U.S. DEPARTMENT OF THE INTERIOR
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Habitat, Biota, and Sediment Characteristics at Selected Stations in the Lower Illinois River Basin, Illinois, 1996–98

By Debbie L. Adolphson, David J. Fazio, and Mitchell A. Harris

Water-Resources Investigations Report 01–4068

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FOREWORD

The U.S. Geological Survey (USGS) is committed to serve the Nation with accurate and timely scientific information that helps enhance and protect the overall quality of life, and facilitates effective management of water, biological, energy, and mineral resources. Information on the quality of the Nation's water resources is of critical interest to the USGS because it is so integrally linked to the long-term availability of water that is clean and safe for drinking and recreation and that is suitable for industry, irrigation, and habitat for fish and wildlife. Escalating population growth and increasing demands for the multiple water uses make water availability, now measured in terms of quantity and quality, even more critical to the long-term sustainability of our communities and ecosystems.

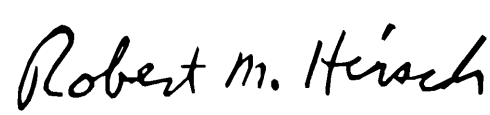
The USGS implemented the National Water-Quality Assessment (NAWQA) Program to support national, regional, and local information needs and decisions related to water-quality management and policy. Shaped by and coordinated with ongoing efforts of other Federal, State, and local agencies, the NAWQA Program is designed to answer: What is the condition of our Nation's streams and ground water? How are the conditions changing over time? How do natural features and human activities affect the quality of streams and ground water, and where are those effects most pronounced? By combining information on water chemistry, physical characteristics, stream habitat, and aquatic life, the NAWQA Program aims to provide science-based insights for current and emerging water issues. NAWQA results can contribute to informed decisions that result in practical and effective water-resource management and strategies that protect and restore water quality.

Since 1991, the NAWQA Program has implemented interdisciplinary assessments in more than 50 of the Nation's most important river basins and aquifers, referred to as Study Units. Collectively, these Study Units account for more than 60 percent of the overall water use and population served by public water supply, and are representative of the Nation's major hydrologic landscapes, priority ecological resources, and agricultural, urban, and natural sources of contamination.

Each assessment is guided by a nationally consistent study design and methods of sampling and analysis. The assessments thereby build local knowledge about water-quality issues and trends in a particular stream or aquifer while providing an understanding of how and why water quality varies regionally and nationally. The consistent, multi-scale approach helps to determine if certain types of water-quality issues are isolated or pervasive, and allows direct comparisons of how human activities and natural processes affect water quality and ecological health in the Nation's diverse geographic and environmental settings. Comprehensive assessments on pesticides, nutrients, volatile organic compounds, trace metals, and aquatic ecology are developed at the national scale through comparative analysis of the Study-Unit findings.

The USGS places high value on the communication and dissemination of credible, timely, and relevant science so that the most recent and available knowledge about water resources can be applied in management and policy decisions. We hope this NAWQA publication will provide you the needed insights and information to meet your needs, and thereby foster increased awareness and involvement in the protection and restoration of our Nation's waters.

The NAWQA Program recognizes that a national assessment by a single program cannot address all water-resource issues of interest. External coordination at all levels is critical for a fully integrated understanding of watersheds and for cost-effective management, regulation, and conservation of our Nation's water resources. The Program, therefore, depends extensively on the advice, cooperation, and information from other Federal, State, interstate, Tribal, and local agencies, non-government organizations, industry, academia, and other stakeholder groups. The assistance and suggestions of all are greatly appreciated.



Robert M. Hirsch
Associate Director for Water

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CONVERSION FACTORS, VERTICAL DATUM, AND ABBREVIATIONS

Multiply	By	To obtain
Length		
millimeter (mm)	0.03937	inch
meter (m)	3.281	foot
kilometer (km)	0.6214	mile
Area		
square kilometer (km^2)	247.1	acre
square meter (m^2)	10.76	square foot
Flow rate		
cubic meter per second (m^3/s)	35.31	cubic foot per second
meter per second (m/s)	3.281	foot per second
Hydraulic gradient		
meter per kilometer (m/km)	5.27983	foot per mile
Drainage density		
kilometer per square kilometer (km/km^2)	1.609	mile per square mile

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F = (1.8 \times °C) + 32$$

Vertical datum: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929 (NGVD of 1929)—a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

Altitude, as used in this report, refers to distance above or below sea level.

Concentrations of chemical constituents in water are given either in milligrams per liter (mg/L).

Specific conductance is given in microsiemens per centimeter at 25 degrees Celsius (μS/cm at 25°C).

Habitat, Biota, and Sediment Characteristics at Selected Stations in the Lower Illinois River Basin, Illinois, 1996–98

By Debbie L. Adolphson, David J. Fazio, *and* Mitchell A. Harris

Abstract

Data collection for the lower Illinois River Basin (LIRB) National Water-Quality Assessment (NAWQA) program began in 1996. Data on habitat, fish, benthic macroinvertebrates, and sediment were collected at eight stations on six streams in the basin—Illinois River, Panther Creek, Mackinaw River, Indian Creek, Sangamon River, and La Moine River. These streams typically flow through agricultural lands with very low gradients. Substrates typically are clay to gravel with areas of cobble. Banks are high, steep, and sparsely vegetated. Topographic surveys provide illustrations of the geometry that promote understanding of channel geometry and a data set that, in the future, can be used by others to assess stream changes.

Suspended-sediment particle size, woody debris, and stream velocity are important to fish and benthic macroinvertebrate communities. Fine particles (silts and clays) were abundant in suspended sediment and stream banks, and fish insectivorous cyprinid community composition increased with decreases in the concentration of these suspended fines. Suckers were prevalent in stream reaches with abundant woody-snag cover, whereas sunfish communities were most abundant in areas with slow water velocities. Hydropsychidae, Chironomidae, and Baetidae were the most abundant benthic macroinvertebrate families collected throughout the region, but stream size and water velocity were important to benthic macroinvertebrate community composition. *Tricorythodes* mayflies and Elmidae had higher relative abundance at sites in small- and moderate-size drainage basins, and Baetidae density was greatest in reaches with highest water velocity.

INTRODUCTION

Investigations in the lower Illinois River Basin (LIRB) study unit of the National Water-Quality Assessment (NAWQA) program began in 1994 (U.S. Geological Survey, 2001). The LIRB encompasses 47,000 km^2 of central Illinois (Warner, 1998) (fig. 1). Collection of data used in this report began in 1996 and concluded in 1998; this information will be integrated into NAWQA's national and regional water-quality assessment framework and will be provided to local, State, and other Federal agencies.

Standardized methods are used to collect ground-water, surface-water, and biological data throughout the United States as part of the NAWQA program. An overview of the NAWQA study design can be found in Gilliom and others (1995).

Habitat characteristics in and surrounding the stream, fish communities, macroinvertebrate communities, and suspended sediment at selected sites in the LIRB are described by the data included herein. Such data provide multiple lines of evidence in a multidisciplinary approach to the evaluation of water quality (Gurtz, 1994). Some data presented or the characteristics described include suspended-sediment particle size, number of suckers, and number of benthic macroinvertebrate taxa. For the purposes of this report, the term "habitat" refers to the wide variety of characteristics that were measured to support interpretation of the biotic and sediment data and include, but are not limited

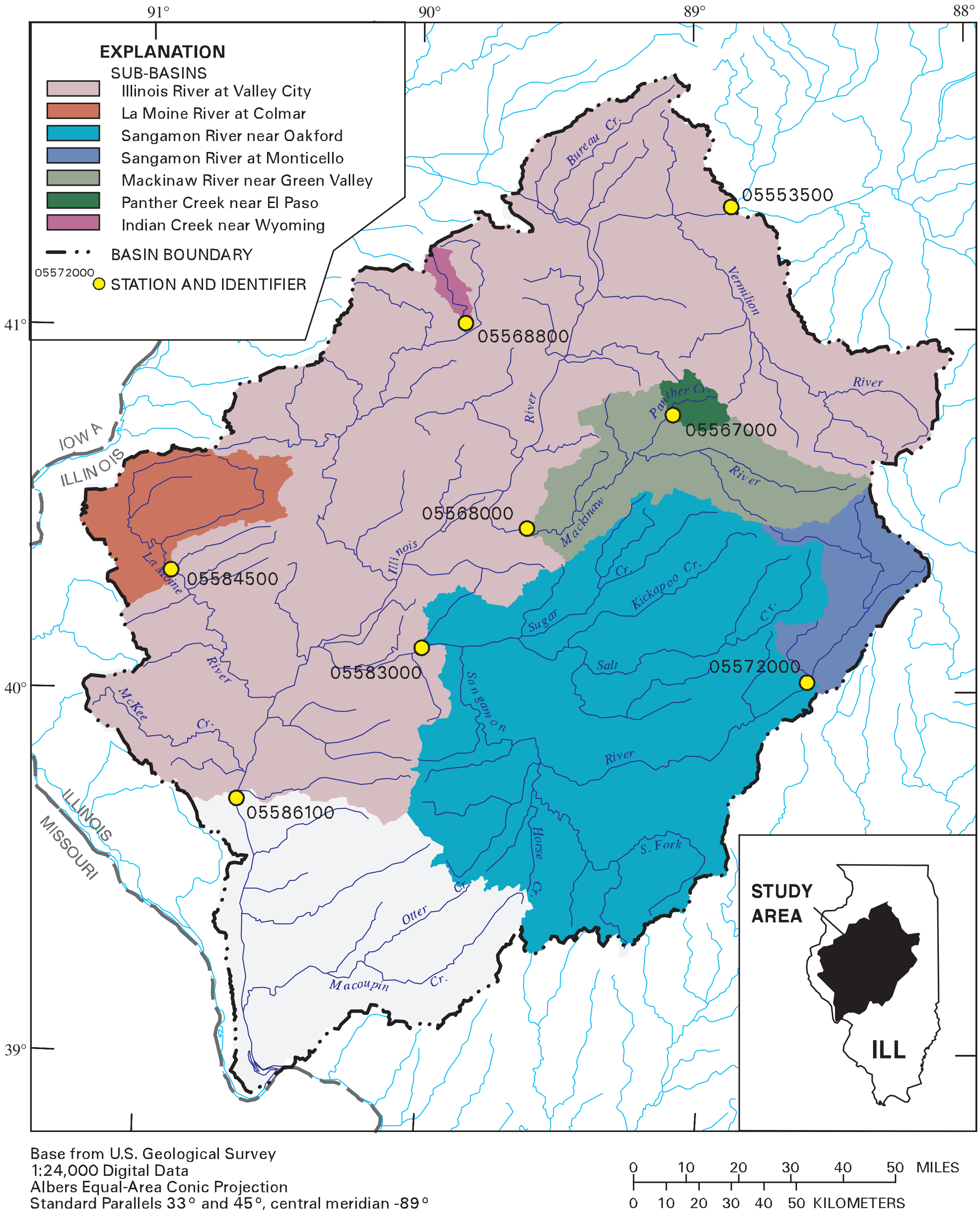


Figure 1. Location of the lower Illinois River Basin study area and stations.

to, bankfull width, bank angle, streambed material size, water velocity, woody vegetation, and land use. Information on these characteristics can be found in the “Tables” section at the end of this report.

Purpose and Scope

This report describes, summarizes, and compares the habitat, biotic (benthic macroinvertebrates and fish), and suspended-sediment data collected near eight stations in the lower Illinois River Basin—Illinois River at Ottawa, Panther Creek near El Paso, Mackinaw River near Green Valley, Indian Creek near Wyoming, Sangamon River at Monticello, Sangamon River near Oakford, La Moine River at Colmar, and Illinois River at Valley City (fig. 1). Data analysis focused on the comparisons, among the eight stations, of the characteristics affecting water quality in the LIRB.

Acknowledgments

Christopher Taylor of the Illinois Natural History Survey (INHS), Champaign, Illinois, identified fish while in the field in 1997 and 1998. Edward DeWalt and Donald Webb of the INHS identified adult macroinvertebrate samples. Kelly Frothingham, an Assistant Professor, Department of Geography and Planning, Buffalo State College, provided helpful input in the review process. Faith Fitzpatrick, George Groschen, Martin Gurtz, Michael Meador, and Angel Martin (all of the U.S. Geological Survey (USGS)) provided helpful information in the report review process. Terri Arnold and Robin King of the USGS provided support in applying geographic information systems (GIS). Collecting the enormous amount and variety of data required the efforts of many USGS staff. The efforts of all the above are greatly appreciated.

STUDY METHODS

The sections below describe the methods used to compile data from available sources, collect field data, and statistically analyze the data. Most methods described are part of the NAWQA program and used by all study units across the Nation.

Background Information

Habitat data were collected at three spatial scales (drainage basin, stream segment, and stream reach) to provide a broader understanding of the physical characteristics that may be affecting biology and water quality in the lower Illinois River Basin (Meador and others, 1993a). The basin- and segment-scale data were compiled in the office to provide background information for each site. The drainage-basin scale is defined as the area drained by the stream. Data compiled at the drainage-basin scale include geology, soils, precipitation, and drainage area. The segment scale is defined as a length of stream in which water quality is relatively homogeneous; the confluence of major tributaries or characteristics that appreciably affect stream water quality define the segment boundaries. Data compiled at the segment scale include but are not limited to stream sinuosity, stream order, and stream gradient.

Data collected at the drainage-basin and segment scales were compiled with digital coverages; relief maps; information from other publications; and data bases from the U.S. Geological Survey (1985), Illinois Department of Natural Resources (1996), Midwest Climate Center (1996), and Green (1990). These data were compiled, edited, and analyzed using GIS ARC/INFO.

USGS 7.5-minute topographic maps were used to delineate stream segments and calculate the segment gradient. Stream orders were calculated on the basis of USGS Digital Elevation Model (DEM) — 30-arc-second digital data (Elassal and Caruso, 1983). A process in ARC/INFO used the DEM elevation information to determine streams in the landscape (Environmental Systems Research Institute, 1994). A threshold of 200 continuous cells was required by the program to define a stream. The generated stream network was used with the Strahler function in ARC/INFO to calculate the Strahler stream order (Strahler, 1957).

Only basin characteristics were calculated for the watershed downstream from Ottawa, Illinois, as part of the LIRB (fig.1). The upper Illinois River Basin (UIRB) NAWQA will determine the information that defines the characteristics upstream from the Ottawa station. Sampling of the UIRB began in 1998 and is scheduled to conclude in 2001. In the UIRB, the major land uses are urban and agriculture (Warner, 1998).

The reach scale is defined in Meador and others (1993a) as a part of the stream within the segment that is 20 times the mean stream width in length, with a minimum length of 150 m and a maximum length of 300 m. Within a reach, six transects were selected for analysis. Some parameters measured at each transect included bank height, velocity, depth, width, and bank vegetation. The reach, independent from the transects, also was sampled for fish and benthic macroinvertebrates. The designated sampling areas were representative of general surface-water conditions in the segment. Three stations—Panther Creek near El Paso, Indian Creek near Wyoming, and Sangamon River at Monticello—were each sampled for 3 years (1996–98).

Field-Data Collection

Habitat characteristics data were collected according to the methods described in Meador and others (1993a). These methods were modified for large streams—those with low-flow depths greater than 1.5 m. Velocity measurements were collected from a boat in nonwadeable areas when possible. In nonwadeable areas, substrates were sampled with a petite Ponar sampler. Most sampling was done during low-flow periods to allow accessibility to the stream and data consistency. Mean data values, rather than specific points, are reported to provide an overall representation of the reach.

Stream features, such as woody snags, undercut banks, boulders, vegetation, sloughs, and rubbish, were measured when found within 1 m of either side of a transect. An estimate of the area of each stream feature was recorded in square meters.

A 400 m^2 plot was used to quantify tree cover along the streams. Only the flood plain areas that were tree covered are considered in the method. The plot began 10 m from the top of the bank and encompassed a 20 m by 20 m square plot, with one side parallel to the stream. The values given are representative of only the tree covered areas. At reaches with large areas not covered by trees, the basal areas recorded are an overestimate of basal area for the entire reach.

A topographical survey was conducted to provide data needed to create cross-section graphs of transects. At four stations, point data were collected between transects to provide longitudinal profiles and used to create relief maps of the stream reach.

Topographical survey data were collected with a Top Gun DTM-A 10LG Total Station, referred to in this report as a “total station.” The total station was used to measure azimuth, distance, and slope between the total station and a prism reflector mounted on a stadia rod. The stadia rod was set up over breaks in slope, and the data collected at those points were measured and recorded. Where possible, a benchmark with known latitude, longitude, and elevation was measured in the survey.

A topographical survey of the stream cross sections was conducted at six of the eight stations. This method was not used to survey the two stations on the Illinois River. Additional point data were collected between the stream transects at four of the six stations surveyed: Panther Creek at El Paso, Indian Creek near Wyoming, Sangamon River near Monticello, and the La Moine River at Colmar.

Contour maps and oblique-angle relief maps were created using Surfer, a grid-based contour program (Keckler, 1994). First, a grid was created by assigning values to a grid of evenly spaced nodes. The assigned values were interpolated from the elevation values of the irregularly spaced survey data points. Second, a contour map was created from the gridded data. The kriging method was selected as the best of several available interpolation options to approximate the contours of the surveyed reaches. Third, the oblique-angle relief maps were created by plotting the elevation values of the contour maps onto a third axis.

The contour maps were illustrated further to show the location of the stream cross sections, the streamflow direction, and a color scale indicating the elevation above an arbitrary datum. Among the relief maps and contour maps, an effort was made to keep the color scale consistent. However, increasing or decreasing the number of categories in the blue color range was necessary to best approximate the wetted area for each station.

The stream cross sections were made in four steps. First, the data points of each cross section were isolated as individual data sets. Second, the origin and axis of each data set were algebraically rotated and translated to generate the true distance between measured points. Third, the new distance values were plotted with the corresponding elevation values. Fourth, the canopy angle and flow at the time of the survey were added to the profile. Note that in figures with vertical exaggeration of the cross section, the canopy angles have not been adjusted to reflect the exaggeration.

The longitudinal profile of each stream reach thalweg were created from two data sources: transect surveys (elevation) and measurements from a laser rangefinder (distance). The distance between transects were plotted with the lowest elevation recorded at each transect.

The Illinois River cross-section data were collected using a Fathometer depth recorder (Raytheon, 1979) and a laser rangefinder. The distances measured by the rangefinder were extrapolated among the data points, providing a unique distance for every depth. Cross sections were generated by plotting depth and distance.

In 1997, grab samples of the bed and bank materials were collected at six of the eight stations sampled (Illinois River stations were not sampled). Streambed samples were collected at equal distances along each of six transects. Bank samples were collected on both left and right banks of three transects. These samples consisted of a composite of three points at equidistant heights on the bank. At the USGS Iowa Sediment Laboratory, the dried samples of the streambed and bank materials were analyzed for particle-size composition using methods described in Guy (1969).

Bank stability was ranked from one to four on the basis of the percent of bank area covered by vegetation, boulders and cobble, or stable manmade structures (Meador and others, 1993a). A rating of one indicates less than 25 percent of the bank was covered with vegetation or other stabilizing material. A rating of four indicates that more than 80 percent of the bank surface was covered by vegetation or other stabilizing material. This value was recorded for left and right banks at each transect.

Water-chemistry characteristics, including suspended-sediment concentration, pH, specific conductivity (SC), dissolved oxygen (DO), and temperature were measured in samples collected at each station. Samples for analysis of suspended sediment were split from an equal-width-increment water sample. Samples were collected throughout the 3-year period at a varied frequency, using sample collection techniques in NAWQA protocols (Shelton, 1994). Only the water-chemistry data from water year 1997 were used in this report. The median of the scheduled sampled data were used in the analysis to avoid bias from multiple storm samples.

Fish-community samples were collected according to Meador and others (1993b). In wadeable streams, seining and barge electroshocking methods were used to collect fish; in nonwadeable streams, a boat electroshocking unit was used, supplemented by seining in the stream margins. Selected fish were preserved in formalin for laboratory identification and stored as vouchered specimens at the INHS. Fish-sampling results are available in LaTour and others (1998).

Fish-community data collected in 1997 (or 1998 for the Illinois River stations) were compared to the habitat characteristics and the 1997 suspended-sediment data. Trophic group composition and selected community measures in the Illinois Index of Biotic Integrity were calculated from the fish-community data (Bertrand and others, 1996). The full Index of Biotic Integrity (IBI) was not calculated because different sampling procedures were used. Fish-trophic groups included omnivores, insectivorous cyprinid, and top carnivores. Community measures included the number of intolerant taxa, minnows (Cyprinidae spp.), suckers (Catostomidae spp.), sunfish (*Lepomis*, *Ambloplites*, and *Pomoxis* spp.), and darters (*Etheostoma* spp.). A percentage of the total community also was calculated for each group.

During 1996–98, benthic macroinvertebrate samples were collected from submerged woody snags (epidendric) according to methods described by Cuffney and others (1993). Benthic macroinvertebrates were collected at different combinations of stations each year. All benthic macroinvertebrate samples were preserved in 10 percent formalin and sent to the U.S. Geological Survey National Water-Quality Laboratory's Biological Unit for identification. The total number of taxa and the sum of Ephemeroptera (mayflies), Plecoptera (stoneflies), and Trichoptera (caddisflies) (EPT) taxa were calculated for each sample. The measure of EPT taxa richness often is used as an indicator of water quality because many taxa in these orders are sensitive to pollution (Lenat, 1988). Density and percent composition of invertebrate taxa also were calculated.

EPT adults were collected during June, July, and August 1997. An ultraviolet light and a white sheet were used to attract the insects. Samples were collected for 1 hour immediately after sunset one evening of each month. This sampling method is referred to as black-light sampling in this report. Collections of the adult stage of aquatic insects permit species-level identification of more specimens than collections of the immature stages. Species-level identifications allow better association of ecological conditions with species requirements and facilitate comparisons with historical data (DeWalt and others, 1999). Many adult EPT species fly only relatively short distances from where they emerged (Griffith and others, 1998), but data must be used with caution because some adults may not originate from the water body where they were collected. Edward DeWalt and Donald Webb of the INHS identified the samples. Specimens of all species were placed in the Illinois Natural History Survey insect collection (DeWalt and others, 1999).

Statistical Analyses

All collected habitat data were summarized by station. The mean values for the measured characteristics were calculated to provide a comparable set of characteristics for each station. If data were available for more than 1 year of sampling, the mean of all data were used for the station. Tables of the characteristics considered in the analyses are included at the end of this report. Also, the drainage-basin- and segment-scale data were recorded by station. The suspended-sediment-sample values are the medians for the samples collected on a scheduled basis during 1997. Samples collected over the storm hydrograph were not considered in determining median values. Fish data were delineated by trophic groups and tolerance; groupings of taxa are discussed in Bertrand and others (1996). Benthic macroinvertebrates were summarized by common families and EPT taxa. The statistical analysis was limited by the number of stations sampled (n=8).

Kendall's Tau correlations were used to determine covariation among characteristics because Kendall's Tau can analyze small monotonic data sets. Correlations greater than 0.5 were plotted in scatter plots to aid in determining correlation validity. All correlations greater than 0.5 were considered because Kendall's Tau values are typically lower than other correlation methods (Helsel and Hirsch, 1992).

DESCRIPTION OF SELECTED STATIONS IN THE LOWER ILLINOIS RIVER BASIN

Illinois River at Ottawa and Near Lock and Dam at Starved Rock

The LIRB begins at Ottawa, USGS number 05553500 (fig. 2). The Illinois River Basin at Ottawa drains an area of 28,400 km^2, (table 1) (all tables are at the end of the report). None of this area is contained in the LIRB; this area is the baseline input for the portion of the Illinois River in the LIRB.

