptable levels if streams were lined with native plants that shaded the stream, stabilized the banks, and filtered sediment and chemicals from runoff before they reached the stream.

C H A P T E R E I G H T

Sangamon River Watershed

Located in central Illinois, the Sangamon River watershed is the sixth largest ISIS watershed. It has the largest percentage of its land in crops, and has the second highest cropland acreage in the state. It has the smallest amount of upland forest and is the fourth most urbanized watershed in the state. (See page 107 for a color map of the watershed's land cover.)



Two Resource Rich Areas are in this watershed, the Sangamon River RRA and the Middle Illinois River RRA.

- Relatively small at 84 square miles, the Sangamon River RRA is highly agricultural. The major natural features are the Sangamon River and the forest tract at Robert Allerton Park, a relatively undisturbed stream-valley ecosystem which includes bottomland forest, upland forest, reclaimed prairie, and wetlands.
- The Middle Illinois River RRA is 899 square miles — 24% in the Spoon River watershed, 41% in the Sangamon and 35% in the LaMoine. It incorporates floodplain and upland landscapes along the Illinois River from just below Peoria to Florence. The third-largest RRA, the site includes sand prairies, which have a mix of native tallgrass and plants more commonly associated with the western U.S., such as the prickly pear cactus.

ECOSYSTEM MONITORING

CTAP biologists assessed seven streams in this watershed. EPT richness was above the statewide average and habitat quality was higher here than in any

Table 29. *Watershed Land Cover*

Land Cover	Acres	Percent of Watershed		Statewide Percentage*	
Upland forest	163,812	4.4%	(10)	4.0%	(10)
Grassland	458,121	12.4%	(9)	7.1%	(7)
Non-forested wetland	27,496	0.7%	(7)	7.8%	(7)
Bottomland forest	69,397	1.9%	(5)	7.9%	(5)
Water	35,235	1.0%	(8)	7.0%	(8)
Urban/built-up	121,360	3.3%	(4)	6.5%	(4)
Cropland	2,827,500	76.4%	(1)	13.1%	(2)
Total acreage	3,702,925	100.0%		10.2%	(6)

** The watershed's percentage of the land cover type statewide, e.g., 4% of the state's upland forests are located in this watershed. Note: the watershed's rank (1st-10th) is shown in parentheses.*

other basin. However, native fish richness was comparatively low. Many sites had wooded riparian zones, winding stream courses, well-developed undercut banks, and good variation in depth. Sugar Creek, near Armington, had high EPT richness and a low HBI score. The worst site was Horse Creek near Pawnee which had lower than average EPT richness and extremely low habitat quality. Cox Creek, a tributary of Panther Creek near Chandlerville that drains part of the Jim Edgar Panther Creek State Fish and Wildlife Area had good habitat quality, above average EPT richness, but relatively high HBI scores.

Only seven shrub and vine stems were recorded from this site, five of which were invasive shrubs.

Over five years, RiverWatch volunteers collected 47 samples at 30 sites on 28 streams. Monitoring indicates that the Sangamon watershed has near average stream health. The watershed had fairly average scores in MBI and EPT taxa, indices of organic pollution. With respect to macroinvertebrate diversity, the watershed scored well in taxa dominance and poorly in taxa richness. Overall, the most abundant taxa collected from the Sangamon River watershed were midge larvae, stonefly larvae and sowbugs. The stonefly is an EPT taxa that is particularly sensitive to pollution.

Stream quality and the number of sites monitored varied considerably from year to year, making detection of trends difficult. Also, streams in the watershed are subject to frequent flooding and are not always accessible to volunteers.

Table 30. *Watershed Indicator Scorecard*

Indicator	Watershed Value	Statewide Value	Watershed Ranking
Macroinvertebrates			
HBI	5.1	5.2	4
MBI	5.5	5.7	5
EPT richness	9.7	7.1	2
EPT taxa (RW)	2.8	2.6	5
Taxa richness	8.4	8.9	8
Taxa dominance	79.3%	80.4%	4
Fish			
Native fish	11.7	13.6	7
Darter richness	2.7	1.9	5
Exotic species	0.0	0.2	1
Habitat			
Habitat score	111.0	88.6	1

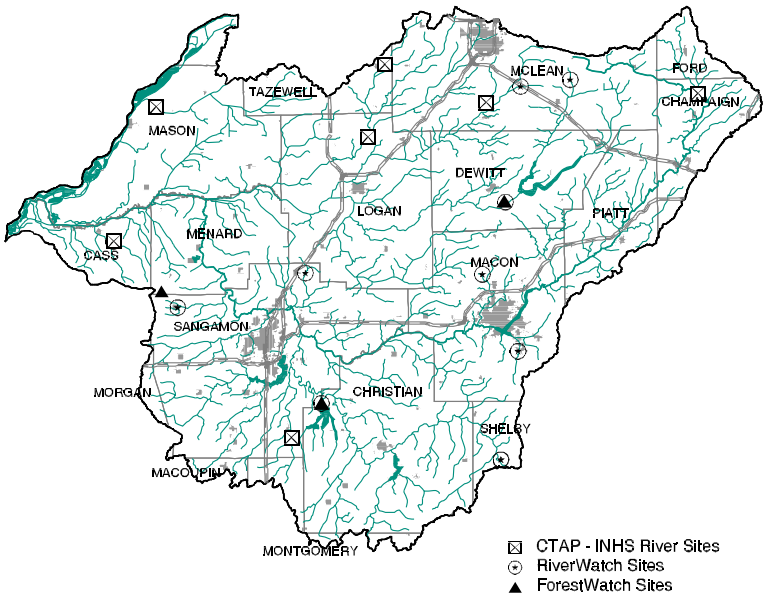


Figure 47. *Monitoring sites*

Table 31. *MBI Values*

Statistic	1995	1996	1997	1998	1999	Overall
Average	7.89	5.61	4.72	3.99	5.69	5.47
Standard deviation	3.21	1.48	2.23	2.84	1.36	1.81
Minimum	5.63	2.22	2.40	1.99	3.09	1.99
Maximum	10.16	9.72	9.18	6.00	7.75	10.16
Number of sites	2	20	9	2	9	42

** Only samples with at least 25 organisms were included in the analysis.*

ForestWatch volunteers monitored one site, an oak-hickory upland forest, in the Sangamon River watershed in the fall of 1998. Thirteen tree taxa were recorded at the site, slightly above the statewide average of 11.8 per site. Hickory and honey locust were the most abundant, and white oak and honey locust led in basal area and importance values (Table 32).

Only seven shrub and vine stems were recorded from this site, five of which were invasive shrubs — two gooseberry stems and three honeysuckle shrub stems. No sugar maples were recorded at the site and oak and hickory trees seem to be replacing themselves. Although there were no signs of gypsy moths or dogwood anthracnose, more sites are needed to determine if these pests are present within the watershed.

Table 32. *Tree Species with the Highest Importance Values*

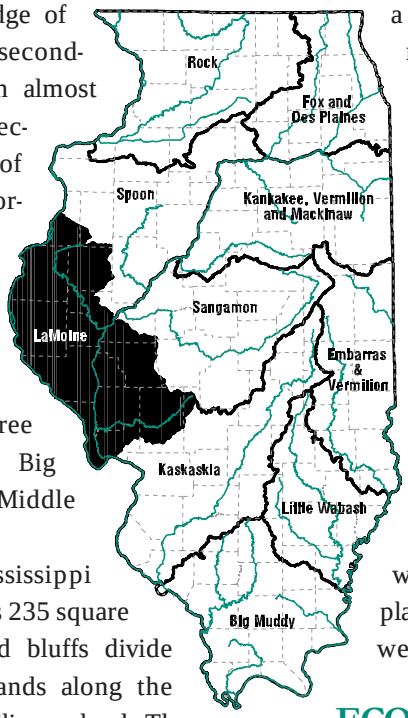
Importance Values	Species	% of total trees counted (n=138)	% of total basal area ($27.8m^2$/ha)
38	Honey locust	19%	19%
28	White oak group	7%	21%
25	Hickory	19%	6%
24	Black walnut	7%	17%
24	Hackberry	17%	7%
22	White oak	2%	20%
11	Black cherry	9%	2%
11	Osage orange	9%	1%
8	Tupelo	6%	2%
6	Post oak	3%	3%
3	Slippery elm	1%	2%
<1	Shingle oak	1%	<1%
<1	Pine	1%	<1%

C H A P T E R N I N E

LaMoine River Watershed

The watershed has three Resource Rich Areas — Big Rivers, Nauvoo and the Middle Illinois River.

Located on the western edge of the state, the LaMoine is the second-largest ISIS watershed with almost 4.3 million acres. It is the second-highest in the amount of surface water and upland forest, and second-to-last in the amount of urban and built-up land. (See page 108 for a color map of the watershed's land cover.)



The watershed has three Resource Rich Areas — Big Rivers, Nauvoo and the Middle Illinois River.

- Located on the Mississippi River, the Nauvoo RRA is 235 square miles. Sharply dissected bluffs divide the low, level bottomlands along the river from the higher rolling uplands. The natural resources — woodlands, wetlands and natural areas — are mainly associated with the river. The Cedar Glen Nature Preserve is a significant roosting site for wintering bald eagles.
- Big Rivers, at 979 square miles, is the largest of the Resource Rich Areas. It is characterized by a narrow band of bluffs and rugged topography that borders the floodplains of the Mississippi and Illinois Rivers. Forest is the predominant natural vegetation, but hill prairies are common on west-facing bluffs. Sinkholes and sinkhole ponds also occur here.
- The Middle Illinois River RRA is 899 square miles — 24% in the Spoon River Watershed, 41% in the Sangamon and 35% in the LaMoine. It incorporates floodplain and upland landscapes along the Illinois River from just below Peoria to Florence. The third-largest RRA, the site includes sand prairies, plant communities which are a mix of native tallgrass and plants more commonly associated with the western U.S., such as the prickly pear cactus.

ECOSYSTEM MONITORING

Eleven sites were investigated by CTAP biologists. EPT richness, composed of taxa of moderate tolerance to organic enrichment, was slightly above the statewide average. Native fish richness was low, however. Habitat quality was a little above average,

Table 33. *Watershed Land Cover*

Land Cover	Acres	Percent of Watershed		Statewide Percentage*	
Upland forest	720,848	16.8%	(2)	17.4%	(2)
Grassland	780,215	18.2%	(5)	12.1%	(4)
Non-forested wetland	25,767	0.6%	(8)	7.3%	(8)
Bottomland forest	105,135	2.5%	(4)	12.0%	(3)
Water	73,928	1.7%	(2)	14.8%	(2)
Urban/built-up	59,918	1.4%	(9)	3.2%	(9)
Cropland	2,521,457	58.8%	(7)	11.7%	(4)
Total acreage	4,287,271	100.0%		12.0%	(2)

** The watershed's percentage of the land cover type statewide, e.g., 17.4% of the state's upland forests are located in this watershed. Note: the watershed's rank (1st-10th) is shown in parentheses.*

despite scores being lowered by the many streams that had bottoms of highly compacted clay, providing little habitat for fish and EPT species. The best streams were Hurricane Creek near White Hall and Little Indian Creek near Virginia, small drainages that had relatively high EPT, fish richness, and habitat quality. The worst stream was the Left Fork Apple Creek near Franklin; the sampling site was near a fertilizer distributing company. Only two EPT and two native fish taxa were taken from this stream, which also scored poorly for habitat quality.

RiverWatch volunteers monitored 64 sites on 53 streams, collecting 157 samples over five years. Biological indicators suggest an average watershed. The watershed's taxa richness ranked sixth best, while taxa dominance ranked only eighth. The MBI and EPT taxa values were also near the mean. The most dominant taxa overall were midges, sowbugs, and scuds, all common organisms across the state. Although the MBI declined, the change is not statistically significant and no trends are evident.

Table 34. *Watershed Indicator Scorecard*

Indicator	Watershed Value	Statewide Value	Watershed Ranking
Macroinvertebrates			
HBI	5.4	5.2	7
MBI	5.7	5.7	6
EPT richness	8.2	7.1	4
EPT taxa (RW)	2.5	2.6	7
Taxa richness	8.8	8.9	6
Taxa dominance	82.0%	80.4%	8
Fish			
Native fish	10.6	13.6	10
Darter richness	1.1	1.9	9
Exotic species	0.1	0.2	4
Habitat			
Habitat score	97.8	88.6	3

In the fall of 1998, ForestWatch volunteers monitored three sites, all oak-hickory upland forests. During the previous spring, two sites were monitored. Tree species richness ranged from 9 to 15 species, with an average of 12 tree species per site, similar to the statewide average of 11.8 species. Twenty-one tree taxa were recorded in the watershed (75 taxa statewide). In general, the trees that were most abundant also had the highest basal areas and importance values (Table 36).

None of the sites showed signs of maple takeover and oak and hickory trees seem to be replacing themselves. Within the watershed, there were no signs of gypsy moths, but one site had evidence of dogwood anthracnose — several flowering dogwood trees were dead or dying in the sampling area as well as elsewhere in the forest.

Table 35. *MBI Values*

Statistic	1995	1996	1997	1998	1999	Overall
Average	6.04	5.77	5.76	5.61	5.43	5.67
Standard deviation	1.03	0.77	0.86	1.36	0.68	0.97
Minimum	3.66	3.73	4.07	3.32	4.00	3.32
Maximum	8.63	7.17	8.00	9.65	6.78	9.65
Number of sites	15	21	33	31	35	135

** Only samples with at least 25 organisms were included in the analysis.*

Figure 48. *Monitoring sites*

Table 36. *Tree Species with the Highest Importance Values*

Importance Value	Species	% of total trees counted (n=285)	% of total basal area ($19.6m^2$/ha)
52.8	Slippery elm	33%	20%
24.5	White oak	7%	18%
22.3	Flowering dogwood	12%	5%
21.3	Swamp white oak	7%	15%
17.8	Red oak	3%	16%
15.5	Hickory	12%	5%
7.8	Hackberry	5%	3%
7.8	Ash	4%	3%
6.5	Sassafras	5%	1%
6.2	Black cherry	5%	2%

Gooseberry and multiflora rose were the only invasive species recorded, but they comprised more than 75% of the shrubs and vines recorded. The density of gooseberry was much higher than the statewide average and one site had 50% of the gooseberry stems recorded statewide. During the spring survey, two disturbance-sensitive species — blue cohosh and large-flowered bellwort — were found at one site. No non-native invasive ground cover species were reported.

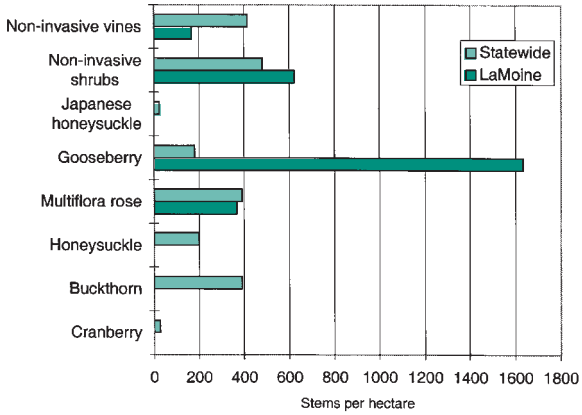
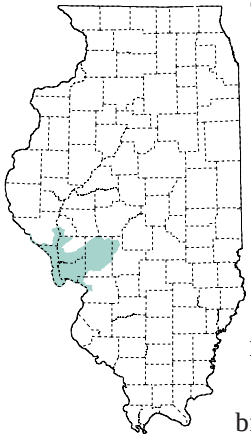


Figure 49. *Number of invasive and non-invasive shrub and vine stems*

REGIONAL ASSESSMENTS

One regional assessment has been conducted for this watershed — for the Big Rivers area.

Big Rivers



The Big Rivers area combines parts of five counties of west-central Illinois near where the lower Illinois River enters the Mississippi. Centered in Jersey, Madison, Greene, Calhoun, and Macoupin counties, the Big Rivers area covers some 1,770 square miles.

Much of the region is broad prairie, growing on the Central Till Plain that dominates the middle U.S.The most remarkable feature in the area is the confluence of the Mississippi and Illinois rivers near Grafton. Along the lower Illinois River, a small part of the Ozarks plateau intrudes in the form of rugged rocky hills and limestone bluffs. The region boasts several local habitats unusual elsewhere in Illinois — 16 springs, 14 caves, glades where bedrock protrudes at or near the surface of woods or prairies, and limestone cliffs whose plant communities vary according to how much sunlight each receives. Other significant features:

- one section of the Mississippi River — miles 232.5 - 241.5 in Calhoun County — has been recognized as Biologically Significant because two state endangered species, the spectacle-case mussel and the western sand darter, are found there;
- 626,795 acres have been designated a state Resource Rich Area;
- one of the few remaining small, temporary forest ponds (free of egg-eating fish) is found in the John M. Olin Nature Preserve in Madison County.

