Fish Community and Habitat Data at Selected Sites in the White River Basin, Indiana, 1993–95

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FOREWORD

The mission of the U.S. Geological Survey (USGS) is to assess the quantity and quality of the earth resources of the Nation and to provide information that will assist resource managers and policymakers at Federal, State, and local levels in making sound decisions. Assessment of water-quality conditions and trends is an important part of this overall mission.

One of the greatest challenges faced by water-resources scientists is acquiring reliable information that will guide the use and protection of the Nation's water resources. That challenge is being addressed by Federal, State, interstate, and local water-resource agencies and by many academic institutions. These organizations are collecting water-quality data for a host of purposes that include: compliance with permits and water-supply standards; development of remediation plans for a specific contamination problem; operational decisions on industrial, wastewater, or water-supply facilities; and research on factors that affect water quality. An additional need for water-quality information is to provide a basis on which regional and national-level policy decisions can be based. Wise decisions must be based on sound information. As a society we need to know whether certain types of water-quality problems are isolated or ubiquitous, whether there are significant differences in conditions among regions, whether the conditions are changing over time, and why these conditions change from place to place and over time. The information can be used to help determine the efficacy of existing water-quality policies and to help analysts determine the need for and likely consequences of new policies.

To address these needs, the Congress appropriated funds in 1986 for the USGS to begin a pilot program in seven project areas to develop and refine the National Water-Quality Assessment (NAWQA) Program. In 1991, the USGS began full implementation of the program. The NAWQA Program builds upon an existing base of water-quality studies of the USGS, as well as those of other Federal, State, and local agencies. The objectives of the NAWQA Program are to:

- Describe current water-quality conditions for a large part of the Nation's freshwater streams, rivers, and aquifers.
- Describe how water quality is changing over time.
- Improve understanding of the primary natural and human factors that affect water-quality conditions.

This information will help support the development and evaluation of management, regulatory, and monitoring decisions by other Federal, State, and local agencies to protect, use, and enhance water resources.

The goals of the NAWQA Program are being achieved through ongoing and proposed investigations of 60 of the Nation's most important river basins and aquifer systems, which are referred to as study units. These study units are distributed throughout the Nation and cover a diversity of hydrogeologic settings. More than two-thirds of the Nation's freshwater use occurs within the 60 study units and more than two-thirds of the people served by public water-supply systems live within their boundaries.

National synthesis of data analysis, based on aggregation of comparable information obtained from the study units, is a major component of the program. This effort focuses on selected water-quality topics using nationally consistent information. Comparative studies will explain differences and similarities in observed water-quality conditions among study areas and will identify changes and trends and their causes. The first topics addressed by the national synthesis are pesticides, nutrients, volatile organic compounds, and aquatic biology. Discussions on these and other water-quality topics will be published in periodic summaries of the quality of the Nation's ground and surface water as the information becomes available.

This report is an element of the comprehensive body of information developed as part of the NAWQA Program. The program depends heavily on the advice, cooperation, and information from many Federal, State, interstate, Tribal, and local agencies and the public. The assistance and suggestions of all are greatly appreciated.

Robert M. Hirsch
Chief Hydrologist

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FIGURES

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TABLES

CONVERSION FACTORS AND ABBREVIATIONS

Multiply	By	To obtain
cubic foot per second (ft^3/s)	0.02832	cubic meter per second
foot (ft)	0.3048	meter
foot per mile (ft/mi)	0.1894	meter per kilometer
feet per second (ft/s)	0.3048	meter per second
mile (mi)	1.609	kilometer
square mile (mi^2)	2.590	square kilometer
inch (in.)	0.2540	meter

The following abbreviations are used in this report:

IBI	Index of Biological Integrity
NAWQA	National Water-Quality Assessment Program
QHEI	Qualitative Habitat Evaluation
USGS	U.S. Geological Survey

Fish Community and Habitat Data at Selected Sites in the White River Basin, Indiana, 1993–95

By Nancy T. Baker *and* Jeffrey W. Frey

Abstract

A fish community study was conducted at selected sites in the White River Basin, Indiana, as part of the U.S. Geological Survey's National Water-Quality Assessment Program. Fish were collected and identified at 11 sites in the White River Basin during June 1993 through September 1995. Fish were collected along a single sampling reach at each of the 11 sites in 1993 and 1995 to compare spatial and temporal variation within the basin. Fish were collected along 3 sampling reaches at 3 of the 11 sites in 1994 to compare variability between reaches at a site. Seven of the study sites were on small streams (17- to 318-square-mile drainages) that could be sampled by wading, and four of the sites were on large rivers (2,444- to 11,305-square-mile drainages) that required sampling by boat. The small streams were selected to be representative of relatively homogeneous combinations of land use, physiography, and geology. The location of the sampling reach, the aquatic habitat characteristics, and the hydrologic conditions during sampling are described for each site. Aquatic habitat data necessary to calculate the Ohio Environmental Protection Agency's Qualitative Habitat Evaluation Index are presented. Other mean stream-reach characteristics such as length, channel width, depth, velocity, bank height, and canopy angle also are documented.

Ninety-one species from 18 families of fish were collected in the 3 years of sampling. The numbers of fish collected increased every year in all but two reaches. Low numbers of fish were collected in 1993 at the four large river sites. The highest species richness was documented in three small streams in the northern part of the basin. The highest family richness was found near the mouth of the White River. One species of fish showed an extension into a new range. The alligator gar (*Lepisosteus spatula*), previously undocumented in the basin, was identified at the White River at Hazleton in 1993.

Fish community data necessary to calculate the Ohio Environmental Protection Agency's Index of Biological Integrity scores are presented. The number of fish species present and their abundance at each site are documented by species, "family" composition (number of fish identified in each of the following groups: sport species, minnow species, sucker species, sunfish species, and darter species), and feeding guild (carnivores, piscivores, insectivores, herbivores, and omnivores).