Habitat was sampled near two stations: Illinois River near Lock and Dam at Starved Rock (USGS station identification number 05553800) in 1997 and Illinois River at Ottawa (USGS station identification number 05553500) in 1998. The sampling reach at Starved Rock was around Plum Island, river mile 230 (370 km), whereas the Ottawa sampling reach was around Hitt

Figure 2. Illinois River at Ottawa, Illinois, U.S. Geological Survey station identification number 05553500, view of the main channel from transect 4, looking at the right bank.

Island, river mile 239 (384 km). Water-chemistry samples also were collected at Ottawa during 1996–97. Samples of benthic macroinvertebrates were collected at Illinois River near Lock and Dam at Starved Rock, downstream from the dam, in 1997. Fish communities and benthic macroinvertebrate communities were sampled in 1998 at the Ottawa station. The Illinois River has a stream order of 7 at both stations (table 2).

The general structure of the reach sampled includes a dredged main channel, islands, and an undredged side channel (fig. 3). Transect locations along the reach are shown in figure 3. The cross section at each transect shows the variation in the stream channel geometry between the two channels. The island elevations were not measured, therefore, are not included in the cross sections. The boundaries, however, are noted by B', C, D', and E (fig. 4). Biotic sampling was focused in the side-channel areas because they were less disturbed by dredging and watercraft. Often, the side channels are narrow enough to allow the riparian trees to provide some shade. Woody snags, the habitat targeted for benthic macroinvertebrate community sampling, were more abundant in side-channel areas.

The banks were mainly silt and sand where artificial structures or bedrock banks were not present. The artificial structures and bedrock banks increased the mean bank angle at Ottawa compared with the mean angle at Starved Rock (table 3). The banks noted on figure 4 as B, D, A', C', E', and F' show the steep angle of the bedrock banks. Streambed materials were mainly sands with some cobbles at Ottawa, and gravel and silt at Starved Rock, although lab analyses were not done to quantify the size distribution. Suspended silt and clays made up 97 percent of the transported suspended sediment (table 4).

On the flood plain, 11 tree species were identified (table 5). The most abundant species were silver maple and common buckthorn. Black locust and silver maple provided the greatest amount of basal

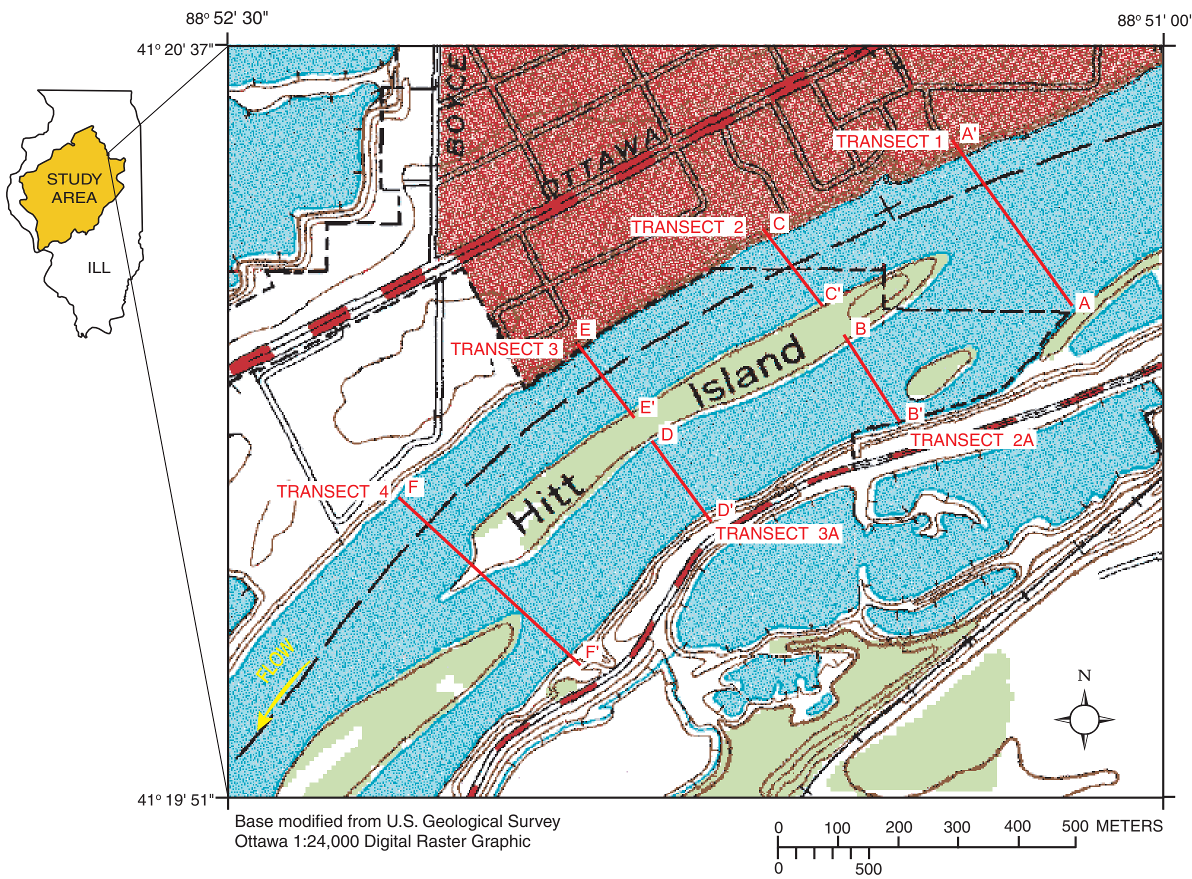


Figure 3. Location of transects along the measured reach and flow direction of the Illinois River at Ottawa, Illinois.

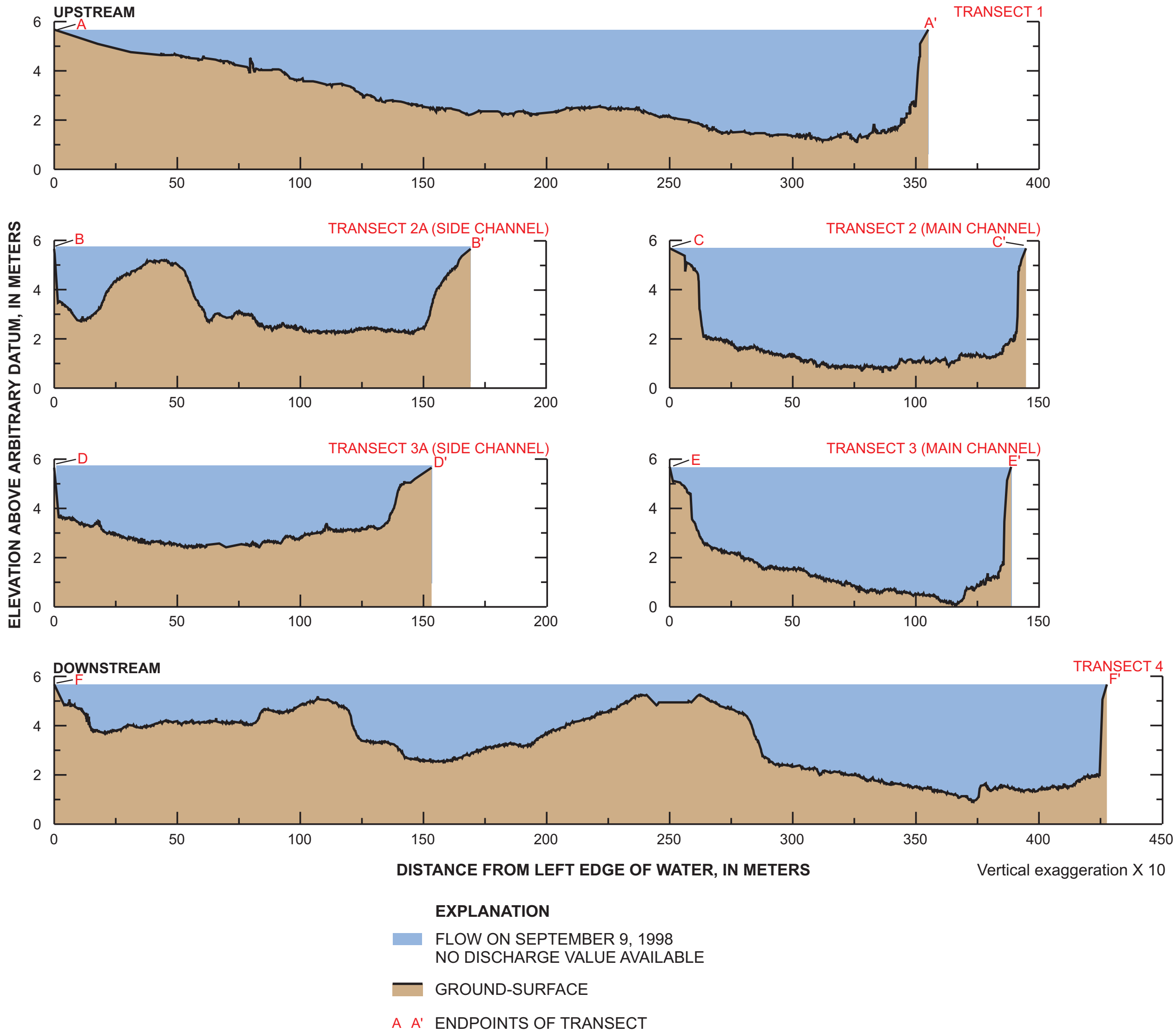


Figure 4. Characteristics of the transects at the Illinois River at Ottawa, Ill. (See figure 3 for the locations of transects 1–4.)

area. Buckthorn (a shrub) has many small stems, whereas silver maple and black locust are trees that typically have one large stem.

The fish community at Ottawa was composed of 22 total taxa. The six omnivorous taxa made up 61 percent of the individuals collected. No darters were collected; however, riffles, the preferred habitat of darters, were not present for seining. A total of four intolerant taxa were collected, accounting for 6 percent of the sampled community (table 6).

The benthic macroinvertebrate samples at Ottawa and Starved Rock were dominated by Chironomidae and Hydropsychidae (table 7). Adult EPT black-light samples at Starved Rock had high relative abundance of the Hydropsychidae genus *Cheumatopsyche* and large-river taxa *Hydropsyche bidens* and *Potamyia flava*.

Panther Creek Near El Paso

The watershed above Panther Creek near El Paso (fig. 5), USGS station identification number 05567000, comprises 243 km^2 of the Mackinaw River Basin. The reach sampled started 20 m upstream from the gaging station. Land use in the Panther Creek Basin is about 87 percent row-crop agriculture, the highest percentage of all stations studied (table 1).

Panther Creek has a stream order of 4 and a sinuosity of 1.1 (table 2). The longitudinal profile shows the low stream reach water-surface gradient (0.02 percent) (table 3) (fig. 6). A beaver dam downstream often influences the flow within this reach. The bankfull width-to-depth ratio was 8 (table 3). The stream cross sections show how these characteristics vary within the stream reach (fig. 7). In figure 7, transect 3 shows an over-flow channel, C' side of the cross section. Transect locations on the stream reach are shown in figure 8. The relief map in figure 9 shows the stream and how it fits into the landscape. Over the long term, the cross sections and relief map can be compared to future data to help assess the physical changes over time (figs. 7 and 8), for instance changes in sinuosity.

Measured low-flow velocities ranged from 0 to 0.2 m/s. Low-flow water depths averaged 0.3 m., with a maximum depth of 0.8 m (table 3). Beaver activity downstream from the reach affected the velocities and depths measured.

Materials smaller than sand (silts and clays) made up 64 percent of the bank materials and 33 percent of the remaining materials was sand. In contrast, 8 percent of the bed materials was smaller than sand, with 52 percent smaller than gravel (44 percent sand) (table 3). Materials smaller than sand (silt and clay) accounted for 85 percent of the suspended sediment (table 4). The dark green areas of figure 9 show the steep banks, 66 percent of which was less than 50 percent covered with vegetation (table 3).

The mean canopy angle was 15° (table 3). Individual transect values shown in figure 7 provide a

Figure 5. Panther Creek near El Paso, Illinois, U.S. Geological Survey station identification number 05567000. Photograph taken from the bridge looking upstream towards the east.

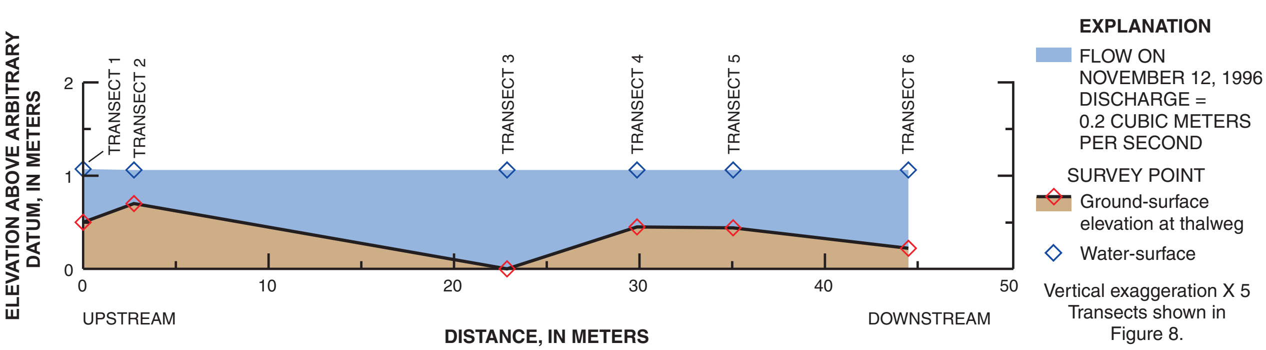


Figure 6. Water-surface gradient and stream bottom at thalweg of Panther Creek near El Paso, Illinois. The arbitrary datum is defined as the greatest measured depth. The point symbols represent measured data points.

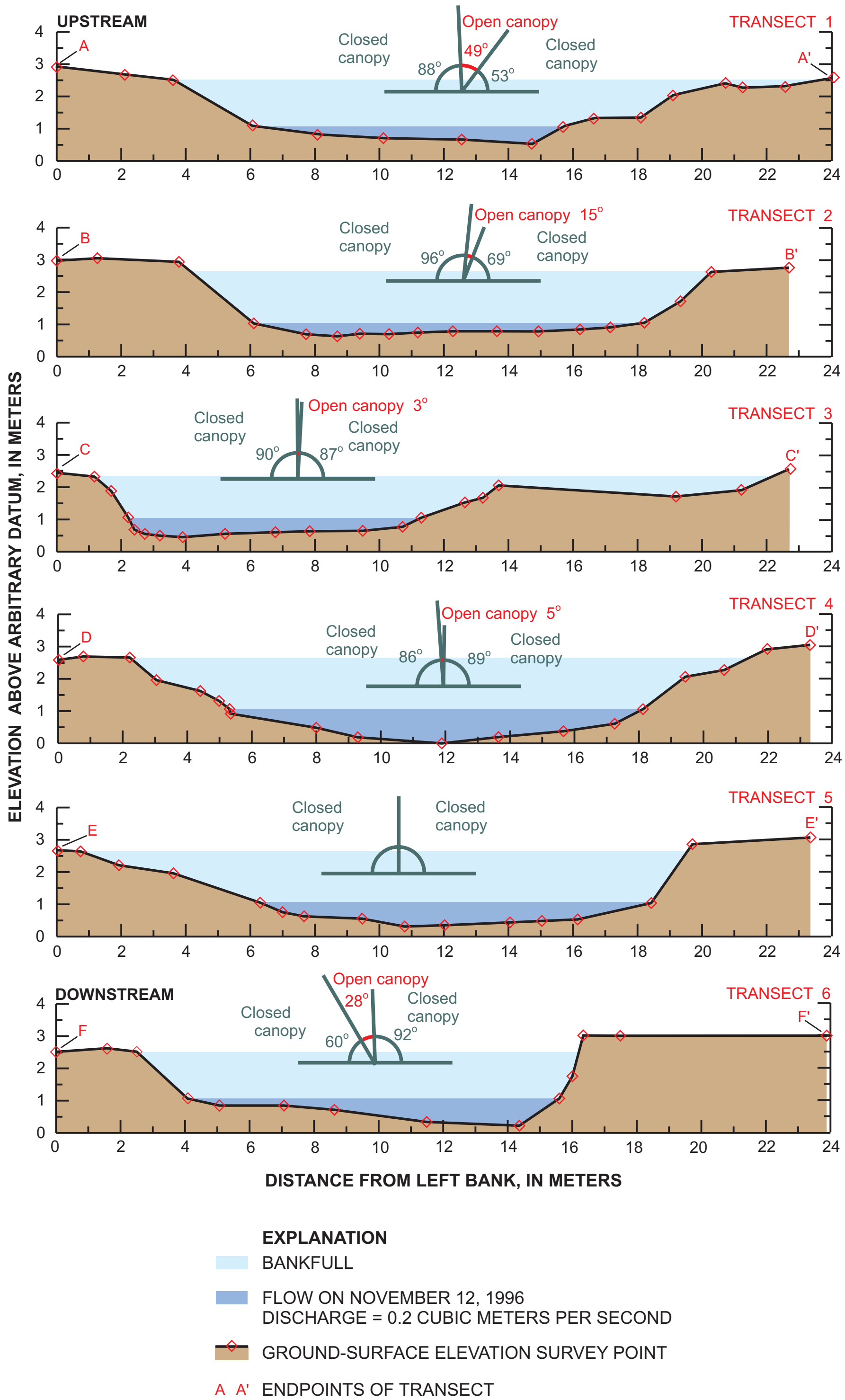


Figure 7. Characteristics of the transects at Panther Creek near El Paso, Illinois. The point symbols represent measured data points. (See figure 8 for the locations of transects 1–6.)

visual reference of the shade provided to the stream by bank vegetation. Nine tree species were found; the most common species were boxelder and silver maple (table 5). Silver maple provided a larger part of the shade available to the stream than boxelder. In a mature state, silver maple typically is taller with a larger basal area than that of boxelder. Woody snags and undercut banks were the most common types of stream features providing shelter for aquatic biota (table 3).

The Panther Creek fish community had four darter taxa; the most darters collected among the stations. Minnows made up 77 percent of the fish community. Of the fish sampled, 68 percent was classified as insectivorous cyprinids. A total of 21 taxa were collected at Panther Creek near El Paso (table 6).

Chironomid midges commonly dominated benthic macroinvertebrate samples at El Paso, making up between 39 and 69 percent of the individuals, and Elmidae (riffle beetles) was usually the second most-common family (table 7). Adult EPT were not dominated by any one species. The most abundant adult EPT taxa at El Paso were the caddisflies (*Cheumatopsyche pettiti*, *Cheumatopsyche* sp., and *Nectopsyche* sp.), but other mayflies and caddisflies also were common.

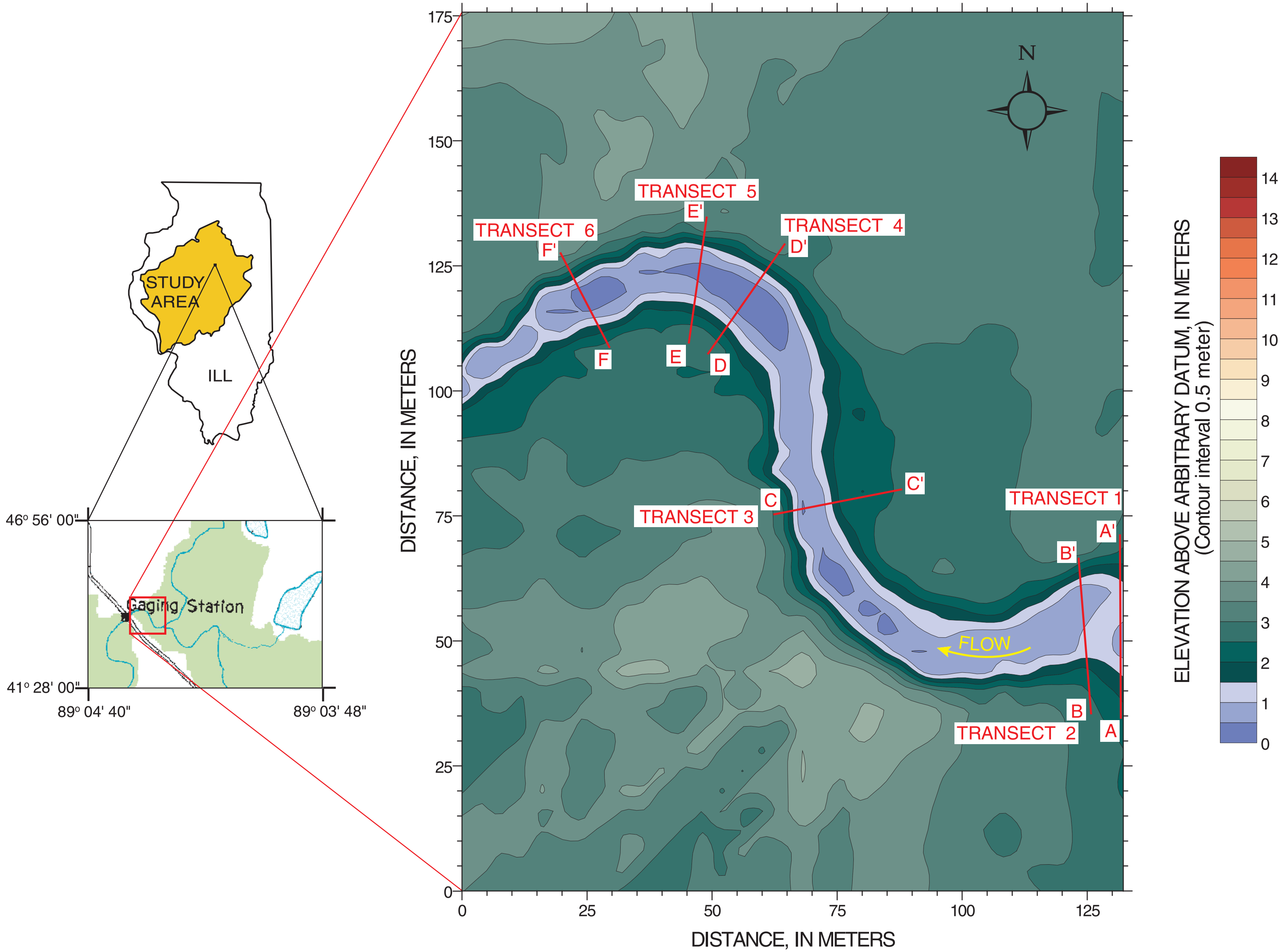


Figure 8. Transect locations along the reach and flow direction at Panther Creek near El Paso, Illinois.