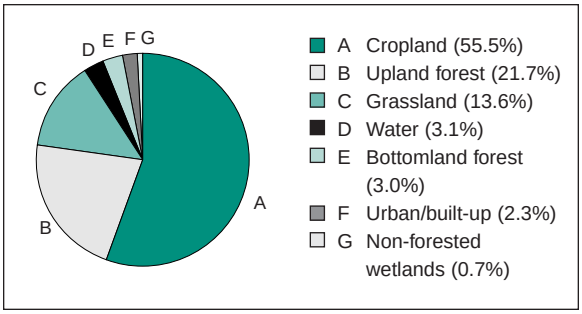


Figure 50. *Big Rivers land cover*

Plant and animal life

Although animal life has declined statewide since European settlement, it remains richly varied here. The region is a haven for birds, largely because of its extensive tracts of upland and floodplain forests and riverine wetlands. The bird species that live in the area (at least 90% of the species found in Illinois) are ecologically diverse and, although some are able to live in a variety of habitats, many occupy only one or a few habitats. Thirty-three of them are on the T&E list and 23 of those breed in the area.

Basin acreage - 1,133,172 acres
State land* - 10,147 acres
Federal land - 21,199 acres
Total natural areas - 5,584 acres
High-quality natural areas - 571.5 acres
Nature preserves - 509 acres

** Does not include natural areas or nature preserves that may be state owned.*

Among the rare plant species found here is the decurrent false aster, a federally threatened species. Two federally-listed endangered species, the Indiana bat and the gray myotis, are also found here, as is the state-threatened river otter. The largest venomous snake in Illinois, the timber rattlesnake, also makes its home here.

Local economy and outdoor recreation

Most of the Big Rivers area is rural and has experienced minimal population growth since early settlement. Calhoun and Greene counties have actually lost population in the last 120 years. Only Madison County, which is located in the St. Louis Metropolitan Statistical Area, has grown significantly. Its population grew five-fold between 1870 and 1970 — from less than 50,000 to about 250,000 — but has stabilized during the last two decades. More than 80% of Madison County is urban, while Calhoun County is entirely rural. In the five-county area urbanized land has grown 10% in the last ten years.

Area employment growth has been slower than that experienced statewide, and Calhoun and Green counties both lost jobs over the past 25 years. Manufacturing has declined by one-third, although it continues to be the largest source of earnings. During the same time period, the services sector more than doubled in size and wholesale/retail trade grew by 50%. In the more rural counties, farming continues to be a major employer; in Calhoun and Greene counties 19-28% of jobs are in agriculture.

Outdoor recreation opportunities are shaped largely by the Mississippi and Illinois rivers. The river bluffs, marshes, backwater lakes, and wooded areas immediately surrounding the rivers provide the setting for several public recreation areas and for associated activities including hiking, wildlife viewing, fishing, and boating. The most frequently visited sites include Pere Marquette State Park, Beaver Dam State Park, Mississippi River State Fish and Wildlife Area, and the Mark Twain National Wildlife Refuge. The state sites contribute to the local economy, generating about $22 million in economic output and 320 jobs.

Threats

Physical alteration - Physical change has had a profound impact on the area. For example, grazing by cattle and other livestock kills many species of forest plants, and removing trees and other bank-side vegetation over-warms streams. Building drainage ditches or straightening streams speeds the flow of water from land into streams, aggravating flooding. Virtually all of Macoupin Creek west of Carlinville has been altered in this way.

Hydrologic modification - The development of the water transportation system on the Mississippi and Illinois rivers has led to a series of dams to create pools of sufficient depth to float today's barges. The "big rivers" have been transformed into

Building drainage ditches or straightening streams speeds the flow of water from land into streams, aggravating flooding.

a series of big lakes, eliminating much of the riverine habitat such as shoals, bars, and rapids. Dams act as silt traps by slowing currents; the smothering of the riverbottom with silt has greatly reduced benthic diversity. The wakes from powerful tugboats chew away at banks and muddy the water by resuspending sediments, increasing the turbidity that hides prey from predator and cheats water plants of light. The deepening of water forced the retreat of shallow-rooted aquatic vegetation needed as shelter and food by river creatures.

Because fragmentation is not as advanced here as it is elsewhere in Illinois, the challenge is how to prevent it.

Pollution - The area is relatively untroubled by conventional pollutants. However, acid runoff from abandoned mine sites is a problem in places, mainly Macoupin County. In much of the Illinois River valley, agricultural chemicals are applied directly to the floodplain and thus are readily available to be carried into that stream. In parts of Calhoun County, farm chemicals easily enter aquifers via erosion-exposed bedrock.

Habitat loss - The local loss of presettlement habitat, while substantial, was less severe than in Illinois as a whole, except for forests. Only about 0.13% (358 acres) of local woods of any age are undegraded forest of high quality. Habitat loss often results in reduction in population sizes for many species, particularly those sensitive to habitat degradation and fragmentation. The richness of native species probably has declined in the region; in contrast, non-native taxa have increased.

Habitat fragmentation - The average size of contiguous forested wetlands in the area is 17.4 acres. The mean size of emergent wetlands, such as marsh, is 2.4 acres. Such isolated habitat fragments often cannot supply the resources needed by species with more extensive home ranges, and the entire local populations of some plants and animal species in these tracts may consist of only a few individuals, making them more vulnerable to disease and in-breeding stress.

Because fragmentation is not as advanced here as it is elsewhere in Illinois, the challenge is how to prevent it. The large forests around the confluence of the Illinois and Mississippi are among the last sizable wooded tracts in this part of the continent. Many bird species are thought to have declined elsewhere in the Midwest, but the Big River's breeding grounds produce enough surplus birds to repopulate them.

Opportunities

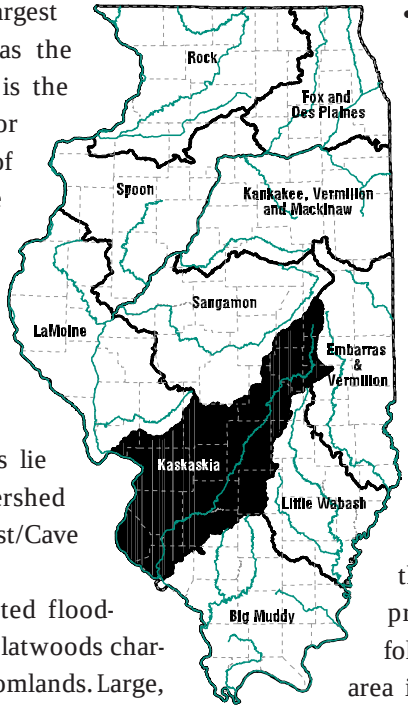
Ecologically informed management has the potential to improve several impaired Big Rivers habitats.

- Smaller streams can be restored if streamside vegetation is replanted.
- The short grass of mowed roadsides near Pere Marquette State Park are perfect feeding grounds for cowbirds that parasitize song bird nests inside the park; allowing mowed grasses to grow taller at key times in the cowbird's life cycle would reduce their numbers.
- Burning the forest understory favors oak trees, which in turn favor Cerulean warblers and other spring migrant birds, and the tree and flying squirrels that eat their acorns.
- "Moist-soil" units managed for waterfowl can be drawn down in spring and fall to create excellent shorebird habitat for non-game birds.
- Small stock and farm ponds that are too small to support sport fish can provide important breeding sites for amphibians.
- Breeding populations of peregrine falcons could be re-established on the cliffs they once frequented along the Mississippi River.

C H A P T E R T E N

Kaskaskia River Watershed

At 4.4 million acres, this is the largest watershed in Illinois as well as the most diverse in land cover. It is the only watershed to have 10% or more of the statewide acreage of each land cover type. It is the second most urbanized watershed and also has the second most acres of bottomland forest. (See page 109 for a color map of the watershed's land cover.)



Three Resource Rich Areas lie within the borders of this watershed — the Kaskaskia Bottoms, Karst/Cave Area, and Southern Till Plain.

- A complex of interconnected floodplain forests, wetlands and flatwoods characterize the Kaskaskia bottomlands. Large, contiguous forest stands are rare in Illinois, and the largest tract in the state is located here.
- The Karst/Cave Area RRA includes Mississippi bottomlands and part of the Ozark plateau. Exceptional features are its limestone bedrock, numerous caves and sinkholes, old growth forest, and unique flora and fauna.
- Most (88%) of the Southern Till Plain RRA lies within the Little Wabash River watershed, but the western arm comprising 12% of the area lies in the Kaskaskia River watershed. With 914 square miles, the Southern Till Plain is the second largest RRA. In presettlement times, the region was characterized by rolling prairies between broad woodlands following stream corridors. Today the area is largely agricultural but almost one-fifth of the RRA remains wooded.

Exceptional features of the Karst/Cave Area RRA are its limestone bedrock, numerous caves and sinkholes, old growth forest, and unique flora and fauna.

Table 37. *Watershed Land Cover*

Land Cover	Acres	Percent of Watershed		Statewide Percentage*	
Upland forest	490,663	11.1%	(5)	11.9%	(3)
Grassland	784,953	17.8%	(6)	12.2%	(3)
Non-forested wetland	48,066	1.1%	(4)	13.5%	(3)
Bottomland forest	162,693	3.7%	(3)	18.6%	(2)
Water	70,486	1.6%	(3)	14.1%	(3)
Urban/built-up	196,885	4.5%	(2)	10.5%	(2)
Cropland	2,659,417	60.3%	(6)	12.3%	(3)
Total acreage	4,413,165	100.0%		12.2%	(1)

** The watershed's percentage of the land cover type statewide, e.g., 11.9% of the state's upland forests are located in this watershed. Note: The watershed rank (1st-10th) is shown in parentheses.*

ECOSYSTEM MONITORING

For the nine sites assessed by CTAP scientists, nearly all indicators were below statewide averages and none of the sampled streams were high quality. Most were agricultural ditches or urban drainage systems. The worst site was Copper Slough, which runs through southwest Champaign. No EPT taxa were taken at this site, and habitat quality was poor.

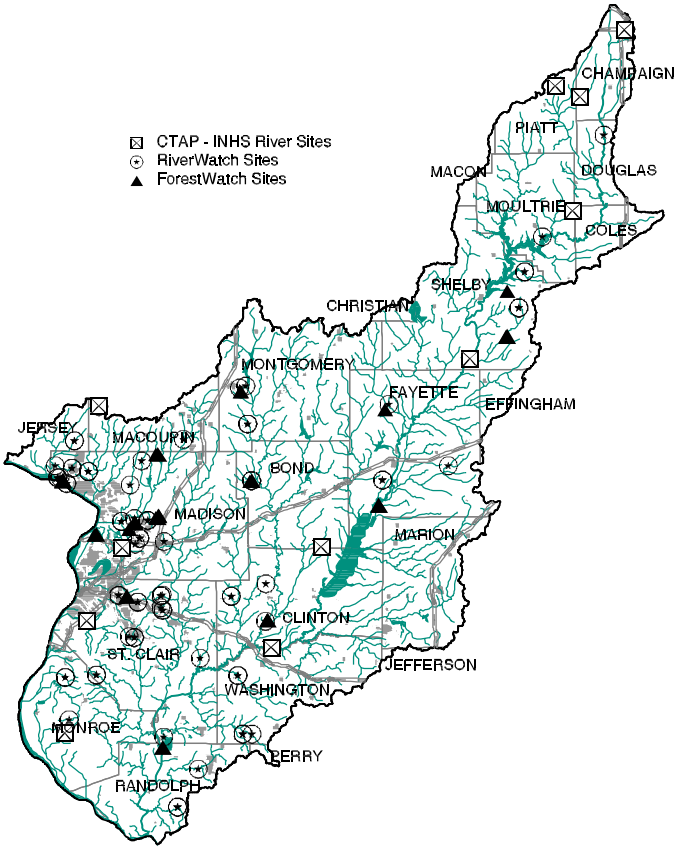


Figure 51. *Monitoring sites*

The RiverWatch biological indicator values confirm that the Kaskaskia River watershed is the most disturbed among the ten watersheds. RiverWatch volunteers collected 167 samples at 69 sites along 61 streams between 1995 and 1998. The Kaskaskia ranked nearly last in all measures of macroinvertebrate diversity and pollution tolerance. Even so, hydropsychid caddisfly larvae, a common and moderately pollution-intolerant EPT taxa, were the most abundant macroinvertebrates. Statistical analysis showed no significant change in MBI values.

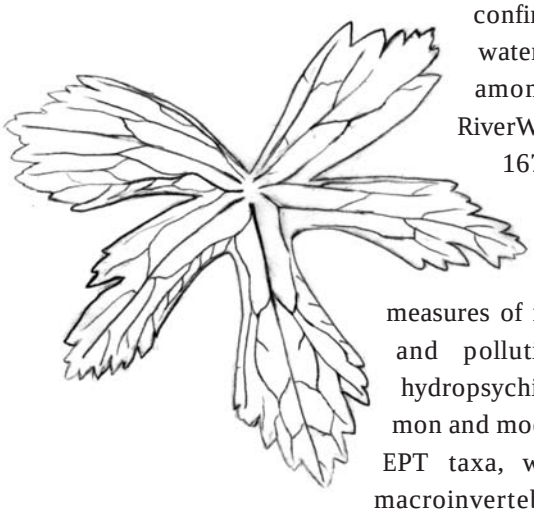


Table 38. *Watershed Indicator Scorecard*

Indicator	Watershed Value	Statewide Value	Watershed Ranking
Macroinvertebrates			
HBI	5.0	5.2	3
MBI	6.0	5.7	8
EPT richness	4.9	7.1	10
EPT taxa (RW)	1.8	2.6	10
Taxa richness	7.7	8.9	9
Taxa dominance	85.9%	80.4%	10
Fish			
Native fish	11.3	13.6	8
Darter richness	0.7	1.9	10
Exotic species	0.3	0.2	6
Habitat			
Habitat score	76.1	88.6	10

Table 39. *MBI Values*

Statistic	1995	1996	1997	1998	1999	Overall
Average	6.82	6.18	6.02	5.57	5.92	5.97
Standard deviation	4.20	1.13	0.98	1.48	1.17	1.24
Minimum	3.85	4.39	3.77	1.71	4.04	1.71
Maximum	9.78	8.67	8.85	9.61	8.73	9.78
Number of sites	2	23	42	33	35	135

** Only samples with at least 25 organisms were included in the analysis.*

Thirteen forest sites were monitored in Fall 1998 by ForestWatch volunteers. Eight were oak-hickory upland forests and five were ash-elm-maple bottomland forests. Tree species richness ranged from eight to 17 species, with an average of 12 species per site, similar to the statewide average of 11.8 species. Forty-three tree taxa were recorded in the watershed, the second-highest in the state.

In general, the trees that were most abundant also had the highest basal areas and importance values (Table 40). Exceptions are understory trees such as flowering dogwood and redbud that are numerous but not very large, therefore not rating high for basal area or importance value.

Two upland sites showed moderate signs of maple takeover. At one of them, approximately 40 sugar maples within one hectare were greater than 40 cm in diameter. This may explain the proliferation of smaller maples at the site — 833 maple seedlings per hectare that were less than five

centimeters in diameter, about eight times the number of smaller hickories. No oaks were found that were less than 5 centimeters.

Table 40. *Tree Species with the Highest Importance Values*

Importance Value	Species	% of total trees counted (n=1,198)	% of total basal area (24.4m^2/ha)
31.0	White oak	9%	24%
25.8	Slippery elm	17%	8%
20.8	Hickory	12%	9%
17.5	Ash	7%	10%
16.0	Hackberry	11%	5%
8.4	Box elder	6%	2%
8.3	Red oak	2%	6%
7.0	Black walnut	3%	3%
5.7	Sugar maple	3%	2%
5.5	Pin oak	1%	4%

There were no signs of gypsy moths, but one site showed evidence of dogwood anthracnose and another site showed possible anthracnose. This disease is becoming widespread in the state, and since flowering dogwood is a common species in the southern half of Illinois, it is likely that dogwood anthracnose is present in other forests in the watershed.

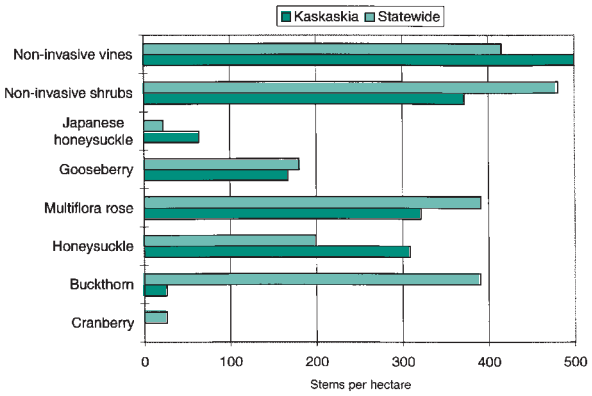


Figure 52. *Number of invasive and non-invasive shrub and vine stems*

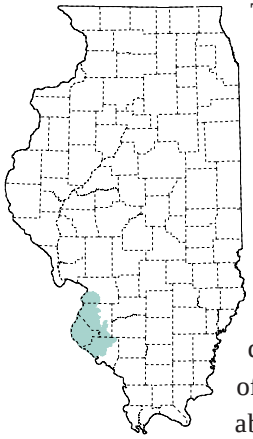
About 70% of the 688 shrub and vine stems recorded were from invasive species, mostly honeysuckle shrub and multiflora rose. Of the 10 watersheds, the Kaskaskia watershed recorded the second-highest abundance of honeysuckle. The watershed also recorded more than 70% (of 34 stems) of the Japanese honeysuckle found statewide. Additional monitoring will help delineate how widespread this species is.