INTRODUCTION

In 1991, the Indiana District of the U.S. Geological Survey (USGS) began a study of the White River Basin as part of the National Water-Quality Assessment (NAWQA) Program. The long-term goals of the NAWQA Program are to describe the status and trends in the quality of a large, representative part of the Nation's surface- and ground-water resources and to provide a sound,

scientific understanding of the primary natural and human factors affecting the quality of these resources (Hirsch and others, 1988). The White River Basin in Indiana was among the first 20 study units to be investigated as part of this program. One aspect of the study is to collect information about biological communities in streams that helps define the relations among the physical, chemical, and biological characteristics of streams (Gurtz, 1994).

Fish are particularly sensitive indicators of water-quality conditions (Smith, 1971; Fausch and others, 1990). The study of fish community structure is an essential component of the NAWQA Program.

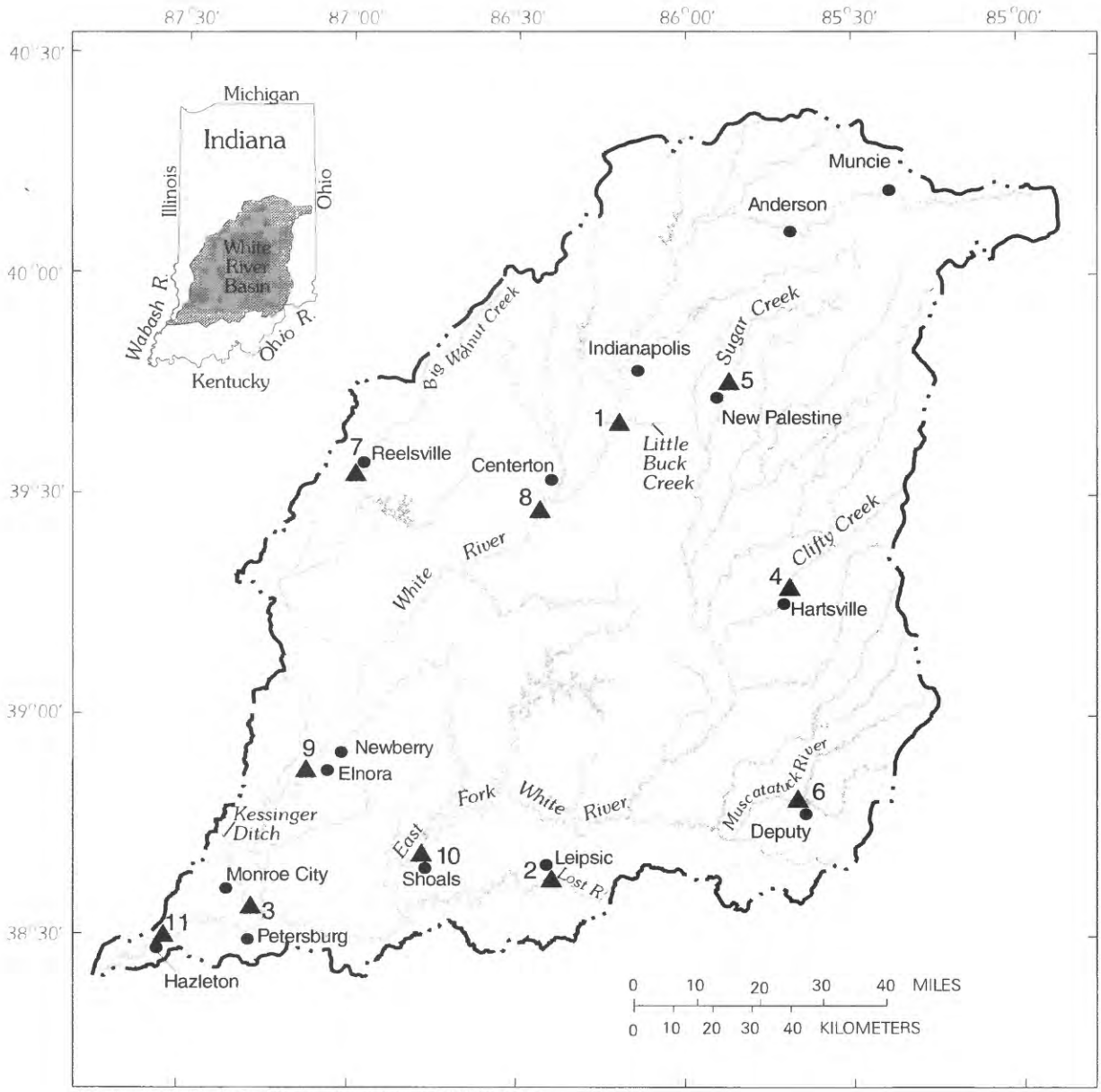
A fish community is a group of fishes belonging to a number of different species that live in the same area and interact with each other. The structure of a fish community is determined in part by the species present, their abundance, and their distribution within the watershed. Changes in fish community structure can be detected through changes in the functional groups, species diversity, and relative abundance (Wootton, 1990).

This report documents fish community data (fish species present and their abundance) collected at 11 sampling sites within the White River Basin from June 1993 through September 1995. Species richness, family composition, feeding guild, and spawning patterns also are documented. A description also is included of the location of the sampling reach, the aquatic habitat, and the hydrologic conditions during sampling at the 11 sampling sites where fish community data were collected.

Description of the White River Basin

The White River Basin is part of the Mississippi River system and drains about 11,350 mi^2 of central and southern Indiana (fig. 1). The White River Basin has two subbasins of nearly equal size. The eastern part of the basin is drained by the East Fork White River, and the western part of the basin is drained by the main stem of the White River. The two forks of the river converge near Petersburg, 46 mi upstream from the confluence of the White River with the Wabash River in southwestern Indiana. Mean annual streamflow for the White River at Petersburg for 1968 through 1995 was 13,200 ft^3/s (Stewart and others, 1996). Streamflow in the basin is typically highest in April and May and lowest in late summer and fall. Mean annual precipitation for 1961 through 1990 ranged from 39 in. in the northeastern part of the basin to 45 in. in the southwestern part of the basin and usually is distributed evenly throughout the year (National Oceanic and Atmospheric Administration, 1994).