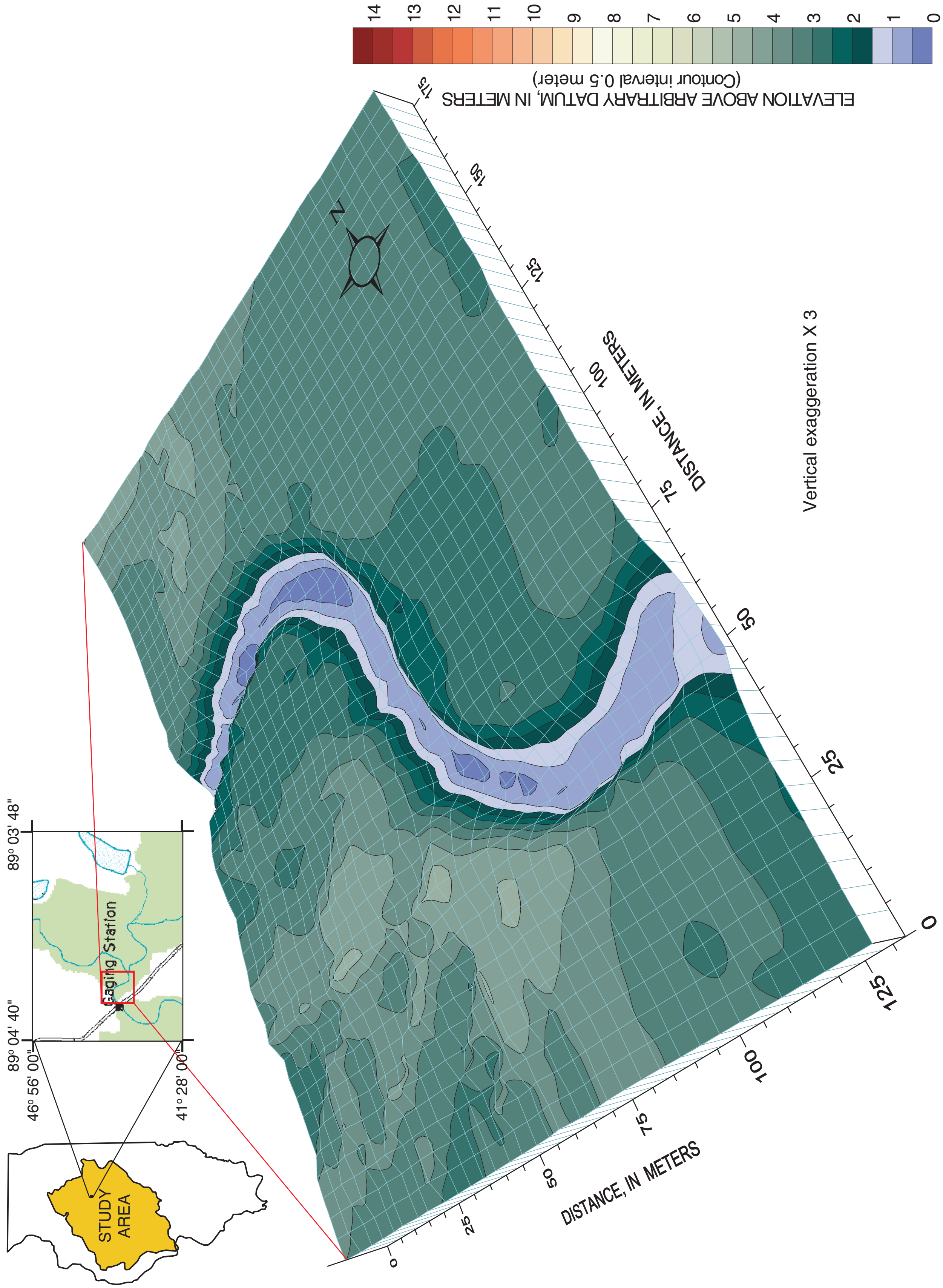


Figure 9. Sampled reach at Panther Creek near El Paso, Illinois.

Mackinaw River Near Green Valley

The watershed above Mackinaw River near Green Valley (fig. 10) (USGS station identification number 05568000) comprises 2,780 km^2 of the Mackinaw River Basin. The reach sampled starts 610 m upstream from the gaging station. Land use in the Mackinaw River Basin above Green Valley is 75 percent row-crop agriculture (table 1).

The Mackinaw River has a stream order of 5 and a sinuosity of 1.5 (table 2). The longitudinal profile illustrates the stream reach water-surface gradient (0.01 percent) (table 3) over the reach and also the variation in depth throughout the reach (fig. 11). Low-flow velocities ranged from 0 to 0.8 m/s. The low-flow water depth average was 0.7 m, with a maximum depth of 1.3 m (table 3). The bankfull width-to-depth ratio is 15 (table 3). The cross sections shown in figure 12 illustrate the physical stream characteristics at six locations in the reach. A central bar is a prominent feature of the reach (fig. 12, transects 4 and 5). Areas of runs, transects 4 and 5; pools, transects 3 and 6; and riffles, transects 1 and 2 also are shown in the cross sections in figure 12. The locations of the cross sections along the stream reach are shown in figure 13. The variation in the geometry often was affected by accumulated woody snags. The varied fish habitat contributed to the high fish diversity found at this station.

The banks of the Mackinaw River are composed of mainly sand and silt but had the highest percentage of gravel of all the streambanks sampled during the study. In the banks, the relatively high amount of sand reduces bank stability. Banks were relatively unstable; 50 percent of the banks had less than 25 percent of the bank area covered by stabilizing vegetation. The streambed is composed of materials mainly sand and gravel in size, with only 3 percent smaller than sand (silt and clay) (table 3). The suspended sediment was 76 percent silt and clay (table 4).

The mean canopy angle at Mackinaw River near Green Valley was 114° (table 3). Individual mean transect values illustrate the shading effect of the bank vegetation (fig. 12). The most common tree species found at this station include silver maple, boxelder, hackberry,

Figure 10. Mackinaw River near Green Valley, Illinois, U.S. Geological Survey station identification number 05568000. Photograph was taken downstream near transect 5, looking southwesterly (fig. 13).

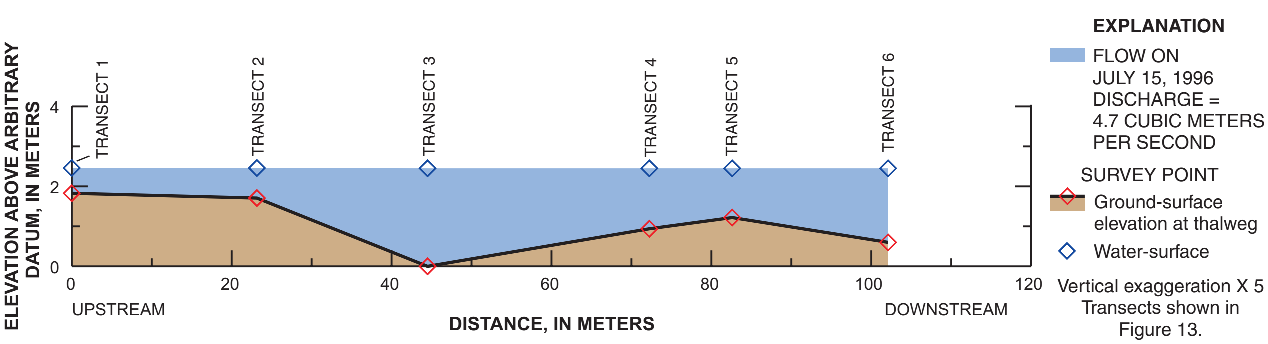


Figure 11. Water-surface gradient and stream bottom at thalweg of the Mackinaw River near Green Valley, lower Illinois River Basin, Illinois. The arbitrary datum is defined as the lowest measured depth. The point symbols represent measured data points.

and Osage orange (table 5). The riparian vegetation provided a substantial source for woody snags, the most abundant stream features providing hiding cover for aquatic fauna (table 3).

A total of 22 fish taxa were collected in the Mackinaw River. Intolerant taxa accounted for 15 percent of the fish collected — the second-highest composition of intolerant taxa among the stations. Mackinaw River was the only station at which no sunfish were collected in the sample. Although no darters were collected (table 6), sampling techniques may have missed the riffle areas preferred by darters.

Baetidae and Hydropsychidae were the most common families in the single benthic macroinvertebrate sample at Green Valley (table 7). The most common adult EPT taxa were *Potamyia flava*, *Cheumatopsyche* sp., and *Ceraclea tarsipunctata*.

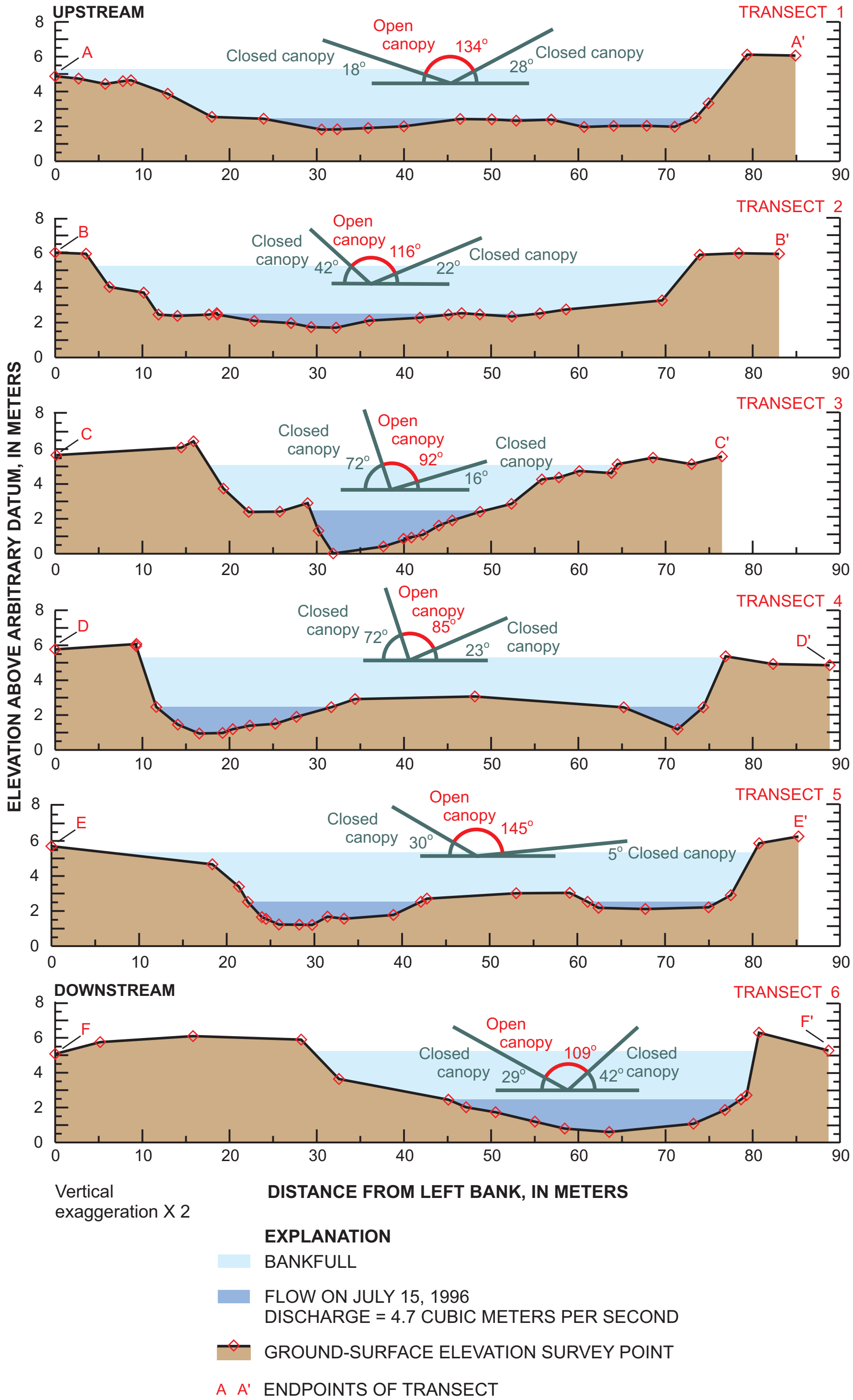
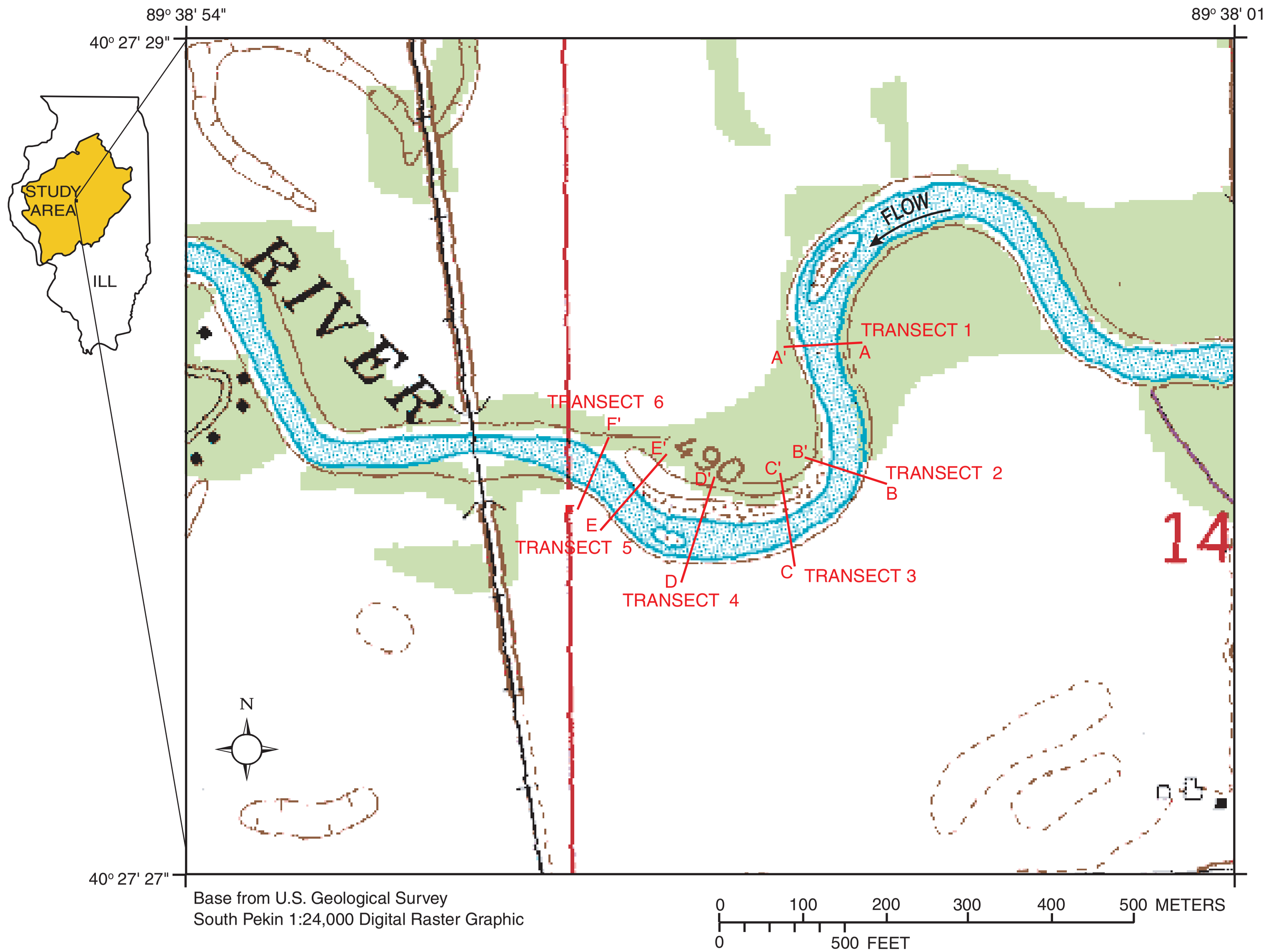


Figure 12. Characteristics of the transects at the Mackinaw River near Green Valley, Illinois. The point symbols represent measured data points. (See figure 13 for locations of transects 1–6. Note: The canopy angles have not been adjusted to reflect the vertical exaggeration.)



Base from U.S. Geological Survey
South Pekin 1:24,000 Digital Raster Graphic

Figure 13. Transect locations along the reach and flow direction at Mackinaw River near Green Valley, Illinois.

Indian Creek Near Wyoming

The watershed above Indian Creek near Wyoming (fig. 14) (USGS station identification number 05568800) comprises 160 km^2 of the Spoon River Basin. The reach sampled started 3.3 km upstream from the gaging station. Land use in the Indian Creek Basin is 76 percent row-crop agriculture (table 1).

Indian Creek has a stream order of 3 and a sinuosity of 1.5 (table 2). The longitudinal profile shows the stream reach water-surface gradient (0.8 percent) (table 3) over the reach, the highest of all the stations (fig. 15). The bankfull width-to-depth ratio is 6 (table 3). Cross sections illustrate these characteristics and how they change at six locations along the reach (figs. 16 and 17). The surface map (fig. 18) shows how the characteristics above fit in the landscape. Future data can be compared to the figures given here to determine if downcutting or sedimentation has occurred over the reach. Low-flow velocities measured during the study ranged from 0 to 0.7 m/s. Measured low-flow water depths averaged 0.3 m, with a maximum depth of 0.8 m (table 3).

Bank materials at Indian Creek near Wyoming were 43 percent sand (0.062–2.00 mm in size). The bed materials were 59 percent sand (table 3). One-half of the high, steep banks of Indian Creek have less than 50 percent of the area covered by stabilizing vegetation or cobbles (table 3). The streambed at Indian Creek near Wyoming is dynamic because the sands often are redistributed during high flows. Areas of cobbles, boulders, and hardpan clay are alternately covered and exposed by these mobile sands. The suspended sediment was 72 percent silt and clay (table 4).

Mean canopy angles at Indian Creek near Wyoming averaged 93° (table 3); individual mean transect values are shown in figure 16, illustrating the shading from bank vegetation. The most common tree species were sugar maple and silver maple (table 5). The sugar maples were found on the hill not in the flood plain. The riparian area was sparse but provided a source of woody snags. which, with undercut banks, provide shelter for aquatic biota (table 3).

A total of 15 fish taxa were collected during 1997 at Indian Creek near Wyoming. Insectivorous

Figure 14. Indian Creek near Wyoming, Illinois, U.S. Geological Survey station identification number 05568800, looking east downstream from transect 4 (fig. 17).

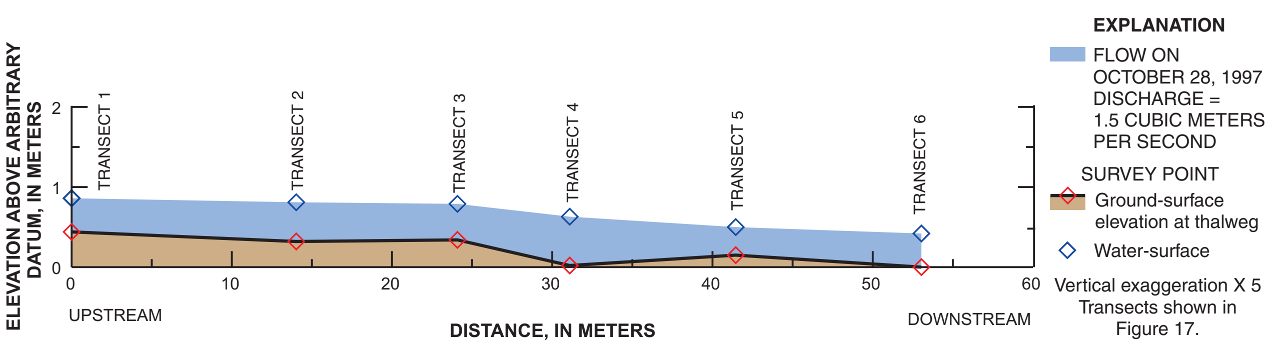


Figure 15. Water-surface gradient and stream bottom at thalweg of the Indian Creek near Wyoming, Illinois.The arbitrary datum is defined as the lowest measured depth. The point symbols represent measured data points.

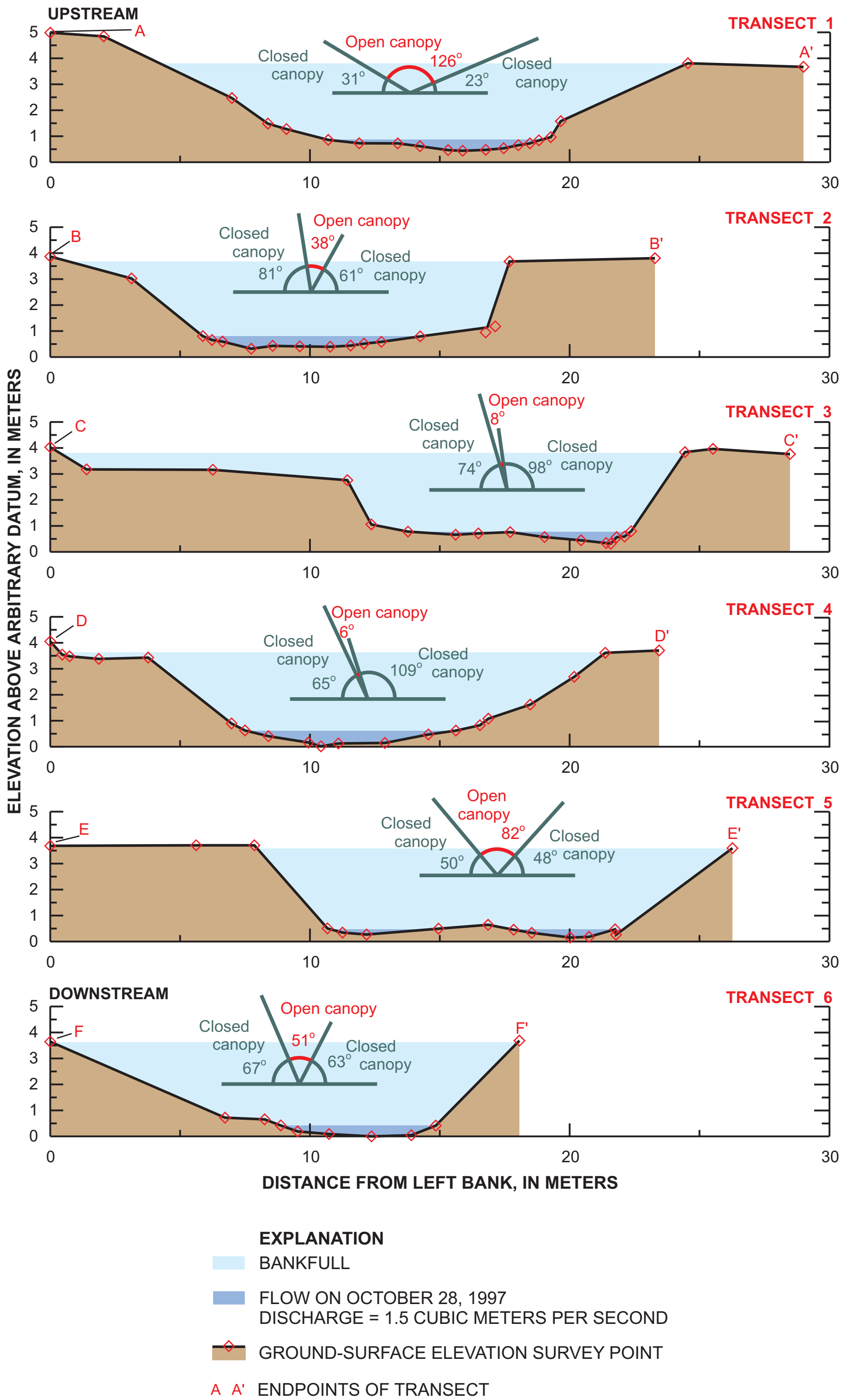


Figure 16. Characteristics of the transects at Indian Creek near Wyoming, Illinois. The point symbols represent measured data points. (See figure 17 for the locations of transects 1–6.)

cyprinids and omnivores made up 74 percent of the fish community; however, no top carnivores were collected. Minnows made up 81 percent of the fish community collected. Only two of the taxa found were intolerant, representing 5 percent of the total community (table 6).

The highest numbers of taxa were found in Indian Creek in 1996 and 1998, and the most adult EPT taxa (38) were identified from Indian Creek (table 8). Baetidae was the most abundant family of benthic macroinvertebrates present at Indian Creek near Wyoming in all years of epidendric sampling (table 7). The two baetid species identified from this station (*Baetis intercalaris* and *B. flavistriga*) typically favor streams with rocky substrates (Morihara and McCafferty, 1979). The caddisfly *Hydroptila* sp. was abundant in the 1997 epidendric sample, accounting for 9 percent of the sample, and the species *Hydroptila ajax* made up 27 percent of the adult EPT insects captured during black-light sampling.