Spring monitoring at three sites recorded only two disturbance-sensitive ground cover species, maidenhair fern and Virginia spiderwort, both found at the same site.

REGIONAL ASSESSMENTS

One regional assessment has been completed for this watershed — for the Sinkhole Plain.

Sinkhole Plain



The Sinkhole Plain encompasses the karst area in southwestern Illinois near the Mississippi River. Karst areas are characterized by easily erodible carbonate bedrock, which promotes the formation of caves and sinkholes. Rather than draining to a stream, water often slips through innumerable sinkholes directly into groundwater.

The Sinkhole Plain and its environs cover about 1,228 square miles in southwest Illinois, including all of Monroe County, much of St. Clair, and portions of Randolph and Madison counties. Bordered by two major rivers — the lower Kaskaskia River to the east and the Mississippi to the west — the region has examples of virtually every habitat known in Illinois, from floodplains lined by bluffs of exposed bedrock to prairies and wooded ravines, sluggish rivers and clear-running springs.

Basin acreage - 785,821 acres
State land* - 20,070 acres
Total natural areas - 7,177 acres
High quality natural areas - 1,215.5 acres
Nature preserves - 854 acres
** Does not include natural areas or nature preserves that may be state owned.*

About 60% of the land in and around the Sinkhole Plain is used for agriculture of one kind or another. This is less than in Illinois as a whole, where nearly 78% of the land is farmed. The region also has proportionately more trees, more wetlands, and twice as much urban and built-up land than does Illinois on average. Other significant features:

- about 44% of the presettlement-quality floodplain forest still standing in Illinois is found in the region, as is more than a third of all southern flatwoods (in the Marissa Woods Nature Preserve in St. Clair County) and about 43% of the high-quality limestone glades;
- two watercourses have been recognized as Biologically Significant Streams — a tributary to Horse Creek in Monroe County and a six-mile stretch of the Mississippi River in Randolph County;
- nearly half of Illinois' surviving loess hill prairie is here and the 532-acre Fults Hill Prairie Nature Preserve in the Mississippi bluffs of Monroe County contains the largest complex of undisturbed prairie of this type in Illinois;
- 291,305 acres have been designated a Resource Rich Area.

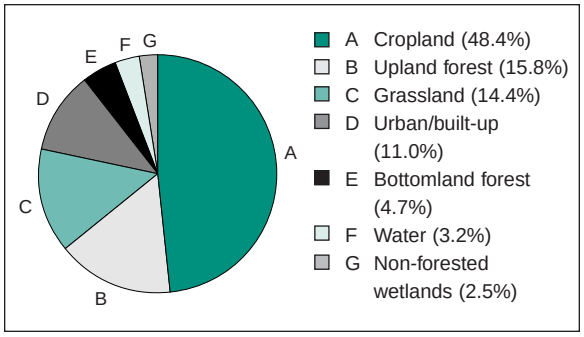


Figure 53. *Sinkhole Plain land cover*

Plant and animal life

The region harbors 75 plant and animal species whose survival is threatened or endangered, including five species whose survival is at issue not only in Illinois but in the U.S. as a whole. The western sand darter, an Illinois endangered species, is fairly common in clear sandy runs of the upper Mississippi, but outside of that setting it survives in only a few places, including the Mississippi River just south of Prairie du Rocher.

Among the mammals known from the region are the Indiana bat and river otter, whose survival in Illinois is considered to be endangered or threatened. Other rare species include the Illinois chorus frog, the coachwhip snake, the timber rattlesnake, and the eastern massasauga. Illinois' largest colonies of snowy egrets and little blue herons are found here, along with some of the largest colonies of great egrets and black-crowned night herons. A few previously extipated species such as the double-crested cormorant (which nest on the edges of backwater lakes along the Mississippi), the wild turkey, and the bald eagle have been re-established in recent years. Other bird species are still present but no longer breed here, among them the trumpeter swan, osprey, least tern, and yellow-headed blackbird.

One of Illinois' rare aquatic worms (a sludge worm) dwells only in springs found at two sites in Monroe County and one site in St. Clair County. The Illinois cave amphipod is found only in the caves of the Sinkhole Plain and was recently listed by federal authorities as an endangered species.

Local economy and outdoor recreation

Since 1870 the population of the Sinkhole Plain area has grown 277% (compared to 350% statewide), and now accounts for 2.8% of the state's residents. Nearly all growth occurred in urbanized St. Clair County, which grew steadily until 1970, when population began falling. Not surprisingly, St. Clair County accounts for about eight-tenths of the area's employment and earnings. While the service sector is now the largest employer in the area, government earnings remain strong.

The area is home to five major state-owned recreation sites. Frank Holten State Park is an urban site near East St. Louis featuring a golf course and expansive picnicking facilities. It hosts over a half-million visitors each year. Horseshoe Lake State Park, Kaskaskia River State Fish and Wildlife Area, and Peabody-River King State Fish and Wildlife Area are directed towards fishing and hunting enthusiasts. Illinois Caverns State Natural Area receives fewer visitors, but provides an example of the area's unique topography. Collectively, the 850,000 visitors to these sites generate $9.1 million in economic output and 140 jobs each year.

Threats

Pollution - Much progress has been made in reducing pollutants that enter area rivers and streams from 'point sources' like factories and city sewer systems. Nonetheless, in general water quality in the region's streams and rivers remains only fair.

While groundwater is generally safe, the peculiar geology of the Sinkhole Plain poses unique risks of contamination. Water moves freely into and through the shallow limestone nearly as freely as water moves through a tile drain, taking mere hours to cover distances that take days or weeks in less porous formations. Water entering these rocks is not filtered or chemically buffered by slow seepage through upper layers of clays and sands, as is the case in many parts of Illinois. As a result, there is a significant threat of contamination by pollutants spilled, dumped, or stored on the surface, from septic field discharges, road runoff, and pesticide and fertilizer runoff from farm fields. A recent four-year Illinois State Geological Survey study sampled wells and springs throughout the Sinkhole Plain, and found that in the summer months 55% of 29 private wells drilled into bedrock contained higher-than-recommended levels of coliform bacteria, a common indicator of fecal wastes.

Illinois Caverns State Natural Area receives fewer visitors, but provides an example of the area's unique topography.

Erosion - Much of the soil displaced by erosion ends up in streams, lakes, and ponds, often in such quantities that soil becomes, in effect, a water pollutant. The packed sand and gravel bottom of the lower Kaskaskia, where that river nears the Mississippi, is buried each summer beneath fine silt as much as a foot deep.

Erosion from fields has been much reduced since the 1980s. By 1997 nearly six of ten farm acres were losing soil no faster than it was being replaced by nature. This is a relatively sizable proportion, given how vulnerable the sloping farmland is to erosion.

Habitat fragmentation - Once-extensive wetlands, forests, and prairies have been fragmented into small habitat "islands". The developed land often becomes a barrier to animals moving between habitats. The great plains rat snake, a denizen of the Mississippi bluffs from Fults to Renault, is undisturbed within the Fults Hill Prairie Nature Preserve. Many of these snakes, however, are killed by traffic when they attempt to cross the roads that divide their larger habitat, of which the nature preserve is only a part.

Plant populations in these splintered habitats become so small that they are vulnerable to disease and genetic weaknesses, a result of in-breeding. The

region in and around the Sinkhole Plain still boasts a handful of sizable forested tracts — the two largest are about 1,250 acres each — along the Mississippi and Kaskaskia rivers. However, the mean size of surviving tracts of contiguous forested bottomland is 19 acres, vastly smaller than the 500 acres thought to be the minimum-sized woods capable of sheltering nesting songbirds. The 173 acres of loess hill prairie in the region is split into 12 sites. The more than 3,000 emergent wetlands include a few large ones on the Mississippi near the former site of Valmeyer and near Fults, but the mean size of emergent wetlands is only 4.1 acres.

Bobcats, which have been sighted in Randolph and Madison counties since the 1980s, require extensive and varied terrain and cover.

Hydrology - Paving once-porous surfaces and installing storm drains concentrates runoff from rains and melting snow, making bigger floods out of less water. The lower Kaskaskia River has always tended to flood. Carlyle Lake was built in 1969, 50 miles upstream from the Kaskaskia's confluence with the Mississippi, to catch and hold water that used to overwhelm downstream parts of the valley. The lake has caused noticeable reductions in peak water flow downstream. Carlyle not only lowers flood peaks but boosts flows during droughts when water is released from the reservoir.

The remodeling of the watershed in and around the Sinkhole Plain has tended to aggravate the effects of drought. Drained farm fields speed the flow of water into nearby streams. This water used to soak slowly into the soil, building up subsoil moisture that fed streams for weeks or months. As a result, droughts that once merely reduced flow through the region's upland creeks now cause them to dry up completely. In low-water seasons, most of the flow of some streams like Richland Creek is effluent from sewage treatment plants.

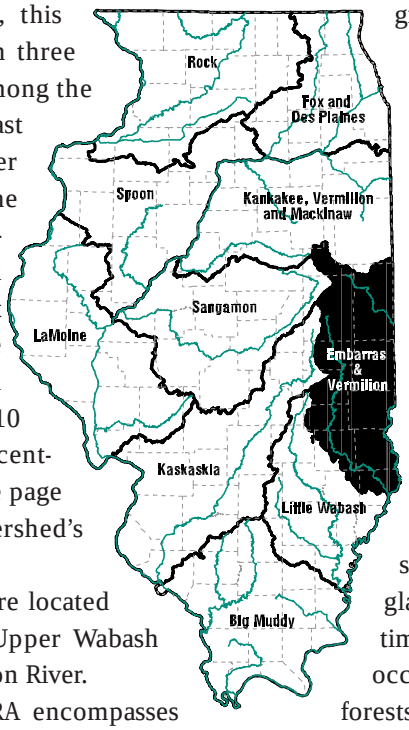
Opportunities

Several large tracts of forested land along the Mississippi in Monroe and Randolph counties and the more than 15,000 acres in the Kaskaskia River State Fish and Wildlife Area have potential as breeding grounds for birds that could populate the rest of the region. Bobcats, which have been sighted in Randolph and Madison counties since the 1980s, require extensive and varied terrain and cover; the Kaskaskia River corridor and the forested bluffs in Monroe County offer suitable habitat. In addition, the State of Illinois has been releasing river otters from Louisiana in Illinois river systems, including sites near the Sinkhole Plain.

CHAPTER ELEVEN

Embarras and Vermilion Rivers Watershed

Located in east-central Illinois, this watershed has a little more than three million acres, ranking it eighth among the 10 ISIS watersheds. It has the least amount of aquatic acreage (water plus non-forested wetlands) of the 10 watersheds; less than one percent of the watershed is covered by water. It is second-to-last in grassland acreage and has the smallest percentage of land in grassland. It is third among the 10 watersheds, however, in the percentage of land devoted to crops. (See page 110 for a color map of the watershed's land cover.)



Three Resource Rich Areas are located within this watershed — the Upper Wabash River, Embarras River and Vermilion River.

- The Upper Wabash River RRA encompasses 267 square miles of the Wabash River mainstem from where it enters Illinois to just above Lawrenceville, and the narrow band of small tributaries to the river. In this area the Wabash River is wide and slow flowing with sand-gravel substrate. It is one of the last relatively unaltered big rivers in the Midwest.
- The Embarras River RRA includes the entire length of the river. Rich species diversity and a variety of habitats such as gravel bars, gravel-sand raceways, sand-bars, riffles, and deep pools are the outstanding features of the river, particularly in the middle sections. The area, encompassing 700 square miles, is one of the most agricultural among the RRAs.
- The Vermilion River RRA (207 square miles) is located on a level glacial plain that in presettlement times was covered with prairie, with occasional savannas on the uplands and forests along the streams. Unusual terrestrial features include seeps, beech-maple forests and hill prairies. A segment of the Middle Fork of the Vermilion is Illinois' only stream designated as a National Wild and Scenic River.

A segment of the Middle Fork of the Vermilion is Illinois' only stream designated as a National Wild and Scenic River.

Table 41. *Watershed Land Cover*

Land Cover	Acres	Percent of Watershed		Statewide Percentage*	
Upland forest	292,549	9.5%	(7)	7.1%	(6)
Grassland	378,123	12.3%	(10)	5.9%	(9)
Non-forested wetland	9,413	0.3%	(10)	2.7%	(10)
Bottomland forest	52,692	1.7%	(6)	6.0%	(7)
Water	14,665	0.5%	(10)	2.9%	(10)
Urban/built-up	74,978	2.5%	(7)	4.0%	(8)
Cropland	2,243,955	73.2%	(3)	10.4%	(6)
Total acreage	3,066,378	100.0%		8.5%	(8)

** The watershed's percentage of the land cover type statewide, e.g., 7.1% of the state's upland forests are located in this watershed. Note: The watershed rank (1st-10th) is shown in parentheses,*

ECOSYSTEM MONITORING

The 10 sites sampled by CTAP biologists scored below average for HBI and about average for habitat quality, but had the best scores for EPT and native fish species richness. Several sites were large streams in the Embarras drainage where a shifting sand bottom predominated. However, snags (wood debris) and undercut banks were plentiful, providing stable habitat for a large number of EPT and fish species. Because the larger streams have a tendency to flood, row crops are kept further from their banks, allowing for meandering, wooded

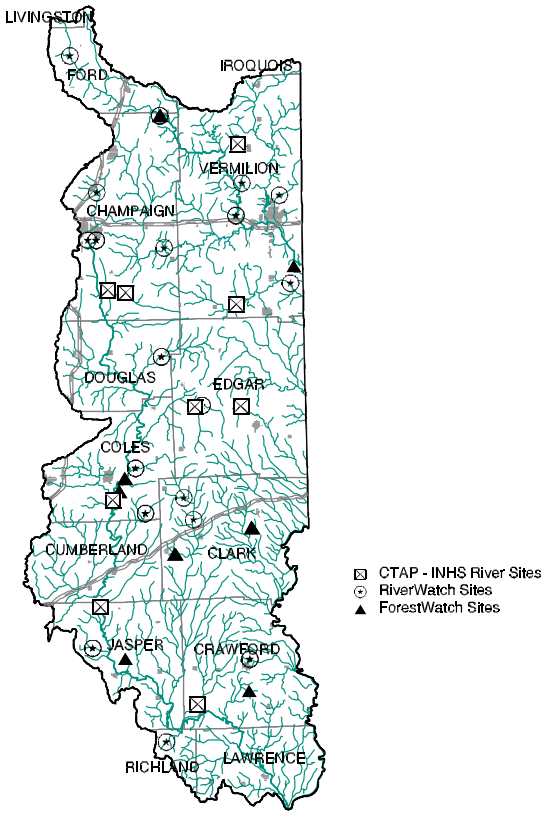


Figure 54. *Monitoring sites*

riparian corridors. Smaller streams, however, have been cleared of trees, wood, and natural bank structures to facilitate drainage for row crops.

The best site was the Embarras River at Fox Ridge State Park, where native fish and EPT richness and habitat scores were well above statewide and basin averages. An unnamed tributary of Freeport Creek near Oblong, channelized long ago but now heavily wooded, had EPT and native fish richness well below statewide and basin averages. This situation suggests a fairly recent spill event that was either toxic or depressed oxygen levels enough to kill sensitive insects.

Table 42. *Watershed Indicator Scorecard*

Indicator Value	Watershed Value	Statewide Ranking	Watershed
Macroinvertebrates			
HBI	5.5	5.2	8
MBI	6.0	5.7	9
EPT richness	13.8	7.1	1
EPT taxa (RW)	3.3	2.6	4
Taxa richness	10.0	8.9	1
Taxa dominance	79.7%	80.4%	5
Fish			
Native fish	19.3	13.6	1
Darter richness	3.3	1.9	1
Exotic species	0.1	0.2	4
Habitat			
Habitat score	87.6	88.6	6

RiverWatch volunteers monitored 43 sites on 32 streams between 1995 and 1999, collecting a total of 86 samples. The watershed scored high in taxa richness but low in MBI, indicating that the organisms found there are generally pollution tolerant. It ranked near the average in EPT taxa and taxa dominance. The hydropsychid caddisfly larva was the most common taxa in the watershed, followed by the midge and the riffle beetle. The riffle beetle is more common here than in the other watersheds. The average annual MBI indicates no significant changes in stream quality over the five years.

Table 43. *MBI Values*

Statistic	1995	1996	1997	1998	1999	Overall
Mean	6.40	5.78	5.93	5.41	6.09	5.90
Standard deviation	1.88	1.17	1.55	0.66	1.45	1.46
Minimum	3.49	3.91	4.48	4.36	4.92	3.49
Maximum	10.57	8.44	9.16	6.73	9.74	10.57
Number of sites	19	17	9	9	11	65

** Only samples with at least 25 organisms were included in the analysis.*

In the fall of 1998 ForestWatch volunteers monitored six sites — five oak-hickory upland

forests and one ash-elm-maple bottomland forest. Tree species richness ranged from seven to 16 species, with an average of 12 tree species per site, similar to the statewide average of 11.8 species. A total of 34 tree taxa were recorded. Two sites showed some sign of maple takeover, with one of these having a few large sugar maples.