The White River Basin study used geologic, geomorphologic, and hydrologic factors to delineate the basin into six hydrogeomorphic regions (fig. 2) (Carter and others, 1995). The till plain, located in the northern half of the basin, and the glacial lowland, located in the southwestern part of the basin, are defined primarily by glacial deposits and have a flat to gently rolling landscape. Bedrock geology is the major factor influencing the bedrock uplands and bedrock karst plain, located in the south-central part of the basin, and the bedrock lowland and plain, located in the southeastern part of the basin. A relatively high relief, hill and valley landscape characterizes the bedrock uplands. The bedrock karst plain is an area of low relief with numerous sinkholes, solution features, and discontinuous surface streams with subterranean drainage (Carter and others, 1995). The bedrock lowland and plain is characterized by steep-sided valleys in the eastern half and a broad and gently undulating landscape in the western half. The fluvial deposits comprise outwash (rock and sand deposited by glacial meltwater) and alluvium (recent materials associated with stream systems) and are found along streams and rivers throughout the basin (Carter and others, 1995). Peak flows generally are higher in streams originating in the bedrock than in those originating in glacial deposits because the storage capacity of the glacial material tends to moderate maximum and minimum flows (Carter and others, 1995). During drought, streams originating in the bedrock typically go dry, whereas streams originating in glaciated deposits tend to have a sustained base flow.



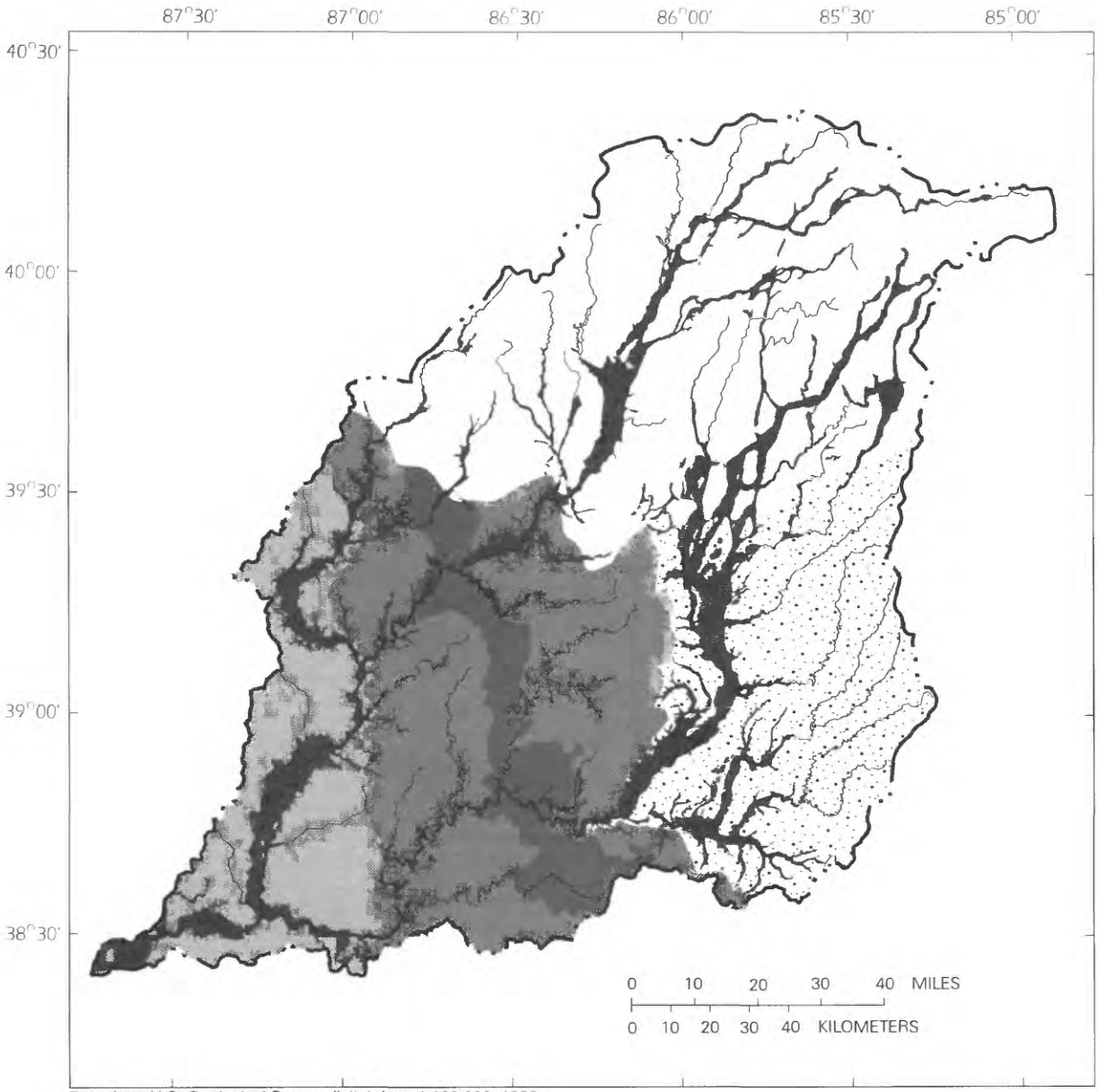
Base from U.S. Geological Survey digital data, 1:100,000, 1983
Albers Equal Area projection
Standard parallels 29°30' and 45°30', central meridian -86°

EXPLANATION

▲1 Fish sampling site (map number corresponds to map number in tables 1-4)

White River Basin boundary

Figure 1. The White River Basin, Ind., and location of fish sampling sites.



Base from U.S. Geological Survey digital data, 1:100,000, 1983
Albers Equal Area projection
Standard parallels 29°30' and 45°30', central meridian -86°

EXPLANATION
HYDROGEOMORPHIC REGIONS

- Till plain
- Glacial lowland
- Bedrock upland
- Bedrock karst plain
- Bedrock lowland and plain
- Fluvial deposits
- White River Basin boundary

Figure 2. Hydrogeomorphic regions of the White River Basin, Ind.