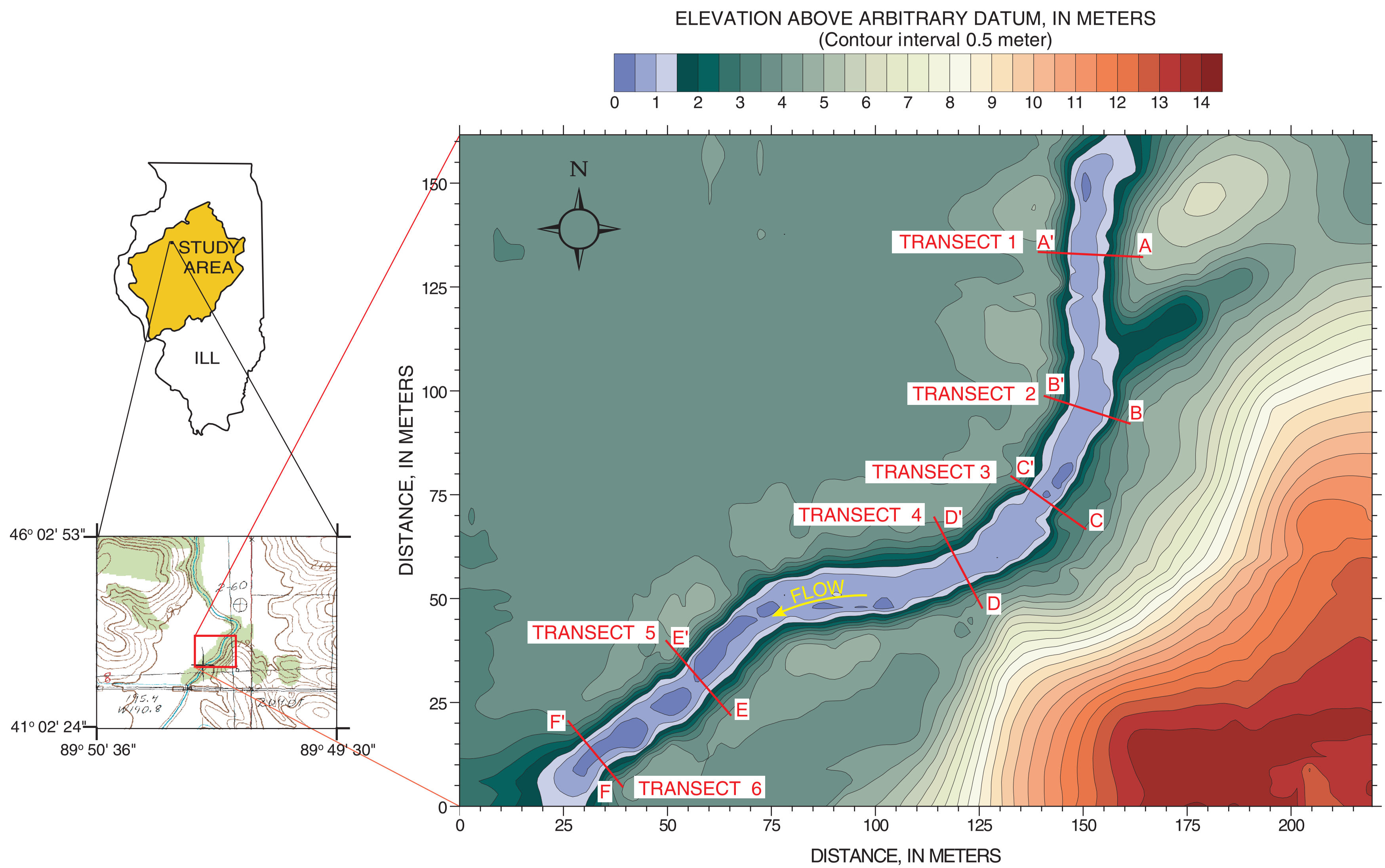


Figure 17. Transect locations and direction of flow along the reach at Indian Creek near Wyoming, Illinois.

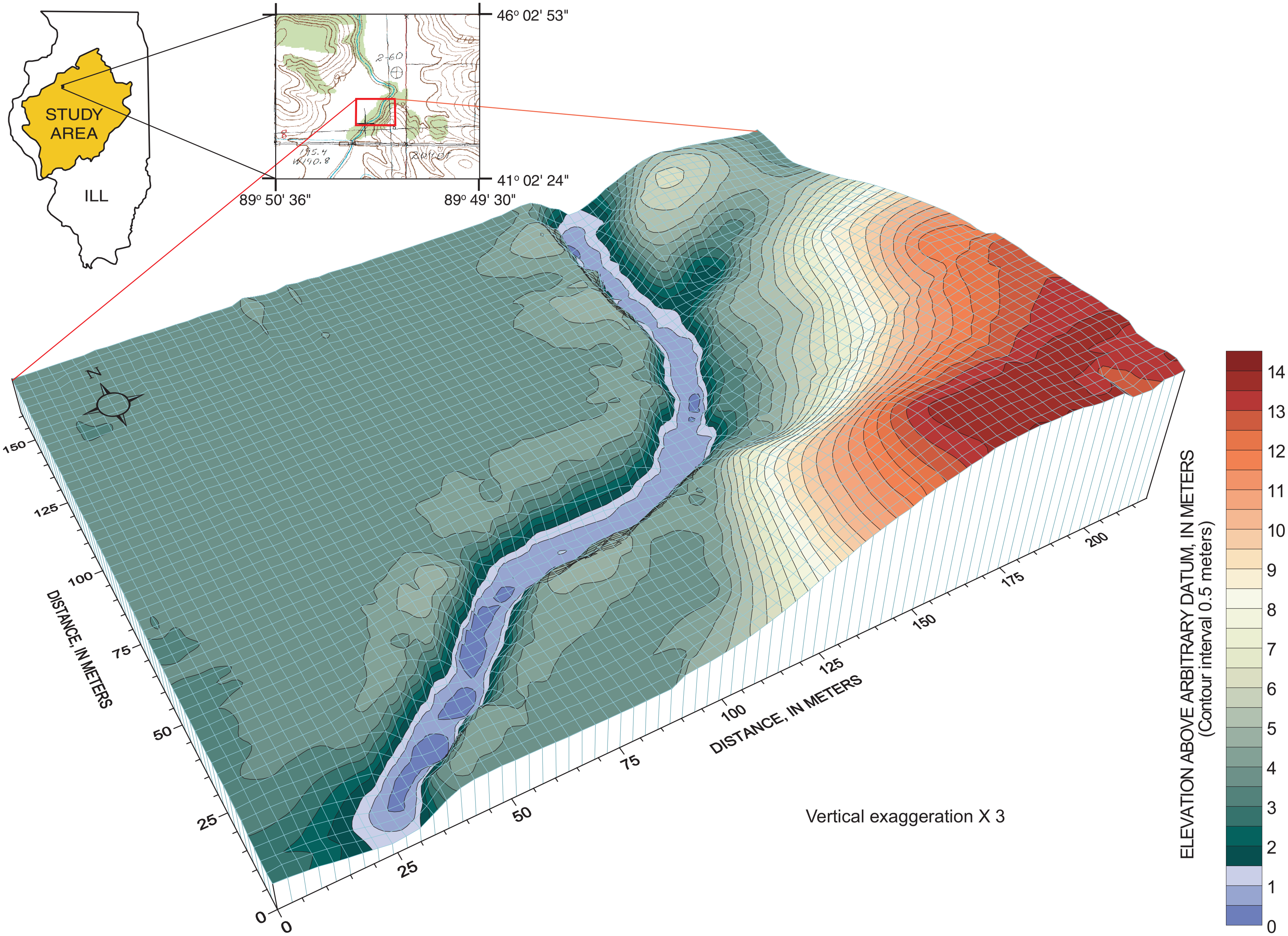


Figure 18. Sampled reach and the landscape at Indian Creek near Wyoming, Illinois.

Sangamon River at Monticello

The watershed above the Sangamon River at Monticello (fig. 19) (USGS station identification number 05572000) comprises 1,430 km^2 of the Sangamon River Basin. The reach sampled starts 250 m upstream from the gaging station. The gage is in Piatt County, Illinois. Land use in the Sangamon River Basin is about 81 percent row-crop agriculture (table 1).

The Sangamon River at Monticello has a stream order of 5 and a sinuosity of 1.3 (table 2). The longitudinal profile shows the stream reach water-surface gradient (0.03 percent) (table 3) over the reach and also the variation in depth (fig. 20). The bankfull width-to-depth ratio is 11 (table 3). Cross sections illustrate these characteristics (fig. 21) at six transects along the reach (fig. 22). The dark blue in figure 23 shows the pool areas, and the dark green shows the steep banks in relation to the surrounding landscape. Low-flow velocities measured during sampling ranged from 0 to 0.3 m/s. Low-flow water depths average 0.8 m, with a maximum measured depth of 1.8 m (table 3).

Bank materials of the Sangamon River at Monticello had the highest content of materials smaller than silt (0.004 mm) of all the stations (32 percent). The high, steep banks are shown in figure 23, 75 percent of which is less than 25 percent vegetated and, therefore, more available for potential erosion. The high clay content may be providing some stabilizing properties as well. Bed materials were 81 percent smaller than gravel and 74 percent sand (table 3). Suspended sediment was 88 percent silt and clay (table 4).

The mean canopy angle was 54° (table 3), individual mean transect values are shown in figure 21, illustrating the shading from bank vegetation. The most common tree species found were silver maple, hackberry, green ash, and downy hawthorn (table 5). Silver maple had the greatest basal area for the reach. The riparian area provides a source of woody snags, the most frequent stream feature

Figure 19. Sangamon River at Monticello, Illinois, U.S. Geological Survey station identification number 05572000, aerial view from radio-controlled helicopter, upstream from transect 3 (fig. 22).

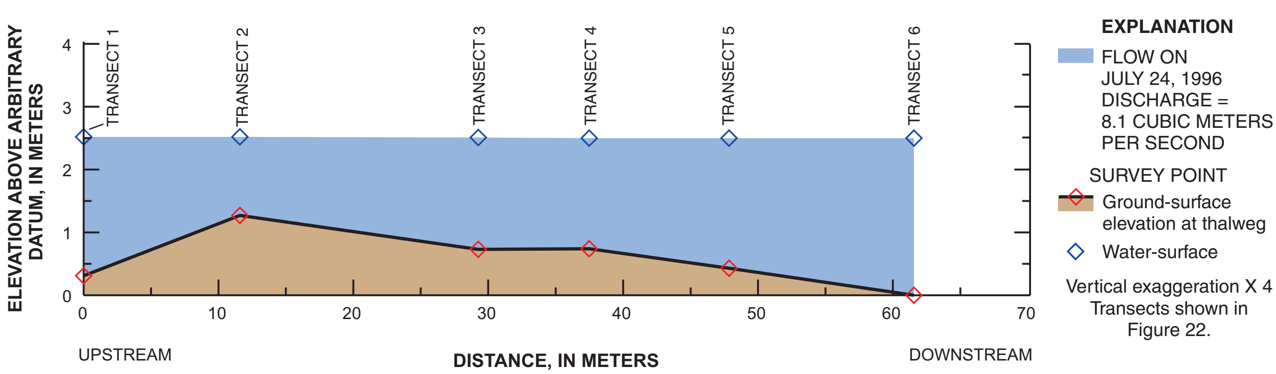


Figure 20. Water-surface gradient and stream bottom at thalweg of the Sangamon River at Monticello. The arbitrary datum is defined as the lowest measured depth. The point symbols represent measured data points.

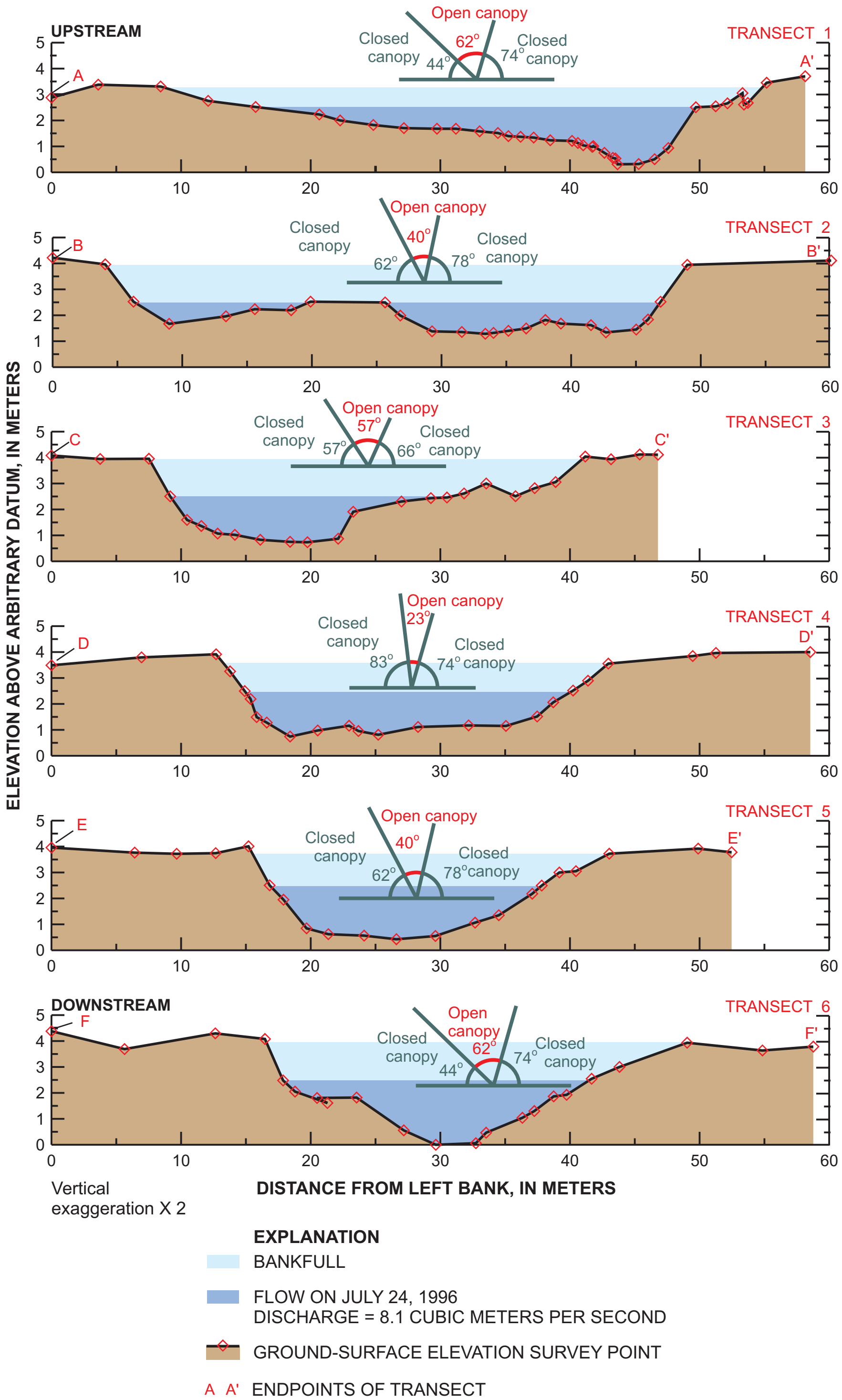


Figure 21. Characteristics of the transects at the Sangamon River at Monticello, Illinois. The point symbols represent measured data points. (See figure 22 for the locations of transects 1–6. Note: The canopy angles have not been adjusted to reflect the vertical exaggeration.)

that provides hiding cover for various aquatic biota. Sloughs and undercut banks also were present in the Sangamon River at Monticello (table 3).

Only 44 fish were collected from the Sangamon River at Monticello. Three of the 12 taxa represented in the sample were intolerant taxa (table 6). Mechanical problems with the boat shocking unit during sampling may have resulted in the small number of fish collected.

Benthic macroinvertebrate samples at Monticello and the similarly sized stream at Colmar were dominated by Hydropsychidae. The mayfly *Tricorythodes* sp. (Leptohyphidae) was abundant in every epidendric sample, with a relative abundance of about 11 percent, about 19 percent, and about 4 percent in 1996, 1997, and 1998, respectively (table 7). Relative to other stations, Monticello had among the most taxa and the most EPT taxa in epidendric samples and the second highest number of adult EPT taxa (table 8).

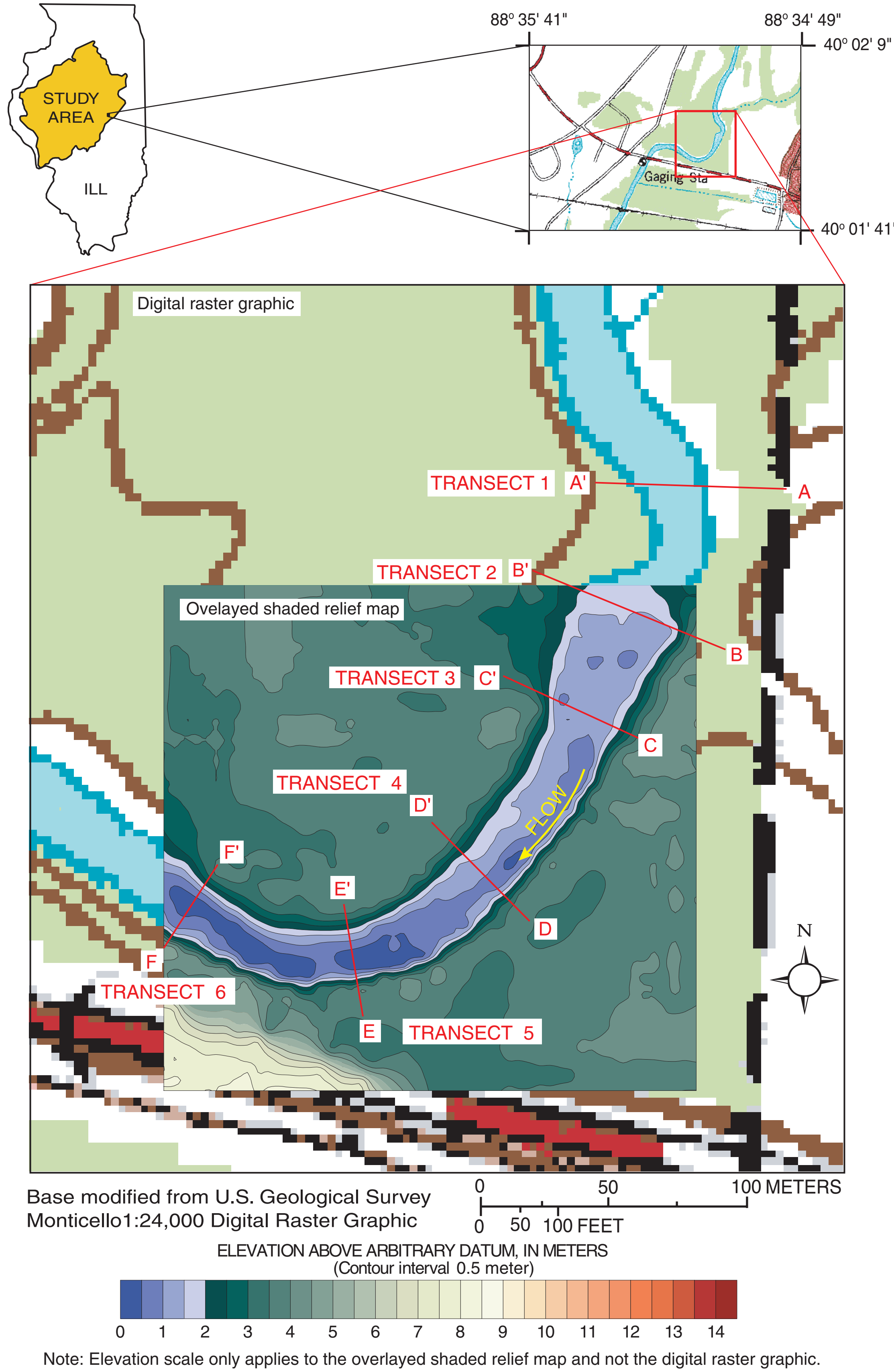


Figure 22. Transect locations along the reach and flow direction at the Sangamon River at Monticello, Illinois.

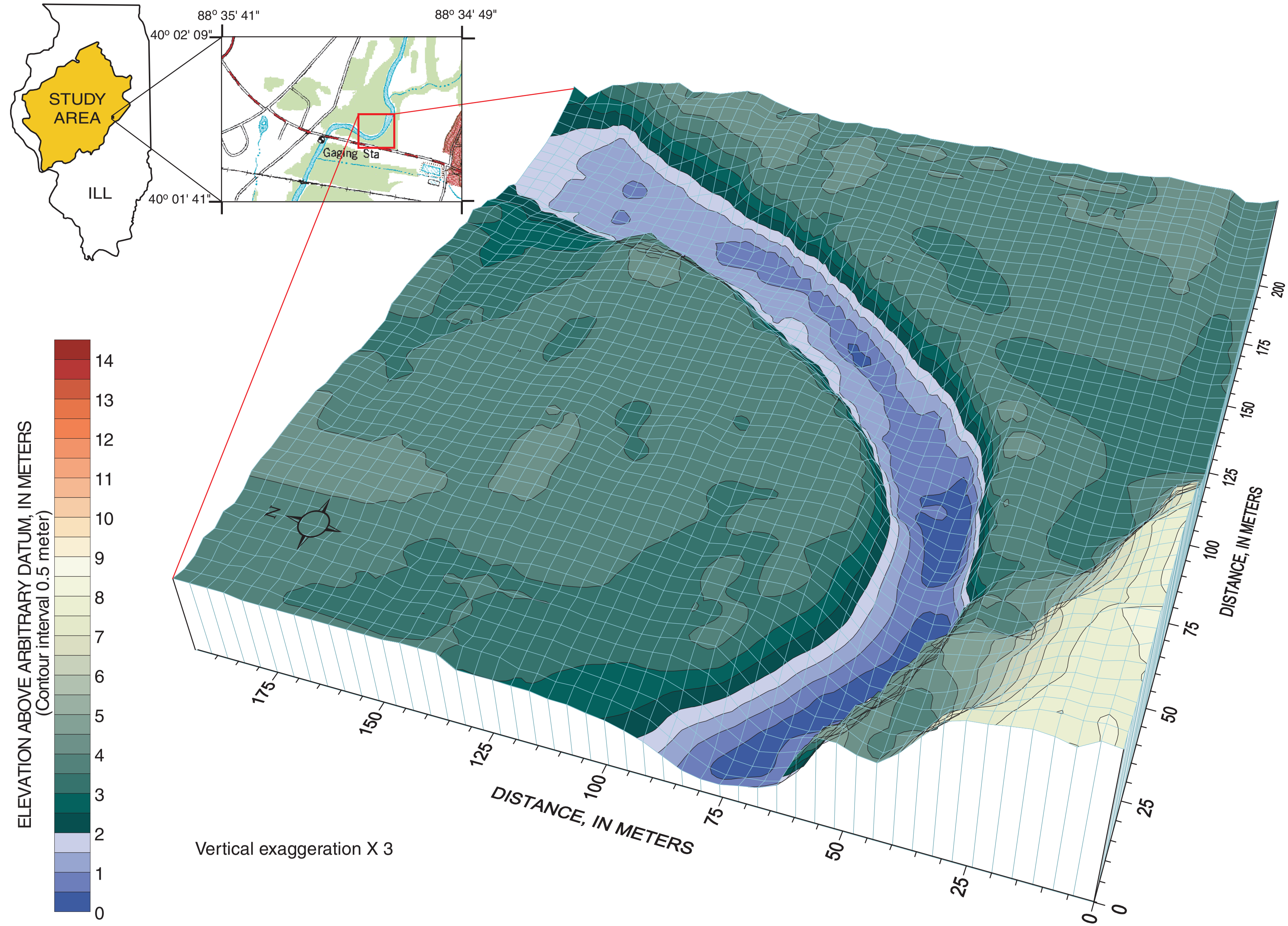


Figure 23. Sampled reach and landscape of the Sangamon River at Monticello, Illinois. Only transects 2–6 are represented in this plot.