Table 44. *Tree Species with the Highest Importance Values*

Importance Value	Species	% of total trees counted (n=616)	% of total basal area ($28.4m^2$/ha)
51.4	Hickory	29%	20%
25.8	Red oak	9%	14%
24.3	Sugar maple	13%	16%
15.1	White oak	8%	8%
13.6	White oak group	3%	10%
8.8	Ash	4%	5%
8.4	Oak species	3%	5%
6.4	Slippery elm	6%	2%
4.4	Flowering dogwood	6%	1%
4.0	Pin oak	1%	6%

There were no signs of gypsy moths, but two sites had evidence of dogwood anthracnose. At one of these sites, nearly all of the dogwood trees showed symptoms of the disease. It is likely that more areas within the watershed have anthracnose since flowering dogwoods are relatively common and the disease is becoming widespread.

Only 41 shrub and vines stems were recorded from all the sites. Of these, 53% were invasive species, the second lowest amount in the state. None of the invasive species present seemed dense or a serious threat at this time, but more sites are needed to determine their extent.

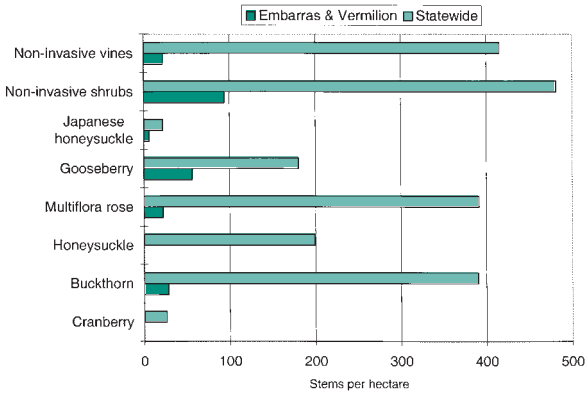
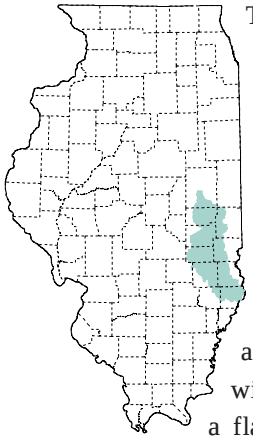


Figure 55. *Number of invasive and non-invasive shrub and vine stems*

REGIONAL ASSESSMENTS

Two regional assessments have been completed for this area —for the Embarras River Basin and the Illinois Headwaters.

Embarras River Basin



The Embarras River is the second-largest Illinois tributary (194 miles) of the Wabash River. Its basin comprises 2,440 square miles, with the northern half falling within the Bloomington Ridge Plain — hilly, morainal ground — and the southern half mostly within the Springfield Plain — a flat landscape. Dominated by agriculture, the basin has only a minuscule amount of original high quality prairie left (0.0002%) and only about 30% of the presettlement area of forest, and the amount that is old-growth is vanishingly small. However, 11% of wetlands remain, more than the statewide average. Other significant features:

- five state-designated nature preserves offer hill prairies, till plains, marsh, sandstone outcrops, prairie-chicken habitat, exposures of Ice Age sediments, and wet-mesic floodplains;
- well over half of the Embarras River's main stem — two sections totaling 112.5 miles, the

second-highest in the state — is designated a Biologically Significant Stream;

- the middle section of the river is considered outstanding because it has a high species count and a diversity of habitats, including sandbars, gravel bars, raceways, riffles, and silt-bottomed pools;
- in general, the basin's aquatic life is in better shape than elsewhere in the state;
- 447,925 acres have been designated a state Resource Rich Area.

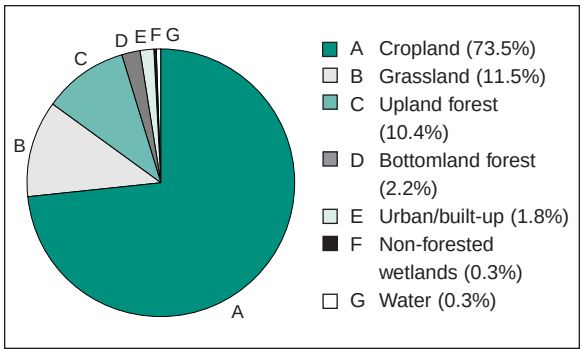


Figure 56. *Embarras River basin land cover*

Plant and animal life

At least 50 state threatened and endangered plant and animal species occur in the region. Some of these species occur only in natural areas or nature preserves because there are very few other places with suitable habitat. The four state endangered plant species include the water pennywort, running pine, halbred-leaved tearthumb, and royal catchfly. The primitive, spore-bearing running pine is restricted to a single locale, a seep springs in Red Hills State Park.

Endangered bird species found here include the short-eared owl, Henslow's sparrow, American bittern and barn owl, among others. Of the 147 recorded breeding birds, 47 are now either locally extinct or are extremely rare during the breeding season, suggesting that habitat loss is a major problem in the area. At least two locally extirpated species, the greater prairie chicken and the wild turkey, have been reestablished in the basin.

In general, habitat losses in the region appear to exceed rates for the state as a whole.

Of the eight mammal species listed as endangered or threatened in Illinois, the Indiana bat (also federally endangered) has been reported in the Embarras basin as has the river otter (state threatened). The insect fauna of the area, particularly butterflies and skippers, are poorly known. But it is likely that at least 74% of the butterflies and 64% of the skippers that occur in Illinois also occur in the Embarras basin.

Local economy and outdoor recreation

The Embarras basin is overwhelmingly rural, with only one city, Charleston, approaching a population of 20,000. The nine main counties through which the Embarras and its tributaries flow contain only 1.6% of the state's population.

Currently, the area economy supports some 95,000 workers and creates $3.1 billion in personal income. Farming remains important — farm employment's share of the total is generally four times and in some counties eight times greater than the state average of 2%.

The dominance of cropland notwithstanding, the Embarras River basin contains a variety of parks which offer open-air recreation such as boating, canoeing, horseback riding, hunting, fishing, and camping. Visitors to state-run lands create $15 million in annual economic activity.

Threats

Habitat loss and fragmentation - In general, habitat losses in the region appear to exceed rates for the state as a whole and habitat which remains is often fragmented. For example, the basin contains stands of forest and small sections of preserved or restored prairie that tend to be separated from one another by large areas of farms and some industrial and urban land. These small, insular habitats often contain a relatively high number of native plant and animal species, with each species prone to at least

local extinction because it is represented by only a small number of individuals.

Stream alteration - The widespread introduction of agricultural tiles, together with substantial channelization — 16% of the stream miles in the basin are channelized — has created new ecological challenges. Both of these modifications promote higher stream velocity, pronounced downcutting, increased sedimentation downstream, and the potential for more destructive flooding. As a result, the Embarras and its feeder streams contain zones of severe bank erosion.

Basin acreage - 1,541,523
State land* - 4,171 acres
Total natural areas - 5,719.6 acres
High-quality natural areas - 379.4 acres
Nature preserves - 252 acres
** Does not include natural areas or nature preserves that may be state owned.*

Water quality - Of the 811 river miles (30% of the basin) assessed by the Illinois Environmental Protection Agency, almost half, 45%, were designated as "full support", meaning they met all applicable water quality standards. Another 46% were determined to be impaired to a minor degree. Two percent (15 miles) were severely impaired.

In certain areas, such as the North Fork and the headwaters above Lake Charleston, oil field pollution and siltation have been identified as water quality problems.

Non-native species - A few aggressive exotic herbaceous plants have had a significant impact on more stable habitats in the basin. In the waters of the Embarras and its tributaries, the introduced common carp has destroyed aquatic vegetation by rooting about in the substrate and increasing turbidity, and by consuming sources of food that would otherwise be available to native fish. Avian invaders such as European starlings have harmed native bird populations by stealing nesting cavities. Their effect is particularly serious in the small lots of woodland that typically remain after large forest tracts are fragmented.

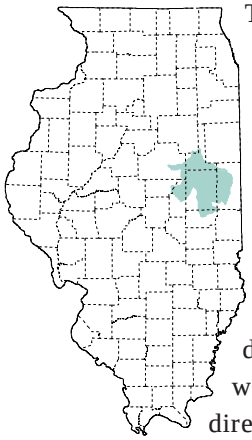
Opportunities

Strategies to restore and manage biodiversity in the region include:

- identify the distribution, abundance, and qualitative condition of remnants among several natural community classes, particularly prairie communities,
- slow or minimize habitat degradation by removing the source, such as grazing,
- restore habitats to high quality condition by using intensive vegetation management,
- reverse exotic species invasion with appropriate control measures, such as controlled burns,
- stabilize stream banks with natural materials and native vegetation, and establish native grassland buffers along drainage ditches and other waterways where needed,
- identify and promote restoration of suitable wetland habitat and promote side stream storage such as sloughs and backwater lakes.

Conservation programs and projects are already underway to protect and enhance the ecology of the area. For example, the Jasper County Prairie Chicken Habitat is restoring the once-substantial prairie-chicken population.

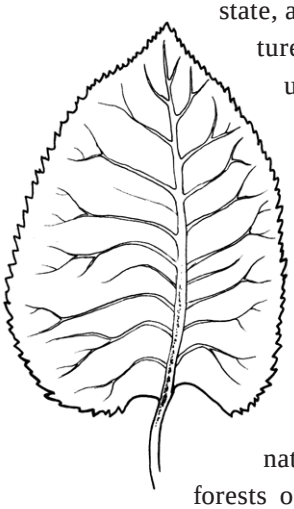
Illinois Headwaters



The Headwaters area is perhaps unique in all of Illinois. Centered in Champaign and Ford counties, it is one of the flattest parts of the state. It is characterized by glacial topography, with the flat areas separated by glacial moraines that serve as drainage divides. This causes water to flow downhill in most directions, giving rise to six major streams — the Vermilion, Embarras, Sangamon, Mackinaw, Kaskaskia, and little Vermilion rivers — that together drain almost one third of the state. Because of the brief time since the retreat of the last glaciers, the Headwaters area has undergone comparatively little erosion.

The streams that originate in the Headwaters area are among the most pristine and scenic in the state.

The streams that originate in the Headwaters area are among the most pristine and scenic in the state, and even though agriculture is the dominant land use, a surprising diversity of natural communities can still be found here. These include seven types of forest, five kinds of prairie, four types of savanna, plus seeps and cliffs, many of which are protected in the region's 15 nature preserves. However, forests of all types cover only a little more than 2% of the land area of the Headwaters compared to more than 11% statewide, and wetlands cover only 1% — about 11,500 acres of floodplain forests, shrub swamps, seeps, ponds and lakes. Other significant features:



- the Middle Fork of the Vermilion River is the first Illinois river to be included in the National Wild and Scenic River System;
- 1.3% of the Headwaters has been set aside by the state and counties as parks, fish and wildlife areas, or forest preserves;
- two hundred and twenty-five miles of six Headwaters streams (the Middle Fork and Salt Fork of the Vermilion River, Jordan Creek, Stony Creek, the upper Sangamon River, and Lone Tree Creek) have been recognized as Biologically Significant because of their fish and mussel diversity;
- 167,101 acres have been designated an Illinois Resource Rich Area.

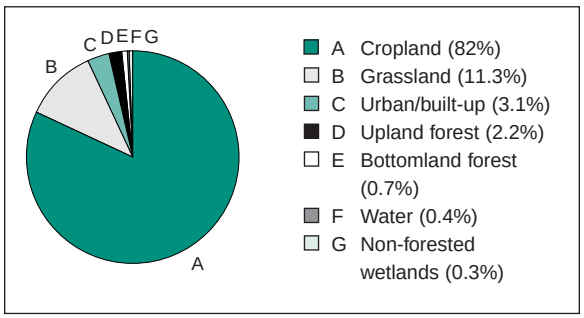


Figure 57. *Illinois Headwaters land cover*

Plant and animal life

At least 46 species of state-threatened or -endangered plants and animals occur in the area, including two species (Indiana bat and clubshell) that are federally endangered.

Basin acreage - 1,072,198
State land* - 7,005 acres
County land - 6,710 acres
Total natural areas - 3,712.6 acres
High quality natural areas - 251.4 acres
Nature preserves - 236 acres

** Does not include natural areas or nature preserves that may be state owned.*

Significant populations of all the songbirds common to this part of the world, from yellow-billed cuckoos to great crested flycatchers, can be found in the Headwaters, as well as endangered or threatened species such as the American bittern, black-crowned night heron and red-shouldered hawk. Forests host locally rare species such as the wood thrush, American redstart, barred owl, and summer tanager.

Of the seven fish considered threatened or endangered, the bluebreast darter occurs in Illinois only in the tributaries of the Vermilion River. Endangered plants include the Sangamon phlox and Wolf's bluegrass.

Local economy and outdoor recreation

Although most of the Headwaters area (Champaign and Ford counties) is rural and agricultural, the metropolis of Champaign-Urbana dominates the central part of the area, with 100,000 of the area's

187,000 population living in these two cities. Champaign and Urbana grew very rapidly following World War II, a time when the University of Illinois became increasingly important to the area. From 1969 to 1993, the area experienced slightly higher employment growth than did the state as a whole, and personal income growth averaged 1% annually.

Both Ford and Champaign counties are among the top five counties in the portion of land that is farmed, with nearly 85% of the land area in agriculture. The 2,000-plus farms in the area produce high yields of both corn and soybeans — Champaign County currently ranks second in the state for crop cash receipts. However, only 2% of the area workforce is engaged in farming and farm earnings accounted for 1% of area earnings in 1993, a drop of 60% since 1969.

More than 13,000 acres have been set aside by the state or the various counties as state parks (Kickapoo), fish and wildlife areas (Middle Fork), or forest preserves.

Threats

Habitat Loss - In general, habitat loss to cropland appears to exceed rates for the state as a whole. Before settlement, 15% of Headwaters land is thought to have been forest and almost all the rest supported grassland ecosystems such as prairie and savanna. Today, only about 2% of the land remains in forest, buildings and roads take up nearly 4%, and slightly more than 2% is open water and wetlands. Almost all the rest is agricultural land.

Absence of fire - Naturally-occurring fires in Headwaters woods and fields have been suppressed to protect fields and buildings. However, the composition and structure of many native plant communities demonstrate some level of fire dependency, and fire absence in these communities can result in profound changes, such as converting from prairie to shrub thicket or forest.

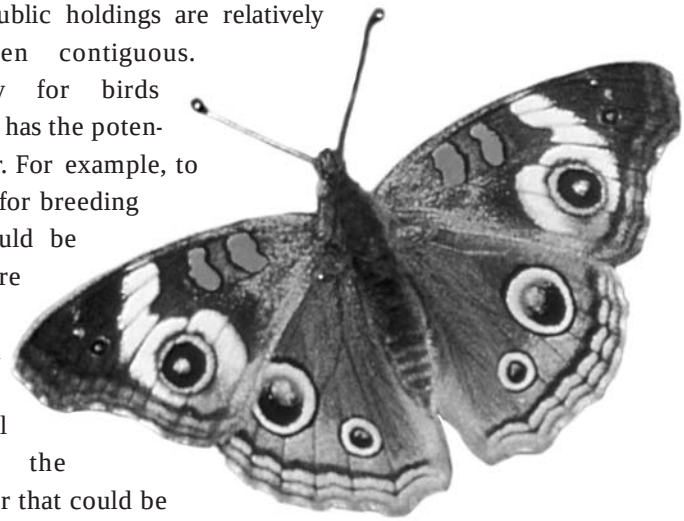
Fragmentation - Construction of roads, fields, and houses divide forests, wetlands, and prairies into habitat "islands." Isolated habitat fragments often cannot supply the resources needed by species with extensive home ranges. Some species are unable to disperse among these isolated fragments, which increase their risk of becoming locally extinct. For example, prairie and savanna remnants in the Headwaters are often less than one acre in size. The entire populations of some plant and animal species in these tracts may include only a few individuals; the smaller such local populations, the more vulnerable they are to disease and in-breeding stress.

Drainage - One of the most significant changes made to the Headwaters ecology is a massive artificial drainage system. Today, some 65-70% of the land in Champaign and Ford counties is underlain with tiles which empty into an extensive network of surface drainage ditches. Not since the glaciers retreated has any single hydrologic change so affected the Headwaters region. Populations of wetland species have declined, and a few species are no longer found here due to the draining of prairie marshes. Wet prairies, once so common, today are not found at all within the Headwaters region.

Prairie and savanna remnants in the Headwaters are often less than one acre in size.

Opportunities

Even though the Headwaters area is one of the most intensively farmed regions in the state, existing public holdings are relatively large and often contiguous. Habitat quality for birds is fairly good and has the potential to get better. For example, to improve habitat for breeding birds forests could be restored where they would contain at least a 500-acre core. There are several sections along the Middle Fork River that could be



enlarged by allowing regeneration of oak forest on ridgetops and along the old floodplain terrace.

Grasslands should be at least 100 acres, should be burned or mowed on a schedule that leaves some areas unmanaged for at least three years, and should contain small wetlands. Even though patches of available grassland habitat in the area are small and heavily used, they have potential for restoration. Many are grassy strips along roads that, if planted in appropriate species and managed to delay mowing until fledglings are out of nests, can boost populations of grassland birds such as the grasshopper sparrow and the Eastern meadowlark.