The population of the White River Basin in 1990 was approximately 2.1 million; about 75 percent is located in the northern part of the basin (U.S. Bureau of the Census, 1991). The primary land use is agriculture, which accounts for about 70 percent of the basin (U.S. Geological Survey, 1990). Extensive soybean and corn production occurs in the northern, southwestern, and southeastern parts of the basin. In 1992, about 22 percent of the basin was planted in corn, and about 18 percent was planted in soybeans (U.S. Bureau of the Census, 1994); these two crops accounted for 78 percent of all cropland. The south-central part of the basin is not farmed as extensively as other parts because of the hill and valley landscape; most of the forested land in the basin is located in this region. There is significant industrialization in the cities of Indianapolis, Muncie, and Anderson.

Acknowledgments

James R. Gammon, DePauw University, Greencastle, Ind., and Thomas P. Simon, U.S. Environmental Protection Agency, Environmental Sciences Division, Chicago, Ill., assisted in the identification of fish. James R. Stahl of the Indiana Department of Environmental Management assisted in the collection of fish in nonwadable sampling reaches. The Indiana Department of Environmental Management provided sampling equipment used at nonwadable sites.

SITE SELECTION AND SAMPLING METHODS

Sampling-site selections were made on the basis of the national NAWQA Program design that enables the integration of water-quality information at different spatial scales. In addition, selections followed an overall sampling scheme designed for the White River Basin NAWQA Study. Part of the sampling scheme includes the establishment of basic- and intensive-fixed sampling sites. Fixed sampling sites are located on streams where flow is measured and water samples are collected at regular intervals. The measurements and collections are used to assess the broadscale spatial and temporal character and transport of selected inorganic and organic constituents of streamwater. The assessment of these characteristics is made in relation to hydrologic conditions and environmental settings (Gilliom and others, 1995). Intensive-fixed sampling sites are sampled more frequently than are basic-fixed sites. For the ecological sampling (characterizations of fish, benthic invertebrate, and algal communities), the intensive-fixed sites were sampled for three reaches for 1 year to evaluate spatial variability between reaches at a site; one reach was sampled for 3 consecutive years to determine temporal variability at these sites. Eleven fixed sites (eight basic- and three intensive-fixed sites) were selected for ecological study in the White River Basin (table 1 and fig. 1).

Stream-reach assessments of biological communities and habitat characteristics were conducted at fixed sampling sites to evaluate the effects of physical and chemical characteristics of water and hydrologic conditions on aquatic biota. The stream reach was chosen as the principal sampling unit for the collection of biological data. Stream reaches were selected at each site on the basis of the width of the stream and the geomorphic channel units (pools, riffles, and runs) present. Identification of geomorphic channel units classifies stream habitat at a spatial scale relevant to most biota in streams (Frissell and others, 1986). Stream reaches were selected at wadable sites to include as many different geomorphic channel units as possible within a 492- to 1,640-ft (150–500 m) length (Meador and others, 1993). In streams where repeating geomorphic channel units were not present, the length of the sampling reach was 20 times the channel width. A maximum reach length criterion of 3,281 ft (1,000 m) was used for nonwadable reaches (Meador and others, 1993).

For the ecological component of the study, eight basic-fixed sites were sampled in 1993 along one reach (Lost River near Leipsic, Kessinger Ditch near Monroe City, Clifty Creek near Hartsville, Muscatatuck River near Deputy, Big Walnut

Table 1. Summary of sampling sites, site types, and sampling dates selected for ecological study of the White River Basin, Ind.

[A, B, C, sampling reach; --, no data collected for reaches B and C at these sites]

Map number (fig. 1) and fixed site name	Site type	Sampling dates per reach				
		1993 A	1994 A	1994 B	1994 C	1995 A
Indicator sites						
1. Little Buck Creek near Indianapolis	Intensive	July 8	July 7	July 8	July 11	August 10
2. Lost River near Leipsic	Basic	July 9	--	--	--	August 15
3. Kessinger Ditch near Monroe City	Basic	June 28	--	--	--	August 17
4. Clifty Creek near Hartsville	Basic	August 4	--	--	--	August 18
5. Sugar Creek at New Palestine	Intensive	August 5	July 12	July 14	July 13	August 8
6. Muscatatuck River near Deputy	Basic	September 8	--	--	--	August 16
7. Big Walnut Creek at Reelsville	Basic	September 22	--	--	--	August 4
Integrator sites						
8. White River near Centerton	Basic	September 1	--	--	--	August 22
9. White River near Elnora	Basic	July 16	--	--	--	August 1
10. East Fork White River at Shoals	Basic	July 16	--	--	--	August 3
11. White River at Hazleton	Intensive	August 31	July 27	July 28	July 28	August 2

Creek at Reelsville, White River near Centerton, White River near Elnora, and East Fork White River at Shoals) for algae, macroinvertebrates, and fish; fish also were collected in 1995 in one reach at each of the eight sites (table 1). At three intensive-fixed sites (Little Buck Creek near Indianapolis, Sugar Creek at New Palestine, and White River at Hazleton), one reach was sampled in 1993 and 1995 and three reaches were sampled in 1994 for algae, macroinvertebrates, and fish (table 1). Seven of the sites were classified as indicator sites and four of the sites were classified as integrator sites. Indicator sites are located in small drainage basins and have relatively homogenous land use, physiography, and geology; integrator sites are located in large drainage basins and represent the influence of multiple land uses and physiographic and geologic settings (Gilliom and others, 1995). All of the indicator sites were wadable at the time of sampling; a boat was needed to collect samples at the integrator sites.