Sangamon River Near Oakford

The watershed above the Sangamon River near Oakford (fig. 24) (USGS station identification number 05583000) comprises 13,300 km^2 of the Sangamon River Basin. The reach sampled starts 180 m upstream from the gaging station. Land use in the Sangamon River Basin near Oakford is 75 percent row-crop agriculture (table 1).

The Sangamon River near Oakford has a stream order of 7 and a sinuosity of 1 (table 2).

The longitudinal profile shows the stream reach water-surface gradient (0.06 percent) (table 3) over the reach and also the variation in depth (fig. 25). Note that over the reach the thalweg streambed gradient actually increases because transect 1 is in a pool. The bankfull width-to-depth ratio is 19 (table 3). Cross sections illustrate these characteristics (fig. 26) at 6 transects along the reach (fig. 27). Low-flow velocities ranged from 0 to 0.7 m/s. Low-flow water depths averaged 1 m, with a maximum measured depth of 1.6 m (table 3).

The banks are very unstable with 92 percent of the banks having less than 25 percent covered by vegetation. The (A') bank shown in transect 1 has noticeable slumping (fig. 26). Materials smaller than sand in size made up 55 percent of the bank. In contrast, 82 percent of the streambed particles was sand and only 1 percent was smaller than sand (table 3). Suspended sediment was 90 percent silt and clay (table 4).

The mean canopy angle at the Sangamon River near Oakford was 141° (table 3); individual mean transect values are shown in figure 26, illustrating the shading from bank vegetation. The relatively large stream width reduces the effectiveness of riparian cover to provide shade to the stream. In areas of abundant riparian trees, only four tree species were represented: boxelder, silver maple, eastern cottonwood, and slippery elm (table 5). Riparian areas with trees were a source of woody snags, the principal stream feature providing shelter for aquatic biota at this station (table 3).

At Sangamon River near Oakford, 15 fish taxa were collected, 6 of which were top

Figure 24. Sangamon River near Oakford, Illinois, U.S. Geological Survey station identification number 05583000, looking southwest upstream from transect 4 (fig. 27).

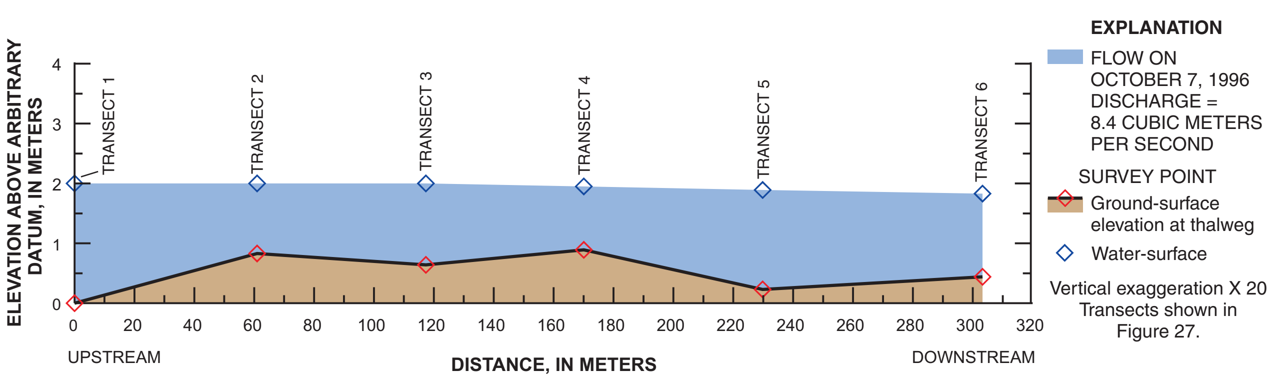


Figure 25. Water-surface gradient and stream bottom at thalweg of the Sangamon River near Oakford, Illinois. Downstream is to the right. The arbitrary datum is defined as the lowest measured depth. The point symbols represent measured data points.

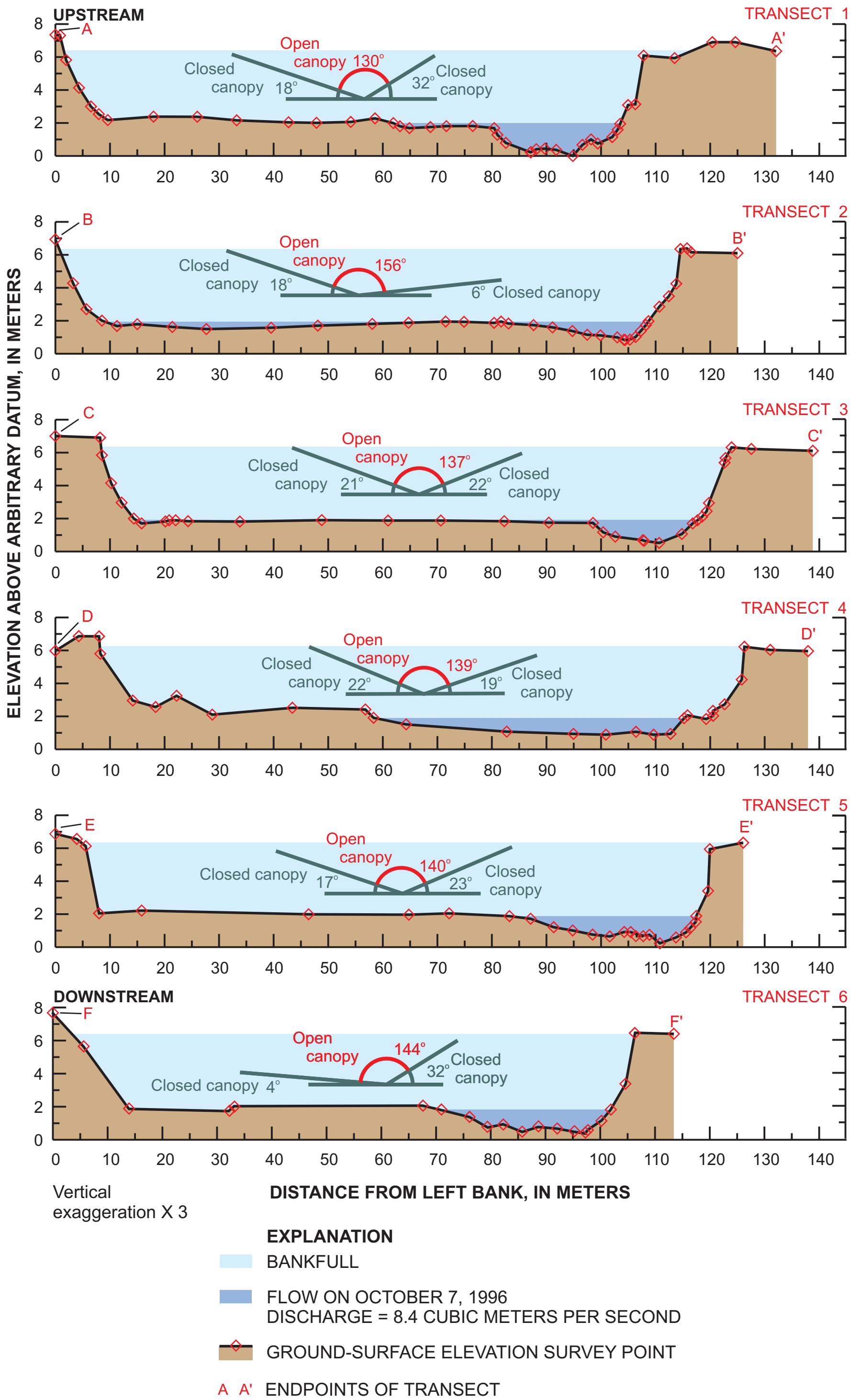


Figure 26. Characteristics of the transects at the Sangamon River near Oakford, Illinois. The point symbols represent measured data points. (See figure 27 for locations of transects 1–6. Note: The canopy angles have not been adjusted to reflect the vertical exaggeration.)

carnivores. Three taxa were intolerant; however, no darters were collected. Suckers made up 35 percent of the fish community and 17 percent were minnows (table 6).

The hydropsychid caddisfly *Potamyia flava* accounted for over one-half of the adult EPT individuals collected. Benthic samples in 1996 were dominated by Chironomidae and Hydropsychidae (table 7).

A depauperate macroinvertebrate community was found at Sangamon River near Oakford compared with those communities at other stations. Of the eight stations, Oakford had the fewest adult EPT taxa, fewest benthic macroinvertebrate taxa, and fewest benthic EPT taxa in 1996 samples (table 8).

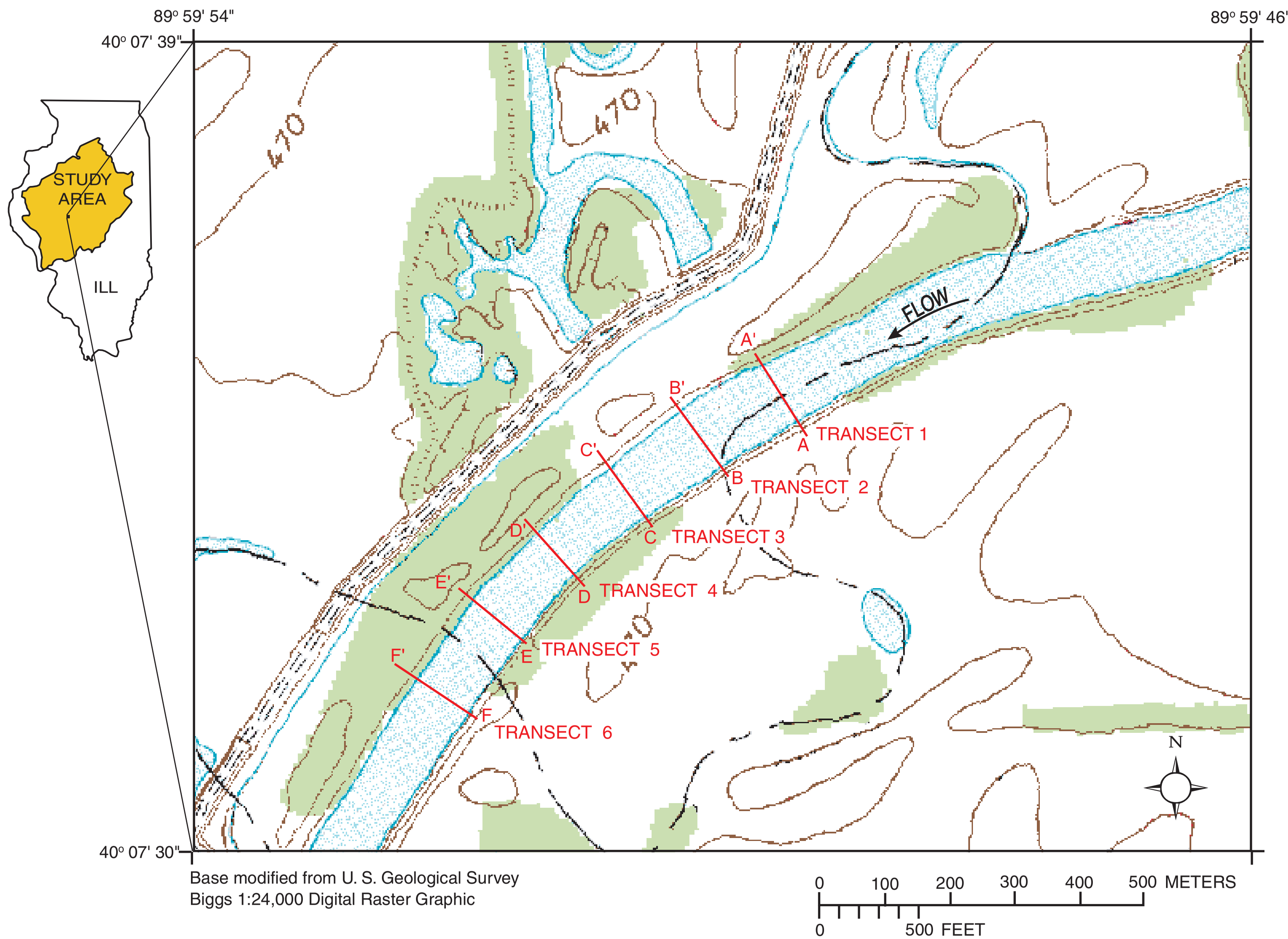


Figure 27. Transect locations along the reach and flow direction at Sangamon River near Oakford, Illinois.

La Moine River At Colmar

The watershed above La Moine River at Colmar (fig. 28) (USGS station identification number 05584500) comprises 1,700 km^2 of the La Moine River Basin. The reach sampled starts 400 m downstream from the gaging station. Land use in the La Moine River Basin is about 63 percent row-crop agriculture (table 1).

The La Moine River has a stream order of 4 and a sinuosity of 1.1 (table 2). The longitudinal profile shows the stream reach surface-water gradient (0.06 percent) (table 3) over the reach and also the variation in depth (fig. 29). The bankfull width-to-depth ratio is 5 (table 3). Cross sections illustrate these characteristics (fig. 30) at six transects along the reach (fig. 31). Note the differences among the transects in water depth and bank shape. The differences among the bank shapes were often caused by slumps. Low-flow velocities ranged from 0 to 0.7 m/s. Low-flow water depths average 1.0 m, with maximum depths that exceeded 2 m (table 3). The steep banks, of which 75 percent is less than 25 percent covered by vegetation (table 3), are shown in figure 32. The shallow riffle area (light blue near transect 5) is visible in figures 31 and 32. Pool areas also are visible and indicated by dark blue. The relief and contour maps can be compared among the stations. The color scheme was kept similar among the maps to aid in visualizing elevation differences. The La Moine River at Colmar station differs from the other stations in the height of the banks and the straightness of the channel.

Sixty-nine percent of the materials making up the banks at Colmar was smaller than sand, the highest percentage among the stations. Similarly, 48 percent of the bed materials also was smaller than sand, much higher than any of the other stations (table 3). Both banks had large areas of slumping. The areas that appear to be benches under the bankfull line are areas where large sections of the bank had begun to slump. The most apparent slump is the right bank of transect 4 (fig. 30). Suspended sediment was 97 percent silt and clay (table 4).

Figure 28. La Moine River at Colmar, Illinois, U.S. Geological Survey station identification number 05584500, aerial view from a radio-controlled helicopter. Transects 3–6 are included in the photograph (fig. 31).

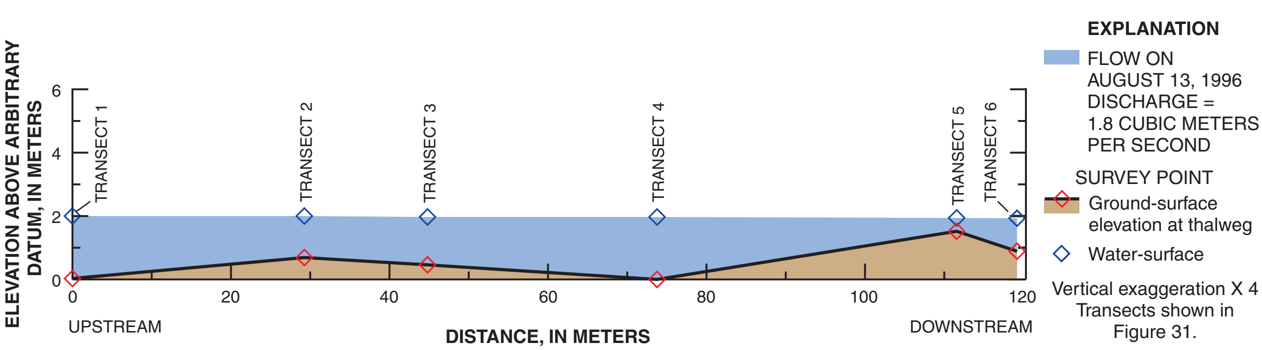


Figure 29. Surface-water gradient and stream bottom at thalweg of the La Moine River at Colmar, Illinois. The arbitrary datum is defined as the lowest measured depth. The point symbols represent measured data points.

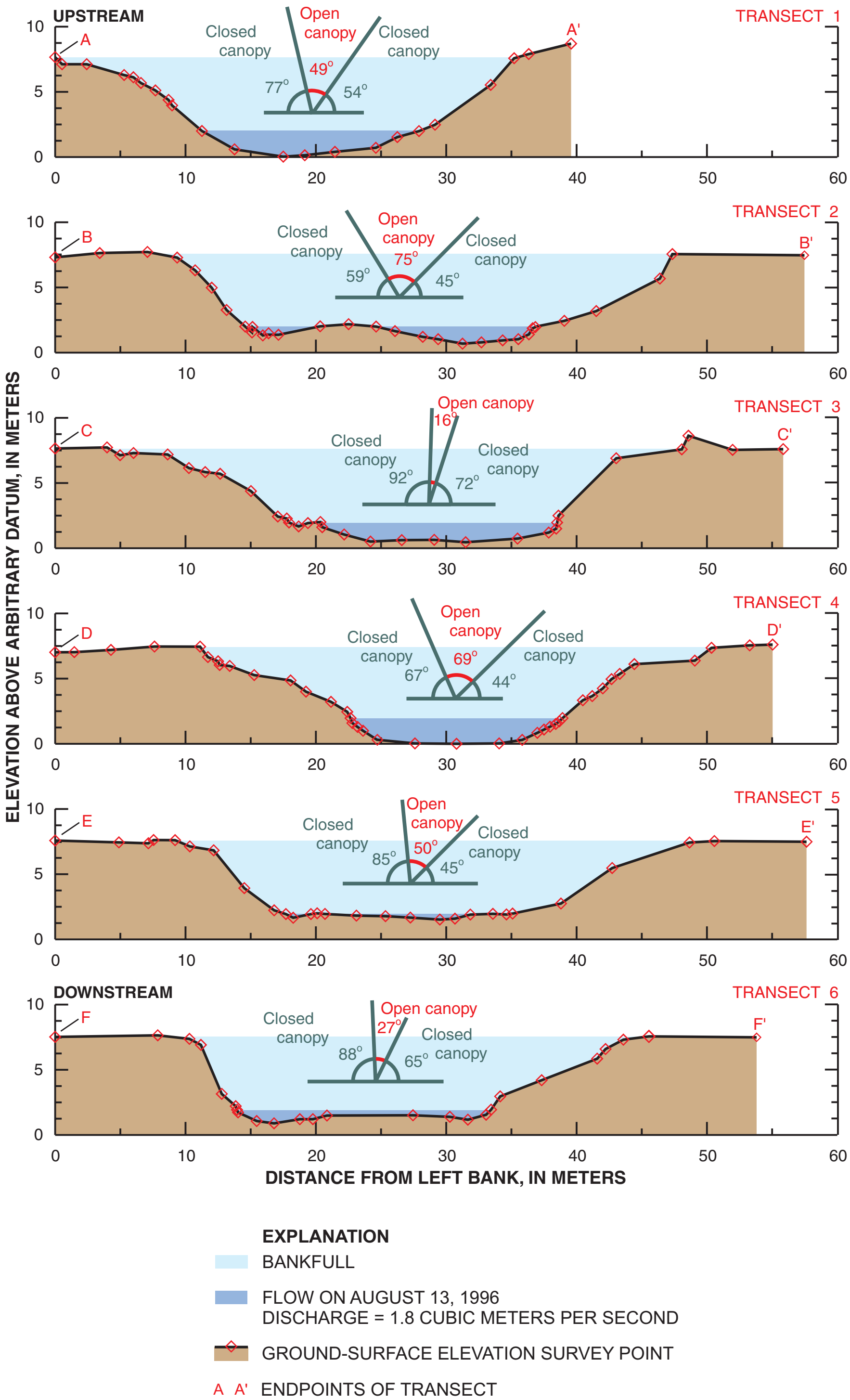


Figure 30. Characteristics of the transects at La Moine River at Colmar, Illinois. The point symbols represent measured data points. (See figure 31 for the locations of transects 1–6.)

The mean canopy angle was 48°; individual mean transect values are shown in figure 30, illustrating the shading from bank vegetation. The most common tree species found were Ohio buckeye, silver maple, and boxelder. Colmar had the greatest tree diversity among the stations, a total of 18 tree species (table 5). The riparian vegetation provides a major source of woody snags, the most common stream feature that provides shelter for aquatic biota (table 3).

The 19 fish taxa collected were evenly distributed among the trophic groups. Two taxa were intolerant, which was only 3 percent of the fish community. Minnows represented 53 percent of the sample community (table 6).

Benthic macroinvertebrate samples at Colmar, similar to the comparably sized Monticello station, were dominated by Hydropsychidae (table 7). The number of taxa found at Colmar varied over 3 years of sampling. Colmar had the most taxa and EPT taxa for epidendric samples in 1997 and 1998 but was among the stations with the fewest adult EPT taxa and the fewest taxa and EPT taxa in epidendric samples in 1996 (table 8).

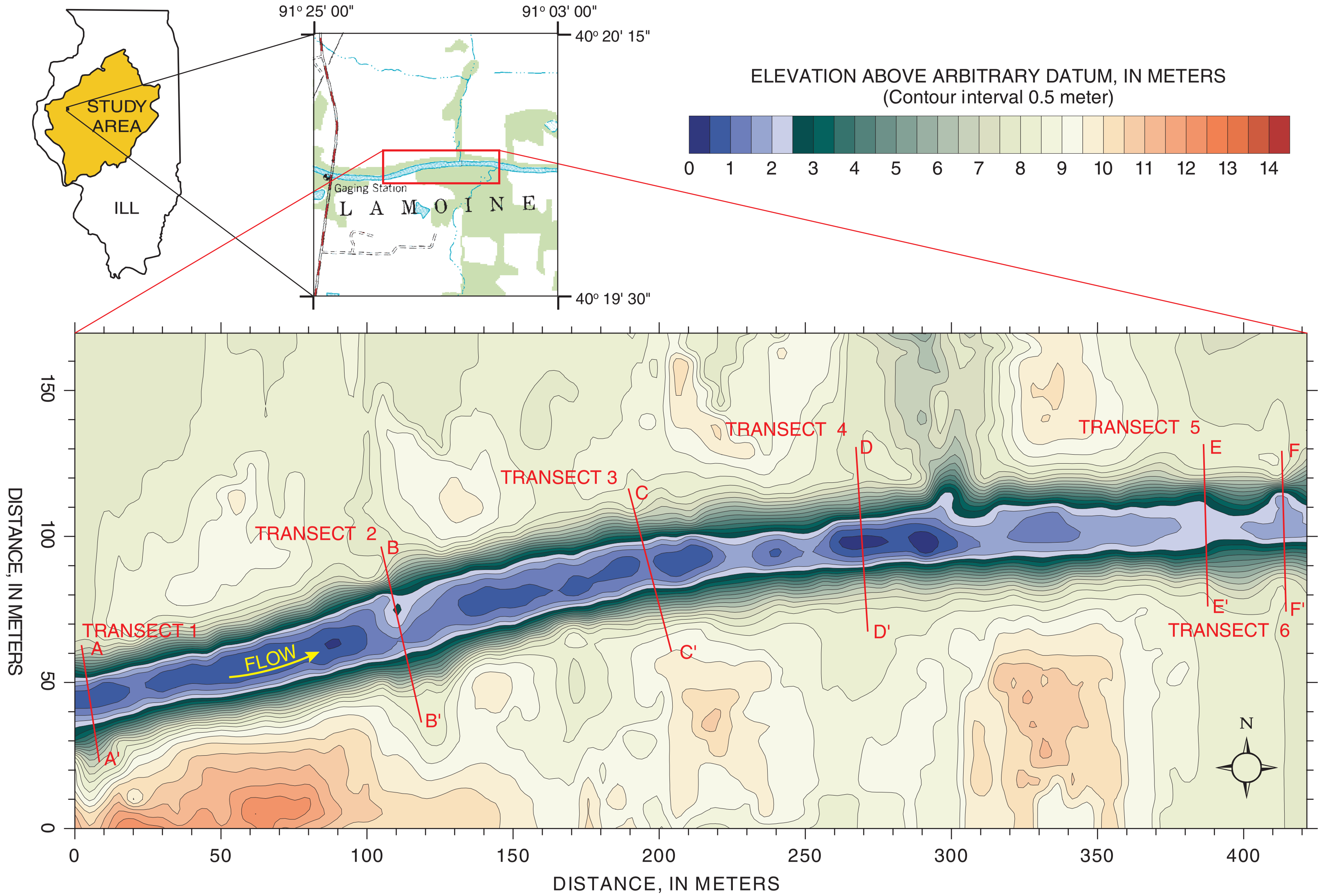


Figure 31. Transect locations along the reach and flow direction at La Moine River at Colmar, Illinois.