Patches of available grassland habitat in the area have potential for restoration.

Other opportunities for restoration:

- restore forested wetlands, as well as grassy wetlands, especially sedge meadows and marshes and along margins of lakes to benefit a variety of amphibians and reptiles;
- improve forest corridors that link larger wooded areas in the Headwaters river valleys to make extensive habitat available to far-ranging animals;
- protect forested riparian corridors and reestablish trees along banks to make rivers and streams more suitable as river otter habitat and to benefit other species that use these zones for foraging (e.g. bats) and as travel routes;
- reduce silt and chemical run-off into wetland habitats;
- maintain fishless upland ponds and wetlands to benefit both of the state-listed salamanders found in the region; ponds in upland forests would be particularly valuable because these habitats are among the rarest in the area.

C H A P T E R T W E L V E

Little Wabash River Watershed

The Little Wabash is the smallest of the 10 watersheds and has the smallest amount of both cropland and urban and built-up acreage. Because of its small size, it ranks near the bottom for statewide acreage in most of the other land cover categories, except for bottomland forest, of which it has the fourth largest amount. (See page 111 for a color map of the watershed's land cover.)

Two Resource Rich Areas are in the watershed, the Lower Wabash River RRA and the Southern Till Plain RRA.

- The 256-square-mile Lower Wabash River RRA includes the mainstem of the Wabash River below Lawrenceville to its confluence with the Ohio River and its small tributaries. The area has bottomland forest with wet prairie, sloughs, oxbows, and marshes. The bottomlands are the last strongholds of the eastern deciduous forest in Illinois. The immense size of the trees (some are over 130 feet tall and six feet in diameter) and diversity of species are remarkable features of the woods. Several state tree champions are present in Beall Woods Nature Preserve.
- Most of the Southern Till Plain RRA lies within the Little Wabash River watershed, but the western arm comprising 12% of the area lies in the Kaskaskia River watershed. With 914 square miles, the Southern Till Plain is the second largest RRA. In presettlement times, the region was characterized by rolling prairies between broad woodlands following stream corridors. Today the area is largely agricultural. Nevertheless, a 50-mile stretch of the Little Wabash is a Biologically Significant Stream and almost one-fifth of the area is wooded.

The Little Wabash is the smallest of the 10 watersheds.

Table 45. *Watershed Land Cover*

Land Cover	Acres	Percent of Watershed		Statewide Percentage*	
Upland forest	259,737	10.8%	(6)	6.3%	(8)
Grassland	456,555	18.9%	(4)	7.1%	(8)
Non-forested wetland	9,949	0.4%	9)	2.8%	(9)
Bottomland forest	90,652	3.8%	(2)	10.4%	(4)
Water	15,851	0.7%	(9)	3.2%	(9)
Urban/built-up	31,979	1.3%	(10)	1.7%	(10)
Cropland	1,547,458	64.2%	(8)	7.2%	(10)
Total acreage	2,412,183	100.0%		6.7%	(10)

** The watershed's percentage of the land cover type statewide, e.g., 6.3% of the state's upland forests.*
Note: the watershed rank (1st-10th) is shown in parentheses.

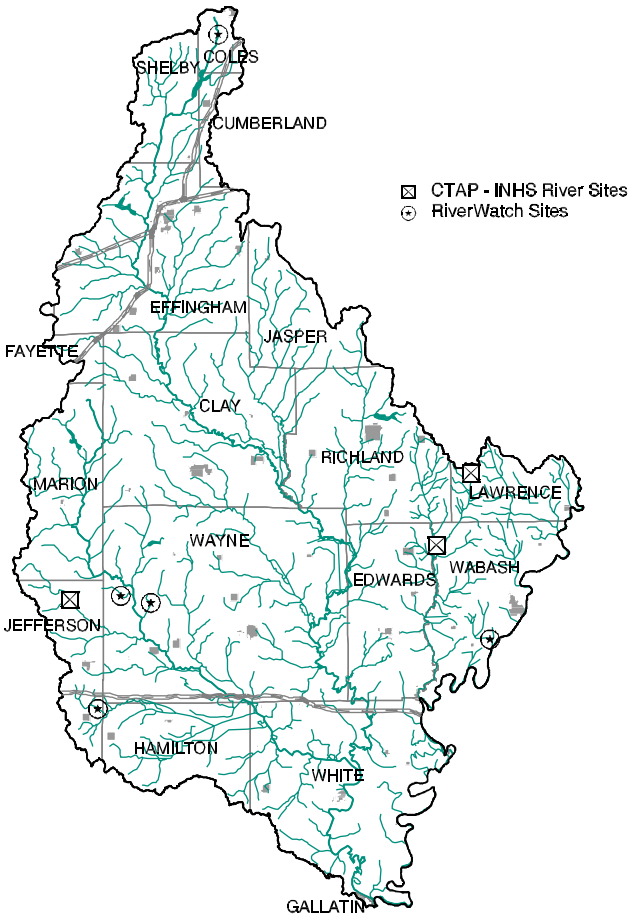
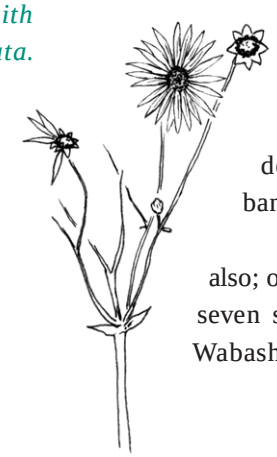


Figure 58. *Monitoring Sites*

ECOSYSTEM MONITORING

The Little Wabash watershed scored poorly according to every biological indicator constructed with RiverWatch data.

Because CTAP biologists have sampled only three sites in the Little Wabash watershed, no definitive statement can be made about the quality of its streams. Of the three sites, Horse Creek near Dix was the best. While it had a somewhat lower EPT taxa richness, its HBI score was very good and its fish richness and habitat quality were extremely high. Bonpas Creek, a large sandy stream near West Salem in Wabash County, had low habitat quality due to tremendous sand deposition, channelization, frequent bank failures, and frequent flooding.



RiverWatch sampling was low also; only 20 samples were collected at seven sites on seven streams. The Little Wabash watershed scored poorly

according to every biological indicator constructed with RiverWatch data.The watershed had the worst MBI among the 10 Illinois watersheds and was ninth or tenth in the other three indicators. Midge larvae, bloodworms, and hydropsychid caddisfly larvae were the most common taxa collected. No trends in MBI or other indices are evident.

Table 46. *Watershed Indicator Scorecard*

Indicator	Watershed Value	Statewide Value	Watershed Ranking
Macroinvertebrates			
HBI	4.6	5.2	2
MBI	6.6	5.7	10
EPT richness	7.0	7.1	5
EPT taxa (RW)	1.9	2.6	9
Taxa richness	7.3	8.9	10
Taxa dominance	82.7%	80.4%	9
Fish			
Native fish	16.5	13.6	2
Darter richness	2.5	1.9	3
Exotic species	0.0	0.2	1
Habitat			
Habitat score	104.0	88.6	2

Table 47. *MBI Values*

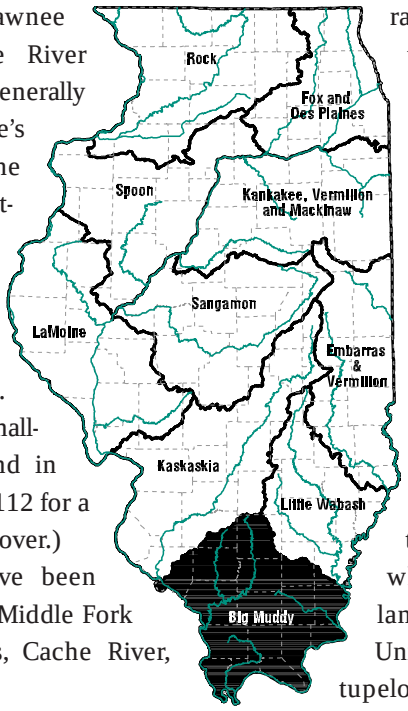
Statistic	1995	1996	1997	1998	1999	Overall
Average	7.77	6.11	7.42	6.10	5.60	6.61
Standard deviation	2.21	0.72	1.49	0.53	0.24	1.45
Minimum	5.13	5.61	5.96	5.42	5.28	5.13
Maximum	10.33	6.62	8.95	6.71	5.84	10.33
Number of sites	4	2	3	4	4	17

** Only samples with at least 25 organisms were included in the analysis.*

C H A P T E R T H I R T E E N

Big Muddy, Saline and Cache Rivers Watershed

This watershed, featuring the Shawnee National Forest and the Cache River wetlands in southern Illinois, is generally considered to be among the state's richest ecological regions. It has the most acreage and the largest percentage of land devoted to upland and bottomland forest and surface water, and it has the second-highest acreage and percentage of land in grassland and non-forested wetland. Conversely, it also has some of the smallest acreage and percentage of land in cropland and urban uses. (See page 112 for a color map of the watershed's land cover.)



Five Resource Rich Areas have been identified in this watershed — the Middle Fork of the Big Muddy, Illinois Ozarks, Cache River, Shawnee Hills and Cretaceous Hills.

- The Middle Fork of the Big Muddy is a small, single watershed site covering 180 square miles. The significant natural features are the large tracts of forest located along the river.
- Covering 729 square miles, the Illinois Ozarks is one of the richest, most biologically diverse areas of the state. Many species found here are rare and limited in distribution to this area of the state. This RRA encompasses the Mississippi River bottomlands, Ozark plateau, and unglaciated hill country. The Illinois Ozarks RRA shares a boundary with the Cache River RRA.
- The Cache River RRA is located at the southern tip of Illinois; it covers 693 square miles. The upper reach flows through the hills of the Ozark plateau; the lower Cache flows through flatter coastal plains where drainage is slow and wetlands become more abundant. Unique features include bald cypress-tupelo gum swamps and several species associated with the southern U.S.
- The Shawnee Hills RRA, covering 745 square miles, is a scenic wooded area in an unglaciated part of the state. An escarpment of sandstone runs east to west in this area. Bluffs, rugged hills, deep ravines, and clear streams support distinctive flora and fauna.

This watershed is generally considered to be among the state's richest ecological regions.

Table 48. *Watershed Land Cover*

Land Cover	Acres	Percent of Watershed		Statewide Percentage*	
Upland forest	991,770	26.6%	(1)	24.0%	(1)
Grassland	924,376	24.8%	(2)	14.4%	(2)
Non-forested wetland	50,302	1.4%	(2)	14.2%	(2)
Bottomland forest	227,037	6.1%	(1)	25.9%	(1)
Water	101,734	2.7%	(1)	20.3%	(1)
Urban/built-up	84,037	2.3%	(8)	4.5%	(7)
Cropland	1,350,312	36.2%	(9)	6.3%	(8)
Total acreage	3,729,571	100.0%		10.0%	(5)

** The watershed's percentage of the land cover type statewide, e.g., 24% of the state's upland forests are located in this watershed. Note: the watershed rank (1st-10th) is shown in parentheses.*

- The Cretaceous Hills RRA, encompassing 137 square miles, is characterized by rolling hills of sand, gravel and clay and bottomlands along the Ohio River. Acidic seeps, which support some of the most interesting natural communities in the state, are found in this area.

ECOSYSTEM MONITORING

The Cache River basin contains some of the most pristine streams in Illinois, but many streams in the Big Muddy and Saline river basins are heavily degraded because the natural riparian corridor has been denuded, and streams have been channelized and polluted with nutrients from row crop agriculture. From 1997 through 1999 CTAP biologists sampled eight randomly chosen streams. They found that, overall, the watershed scored below average for EPT richness and HBI score. It scored slightly above average for total native fish and for habitat quality.

The site with the best habitat condition was an unnamed tributary of Lusk Creek near Golconda. Although it had a very good HBI score, EPT taxa richness was lower than expected. This was probably due to the site being sampled later than usual for the region, with many species entering the egg stage of their life cycle. The worst site was Mud Creek near Unionville, which had low EPT and habitat quality.

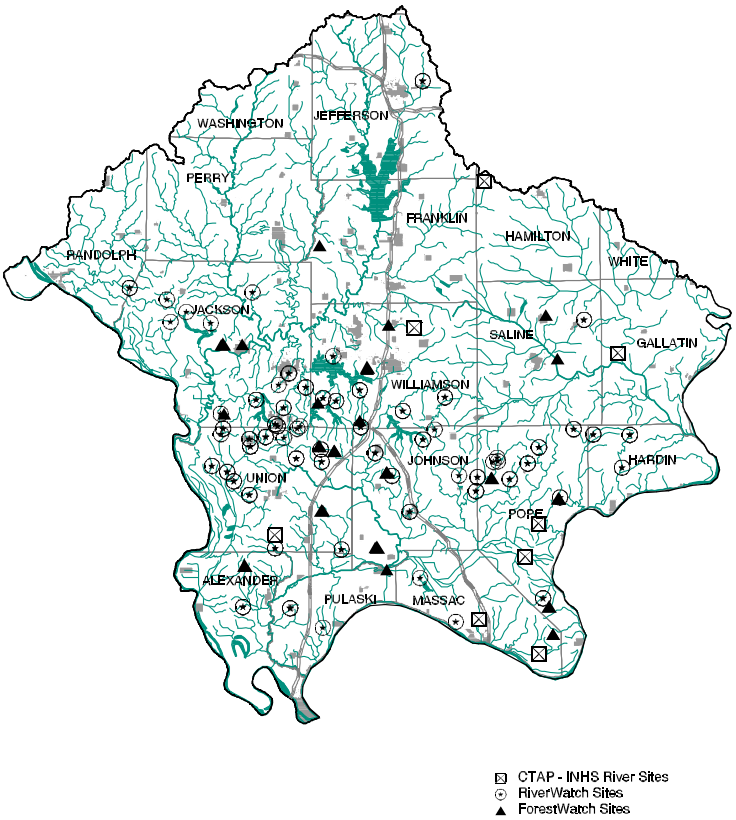


Figure 59. *Monitoring sites*

Table 49. *Watershed Indicator Scorecard*

Indicator	Watershed Value	Statewide Value	Watershed Ranking
Macroinvertebrates			
HBI	5.6	5.2	9
MBI	5.2	5.7	1
EPT richness	6.4	7.1	7
EPT taxa (RW)	3.3	2.6	3
Taxa richness	9.4	8.9	3
Taxa dominance	77.2%	80.4%	1
Fish			
Native fish	16.0	13.6	3
Darter richness	1.8	1.9	5
Exotic species	0.3	0.2	6
Habitat			
Habitat score	94.0	88.6	5

Between 1995 and 1999 RiverWatch volunteers collected 208 macroinvertebrate samples at 79 sites along 68 streams. Most of the streams are located in the southern half of the watershed, either in the Cache River basin or within or near the Shawnee National Forest. Very few of the monitored streams flow through the heavily row-cropped areas of the Big Muddy or Saline river basins.

RiverWatch biological indicators generally reinforce the area's reputation as home to some of Illinois' finest ecosystems. The watershed ranked first among the ten watersheds in MBI and third in the number of EPT taxa, two proxies for the level of organic pollution. Sowbugs, midges, and scuds were the three most common taxa; these species are common throughout the state and have low to medium tolerance for pollution. The watershed also ranked best in taxa dominance, a useful measure of species diversity. Overall, the indicators suggest that the Big Muddy/Saline/Cache watershed — at least the southern portion — is among Illinois' best, rivaled only by the Spoon River watershed.

The average MBI declined from 6.2 to 5.0 between 1995 and 1999, indicating improved

stream quality (Table 50). However, the decline is not statistically significant. In addition, changes in several other indicators (including taxa richness and taxa dominance) suggest degradation, though these changes are also statistically insignificant. It will take more years of data before trends can be assessed with confidence.

Table 50. *MBI Values*

Statistic	1995	1996	1997	1998	1999	Overall
Average	6.19	5. 5	5.35	4.88	5.01	5.22
Standard deviation	1.59	1.23	1.33	0.79	0.70	1.10
Minimum	4.63	3.44	3.19	2.09	3.04	2.09
Maximum	9.82	9.52	9.85	6.00	6.61	9.85
Number of sites	14	29	35	48	48	174

** Only samples with at least 25 organisms were included in the analysis.*

ForestWatch volunteers monitored 13 forest sites in the fall of 1998. Twelve were upland forests (nine oak-hickory, two tulip, one beech-maple) and one was an ash-cottonwood bottomland forest. Tree species richness ranged from seven to 17 species, with an average of 13 tree species per site, slightly above the statewide average of 11.8 species per site. The site with only seven species was a beech-maple upland with a relatively low tree abundance of 62 trees in a monitoring area of 1500 m^2 (the statewide average was 111 trees).

Forty-nine tree taxa were recorded in the watershed, the most in the state (75 taxa were reported statewide). This is not surprising since southern Illinois contains species found in both northern and southern latitudes. In general, the trees that were most abundant also had the largest basal areas and highest importance values (Table 51).