Fish were collected with pulsed Direct Current (DC) electroshocking techniques following NAWQA protocols (Meador and others, 1993). Backpack and barge shocking equipment was used at wadable streams, and a specially equipped shocking boat was used at nonwadable sites. A Smith-Root 12-A 400-watt Backpack Electrofisher[1] was used at all wadable sites (Little Buck Creek, Kessinger Ditch, Muscatatuck River, Lost River, Clifty Creek, Big Walnut Creek, and Sugar Creek) for the 1993 sampling. In 1995, a Smith-Root SR-6 Electrofisher Tote Barge powered by a 2.5-GPP Electrofisher generator was used at all wadable sites. In 1994, the backpack shocker was used at Little Buck Creek and the tote barge was used at Sugar Creek. At nonwadable sites (White River near Centerton, near Elnora, at Hazleton, and the East Fork White River at Shoals), a 16-ft flat-bottomed boat equipped with a Coffelt VVP-2E Electrofishing Pulsator with a spherical ball anode was used.

Fish were taxonomically identified to species level, in the field if possible or in the laboratory, by Michael Lydy and Jeffrey W. Frey, U.S. Geological Survey, Indianapolis, Ind.

[1]The use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by the U.S. Government.

Voucher specimens (representatives of specimens collected from each sampling reach) were preserved and stored at the U.S. Geological Survey office in Indianapolis for quality assurance. Photographs also were taken of many specimens for quality assurance. Identifications were based on the following taxonomic keys: "The Fishes of Missouri" by Pflieger (1975), "The Fishes of Ohio" by Trautman (1981), "Fishes of Arkansas" by Robison and Buchanan (1992), and "Handbook of Darters" by Page (1983). Taxonomic nomenclature follows that established by the American Fisheries Society Committee on Names of Fishes (Robins and others, 1991). Taxonomic verifications were conducted by Thomas P. Simon, U.S. Environmental Protection Agency, Chicago, Ill., and James Gammon, DePauw University, Greencastle, Ind.

DESCRIPTION OF BASIN AND HABITAT CHARACTERISTICS FOR SAMPLING SITES

The basin and habitat characteristics reported for each sampling site are the parameters developed by the Ohio Environmental Protection Agency (1989) to compute the Qualitative Habitat Evaluation Index (QHEI). The QHEI is a physical-habitat index designed to provide an empirical, quantified evaluation of the general stream habitat characteristics important to fish communities (Ohio Environmental Protection Agency, 1989).

Basin and Habitat Characteristics

Basin characteristics such as drainage area, land use, mean discharge, stream gradient, and a basin description are reported in this section for each of the fish sampling sites and are summarized in table 2. The location of the sampling reach, aquatic habitat characteristics, and hydrologic conditions during sampling are described in the text for each sampling site. Habitat characteristics include the dominant and subdominant substrate, the presence of silt cover, and the extent of embeddedness of the substrate within the sampling reach (table 3). The extent and type of instream cover available for fish habitat, the riparian vegetation width, flood-plain land use, and bank erosion for the right and left banks of the sampling reach also are described for each site (table 3).

Mean stream reach length, channel width, depth, velocity, bank height, and canopy angle are documented for sites at the time of sampling (table 4). The canopy angle (in degrees) is the measure, at the midpoint of the transect, of the angle of the line of site of the investigator to the tallest structure (for example—a tree, shrub, building, or grass) on each bank (Meador and others, 1993). The means were calculated by taking an average of measurements made at the six transects. For variables that did not change dramatically over the 3-year sampling period (length, bank height, and canopy angle), the mean for the three measurements at Reach A was calculated.

Sampling Sites

Fish sampling sites for the White River Basin are described according to whether the site is an indicator or an integrator site. Indicator sites are located on small streams and typically have a variety of geomorphic channel units, substrates, and instream covers for fish habitat. Integrator sites are located on large rivers and typically have a single geomorphic channel unit (a run), with limited varieties of substrates and instream covers for fish habitat.

Indicator Sites

Little Buck Creek, Lost River, Kessinger Ditch, Clifty Creek, Sugar Creek, Muscatatuck River, and Big Walnut Creek are indicator sites. These sites, with the exception of Little Buck Creek and Muscatatuck River, are indicators of row-crop agriculture in one hydrogeomorphic region (table 2). Little Buck Creek is an indicator of urbanized areas in the till plain, and Muscatatuck River is an indicator of row-crop agriculture and forest in the bedrock lowland and plain (table 2). Sugar Creek, Big Walnut Creek, and Little Buck Creek flow through the till plain hydrogeomorphic region, Kessinger Ditch flows through the glacial lowland, Clifty Creek and the Muscatatuck River flow through the bedrock lowland and plain, and Lost River flows through the karst plain.

Table 2. Basin characteristics for fish sampling sites in the White River Basin, Ind.

[mi^2, square miles; ft^3/s, cubic feet per second; ft/mi, feet per mile]

Map number (fig. 1) and fixed site name	Site number	Drainage basin area (mi^2)	Percent land use[1]				1968–95[2] Mean discharge at gage (ft^3/s)	Stream gradient (ft/mi)	Basin description
			Agri-culture	Forest	Urban	Other			
Indicator sites									
1. Little Buck Creek near Indianapolis	03353637	17.0	42	< 1	57	< 1	23.5[3]	10.0	Urbanized area in till plain
2. Lost River near Leipsic	03373530	34.8	94	5	<1	<1	47.1[4]	10.1	Row-crop agriculture in karst plain
3. Kessinger Ditch near Monroe City	03360895	56.2	94	4	2	<1	67.9[4]	3.9	Row-crop agriculture in glacial lowland
4. Clifty Creek near Hartsville	391732085414401	87.9	98	<1	<1	<1	98.6[5]	12.3	Row-crop agriculture in bedrock lowland and plain
5. Sugar Creek at New Palestine	394340085524601	93.4	95	1	3	1	103[6]	9.8	Row-crop agriculture in till plain
6. Muscatatuck River near Deputy	03366500	293	71	24	4	1	360	1.6	Row-crop agriculture and forest in bedrock lowland and plain
7. Big Walnut Creek at Reelsville	393306086585201	318	83	15	1	1	375[7]	3.1	Row-crop agriculture in till plain
Integrator sites									
8. White River near Centerton	03354000	2,444	82	3	14	1	2,681	2.9	Integrator for till plain urban and agricultural areas
9. White River near Elnora	385234087071801	4,793	71	19	8	2	5,413[8]	1.4	Integrator for main stem before confluence with East Fork White River
10. East Fork White River at Shoals	03373500	4,927	69	25	5	1	5,874	.9	Integrator for East Fork White River
11. White River at Hazleton	03374100	11,305	70	22	6	2	13,200[9]	.8	Integrator for entire White River Basin

[1]U.S. Geological Survey, 1990.