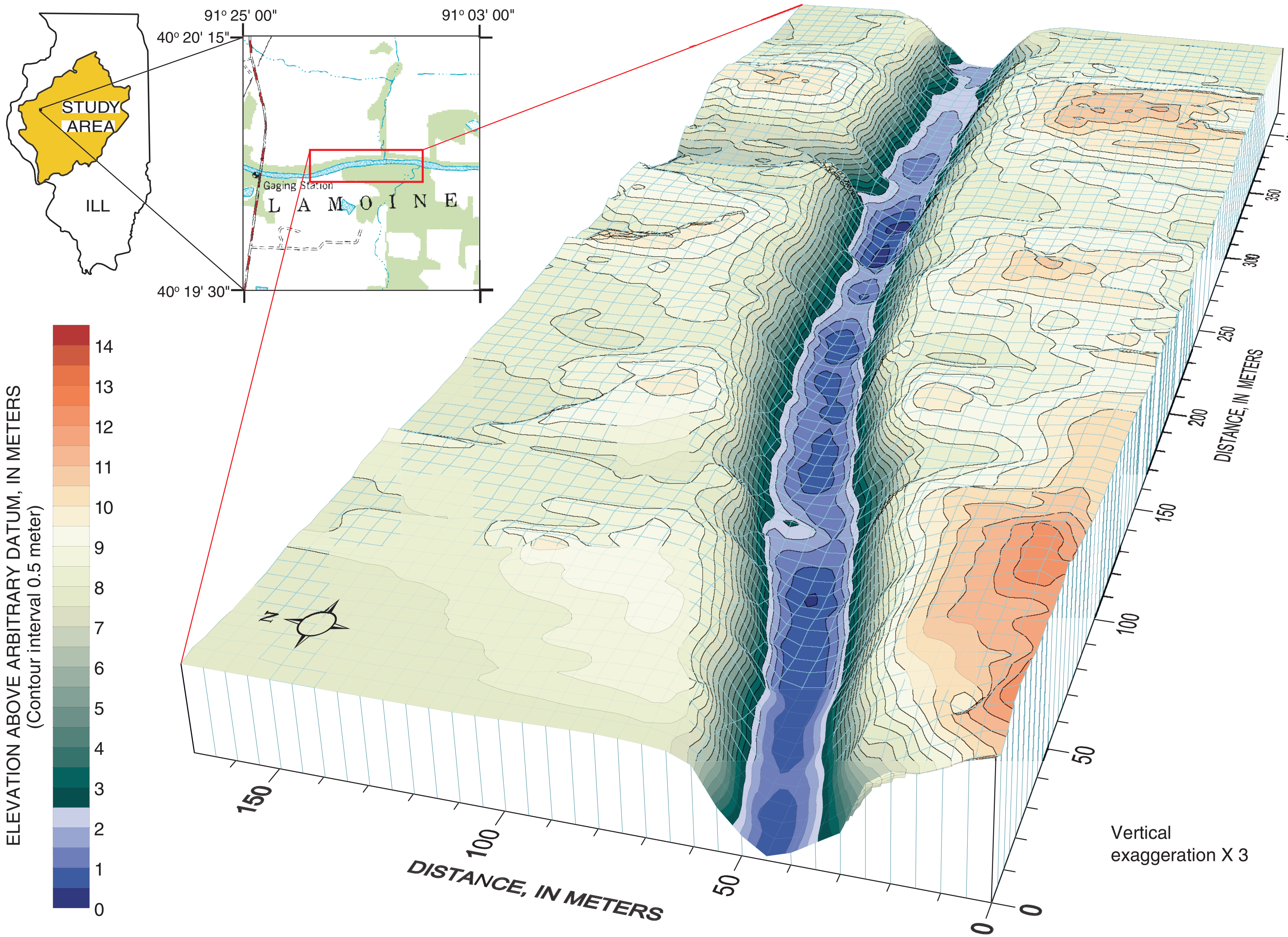


Figure 32. Stream reach and landscape of the La Moine River at Colmar, Illinois.

Illinois River At Valley City

The watershed above Illinois River at Valley City (fig. 33) (USGS station identification number 05586100) comprises 69,300 km^2 of the Illinois River Basin. The basin data calculated for Illinois River at Valley City is based on the 40,900 km^2 downstream from Ottawa. This station was selected to avoid backwater conditions from the Mississippi River that could affect flow at the station. The reach sampled was around Big Blue Island, river mile 59 (95 km). Land use in the basin was about 65 percent row-crop agriculture (table 1).

The Illinois River has a stream order of 8 at Valley City (table 2). The main channel was regularly dredged for barge traffic. The side channel was separated from the main channel by Big Blue Island, which had more woody snags than the main channel. The variance in width and depth of the two channels is shown in the cross sections (fig. 34); the location of the transects along the reach are shown in figure 35. Figures 34 and 35 can be compared with figures 4 and 3, respectively (Illinois River at Ottawa site) to determine differences in the river channel at the two stations. The side channel had a greater habitat diversity and had not been dredged. Measured velocities ranged from 0.1 m/s to 0.4 m/s (table 3). A median of 98 percent of the suspended sediment was silt and clay (table 4). The bank woody vegetation was more effective in delivering shade to the side channel, which is narrower than the main channel. The most common trees were silver maple, burning bush and Eastern cottonwood. Eight tree species were identified at this station (table 5).

A total of 15 fish taxa was collected in the Illinois River at Valley City. Top carnivores represented 45 percent of the community by trophic status. One intolerant fish taxon was collected, which was only 1 percent of the fish community (table 6).

Benthic macroinvertebrate samples were dominated by Hydropsychidae and Chironomidae (table 7). *Cyrnellus fraternus* (Polycentropodidae) was especially abundant at Valley City in epidendric and adult samples. Large-river caddisflies were the most abundant adult EPT species collected at Valley City, with *C. fraternus*, *Potamyia flava*, and *Hydropsyche bidens* making up 86 percent of all individuals collected. Large-river caddisflies abundant in the epidendric samples were *Hydropsyche orris* (14 percent) and *H. orris* (27 percent).

Figure 33. Illinois River at Valley City, Illinois, U.S. Geological Survey station identification number 05586100, looking downstream from the main channel, with Big Blue Island to the left.

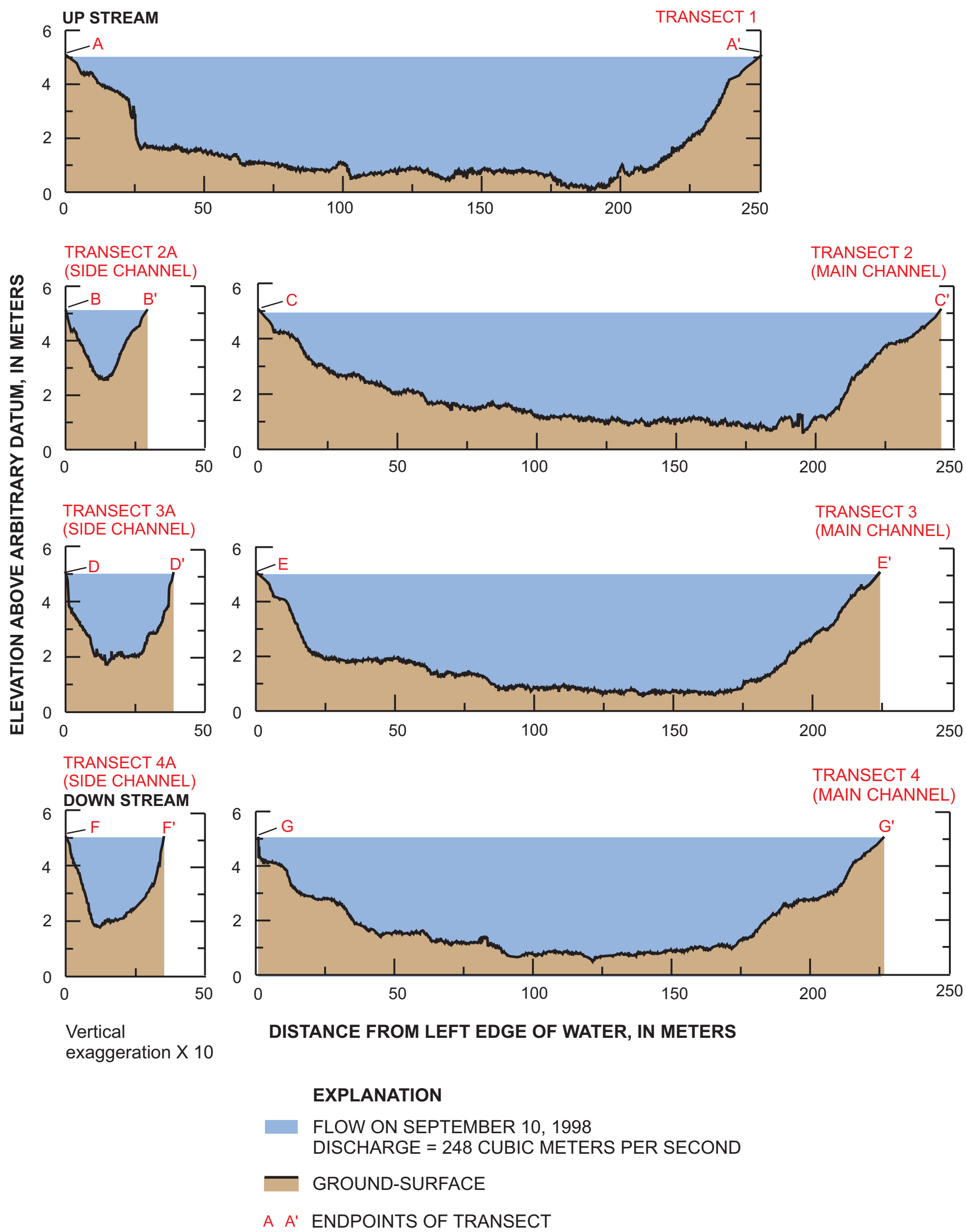


Figure 34. Characteristics of the transects at the Illinois River at Valley City, Illinois. (See figure 35 for the locations of transects1–4.)

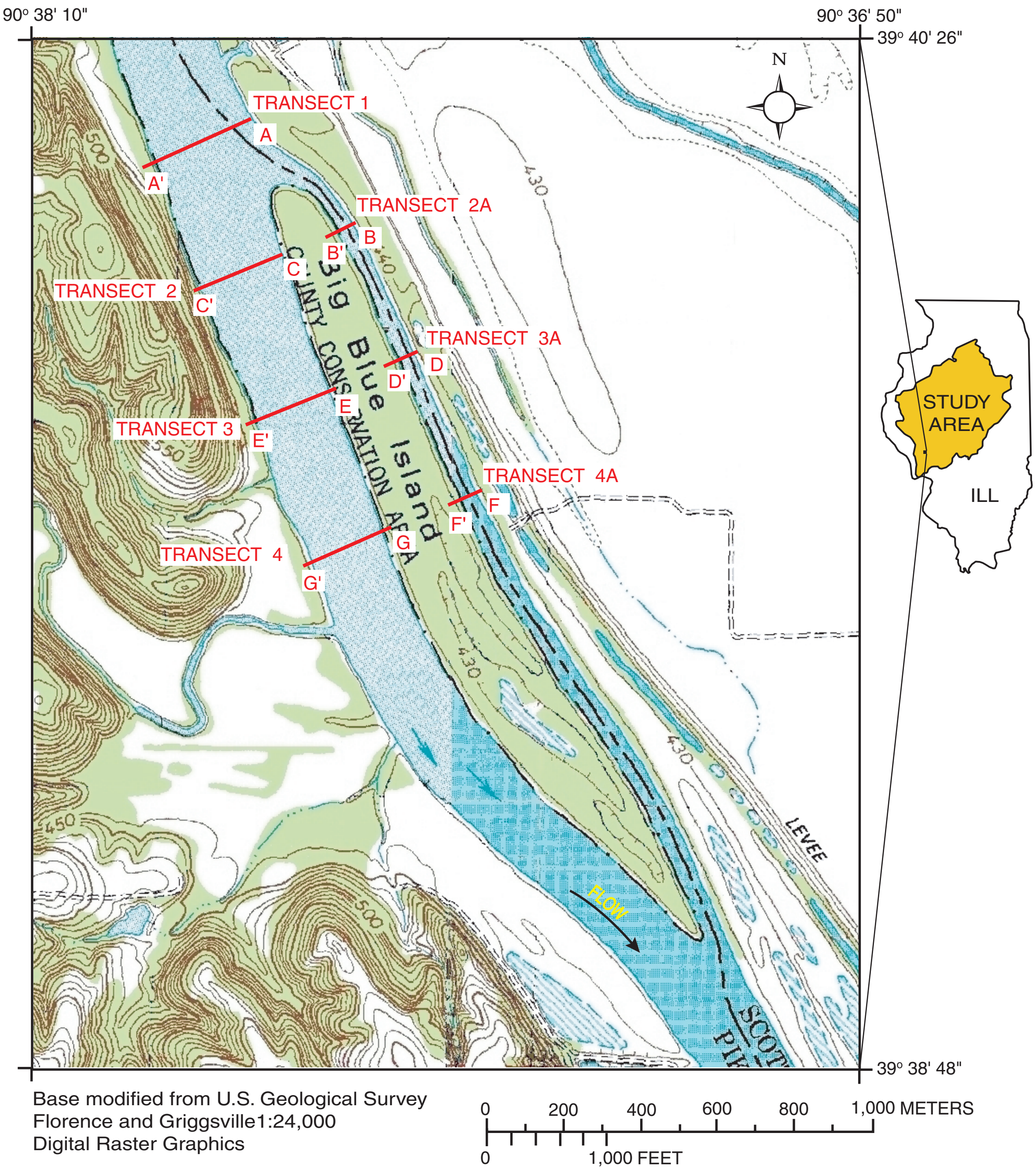


Figure 35. Location of transects along the measured reach at the Illinois River at Valley City, Illinois.

INTERACTION OF HABITAT WITH SEDIMENT AND BIOTIC CHARACTERISTICS

This section of the report focuses on how habitat characteristics interact with sediment and biota. The sediment section focuses on suspended-sediment particle size and the available sources within measured habitat characteristics. The biota section focuses on how selected sediment and selected habitat characteristics interact with fish and benthic macroinvertebrates.

Sediment

In Illinois, one of the major causes of stream degradation is siltation (Page and Jeffords, 1991). In 1997, median suspended-sediment concentrations ranged from 60 to 147 mg/L at stations in the LIRB, and silt and clay constituted at least 72 percent of the suspended material (table 4). This percentage is a result of the availability of the materials and the energy available to suspend the materials in water. The forces created by flowing water detach the particles and transport them in suspension. The physical characteristics of the eroded material determine the capacity of water to suspend materials (Vanoni, 1975, p. 1). The cohesive nature of clays requires more energy for materials to separate. Once in suspension, however, the energy required for transport is less, and clay particles can be kept in suspension at slow velocities and low gradients, common conditions in the LIRB.

Velocities and stream energy were low during bed and bank material sampling. At low flows, the highest measured velocity was 0.8 m/s, at the Mackinaw River station (table 3). The critical time for sediment distribution is bankfull flow (Rosgen, 1996), when the stream has sufficient energy and comes in contact with the fine materials in the bank and flood plain.

Bank erosion is one potential source of suspended sediment, especially silt and clay. The banks of the stations sampled were composed of at least 50 percent silt and clay (fig. 36). In contrast, the streambeds were composed of less than 10 percent

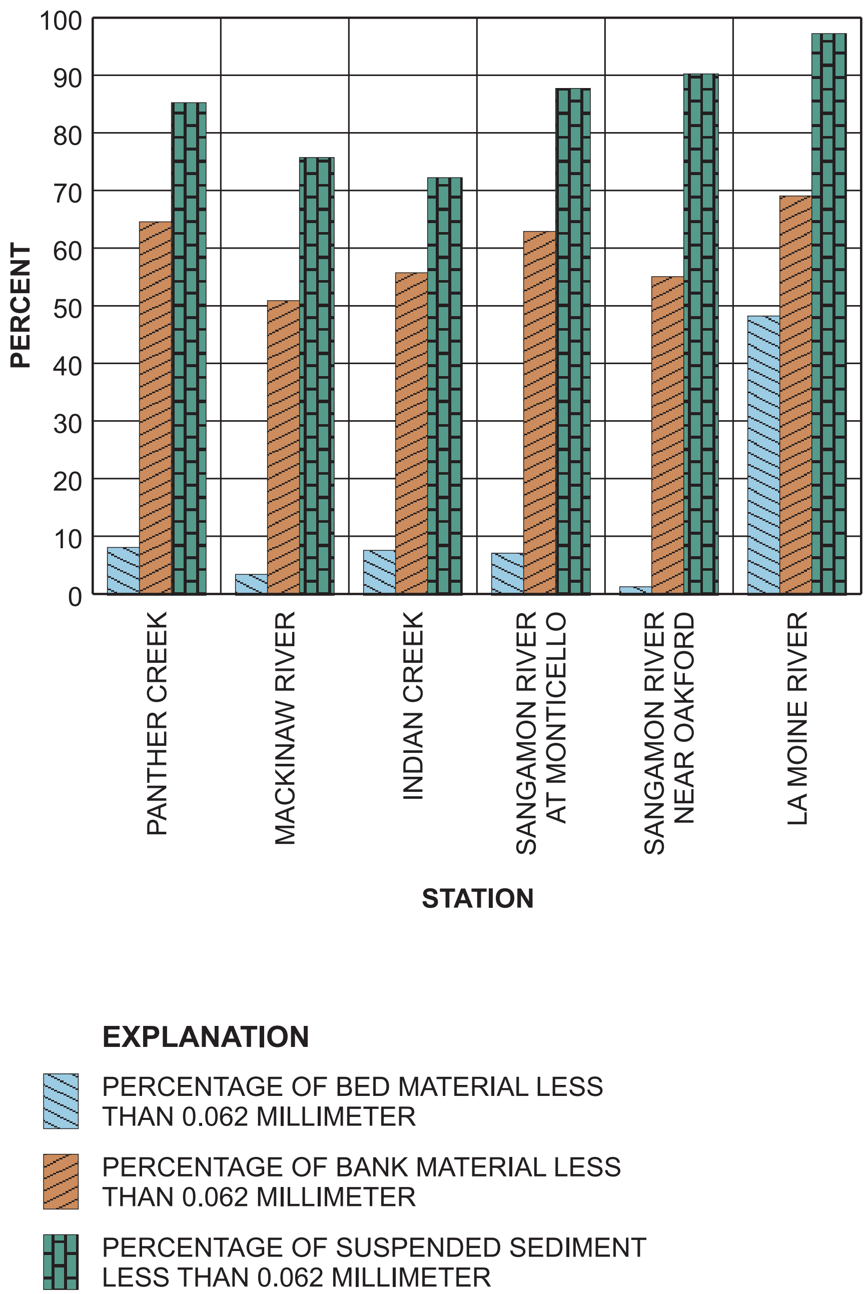


Figure 36. Median percentage of suspended sediment, mean percentage of bed material, and percentage of bank material less than 0.062 millimeters (silt and clay) sampled from selected stations in the lower Illinois River Basin, October 1, 1996–September 30, 1997.

silt and clay, with the exception of the La Moine River station. With the data collected, separating and quantifying the suspended-sediment sources is difficult. Sheet and rill erosion from various land uses, gully erosion, and bank erosion are major sources of suspended sediment (Illinois Environmental Protection Agency, 1979). Silts and clays were available to the streams in the LIRB from all of the above sources.

Biota

Fish Communities

The percentage of insectivorous cyprinids was inversely related to the percentage of suspended silt and clay, with a Kendall's Tau correlation of –0.76; an R^2 of 42 percent, where R^2 is the fraction of the variance explained by regression (Helsel and Hirsch, 1992); and a probability of 0.08 (fig. 37). These results may be an indication that the fines (silts and clays) being transported are affecting the feeding habits of the insectivorous cyprinids. Many macroinvertebrates available for fish foraging typically prefer gravel and cobble riffles (Waters, 1995). Often, gravel and cobble are not available or are covered in streams with large amounts of silt and clay, a common condition in the LIRB. Although similar correlations could not be found between macroinvertebrates and suspended silt and clay, the substrate sampled for macroinvertebrates was woody snags, not rocks. Although woody snags also may be affected by sediment, the relation is not apparent from the data collected. According to Waters (1995), very little work has been done on the effects of sedimentation on

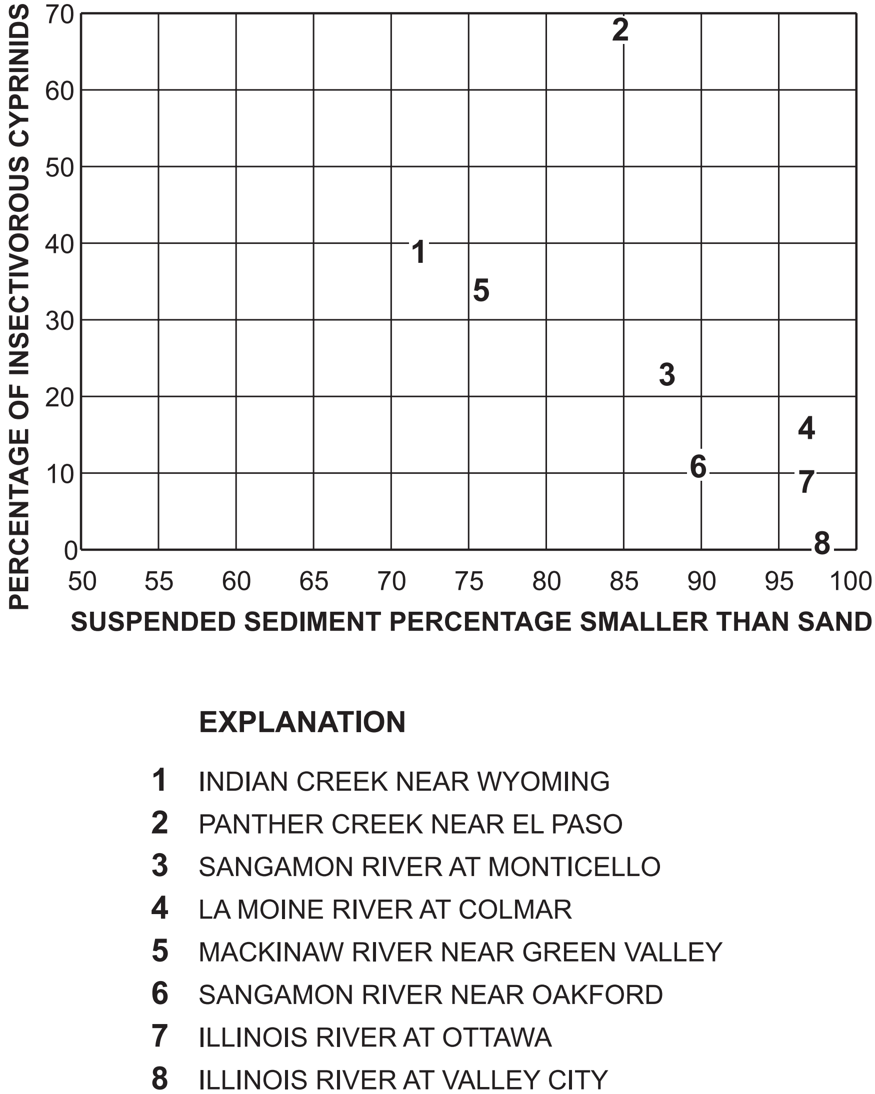


Figure 37. Percentage of insectivorous cyprinids and the percentage of suspended sediment less than 0.062 millimeters in size sampled from stations in the lower Illinois River Basin, 1996–98. (The stations are numbered according to increasing basin area size).

warmwater fishes, but Berkman and Rabeni (1987) found that increased siltation decreases the abundance of cyprinids that require silt-free stony or gravel substrates.