Table 51. *Tree Species with the Highest Importance Values*

Importance Value	Species	% of total trees counted (n=1,448)	% of total basal area (20.9m^2/ha)
33.8	Hickory	16%	20%
28.3	White oak	8%	20%
16.3	Red oak	5%	11%
15.7	Sugar maple	10%	5%
13.8	Tulip tree	4%	8%
10.7	Ash	8%	6%
9.1	Flowering dogwood	6%	1%
7.7	Winged elm	5%	2%
6.9	Southern red oak	2%	6%
5.9	American beech	2%	3%

Only one site showed clear signs of maple takeover (Fig. 60), with the three smallest size classes dominated by sugar maples. Maple takeover is not a factor, however, in most forests in the watershed.

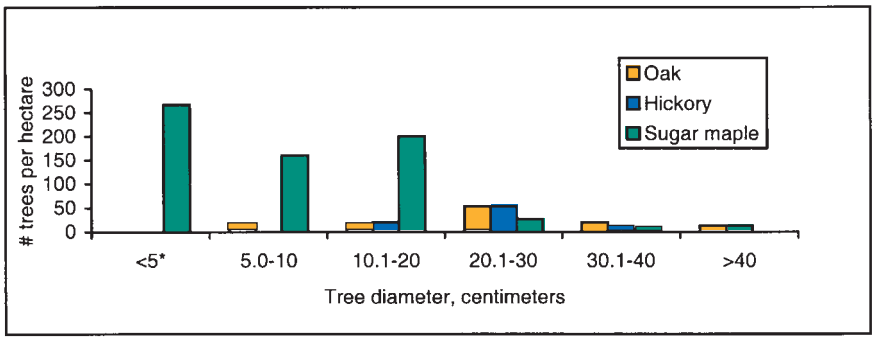


Figure 60. *Maple takeover in an oak-hickory forest*

There were no signs of gypsy moths at any site, but about half of the flowering dogwood trees at one site showed signs of dogwood anthracnose. Because flowering dogwoods are relatively abundant in the watershed and anthracnose has been found elsewhere, it is likely that other forests in the watershed have the disease. Future monitoring will provide more information on the extent of dogwood anthracnose.

This watershed had the fewest number of invasive shrubs and vines recorded during fall monitoring — only 13% of the 534 shrubs and vines recorded. Multiflora rose was the only non-native

shrub recorded and Japanese honeysuckle the only non-native vine. Spring monitoring, at five sites, also recorded few invasive species among ground cover plants. Ground ivy, a non-native invasive species, was recorded at one site. Another site had two disturbance-sensitive plants — bleeding hearts and doll's eyes — while two other sites had one disturbance-sensitive plant, the Virginia spiderwort.

The area is home to unique and extensive complex natural communities that have earned state, federal, and international recognition for their biological significance.

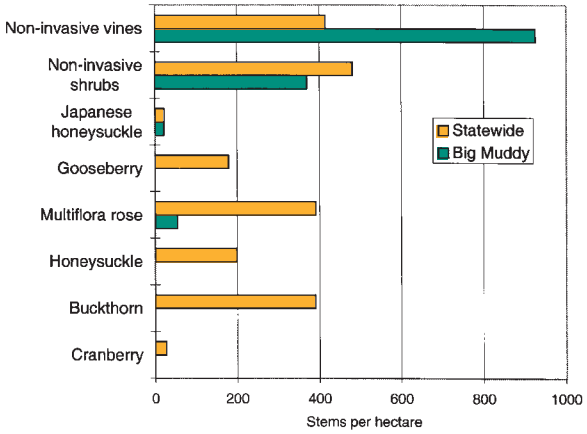


Figure 61. *Number of invasive and non-invasive shrub and vine stems*

REGIONAL ASSESSMENTS

One regional assessment has been conducted in this watershed — for the Cache River basin.

Cache River Basin

The Cache River originates in Union County and runs 110 miles before it empties into the Ohio River. The basin drains nearly the entire southern tip of Illinois and includes nineteen watersheds covering approximately 835 square miles. Sixty-four percent of the land is either cropland or pasture; statewide, 77% of the land is agricultural. Twenty percent of the land is owned by state or federal agencies, primarily the U.S. Department of Agriculture (Shawnee National Forest) and the U.S. Department of the Interior (Cypress Creek National Wildlife Refuge).

The area still has a third of the land in forest, two and a half times higher than the state average, and it has a relatively large percentage of the state's unique habitats. Although it makes up only 1.5% of the land area of Illinois, it contains 23% of the state's remaining high quality barrens, 11.5% of the high quality floodplain forest, 91% of the state's high quality swamp and 42% of the shrub swamp. Also, though caves are scarce in the rest of Illinois, there are 43 caves known here.

Given its relatively large amount of forest, including significant bottomland forest, the area is home to unique and extensive complex natural communities that have earned state, federal, and international recognition for their biological significance. For example:

- the United Nations Educational, Scientific, and Cultural Organization added the Cache River and Cypress Creek wetlands to its list of 15 "Wetlands of International Importance" in the United States because of their crucial role in sustaining waterfowl and shorebirds that use the Mississippi flyway;
- the National Park Service designated three areas of the Cache River basin as National Natural Landmarks because they represent nationally significant types of vegetation and habitat;
- most of the area (443,616 acres) has been designated a state Resource Rich Area;
- 52 miles of Biologically Significant streams are recognized including segments of the Cache River, Limekiln Slough, Horseshoe Lake, Lake Creek, and the Ohio River.

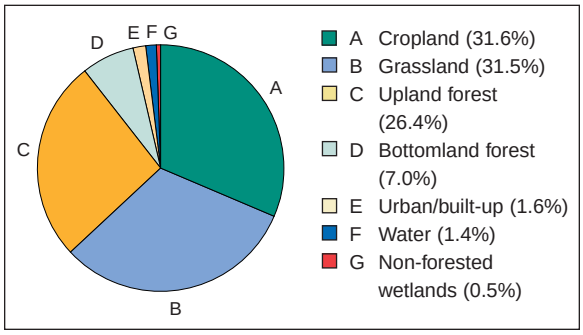


Figure 62. *Cache River basin land cover*

Plant and animal life

Diversity in habitat leads to a diverse flora and fauna. For example, the Cache River bottomlands support the greatest diversity of tree species of any bottomland stream system in Illinois. Consequently, the area is home to 128 native bird species while another 129 migrate to the area.

Basin acreage - 534,786.3
State land* - 24,773 acres
Federal land - 34,775 acres
Total natural areas - 19,074 acres
High quality natural areas - 3,200 acres
Nature preserves - 3,465.6 acres
** Does not include natural areas or nature preserves that may be state owned.*

With so much rare habitat, it is no surprise that the area also shelters many rare creatures — 104 species whose survival in Illinois is considered endangered or threatened, and seven species recognized by federal authorities as endangered or threatened throughout the U.S.

Among the many unique species that live in the area:

- river otters — they persisted in the Cache River basin when they were disappearing from the rest of the state (they have since been reintroduced in several areas);
- bald eagles — 20 to 50 winter in the cypresses lining Horseshoe Lake;
- bobcats — with a home range as much as 3.25 square miles, the Shawnee Hills is one of three places in Illinois that offers this animal enough space to roam;
- the green treefrog, bird-voiced tree frog, cottonmouth and mole salamander — they all reach the northern limits of their distribution here and are restricted to the cypress-buttonbush swamps and adjacent watersheds.

Local economy and outdoor recreation

The area is uniquely rural. Today the population is about the same as it was in 1870 and population density is only one-fifth that of the statewide average. The slow-growing population may be traced to a slow-growing local economy. In recent years, the local economy grew less than one-half as much as the state overall. The five main counties in the basin — Union, Massac, Johnson, Alexander and Pulaski — ranked among the 15 poorest counties in Illinois in 1990.

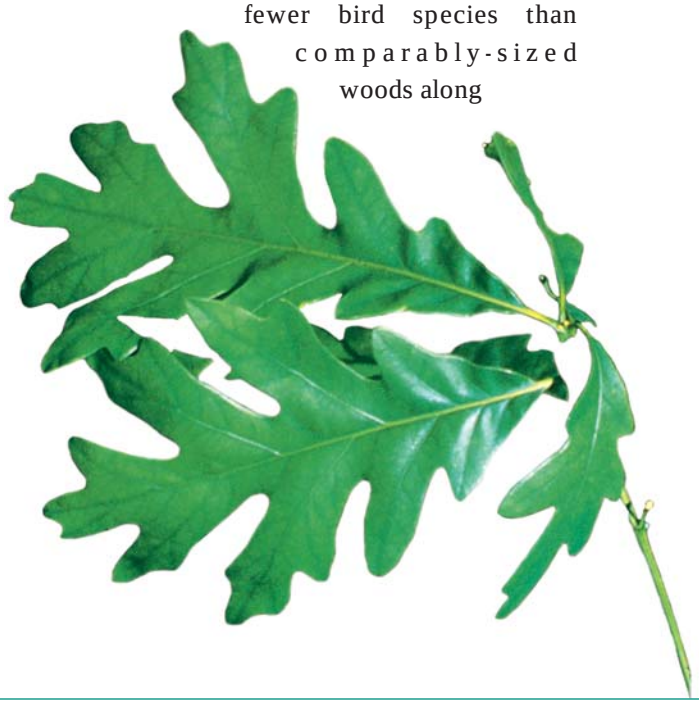
Contributing to the local economy are numerous outdoor recreational opportunities. The area attracts many anglers and hunters, including many from Kentucky, Indiana, and Missouri, and many people visit the three state parks for activities such as sightseeing, hiking, cross-country skiing, and picnicking. In 1994, more than 2.6 million people visited the area's state parks and conservation and natural areas. The parks generated $14.9 million in economic output, created about 396 jobs and increased personal income by more than $8.46 million.

Threats

Logging, water draining, and conversion to agricultural uses have lead to a considerable change since pre-settlement times. Approximately 80% of the area was densely forested when settlers arrived; today only a third of the area is forested. Very little of the swamps and floodplain forests remain in pre-settlement condition. These physical changes to the landscape have had a profound ecological effect.

Approximately 80% of the area was densely forested when settlers arrived; today only a third of the area is forested.

Fragmentation - Fragmentation renders habitats too small to supply a sufficient food supply, to protect animals from predators, or to accommodate genetically varied breeding species. For example, small isolated tracts of forest had 40% fewer bird species than comparably-sized woods along



the Cache corridor. Nests of forest-dwellers in the basin, such as the yellow-billed cuckoo and indigo bunting, suffer more than 60% losses to predators. Losses are lower in the larger wooded tracts.

Non-native species - Many of the plants that grow in the basin were introduced to the area, although the Cache River basin does not suffer infestations as severe as other parts of Illinois. Autumn olive is a significant problem throughout the area, and in the Cache River Natural Area in particular. Black locust, planted to enrich depleted soils and to provide firewood, is a pest in such areas as the Halesia Nature Preserve.

The cypress-tupelo forest and the associated species of the swamps and sloughs are found only in the basin and are totally dependent upon the natural hydrologic cycle of the Cache River.

Altering water flow - No change made in the past 190 years has affected the ecosystem more drastically than the reordering of the presettlement hydrology undertaken to cure the area's chronic flooding. These alterations speed the flow of water from where it falls into the nearest stream channel. Rushing the water downstream has caused massive bank erosion and gullying in the Upper Cache River channel and led to excessive sedimentation and channel aggregation in the Lower Cache River Natural Area. The continued gully formation and deepening of stream channels drains wetlands (e.g., Bird Spring Pond, Heron Pond), whose elevation becomes significantly higher than the stream channel because of channel bed scour. Draining wetlands takes away the natural water control functions they provide, such as slowing moving water and moderating the extremes of flood and drought. It also diminishes habitat for migrating geese, bald eagles, and other waterfowl.

Sedimentation - The reduced flow of the Lower Cache River area has caused most of the sediment from tributaries draining into it to deposit near the mouth of the tributary streams and within the Lower Cache. This has reduced the depth of water within the Lower Cache and degraded the aquatic and plant habitat within the area. The cypress-tupelo forest and the associated species of the swamps and sloughs are found only in the basin and are totally dependent upon the natural hydrologic cycle of the Cache River. This unique vegetation will continue to be threatened unless some favorable hydrologic conditions are recreated in the basin.

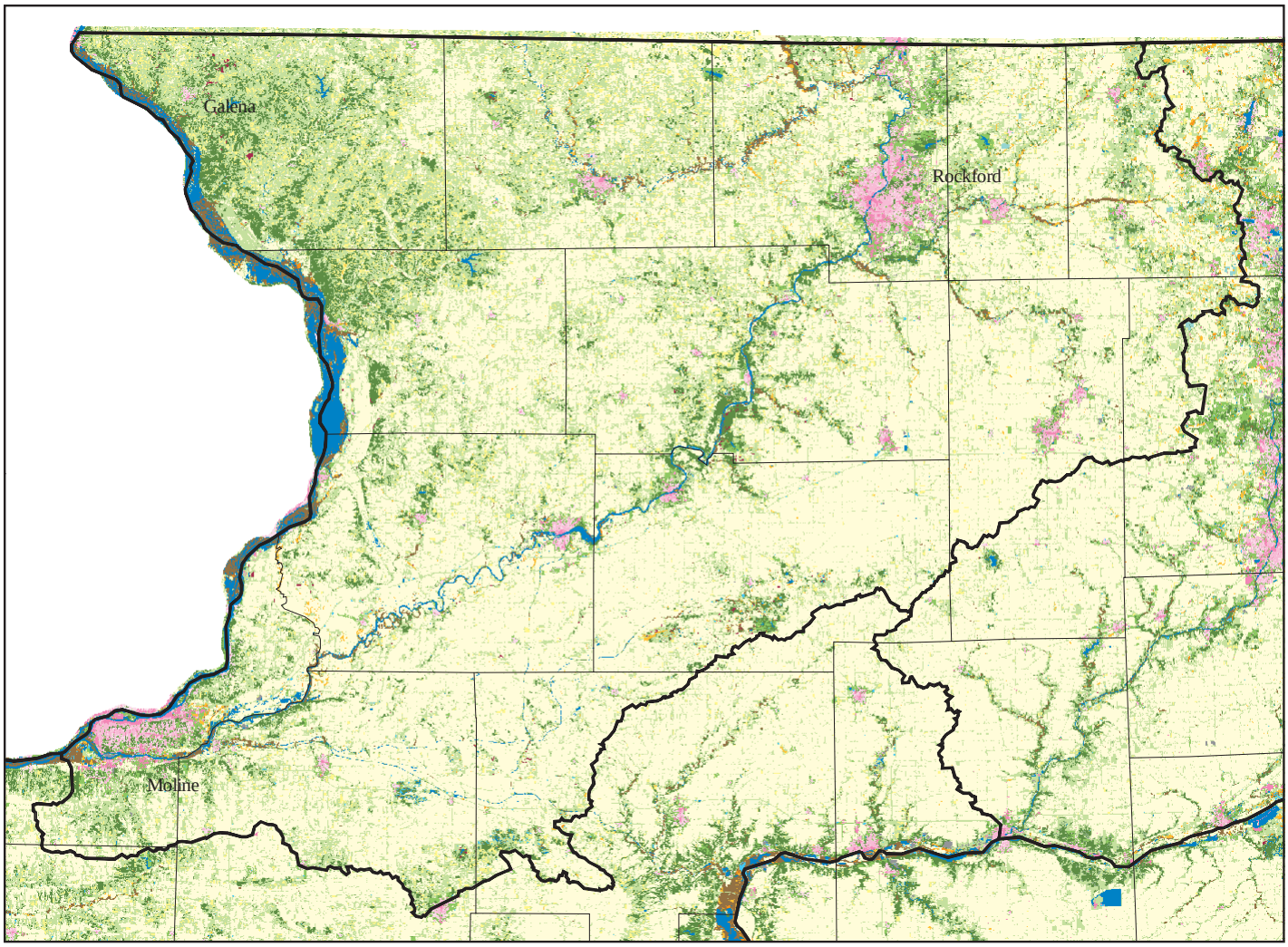
Diminished water quality - Nearly all Cache basin stream segments monitored for water quality by the Illinois Environment Protection Agency were rated as "partial support/minor impairment" (water quality has been impaired to a minor degree). Exceptions include all of Lick Creek which received the highest rating of "full support" and a segment of the upper Cache that was rated as partial support/moderate impairment. Reasons for less than full support ratings include siltation and turbidity from agricultural runoff and erosion in the Upper Cache, and siltation, turbidity, channelization, and sedimentation in the Lower Cache.

Opportunities

Given the many unique natural communities and plant and animal species in the Cache River area, there are many opportunities to preserve and enhance natural resources. For example, preserving and restoring large habitat areas will prevent further habitat fragmentation. Larger tracts of forest and wetland would provide for a greater number of bird species and provide habitat for the state-threatened river otter, which requires large tracts of habitat.

Improving hydrologic conditions — reducing bank erosion, entrenchment, and gullying in the Upper Cache and sedimentation and channel aggregation in the Lower Cache — will in turn improve the water quality of streams and wetlands, prevent further loss of wetlands, and preserve habitat for fish, waterfowl, and other animals.