[2]The mean discharge for 1968–95 (27 years) was chosen because 8 of the 11 sites had discharge data available for this period, and it was the longest common period for those sites.

[3]1990–95 mean discharge.

[4]1993–95 mean discharge.

[5]Discharge data are from USGS gaging station 03364500 located 2 miles downstream from sampling site.

[6]Discharge data are from USGS gaging station 03361650 located 1 mile downstream from sampling site.

[7]Discharge data are from USGS gaging station 03357500 located 1 mile downstream from sampling site.

[8]Discharge data are from USGS gaging station 03360500 located at Newberry, 8 miles upstream from sampling site.

[9]Discharge data are from USGS gaging station 03374000 located at Petersburg, 24 miles upstream from sampling site.

Table 3. Habitat characteristics for fish sampling sites in the White River Basin, Ind.

[Habitat characteristic parameters and criterion listed below were developed for the Qualitative Habitat Evaluation Index by the Ohio Environmental Protection Agency (1989)]

Map number (fig. 1) and fixed site name	Substrate				Instream habitat cover		Riparian vegetation width[3]		Flood-plain land use[4]		Bank erosion[5]	
	Dominant	Subdominant	Silt cover[1]	Extent of embeddedness[2]	Extent[6]	Types present[7]	Left bank	Right bank	Left bank	Right bank	Left bank	Right bank
Indicator sites												
1. Little Buck Creek near Indianapolis	Gravel	Sand	Normal	Moderate	Moderate	-- O S D R B -- W	Moderate	Moderate	Open	Open	Moderate	Moderate
2. Lost River near Leipsic	Cobble	Gravel	Moderate	Moderate	Extensive	U O S D R B A W	Very narrow	Moderate	Open	Forest	Moderate	Moderate
3 Kessinger Ditch near Monroe City	Sand	Cobble	Moderate	Moderate	Moderate	U O S D R B -- W	Moderate	Wide	Forest	Forest	Moderate	Heavy
4. Clifty Creek near Hartsville	Boulder	Cobble	Normal	Low	Extensive	U O S D R B A W	Moderate	Moderate	Forest	Forest	None	Moderate
5. Sugar Creek at New Palestine	Gravel	Sand	Moderate	Moderate	Moderate	U O S D R B -- W	Moderate	Moderate	Forest	Residential	Moderate	Moderate
6. Muscatatuck River near Deputy	Sand	Gravel	Moderate	Moderate	Moderate	U O S D R -- -- W	Very narrow	Very narrow	Open	Open	Moderate	Moderate
7. Big Walnut Creek at Reelsville	Sand	Gravel	Moderate	Moderate	Moderate	U -- S D -- B A W	Narrow	Moderate	Open	Forest	Moderate	None
Integrator sites												
8. White River near Centerton	Gravel	Sand	Normal	Low	Moderate	U -- S D R -- -- W	Moderate	Narrow	Forest	Open	None	None
9. White River near Elnora	Sand	Gravel	Normal	Low	Sparse	-- -- S D R -- -- W	Very narrow	Very narrow	Open	Open	Moderate	Heavy
10. East Fork White River at Shoals	Bedrock	Hardpan	Normal	Moderate	Moderate	U O S D R B -- W	Narrow	Moderate	Open	Forest	Moderate	Moderate
11. White River at Hazleton	Sand	Sand	Normal	None	Sparse	U -- S D R -- -- W	Moderate	Moderate	Open	Open	Moderate	Moderate

[1]Normal—includes areas where silt is deposited in small amounts along the stream margin or is present as a "dusting" that appears to have little functional significance.
Moderate—includes extensive coverings of silts but with some areas of cleaner substrates such as riffles.

[2]Low—less than 25 percent of the substrate is covered by fine material.
Moderate—between 50–75 percent of the substrate is covered by fine material.
None—substrate is not covered by fine material.

[3]Very narrow—riparian (stream side) mature vegetation zone generally 3–15 feet wide.
Narrow—riparian vegetation zone 15–30 feet wide.
Moderate—riparian vegetation zone 30–150 feet wide.
Wide—riparian vegetation zone greater than 150 feet wide.

[4]Open—pasture or row crops planted in the flood plain.
Forest—forest or swamp occupying the flood plain.
Residential—residential areas, park, or new field occupying the flood plain.

[5]None—less than 25 percent of the streambank is false, broken down, or eroding.
Moderate—25–50 percent of the streambank is eroding.
Heavy—50–75 percent of the streambank is eroding.

[6]Sparse—instream cover is present in less than 25 percent of the sampling reach.
Moderate—instream cover is present in 25–75 percent of the sampling reach.
Extensive—instream cover is present throughout the sampling reach, generally greater than 75 percent of the sampling reach.

[7]U—undercut banks; O—overhanging vegetation; S—shallows in slow water; D—deep pool; R—rootwads; B—boulders, A—aquatic macrophytes; W—logs and woody debris; --, type not present.

Table 4. Selected mean stream reach characteristics at the time of sampling for sites in the White River Basin, Ind.