In the LIRB, woody snags provide the main source of habitat for the sucker community. Possible reasons that suckers may be found most frequently in woody-snag areas include hiding cover and food. Benthic macroinvertebrates and algae often are the foods preferred by suckers and are found on hard substrates. The woody snags may provide the hard surface in areas with fine substrates. The Kendall's Tau correlation between suckers and woody snags was 0.79, with an R^2 of 92 percent and a probability of 0.0002 (fig. 38). As noted in many of the station descriptions, often the only measured instream habitat feature was woody snags.

The areas with the highest water velocities appear to have fewer sunfish as indicated by a

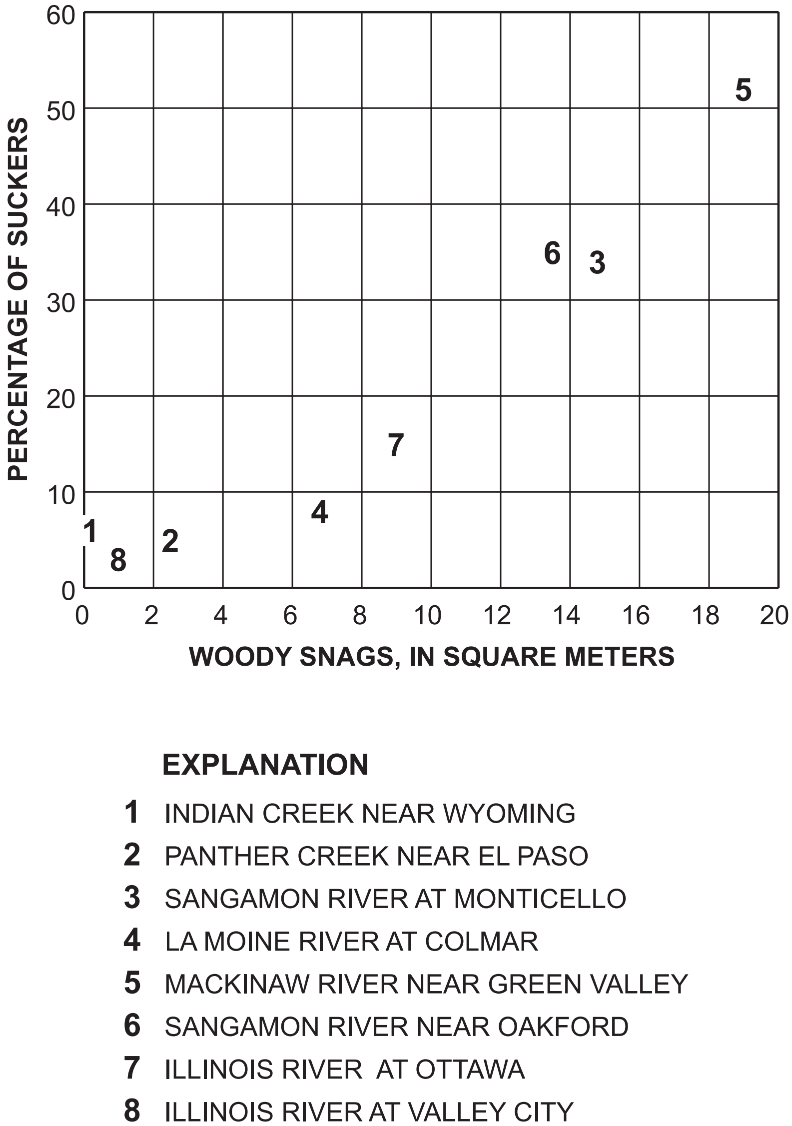


Figure 38. Percentage of suckers and woody-snag areas at selected stations in the lower Illinois River Basin, 1996–98. (The stations are numbered according to increasing basin area size.)

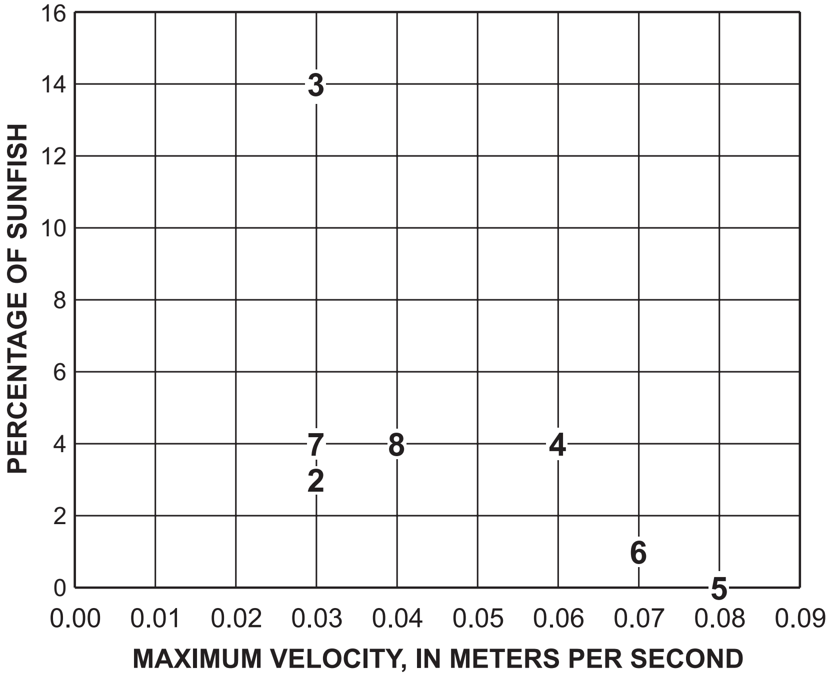
Kendall's Tau correlation of –0.65, an R^2 of 39 percent, and a probability of 0.08 (fig. 39). Although the correlation is only –0.65, this correlation is expected because most sunfish are found in pools or lakes. The gradient of most streams in the LIRB tended to promote slow velocities and pool-type conditions. Panther Creek was affected by beaver activity that further lowers water velocities. Confounding characteristics that likely decreased the strength of the correlation include the relatively large size of the Illinois River in comparison with the size of the other streams and the Illinois River stations were sampled at night, whereas the other stations were sampled during the day.

Insectivorous cyprinids (Bertrand and others, 1996) correlated with depth, but the correlation among the stations was stronger when the Illinois River stations were omitted from the analysis. Because of dredging, the Illinois River depths were determined artificially. The Kendall's Tau values without the Illinois River stations were –0.9, with an R^2 of 77 percent, and a probability of 0.02 (fig. 40). Smith (1979) found that many insectivorous cyprinids prefer areas of riffles with gravel substrates. Streams with more riffles have a shallower mean depth than runs and pools. The riffle areas may provide better feeding opportunities because the available light makes food more visible and the gravel found in riffles provides hard and more stable substrate for benthic macroinvertebrates.

Benthic Macroinvertebrate Communities

Hydropsychidae, Chironomidae, and Baetidae were the most abundant benthic macroinvertebrate families collected in the LIRB during 1996–98 (table 7). Similarly, abundant Hydropsychidae adults were collected during EPT black-light sampling. Elmidae, Leptohyphidae, and Heptageniidae also were abundant during the sampling period.

Benthic macroinvertebrate community composition was related to stream size. The caddisflies *Potamyia flava*, *Hydropsyche bidens*, and *H. orris* were more prevalent at stations with larger drainage basins than stations with smaller basins. Typically, these species are abundant in large rivers in Illinois (Ross, 1944). The mayfly genus *Tricorythodes* (the only representative of the family Leptohyphidae) and the beetle family Elmidae had higher relative abundance at stations with small- and moderate-size drainage basins than stations with large drainage basins. Adults of two



EXPLANATION

1 INDIAN CREEK NEAR WYOMING
2 PANTHER CREEK NEAR EL PASO
3 SANGAMON RIVER AT MONTICELLO
4 LA MOINE RIVER AT COLMAR
5 MACKINAW RIVER NEAR GREEN VALLEY
6 SANGAMON RIVER NEAR OAKFORD
7 ILLINOIS RIVER AT OTTAWA
8 ILLINOIS RIVER AT VALLEY CITY

Figure 39. Percentage of sunfish and maximum velocity for stations in the lower Illinois River Basin, 1996–98. (The stations are numbered according to increasing basin area size. In the plot, the 1 is covered by the 6).

Leptoceridae species, *Nectopsyche candida* and *Ceraclea tarsipunctata*, were especially abundant in black-light samples at the moderate size basins of the LIRB: Sangamon River at Monticello and La Moine River at Colmar. During adult black-light sampling, *P. flava* also was common at larger streams, including the Illinois River stations and Sangamon River near Oakford.

Baetidae were found at high densities at stations with high maximum velocity (fig. 41). Baetidae are an ubiquitous family of mayflies, with many genera preferring fast-flowing waters.

SUMMARY

Eight stations on six streams in the lower Illinois River Basin were sampled and analyzed for habitat, biota, and sediment during 1996–98 as part of the National Water-Quality Assessment (NAWQA) program of the U.S. Geological Survey. The stations studied include the Illinois River at Ottawa, Panther Creek near El Paso, Mackinaw River near Green Valley, Indian Creek near Wyoming, Sangamon River at Monticello, Sangamon River near Oakford, La Moine River at Colmar, and Illinois River at Valley City.

Habitat, water-chemistry, and biological data were compiled from existing data sets and collected during field observations according to NAWQA protocols. Kendall's Tau was used to examine correlations among the habitat, biota, and sediment characteristics. The characteristics include, woody-snag areas; water velocity; abundance of suckers; abundance of adult Ephemeroptera, Plecoptera, and Trichoptera (EPT) benthic macroinvertebrate taxa; suspended-sediment size, and others.

The six streams studied flow through agricultural lands at very low gradients. Stream size varied greatly among the stations studied (164 to 69,300 km^2). Stream sinuosity varied from 1 to 1.5. Bankfull width-to-depth ratios covered a wide range (5 to 26). Velocities measured during low-flow periods were all less than 1 meter per second. Maximum depths measured during low flow varied from 0.8 to 5.2 meters.

Stream reaches were surveyed to generate longitudinal profiles, transect cross sections, and where possible, relief and contour maps. These illustrations provide a visual representation of the physical stream characteristics. These illustrations can be used to aid in the interpretation of the numbers measured in the field, such as

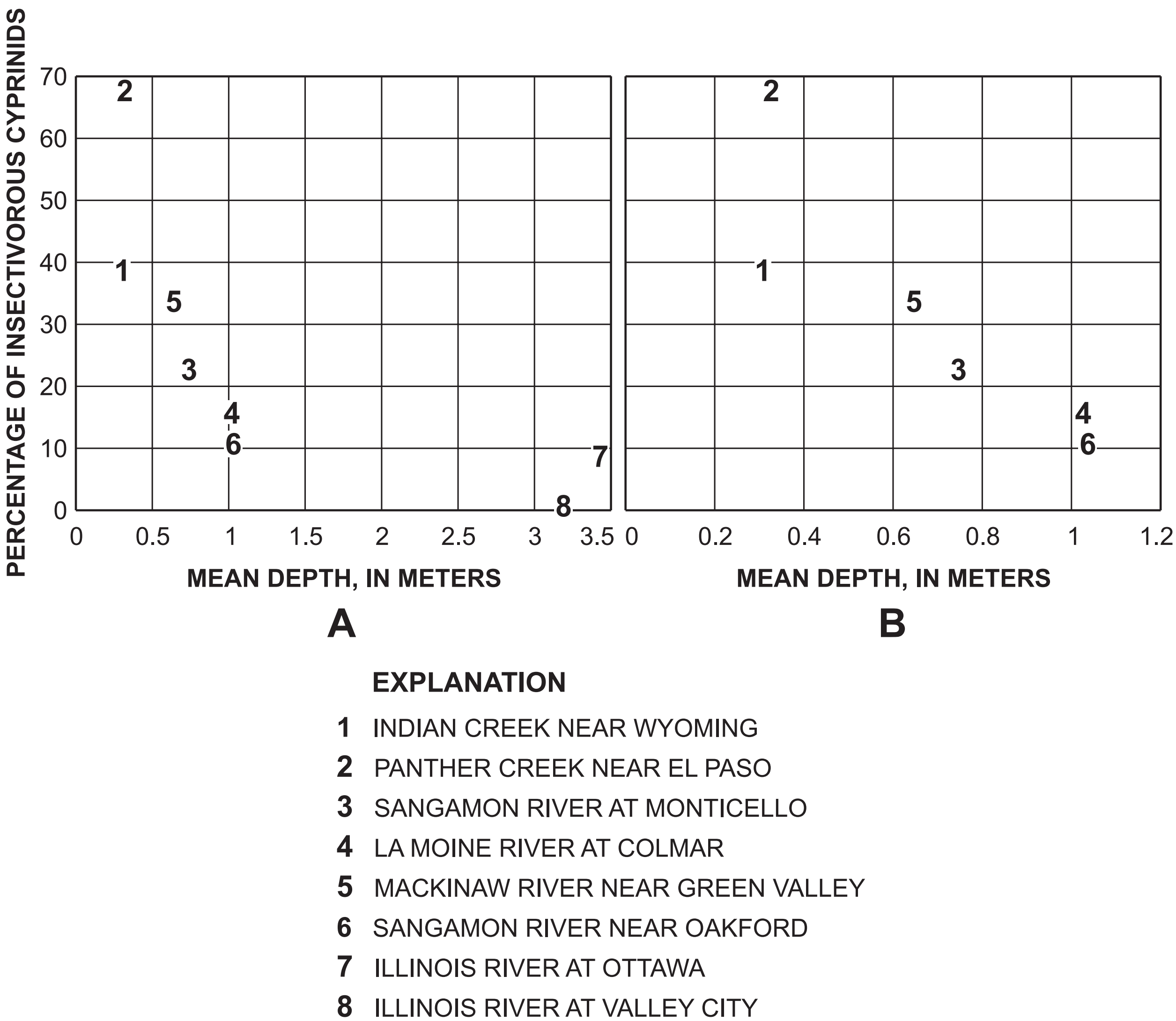


Figure 40. Percentage of insectivorous cyprinids and mean depth, for stations in the lower Illinois River Basin, 1996–98; A shows the relation with Illinois River stations and B shows the relation without Illinois River stations. (The stations are numbered according to increasing basin area size.)

width-to-depth ratios, sinuosity, bank height, and canopy cover. The illustrations also provide a visual comparison of the streams and in the future can be used as a basis from which to measure temporal changes in the stream shape.

More than 50 percent of stream bank materials was particles smaller than sand (silt, clay). In contrast, the streambeds were composed of mainly sand or larger materials, with the exception of the La Moine River at Colmar, in which 48 percent of the materials was smaller than sand.

Most banks were steep (20 to 53 degrees) with little vegetation or stabilizing material (20 to 92 percent of the banks were less than 25 percent covered with vegetation or stabilizing material). Tree coverage on and along the banks of the streams provide a source of shading to the streams, as well as a source for woody snags, the most prominent instream feature. The most common tree species found were silver maple and boxelder.

Suspended-sediment particle size, woody debris, and stream velocity were important to fish and benthic macroinvertebrate communities. Fine particles (silts and clays) were abundant in suspended sediment and streambanks, and fish insectivorous cyprinid community composition increased with decreases in the concentration of these suspended fines. Suckers were prevalent in

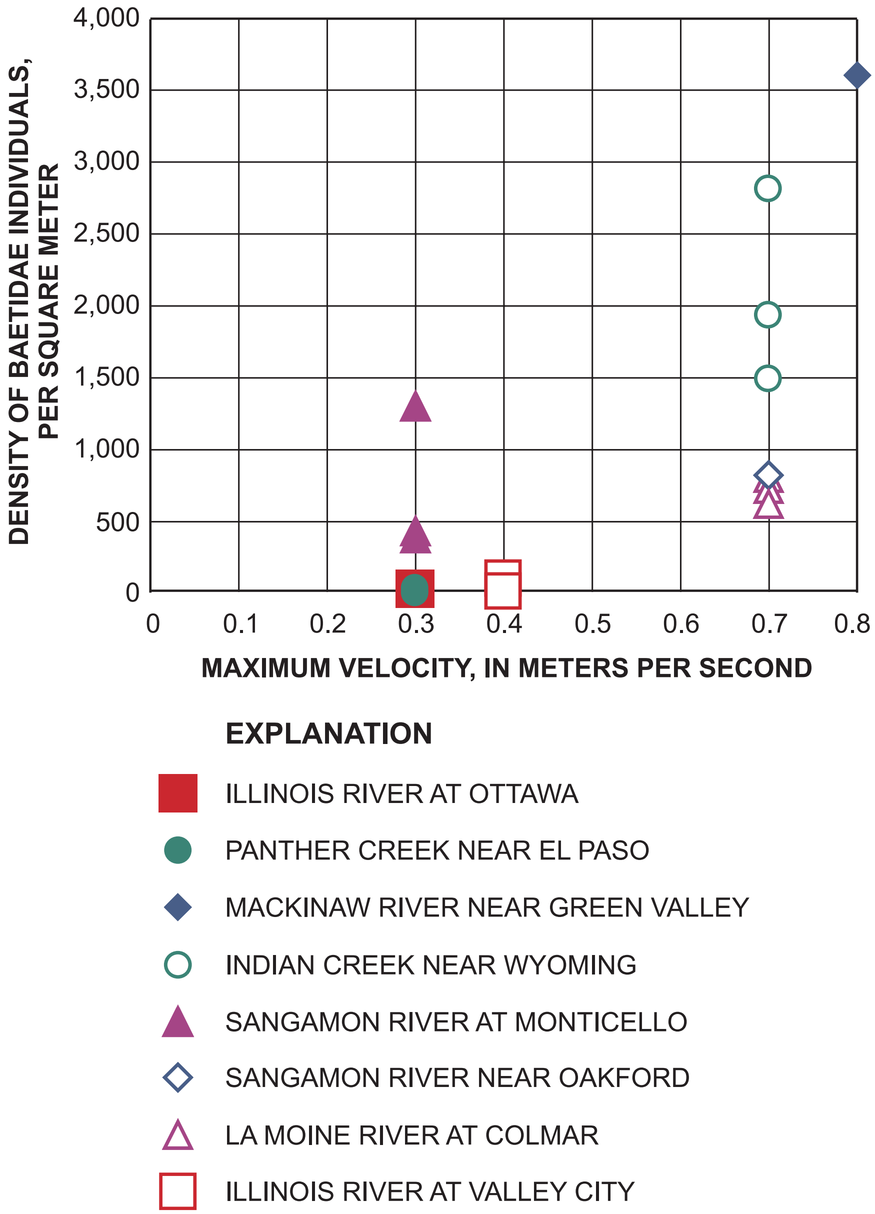


Figure 41. Maximum water velocities during low-flow sampling and Baetidae density for stations in the lower Illinois River Basin, 1996–98.

stream reaches with predominantly woody-snag cover, whereas sunfish communities were most abundant in areas with slow water velocities. Hydropsychidae, Chironomidae, and Baetidae were the most abundant benthic macroinvertebrate families collected throughout the region, but stream size and water velocity were important to benthic macroinvertebrate community composition. *Tricorythodes* mayflies and Elmidae had higher relative abundance at sites in small- and moderate-size drainage basins, and Baetidae density was greatest in reaches with the highest water velocity.