Figure 63. *Rock River Watershed*



Scale 1:1,100,000

0 30 Miles

- Forest- Deciduous,closed canopy
- Forest- Deciduous,open canopy
- Forest- Coniferous
- Wetland- Shallow marsh
- Wetland- Deep marsh
- Wetland- Swamp
- Wetland- Forested
- Wetland- Shallow open water
- Open water deeper than 2m
- Urban- High density
- Urban- Medium high density
- Urban- Medium density
- Urban- Low density
- Urban- Grassland
- Ag- Row crops
- Ag- Small grains
- Ag- Rural grassland
- Ag- Orchards and nurseries
- Barren and exposed land

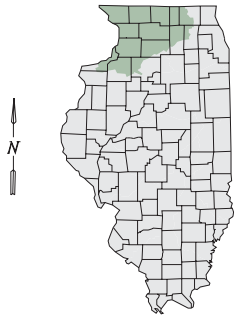


Figure 64. *Fox and Des Plaines Rivers Watershed*

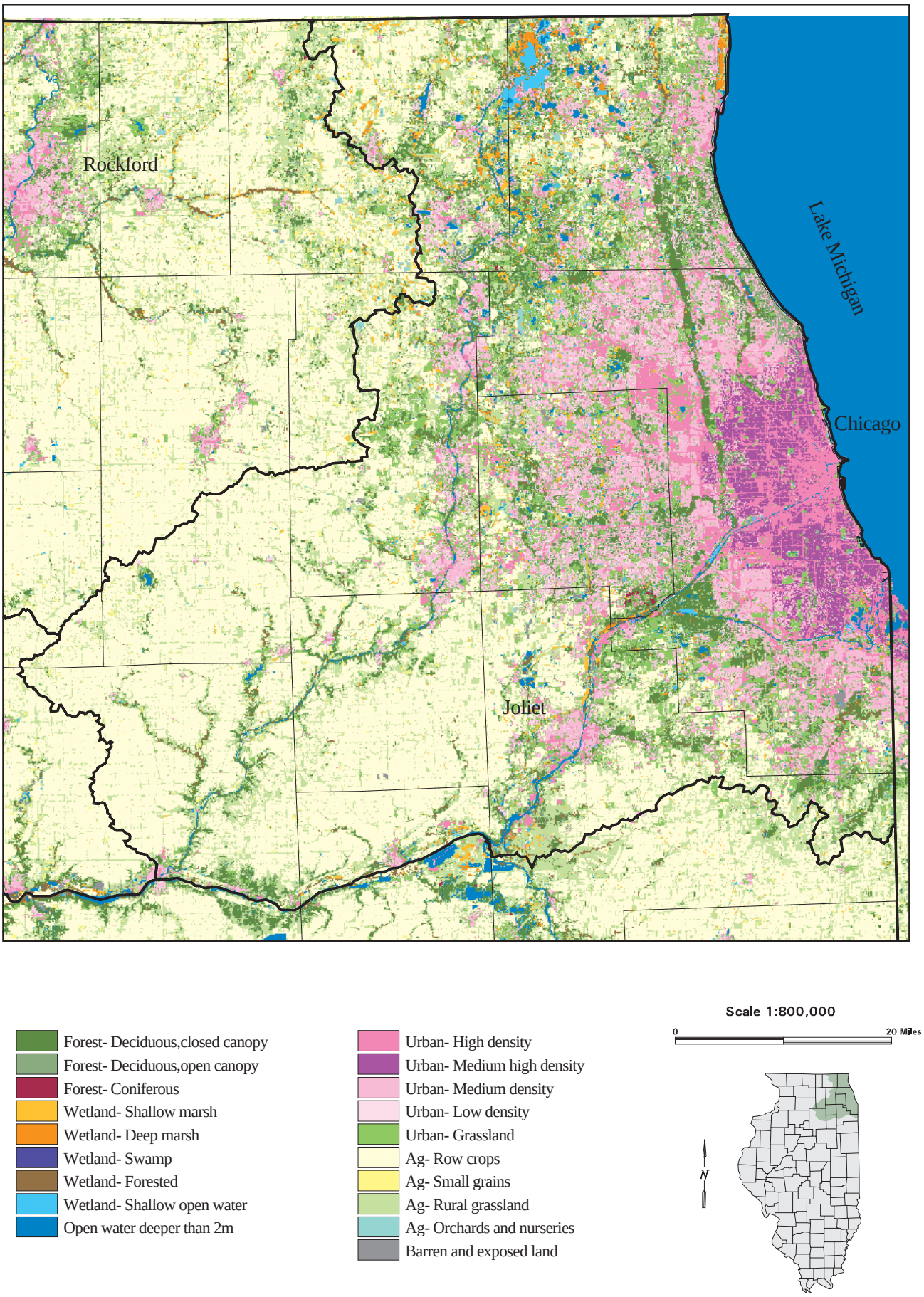
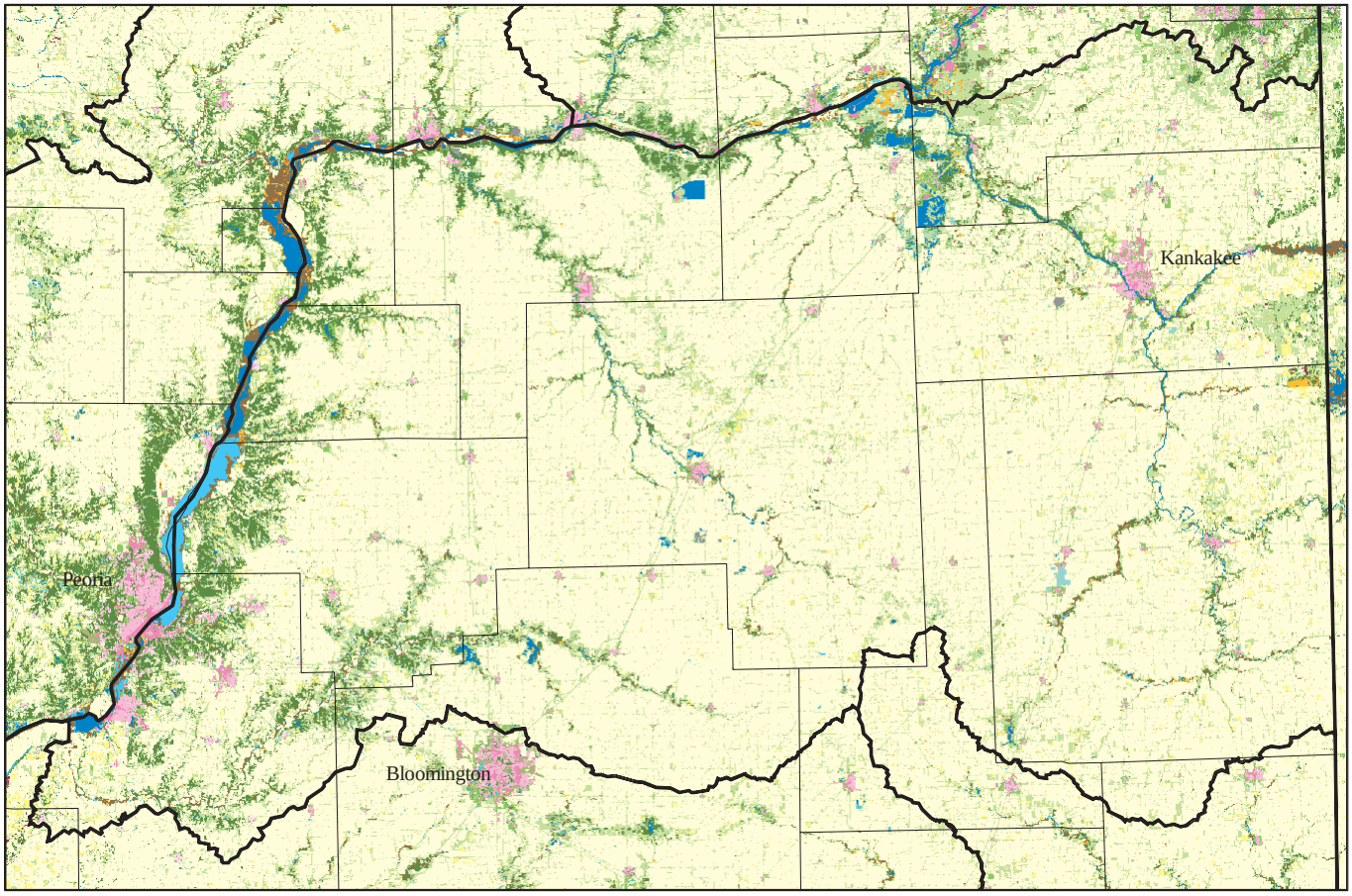


Figure 65. *Kankakee, Vermilion and Mackinaw Rivers Watershed*



Scale 1:1,100,000

0 30 Miles

Forest- Deciduous,closed canopy
Forest- Deciduous,open canopy
Forest- Coniferous
Wetland- Shallow marsh
Wetland- Deep marsh
Wetland- Swamp
Wetland- Forested
Wetland- Shallow open water
Open water deeper than 2m

Urban- High density
Urban- Medium high density
Urban- Medium density
Urban- Low density
Urban- Grassland
Ag- Row crops
Ag- Small grains
Ag- Rural grassland
Ag- Orchards and nurseries
Barren and exposed land

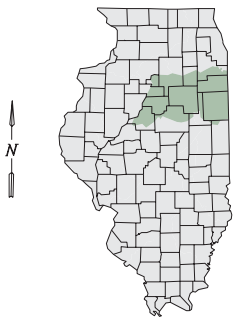
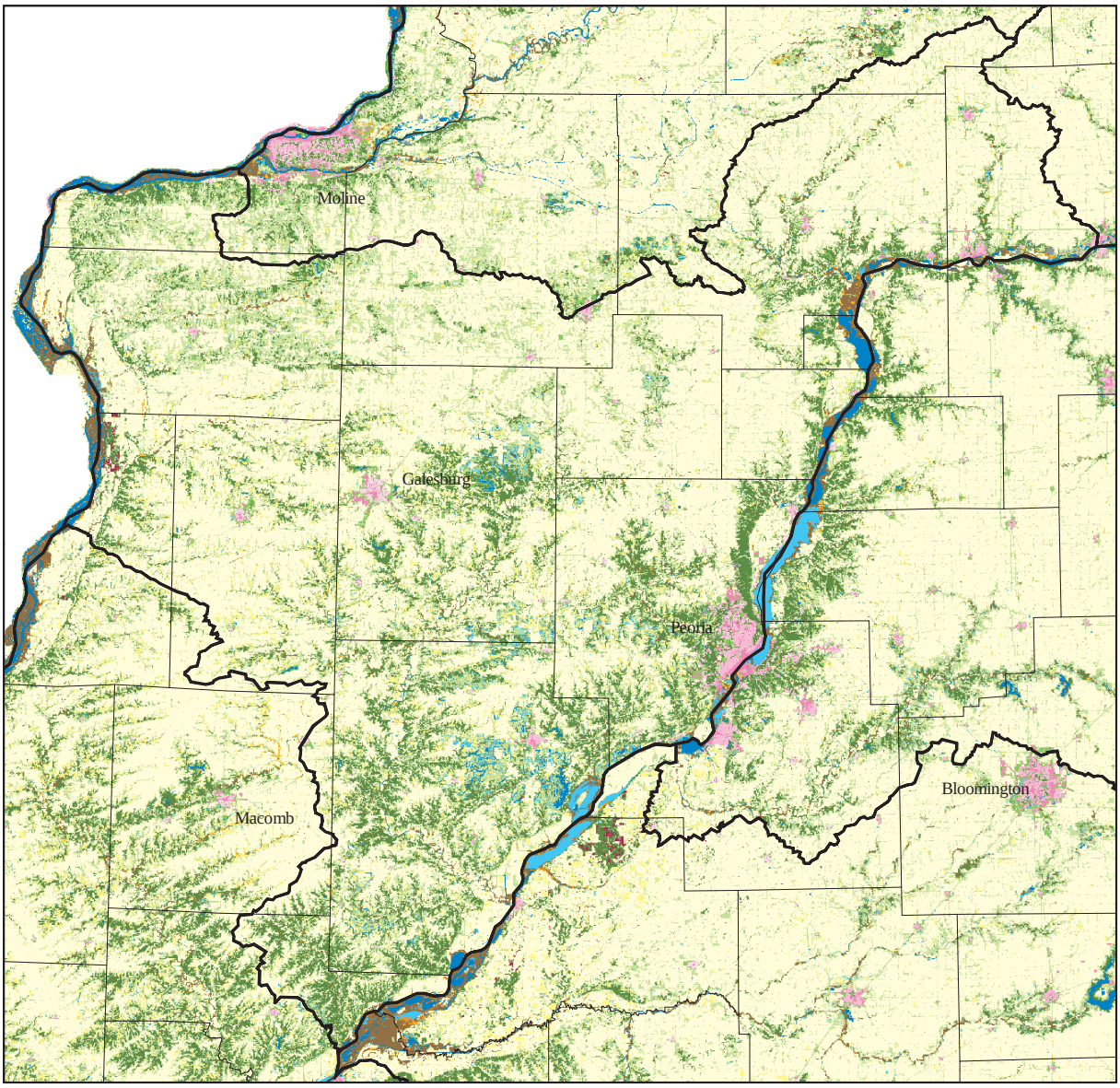


Figure 66. *Spoon River Watershed*



Scale 1:1,100,000

0 30 Miles

Forest- Deciduous,closed canopy
Forest- Deciduous,open canopy
Forest- Coniferous
Wetland- Shallow marsh
Wetland- Deep marsh
Wetland- Swamp
Wetland- Forested
Wetland- Shallow open water
Open water deeper than 2m

Urban- High density
Urban- Medium high density
Urban- Medium density
Urban- Low density
Urban- Grassland
Ag- Row crops
Ag- Small grains
Ag- Rural grassland
Ag- Orchards and nurseries
Barren and exposed land

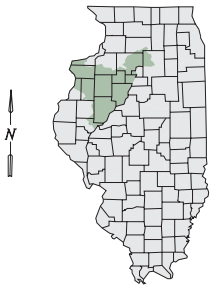
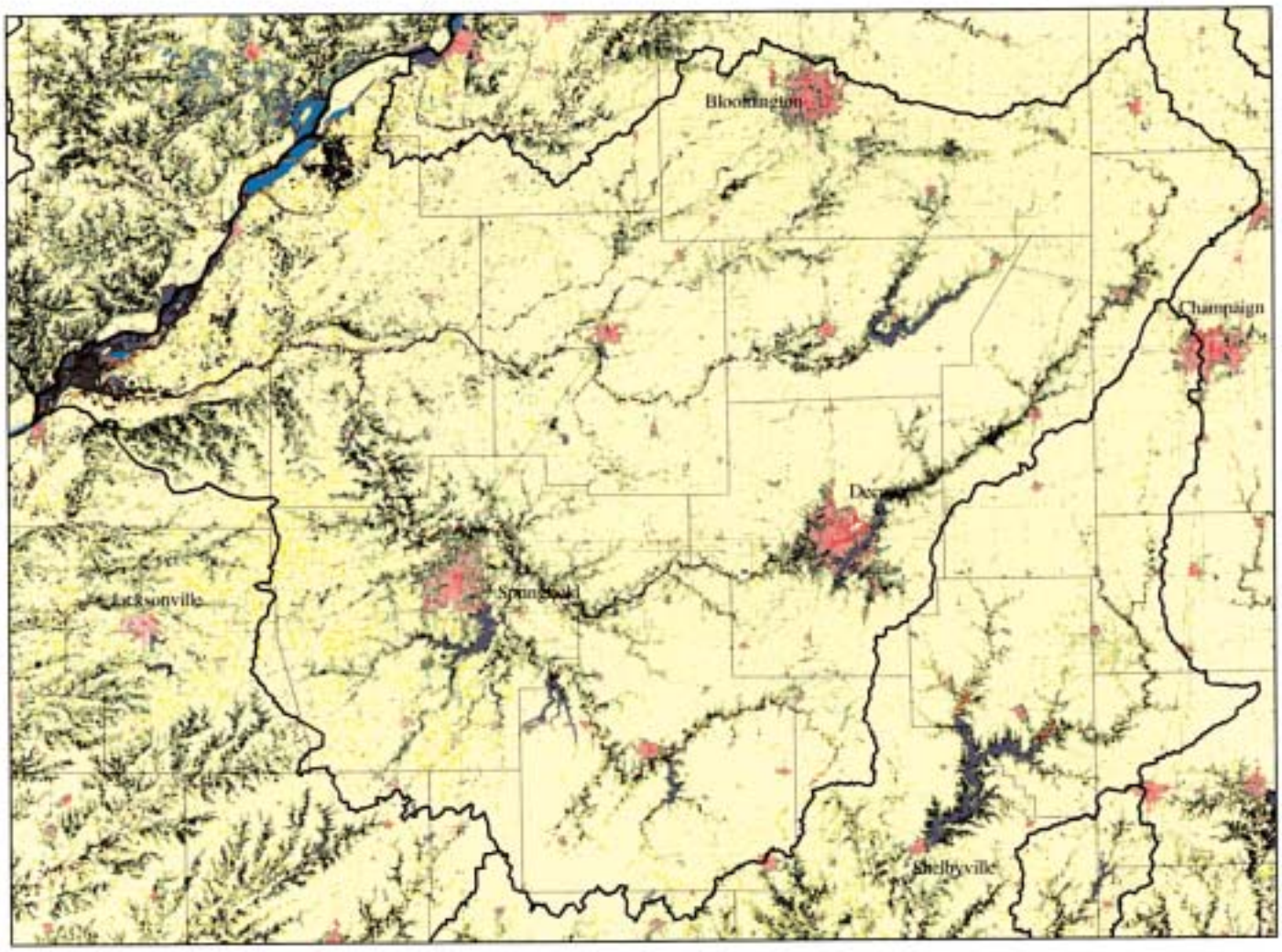