[ft, feet; ft/s, feet per second; A, B, C, stream sampling reach; --, no data collected at these sites]

Map number (fig. 1) and fixed site name	Length (ft)			Channel width (ft)					Depth (ft)				
	1993–95 A	1994 B	1994 C	1993 A	1994 A	1994 B	1994 C	1995 A	1993 A	1994 A	1994 B	1994 C	1995 A
Indicator sites													
1. Little Buck Creek near Indianapolis	634	481	745	33	38	66	37	42	0.9	0.8	0.7	0.5	1.0
2. Lost River near Leipsic	911	--	--	38	--	--	--	--	.4	--	--	--	--
3. Kessinger Ditch near Monroe City	517	--	--	38	--	--	--	--	1.2	--	--	--	--
4. Clifty Creek near Hartsville	1,031	--	--	61	--	--	--	--	1.3	--	--	--	--
5. Sugar Creek at New Palestine	731	528	875	44	48	54	52	50	1.6	2.7	.9	1.4	1.5
6. Muscatatuck River near Deputy	990	--	--	64	--	--	--	--	.9	--	--	--	--
7. Big Walnut Creek at Reelsville	740	--	--	102	--	--	--	--	2.5	--	--	--	--
Integrator sites													
8. White River near Centerton	2,510	--	--	190	--	--	--	--	6.9	--	--	--	--
9. White River near Elnora	3,245	--	--	321	--	--	--	--	11.1	--	--	--	--
10. East Fork White River at Shoals	2,905	--	--	330	--	--	--	310	--	--	--	--	7
11. White River at Hazleton	2,795	2,985	2,587	350	445	573	428	361	10.6	--	--	--	7

Map number (fig. 1) and fixed site name	Velocity (ft/s)					Bank height (ft)			Canopy angle (degrees)		
	1993 A	1994 A	1994 B	1994 C	1995 A	1993–95 A	1994 B	1994 C	1993–95 A	1994 B	1994 C
Indicator sites											
1. Little Buck Creek near Indianapolis	1.5	0.59	1.04	0.58	2.06	6	8	10	66	71	33
2. Lost River near Leipsic	.92	--	--	--	--	7	--	--	24	--	--
3. Kessinger Ditch near Monroe City	.21	--	--	--	--	12	--	--	10	--	--
4. Clifty Creek near Hartsville	1.16	--	--	--	--	8	--	--	8	--	--
5. Sugar Creek at New Palestine	.49	.78	1.17	.80	.80	4	3	5	27	26	24
6. Muscatatuck River near Deputy	.36	--	--	--	--	20	--	--	59	--	--
7. Big Walnut Creek at Reelsville	2.81	--	--	--	--	10	--	--	49	--	--
Integrator sites											
8. White River near Centerton	3.7	--	--	--	--	7	--	--	103	--	--
9. White River near Elnora	3.02	--	--	--	--	5	--	--	150	--	--
10. East Fork White River at Shoals	--	--	--	--	.30	19	--	--	70	--	--
11. White River at Hazleton	2.19	--	--	--	.55	11	13	18	135	131	140

Little Buck Creek near Indianapolis

The Little Buck Creek site is located 1.2 river mi upstream from its confluence with the main stem of the White River on the south side of Indianapolis. Land use in the basin is 57 percent urban and 42 percent agriculture. Urban land use is primarily residential with some commercial development. The basin is in an area of suburban Indianapolis undergoing rapid urbanization. Little Buck Creek flows through the till plain and was selected as an indicator of non-industrial urban influences in the White River Basin. The drainage area of 17.0 mi^2 makes it the smallest basin sampled in the White River Basin study. The mean discharge for the period of record (1990–95) at the USGS gage (station number 03353637) located at the site is 23.5 ft^3/s (Stewart and others, 1996).

One stream reach was sampled in 1993 and 1995, and three stream reaches were sampled during 1994. The first sampling reach (Reach A) begins 247 ft upstream from the State Road 37 bridge (fig. 3). The mean length for reach A for measurements made in 1993–95 is 634 ft and contains multiple riffle-run stretches, with one pool present at the upstream end of the reach. Reach B begins 218 ft upstream from the upstream end of Reach A. The reach is 481 ft long and contains several riffle areas and two large pool areas. Reach C begins 200 ft upstream from the upstream end of Reach B. Reach C is 745 ft long and contains a riffle-run-riffle stretch at the downstream end of the reach and a continuous run for the remainder of the reach. The gradient of the stream at the site is 10.0 ft/mi.

The bed substrate for all three reaches is primarily unstable gravel and sand (table 3). The riffle areas consist of gravel and cobble, and pool areas are composed of muck and detritus. The silt cover is normal, with small amounts of silt present along the stream margin and on the substrate in the slower moving water. The extent of embeddedness is moderate, with 50 to 75 percent of the substrate covered by fine material. The instream habitat cover is moderate (covers 25–75 percent of the sampling area) and includes overhanging vegetation, shallows in slow water, deep pools, rootwads, boulders, logs and woody debris (table 3). The banks show moderate erosion. A moderate riparian vegetation zone of 30 to 150 ft protects most of the bank. In the few areas where riparian vegetation does not exist, bank erosion is severe. Cropland is present on both sides of the creek in the flood plain.

Mean channel width for Reach A was 33 ft in 1993, 38 ft in 1994, and 42 ft in 1995; mean channel width in 1994 for Reach B was 66 ft and for Reach C was 37 ft (table 4). Mean channel depth for Reach A ranged from 0.8 ft in 1994 to 1.0 ft in 1995; mean channel depth in 1994 was 0.7 ft for Reach B and 0.5 ft for Reach C. Mean velocity for Reach A ranged from 0.59 ft/s in 1994 to 2.06 ft/s in 1995; mean velocity in 1994 was 1.04 ft/s for Reach B and 0.58 ft/s for Reach C. Mean bank height was 6 ft for Reach A for measurements made in 1993–95; mean bank height in 1994 was 8 ft for Reach B and 10 ft for Reach C. The mean canopy angle was 66 degrees for Reach A for measurements made in 1993–95; mean canopy angle in 1994 was 71 degrees for Reach B and 33 degrees at Reach C.