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TABLES

Table 1. Basin characteristics of selected stations sampled in the lower Illinois River Basin, Illinois, 1996–98

[USGS, U.S. Geological Survey; km^2, square kilometers; km, kilometers; km/km^2, kilometers per square kilometers; m, meters; mm, millimeters; -, no data collected]

Characteristics	Illinois River at Ottawa, Ill.[1]	Panther Creek near El Paso, Ill.	Mackinaw River near Green Valley, Ill.	Indian Creek near Wyoming, Ill.	Sangamon River at Monticello, Ill.	Sangamon River near Oakford, Ill.	La Moine River at Colmar, Ill.	Illinois River at Valley City, Ill.[2]
USGS, station identification number	05553500	05567000	05568000	05568800	05572000	05583000	05584500	05586100
Drainage area[3] (km^2)	28,400	243	2,780	164	1,430	13,300	1,700	40,900
Storage[3](km^2)	-	1	42	1	20	300	29	-
Basin length[3] (km)	-	17	121	30	85	187	56	-
Stream length[3] (km)	-	22	199	41	144	367	106	-
Perennial stream length[3] (km)	-	108	2,506	171	1,346	11,249	1,497	-
Drainage density[3] (km/km^2)	-	.4	.8	.9	.8	.7	.7	-
Minimum elevation[3] (m)	-	207	151	194	198	140	159	-
Maximum elevation[3] (m)	-	234	290	261	289	289	246	-
Annual mean precipitation[4] (mm)	-	929	939	945	940	959	952	-
Drainage shape[3]	-	.9	4.0	4.2	3.8	2.0	1.4	-
Basin relief[3] (m)	-	27	139	67	91	149	87	-
Land use[5] (percentage in basin)								
Urban high density	-	0.2	0.3	0.2	0.2	0.5	0.2	0.4
Urban medium density	-	.5	.4	.1	.6	1.1	.1	.6
Urban low density	-	.0	.3	.5	.2	.4	.4	.5
Major roadways	-	.6	.5	.3	.5	.5	.3	.5
Active railroads	-	.1	.2	.0	.3	.3	.2	.2
Abandoned railroads	-	.2	.1	.0	.1	.1	.0	.1
Row crop	-	87.3	74.9	76.3	80.9	74.6	62.9	64.6
Small grains	-	.9	2.0	1.9	1.9	3.0	7.8	4.6
Orchards/nurseries	-	.0	.0	.0	.0	.0	.0	.0
Urban grassland	-	.4	.6	1.4	1.1	1.4	.7	1.0
Rural grassland	-	8.3	13.4	16.5	10.4	11.7	14.2	14.6
Deciduous forest closed canopy	-	.1	3.6	1.6	.8	2.6	9.7	7.8
Deciduous forest open canopy	-	.2	1.4	.0	.5	.7	1.1	1.2
Coniferous forest	-	.0	.0	.0	.0	.0	.0	.1
Open water	-	.1	.4	.0	.2	.7	.1	.9
Perennial streams	-	.7	.8	.7	1.0	.8	.7	.8
Shallow marsh/wet meadow	-	.1	.1	.0	.2	.2	.4	.2
Deep marsh	-	.0	.0	.0	.0	.0	.0	.1
Forested wetland	-	.2	.7	.3	.8	1.1	1.0	1.4
Shallow water wetlands	-	.1	.2	.0	.2	.2	.1	.6
Barren land	-	.0	.0	.0	.0	.0	.0	.0

Table 1. Basin characteristics of selected stations sampled in the lower Illinois River Basin, Illinois, 1996–98—Continued

Characteristics	Illinois River at Ottawa, Ill.[1]	Panther Creek near El Paso, Ill.	Mackinaw River near Green Valley, Ill.	Indian Creek near Wyoming, Ill.	Sangamon River at Monticello, Ill.	Sangamon River near Oakford, Ill.	La Moine River at Colmar, Ill.	Illinois River at Valley City, Ill.[2]
Surficial deposits[6] (percentage in basin)								
Forest soils								
Thick loess	-	3.1	18.3	25.3	0.0	9.6	31.4	23.8
Moderate to thin loess over sand	-	.0	.0	.0	.0	1.5	.0	.5
Moderately thick loess	-	.0	1.0	.0	1.5	2.4	.0	1.2
Moderately thick to thin loess or silt	-	.0	.0	.0	.6	.3	.0	.4
Thin loess on loam or sandy loam	-	.0	.0	.0	2.9	.3	.0	.1
Thin loess on silty clay loam	-	.0	.0	.0	2.9	.3	.0	.1
Thick sand	-	.0	.0	.0	.0	.3	.0	1.3
Sandy to clayey alluvial sediments on bottomlands	-	.0	.0	.0	.0	2	.0	.6
Prairie soils								
Thick loess	-	.4	40.2	68.1	16.5	51.8	60.4	37.7
Moderate to thin loess	-	.0	.0	.0	.0	.2	.0	.1
Moderate to thin loess over sand	-	.0	.0	.0	.0	3.2	.0	1.2
Moderately thick loess	-	96.5	17.1	.0	10.8	7.2	.0	8.4
Moderately thick to thin loess or silt	-	.0	3.2	.0	20.1	8.4	.0	6.3
Thin loess on loam or sandy loam	-	.0	12.3	.0	23.0	4.7	.0	3.1
Thin loess on silty clay loam	-	.0	3.0	.0	14.2	1.9	.0	2.0
Thin loess on silty clay or clay	-	.0	.0	.0	5.1	.5	.0	2.1
Thin loam or silt over gravel	-	.0	.0	.0	.1	.0	.0	.2
Thin silt or loam on sand and loam	-	.0	.0	.0	.5	.6	.0	.5
Thick sand	-	.0	.0	.0	.0	.3	.0	2.1
Sandy to clayey alluvial sediments on bottomlands	-	.0	4.9	6.5	1.9	5.9	8.3	7.3
Water	-	.0	.2	.0	.0	.5	.0	.9

Table 1. Basin characteristics of selected stations sampled in the lower Illinois River Basin, Illinois, 1996–98—Continued

Characteristics	Illinois River at Ottawa, Ill.[1]	Panther Creek near El Paso, Ill.	Mackinaw River near Green Valley, Ill.	Indian Creek near Wyoming, Ill.	Sangamon River at Monticello, Ill.	Sangamon River near Oakford, Ill.	La Moine River at Colmar, Ill.	Illinois River at Valley City, Ill.[2]
Bedrock Geology[6] (percentage in basin)								
Cretaceous								
Undifferentiated	-	0.0	0.0	0.0	0.0	0.0	0.0	0.1
Pennsylvanian								
Mattoon	-	.0	.0	.0	.0	5.1	.0	1.6
Bond	-	19.9	35.0	.0	30.1	38.2	.0	18.4
Modesto	-	80.1	38.5	7.5	10.6	40.6	.0	24.1
Carbondale	-	.0	25.6	92.5	3.3	10.2	22.6	34.4
Spoon	-	.0	.9	.0	8.8	1.0	16.9	7.7
Abbott	-	.0	.0	.0	.0	.0	7.7	1.2
Mississippian								
Upper Valmeyeran	-	.0	.0	.0	.0	.0	13.7	1.7
Middle Valmeyeran	-	.0	.0	.0	.0	.0	29.3	3.9
Lower Valmeyeran	-	.0	.0	.0	1.6	.2	10.0	2.4
Kinderhookian	-	.0	.0	.0	5.9	.6	.0	.2
Devonian								
Upper	-	.0	.0	.0	9.0	1.0	.0	.3
Middle	-	.0	.0	.0	21.2	2.2	.0	.7
Silurian								
Undifferentiated	-	.0	.0	.0	9.4	1.0	.0	1.4
Ordovician								
Maquoketa	-	.0	.0	.0	.0	.0	.0	.1
Galena-Platteville	-	.0	.0	.0	.0	.0	.0	.7
Ancell	-	.0	.0	.0	.0	.0	.0	.8
Prairie du Chien	-	.0	.0	.0	.0	.0	.0	.1

[1]This station is the upstream boundary for the basin; therefore, these values were not calculated as a part of this study.
[2]Values are calculated only for the basin area between the upstream boundary at Ottawa, Ill. and the downstream boundary at Valley City, Illinois.
[3]U.S. Geological Survey, 1985
[4]Midwest Climate Center, 1996.
[5]Multiple resolution land cover from the Illinois Department of Natural Resources, 1996.
[6]Green, 1990.

Table 2. Segment characteristics of selected stations sampled in the lower Illinois River Basin, Illinois, 1996–98

[USGS, U.S. Geological Survey; -, no data collected; m/km, meter per kilometer]

Characteristics	Illinois River at Ottawa, Ill.	Illinois River near Lock and Dam at Starved Rock, Ill.	Panther Creek near El Paso, Ill.	Mackinaw River near Green Valley, Ill.	Indian Creek near Wyoming, Ill.	Sangamon River at Monticello, Ill.	Sangamon River near Oakford, Ill.	La Moine River at Colmar, Ill.	Illinois River at Valley City, Ill.
USGS station identification number	05553500	05553800	05567000	05568000	05568800	05572000	05583000	05584500	05586100
1:24,000 scale map name	Ottawa	La Salle, Starved Rock	Benson	Delavan North	Wyoming	Monticello	Oakford	Plymouth	Griggsville
Map year	1970	1993, 1970	1983	1971	1983	1979	1971	1974	1980
Segment code	05553500	05553800	05567000	05568000	05568800	05572000	05583000	05584500	05586100
State	Illinois	Illinois	Illinois	Illinois	Illinois	Illinois	Illinois	Illinois	Illinois
County	La Salle	La Salle	Woodford	Tazewell	Stark	Piatt	Mason	Mc Donough	Scott
Township	33 N	33 N	27 N	23 N	12 N	18 N	19 N	04 N	15 N
Range	03 W	03 W	01 E	05 W	06 E	05 E	08 W	04 W	14 W
Section	11	21	26	12	17	12	3	18	34
Segment length (meters)[1]	-	-	3,654	17,040	11,029	7,876	3,353	3,144	-
Side slope gradient (percent)	-	-	4.0	1.2	4.7	1.7	1.6	2.0	-
Altitude at gage (meters above sea level)	-	-	201	145	188	191	138	150	127
Segment gradient (m/km)	-	-	.02	.01	.02	.02	.02	.02	-
Channel sinuosity[1]	-	-	1.1	1.5	1.5	1.3	1.0	1.1	-
Stream order (Strahler)[2]	7	7	4	5	3	5	7	4	8
Stream order (Shreve)[2]	1,443	-	17	168	12	76	737	10	3,724

[1]U.S. Geological Survey, 1985.
[2]Elassal and Caruso, 1983.

Table 3. Reach characteristics at selected stations in the lower Illinois River Basin, Illinois, 1996–98

[m, meters; -, no data collected; m/s, meters per second; mm, millimeters]

Characteristics	Illinois River at Ottawa, Ill.	Illinois River near Lock and Dam at Starved Rock, Ill.	Panther Creek near El Paso, Ill.	Mackinaw River near Green Valley, Ill.	Indian Creek near Wyoming, Ill.	Sangamon River at Monticello, Ill.	Sangamon River near Oakford, Ill.	La Moine River at Colmar, Ill.	Illinois River at Valley City, Ill.
Bankfull width (m)	-	145	16	65	18	36	112	34	161
Bankfull depth (m)	-	6	2	4	3	3	6	6	6
Width-to-depth ratio	-	25	8	15	6	11	19	5	26
Mean measured depth (m)	3.4	2.9	.3	.7	.3	.8	1.0	1.0	3.2
Maximum measured depth (m)	5.2	4.5	.8	1.3	.8	1.8	1.6	2.0	4.9
Mean velocity (m/s)	.2	.6	.0	.2	.3	.1	.2	.1	.2
Maximum velocity (m/s)	.3	1	.2	.8	.7	.3	.7	.7	.4
Minimum velocity (m/s)	.2	.3	0	0	0	0	0	0	.1
Mean canopy angle (degrees)	161	149	15	114	93	54	141	48	127
Mean bank height (m)	1	3	2	3	3	2	5	6	3
Mean bank width (m)	24	7	3	5	5	7	5	9	10
Mean bank angle (degrees)	53	27	35	41	34	24	44	35	20
Reach water-surface gradient (percent)	-	-	.02	.01	.8	.03	.06	.06	-
					Percentage of sample				
Bank material diameter:									
Smaller than 0.002 mm (clay)	-	-	21	15	16	28	14	19	-
Smaller than 0.004 mm (silt)	-	-	24	17	18	32	16	21	-
Smaller than 0.062 mm (sand)	-	-	64	51	56	63	55	69	-
Smaller than 2.00 mm (gravel)	-	-	97	90	99	100	99	100	-
					Percentage of sample				
Bed material diameter:									
Smaller than 0.002 mm (clay)	-	-	3	1	3	3	0	13	-
Smaller than 0.004 mm (silt)	-	-	3	1	3	3	0	15	-
Smaller than 0.062 mm (sand)	-	-	8	3	7	7	1	48	-
Smaller than 2.00 mm (gravel)	-	-	52	76	66	81	83	95	-
					Percentage of reach in each category				
Stream features:									
Undercut banks	0	0	1.4	0	.1	.4	0	.7	0
Woody snags	9.0	0	2.5	19.0	.2	14.8	13.5	6.8	1.0
Sloughs	0	0	0	0	0	6.5	0	0	0
Boulder	0	0	0	0	0	0	0	0	0
Macrophytes-submerged	0	0	0	0	0	0	0	0	0
Overhanging vegetation	0	0	.2	0	0	0	0	0	0

Table 3. Reach characteristics at selected stations in the lower Illinois River Basin, Illinois, 1996–98—Continued

Characteristics	Illinois River at Ottawa, Ill.	Illinois River near Lock and Dam at Starved Rock, Ill.	Panther Creek near El Paso, Ill.	Mackinaw River near Green Valley, Ill.	Indian Creek near Wyoming, Ill.	Sangamon River at Monticello, Ill.	Sangamon River near Oakford, Ill.	La Moine River at Colmar, Ill.	Illinois River at Valley City, Ill.
	Percentage of reach in each category								
Embeddedness of gravel, cobble, and boulders:									
No gravel, cobble, or boulder present	-	46	26	61	17	70	100	48	48
76+ percent covered	-	15	35	11	38	22	0	9	0
51–75 percent covered	-	8	17	22	2	4	0	6	0
26–50 percent covered	-	31	7	6	9	2	0	2	2
5–25 percent covered	-	0	13	0	11	0	0	0	0
0–5 percent covered	-	0	2	0	22	2	0	2	0
	Percentage of reach in each category								
Bank shape:									
Concave	58	-	31	0	47	46	33	29	7
Convex	0	-	22	17	14	13	0	13	7
Linear	42	-	47	83	39	42	67	59	86
	Percentage of reach in each category								
Bank erosion;									
Rotational failure	0	-	14	33	20	4	25	4	0
Cut-bank scalloping	75	-	56	42	47	71	67	75	93
Slab failure	0	-	3	0	3	0	0	9	0
Debris avalanche	0	-	0	0	6	0	0	0	0
None	25	-	28	25	25	25	8	13	7
	Percentage of reach in each category								
Bank stability rating:									
Less than 25 percent covered	33	-	30	50	20	75	92	75	50
25–49 percent covered	0	-	36	25	30	17	8	17	21
50–79 percent covered	8	-	25	25	20	9	0	0	29
80+ percent covered	58	-	8	0	31	0	0	8	0

Table 4. Median values for scheduled water-chemistry samples collected at selected stations in the lower Illinois River Basin, 1997

[Original raw data can be found in Wicker and others, 1996; Wicker and others, 1997; and LaTour and others, 1998. mg/L, milligrams per liter; mm, millimeter; m^3/s, cubic meters per second; °C, degrees Celsius; µS/cm, microSiemens per centimeter; $CaCO_3$, calcium carbonate Calculated median values do not include storm samples.]

Station name	Year	Suspended-sediment concentrations (mg/L)[1]	Percentage of suspended sediment less than 0.062 mm[2] (silt and clay)	Discharge (m^3/s)	Water temperature (°C)	Air temperature (°C)	pH (Standard units)	Specific conductance (µS/cm at 25°C)	Dissolved oxygen (mg/L)	Alkalinity (mg/L as $CaCO_3$)
Illinois River at Ottawa, Ill.	1997	64	97	377	21	26	8	703	10	165
Panther Creek near El Paso, Ill.	1997	60	85	.2	16	23	8	830	9	256
Mackinaw River near Green Valley, Ill.	1997	68	76	3	17	20	8	637	11	237
Indian Creek near Wyoming, Ill.	1997	88	72	.7	17	22	8	683	11	241
Sangamon River at Monticello, Ill.	1997	116	88	5	16	23	8	614	9	218
Sangamon River near Oakford, Ill.	1997	145	90	28	17	21	8	729	12	200
La Moine River at Colmar, Ill.	1997	128	97	5	18	22	8	509	9	172
Illinois River at Valley City, Ill.	1997	147	98	617	17	20	8	684	7	184

[1]These values are the median of the sample results.

[2]Typically considered to be silt and clay-sized particles.

Table 5. Tree species at selected stations in the lower Illinois River Basin, Illinois, 1996–98

[m^2, square meters; -, data not collected]

Scientific species name	Common name	Illinois River near Lock and Dam at Starved Rock, Ill.		Panther Creek near El Paso, Ill.		Mackinaw River near Green Valley, Ill.		Indian Creek near Wyoming, Ill.		Sangamon River at Monticello, Ill.		Sangamon River near Oakford, Ill.		La Moine River at Colmar, Ill.		Illinois River at Valley City, Ill.	
		Basal area per 100 m^2	Stem count	Basal area per 100 m^2	Stem count	Basal area per 100 m^2	Stem count	Basal area per 100 m^2	Stem count	Basal area per 100 m^2	Stem count	Basal area per 100 m^2	Stem count	Basal area per 100 m^2	Stem count	Basal area per 100 m^2	Stem count
Acer negundo	Boxelder	0.11	48	0.12	68	0.10	45	-	-	0.00	1	0	8	0.02	18	0.15	2
Acer saccharinum	Silver maple	.28	89	1.65	58	.41	53	0.09	44	.85	30	.07	7	.73	24	.78	19
Acer saccharum	Sugar maple	-	-	-	-	-	-	.13	55	-	-	-	-	-	-	-	-
Aesculus glabra	Ohio buckeye	-	-	-	-	-	-	-	-	-	-	-	-	.06	30	-	-
Carya ovata	Shagbark hickory	-	-	-	-	-	-	-	-	-	-	-	-	.02	5	-	-
Celtis occidentalis	Hackberry	.01	10	.02	6	.07	24	-	-	.07	19	-	-	.02	3	-	-
Cercis canadensis	Eastern redbud	-	-	-	-	-	-	-	-	-	-	-	-	0	1	-	-
Cornus florida	Flowering dogwood	-	-	-	-	0	4	-	-	-	-	-	-	-	-	-	-
Crataegus mollis	Downy hawthorn	-	-	.05	26	0	2	-	-	.10	16	-	-	0	1	-	-
Euonymus atropurpureus	Burningbush	.01	34	-	-	0	1	-	-	-	-	-	-	0	3	.06	50
Fraxinus pennsylvanica	Green ash	.01	6	.05	22	.01	16	0	1	.48	17	-	-	0	7	0	4
Gleditsia triacanthus	Honeylocust	-	-	.37	15	-	-	-	-	.07	2	-	-	.01	2	-	-
Juglans cinerea	Butternut	-	-	-	-	-	-	-	-	-	-	-	-	.00	1	-	-
Juglans nigra	Black walnut	-	-	-	-	.02	5	.06	6	-	-	-	-	.10	8	-	-
Maclura pomifera	Osage orange	-	-	.05	12	.03	24	-	-	.01	1	-	-	.02	9	-	-
Morus rubra	Red mulberry	.03	16	.02	22	.02	7	-	-	.03	6	-	-	0	5	0	1
Platanus occidentalis	American sycamore	-	-	-	-	.10	1	-	-	-	-	-	-	.08	14	-	-
Populus deltoides	Eastern cottonwood	.16	5	-	-	0	1	-	-	-	-	0	3	-	-	.51	12
Prunus serotina	Black cherry	-	-	-	-	-	-	.02	2	-	-	-	-	-	-	-	-
Quercus alba	White oak	-	-	-	-	-	-	0	1	-	-	-	-	-	-	-	-
Quercus macrocarpa	Bur oak	-	-	-	-	-	-	-	-	-	-	-	-	.01	2	-	-
Quercus velutina	Black oak	-	-	-	-	-	-	-	-	-	-	-	-	0	1	-	-
Rhamnus cathartica	Common buckthorn	.02	68	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Robinia pseudoacacia	Black locust	.36	34	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Salix exigua	Sandbar willow	.01	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Salix nigra	Black willow	-	-	-	-	.02	1	-	-	-	-	-	-	-	-	-	-
Ulmus rubra	Slippery elm	.03	8	.20	12	.03	18	.03	7	.10	8	0	4	.04	16	.02	11
Viburnum sp.	Viburnum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.01	10

Table 6. Distribution of fish groupings in the lower Illinois River Basin, Illinois, 1996–98

Fish groups[1]	Illinois River at Ottawa, Ill. for 1998	Panther Creek near El Paso, Ill. for 1997	Mackinaw River near Green Valley, Ill. for 1997	Indian Creek near Wyoming, Ill. for 1997	Sangamon River at Monticello, Ill. for 1997	Sangamon River near Oakford, Ill. for 1997	La Moine River at Colmar, Ill. for 1997	Illinois River at Valley City, Ill. for 1998
Abundance								
Number of fish	194	168	143	218	44	75	74	100
Number of taxa								
Total taxa	22	21	22	15	12	15	19	15
Omnivores	6	2	8	3	3	4	4	2
Insectivores	3	6	3	5	1	1	3	1
Top carnivores	6	2	4	0	1	6	3	8
Other	7	11	7	7	7	4	9	4
Relative abundance (percentage)								
Omnivores	61	9	27	35	27	48	53	38
Insectivores	9	68	34	39	23	11	16	1
Top carnivores	16	2	3	0	5	15	7	45
Other	14	21	36	26	45	26	24	16
Number of taxa								
Intolerant[2]	4	6	7	2	3	3	2	1
Minnows[3]	6	8	7	9	3	3	6	2
Suckers[4]	5	3	9	3	4	4	5	1
Sunfishes[5]	4	3	0	1	2	1	1	1
Darters[6]	0	4	0	2	1	0	2	0
Other	7	3	6	0	2	7	5	11
Relative abundance (percentage)								
Intolerant	6	12	15	5	34	11	3	1
Minnows	18	77	44	81	39	17	53	15
Suckers	15	5	52	6	34	35	8	3
Sunfish	4	3	0	1	14	1	4	4
Darters	0	13	0	12	2	0	9	0
Other	63	2	4	0	11	47	26	78

[1]Determined by Bertrand and others (1996) and Smith (1979).
[2]The group intolerant includes fish from other groupings.
[3]Includes all cyprinids.
[4]Includes all catostomids.
[5]Includes all *Lepomis*, *Ambloplites*, and *Pomoxis*.
[6]Includes all *Percina*, *Ammocrypta*, and *Etheostoma.*

Table 7. Relative abundance of most common benthic macroinvertebrate families collected in epidendric samples at selected stations in the lower Illinois River Basin, Illinois, 1996–98

Station name	Leptohyphidae	Baetidae	Heptageniidae	Hydropsychidae	Elmidae	Chironomidae	Other
		1996					
Panther Creek near El Paso, Ill.	3.6	0.5	11.3	0.9	24.0	39.4	20.3
Mackinaw River near Green Valley, Ill.	.4	33.6	2.5	34.9	.4	17.8	10.4
Indian Creek near Wyoming, Ill.	16.6	19.9	2.7	11.8	6.7	15.9	26.5
Sangamon River at Monticello, Ill.	10.9	8.0	7.5	45.5	3.9	9.4	14.8
Sangamon River near Oakford, Ill.	0	3.3	0	48.7	0	39.7	8.3
La Moine River at Colmar, Ill.	1.9	12.7	22.8	29.1	1.5	17.2	14.8
		1997					
Illinois River near Lock and Dam at Starved Rock, Ill.	0	.0	0	82.9	0	14.3	2.8
Panther Creek near El Paso, Ill.	1.7	2.4	1.0	4.1	3.4	68.9	18.4
Indian Creek near Wyoming, Ill.	4.2	28.6	1.0	24.6	3.5	8.2	30.0
Sangamon River at Monticello, Ill.	18.8	9.2	4.6	37.4	14.5	6.9	8.6
La Moine River at Colmar, Ill.	4.2	16.0	11.9	43.6	2.7	7.8	13.8
Illinois River at Valley City, Ill.	1.8	2.8	.3	18.8	0	42.0	34.3
		1998					
Illinois River at Ottawa, Ill.	0.4	.2	.3	21.0	.2	63.6	14.3
Panther Creek near El Paso, Ill.	1.0	0	.7	1.5	10.7	69.2	16.7
Indian Creek near Wyoming, Ill.	1.4	25.4	5.0	22.9	6.5	24.2	14.6
Sangamon River at Monticello, Ill.	4.3	2.7	8.1	68.6	4.8	9.5	2.0
La Moine River at Colmar, Ill.	1.7	13.2	5.4	36.7	2.1	29.6	11.5
Illinois River at Valley City, Ill.	1.1	.2	.9	53.8	.5	28.8	14.6

Table 8. Number of adult Ephemeroptera, Plecoptera, and Trichoptera (EPT) taxa found during black-light sampling in 1997 and total benthic macroinvertebrate taxa and EPT taxa identified during benthic macroinvertebrate sampling at selected stations in the lower Illinois River Basin, Illinois, 1996–98

[-, data not collected]

Station name	Adult EPT taxa	Total taxa			EPT taxa		
	1997	1996	1997	1998	1996	1997	1998
Illinois River at Ottawa, Ill.	-	-	-	17	-	-	8
Illinois River near Lock and Dam at Starved Rock, Ill.	29	-	16	-	-	6	-
Panther Creek near El Paso, Ill.	31	29	35	39	6	5	9
Mackinaw River near Green Valley, Ill.	32	19	-	-	8	-	-
Indian Creek near Wyoming, Ill.	38	32	25	46	11	9	11
Sangamon River at Monticello, Ill.	34	29	31	30	11	10	12
Sangamon River near Oakford, Ill.	19	16	-	-	3	-	-
La Moine River at Colmar, Ill.	24	20	35	52	7	14	17
Illinois River at Valley City, Ill.	24	-	19	19	-	6	7