Figure 67. *Sangamon River Watershed*



Scale 1:1,100,000

0 30 Miles

Forest- Deciduous,closed canopy
Forest- Deciduous,open canopy
Forest- Coniferous
Wetland- Shallow marsh
Wetland- Deep marsh
Wetland- Swamp
Wetland- Forested
Wetland- Shallow open water
Open water deeper than 2m

Urban- High density
Urban- Medium high density
Urban- Medium density
Urban- Low density
Urban- Grassland
Ag- Row crops
Ag- Small grains
Ag- Rural grassland
Ag- Orchards and nurseries
Barren and exposed land

Figure 68. *LaMoine River Watershed*

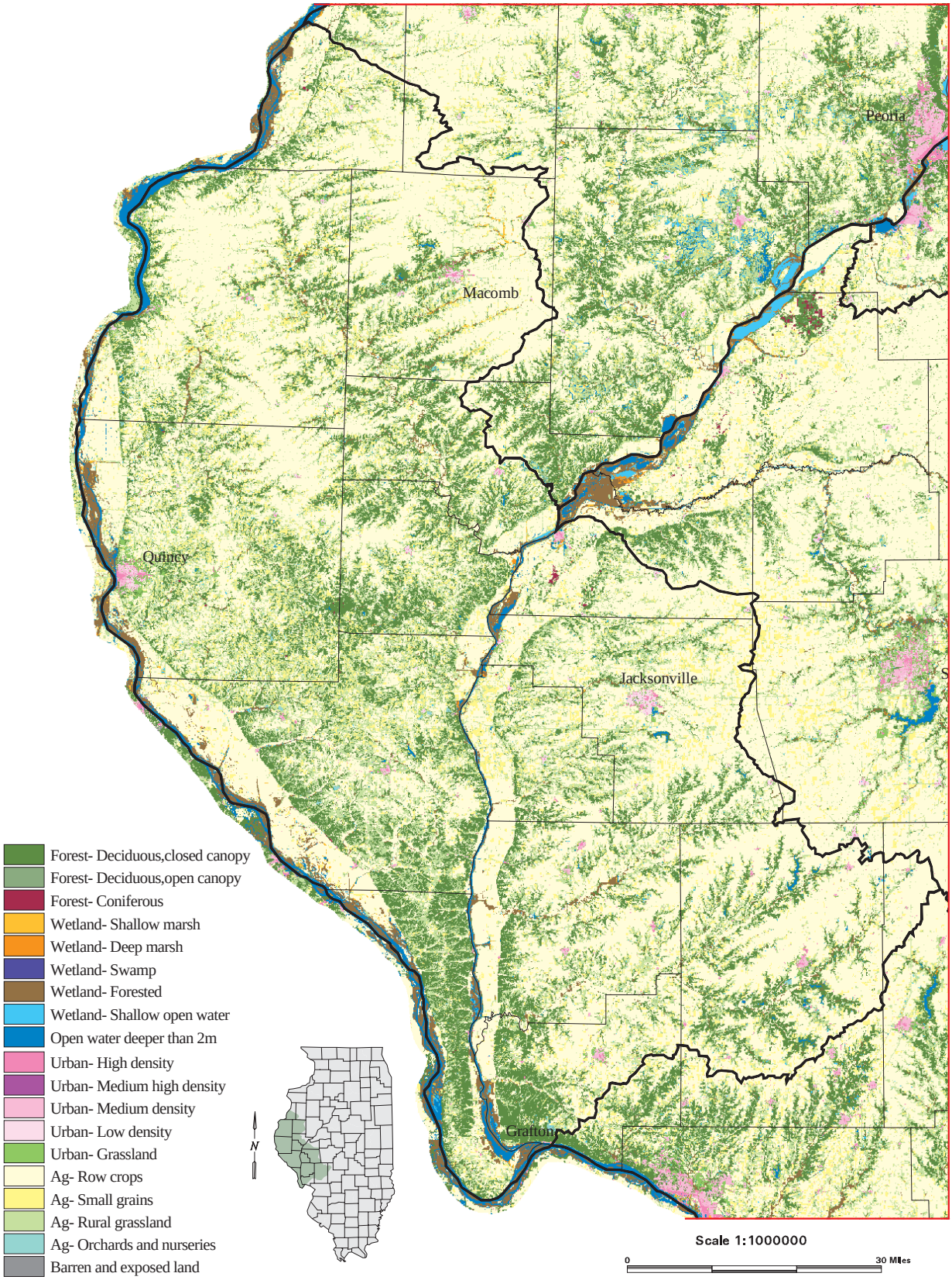


Figure 69. *Kaskaskia River Watershed*

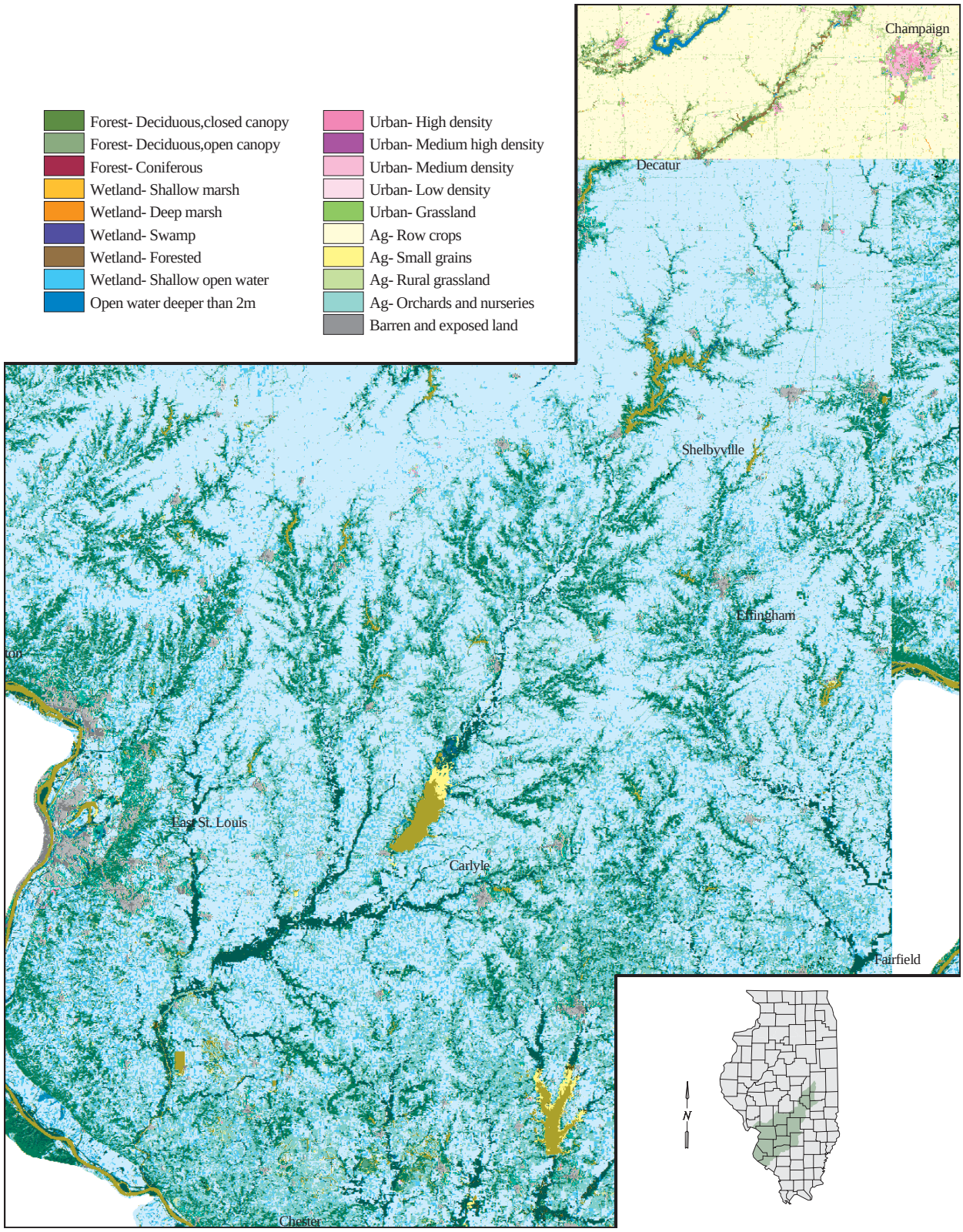


Figure 70. *Embarras and Vermilion Rivers Watershed*

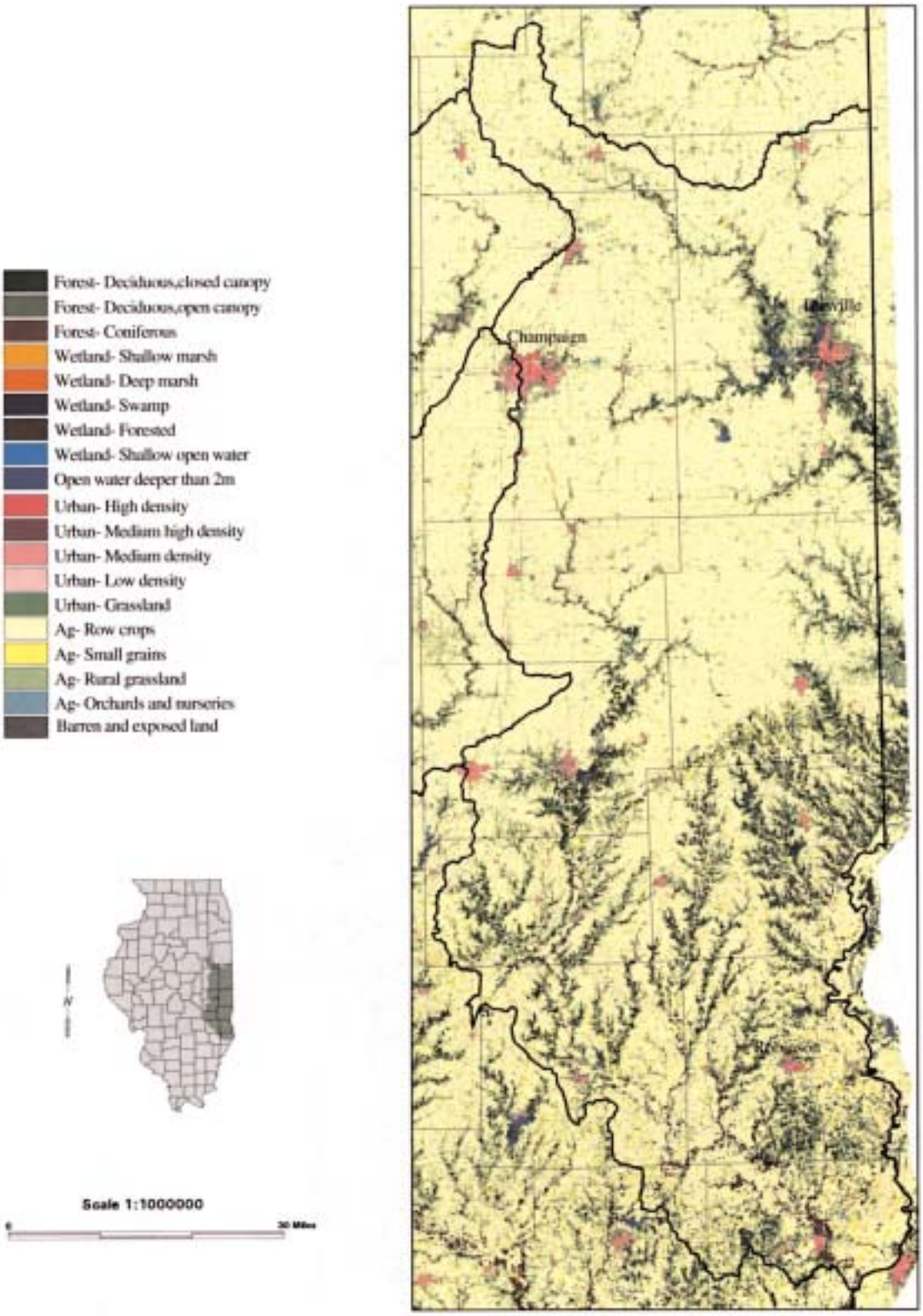


Figure 71. *Little Wabash River Watershed*

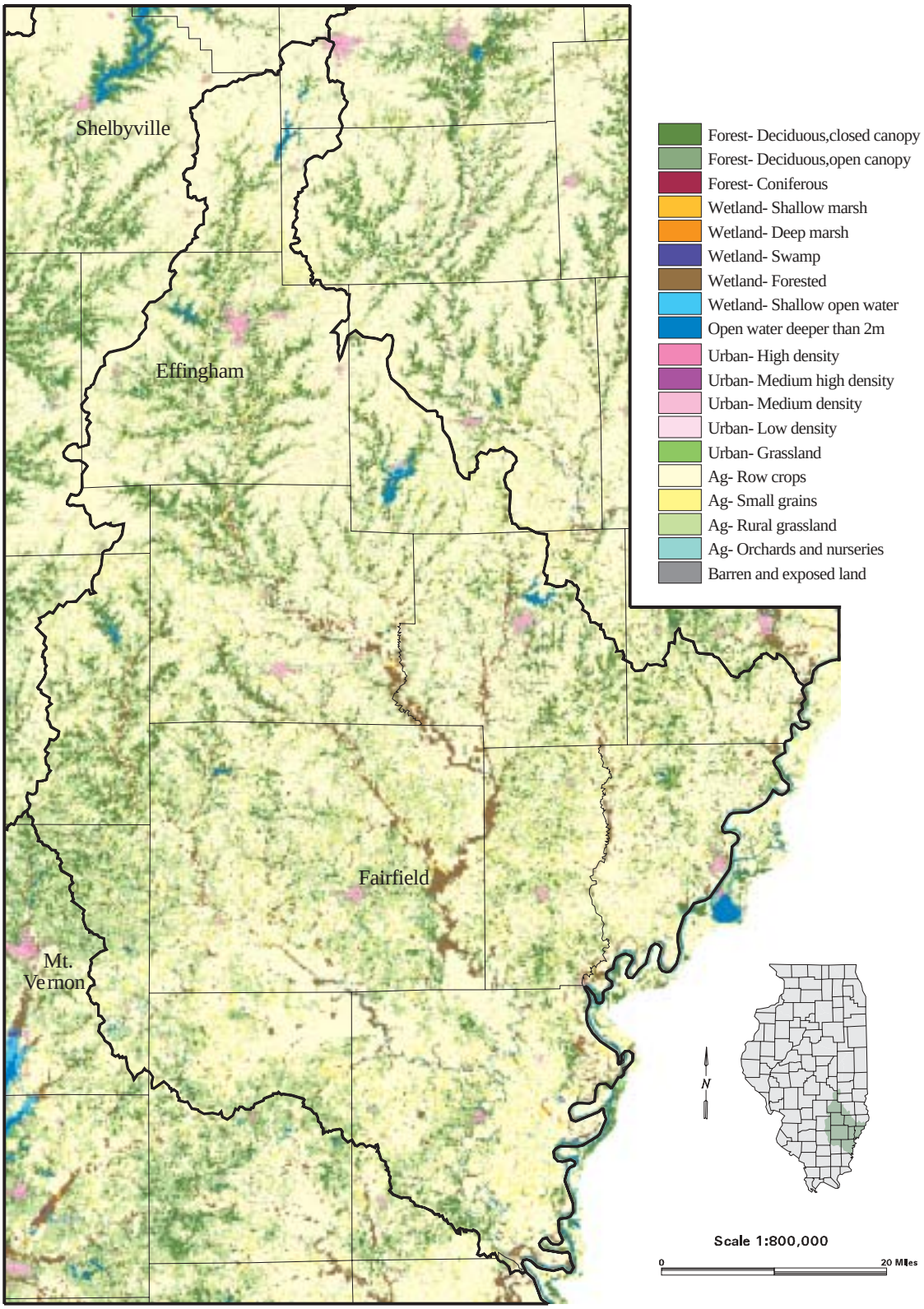


Figure 72. *Big Muddy, Saline and Cache Rivers Watershed*

Scale 1:1000000

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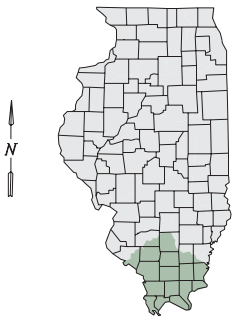
- Forest- Deciduous,closed canopy
- Forest- Deciduous,open canopy
- Forest- Coniferous
- Wetland- Shallow marsh
- Wetland- Deep marsh
- Wetland- Swamp
- Wetland- Forested
- Wetland- Shallow open water
- Open water deeper than 2m
- Urban- High density
- Urban- Medium high density
- Urban- Medium density
- Urban- Low density
- Urban- Grassland
- Ag- Row crops
- Ag- Small grains
- Ag- Rural grassland
- Ag- Orchards and nurseries
- Barren and exposed land