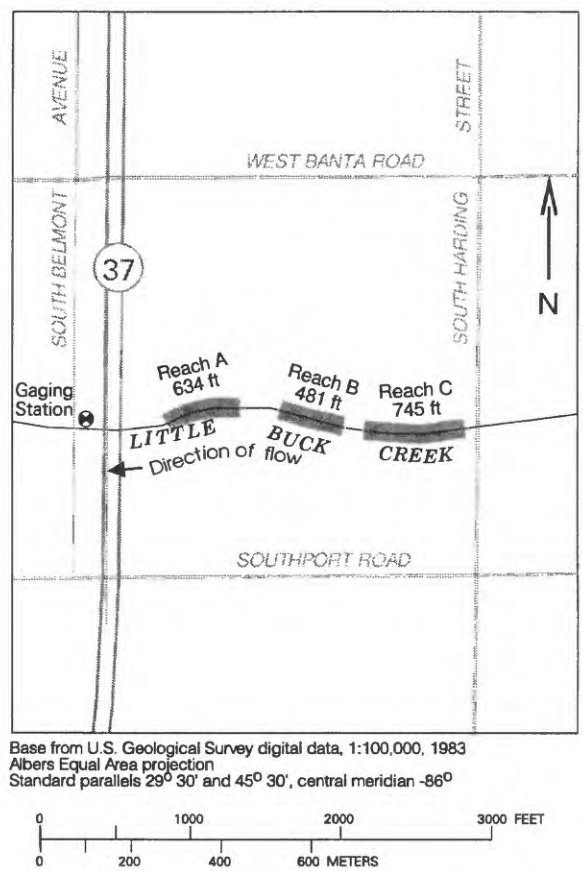


Figure 3. Location of fish sampling reaches, Little Buck Creek near Indianapolis, Ind.

Little Buck Creek is an intermittent stream and has no flow after sustained periods of low rainfall. Figure 4 (page 13) shows the mean daily discharge at Little Buck Creek from May 1993 through September 1995 and the mean daily discharge preceding and during each of the sampling times.

Lost River near Leipsic

The Lost River near Leipsic is located about 75 river mi upstream from its confluence with the East Fork White River and 500 ft upstream from its confluence with Carter's Creek. Ninety-four percent of the land in the basin is used for agriculture. The site was selected because it is indicative of processes occurring in a karst environment (table 2). It has a drainage area of 34.8 mi^2. The mean discharge for the period of record (1993–95) at the USGS gage (station number 03373530) at the site is 47.1 ft^3/s (Stewart and others, 1996).

The sampling reach begins 195 ft upstream from the County Road 500 E. bridge (fig. 5). The sampling reach length is 911 ft with a gradient of 10.1 ft/mi. The reach consists of several riffle-run geomorphic units. Beaver activity is evident at the site, and beaver dams occasionally have changed the riffle-run morphology to a pool-run morphology.

Cobble and gravel are the predominant substrates, but significant amounts of sand are present in the reach. The silt cover and the extent of embeddedness are moderate (table 3). Extensive habitat cover exists within the reach, with greater than 75 percent of the area within the reach providing some type of instream cover. Habitat cover consists of undercut banks, overhanging vegetation, shallows in slow water, deep pools, rootwads, boulders, logs or woody debris and aquatic macrophytes. Bank material is a clay silt mix. Bank erosion is moderate. The riparian vegetation zone is very narrow to moderate along the length of the reach. The flood plain has cropland along the left bank and forest along the right bank.

The mean channel width for Reach A was 38 ft in 1993 (table 4). Mean channel depth for Reach A was 0.4 ft, and mean velocity was 0.92 ft/s. Mean bank height was 7 ft, and the mean canopy angle was 24 degrees.

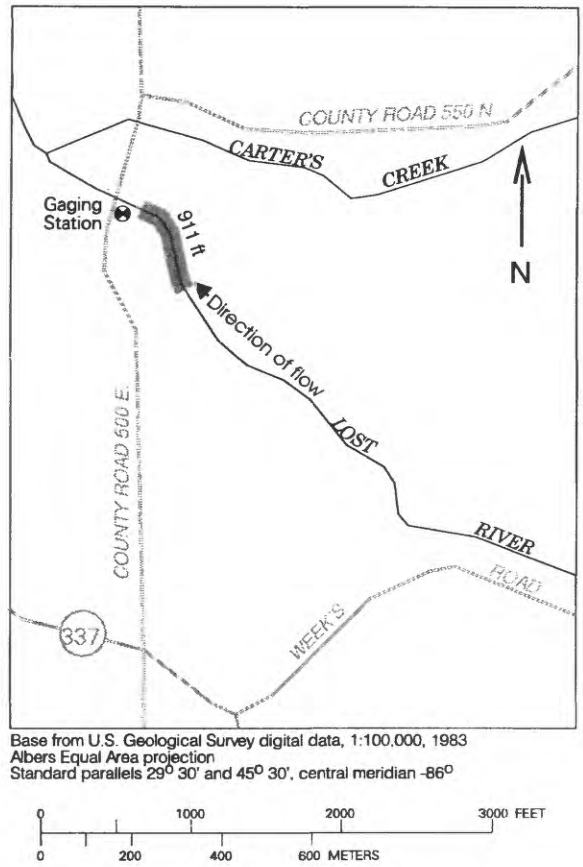


Figure 5. Location of fish sampling reach, Lost River near Leipsic, Ind.

Figure 6 (page 14) shows the mean daily discharge at the Lost River near Leipsic from May 1993 through September 1995 and for the 1993 and 1995 sampling times. Two periods of relatively high streamflow (170 ft^3/s and 157 ft^3/s peak flow) occurred 10 and 5 days preceding sampling in 1995.

Kessinger Ditch near Monroe City

Kessinger Ditch near Monroe City is located 1.8 river mi upstream from its confluence with the main stem of the White River. Row-crop agriculture is the dominant land use (94 percent), and the site was selected to represent an agricultural basin in the glacial lowland (table 2). The site is a small tributary with a drainage area of 56.2 mi^2 that flows entirely through the glacial lowland hydrogeomorphic region. The mean discharge for the period of record (1993–95) at the USGS gage (station number 03360895) located at the site is 67.9 ft^3/s (Stewart and others, 1996).

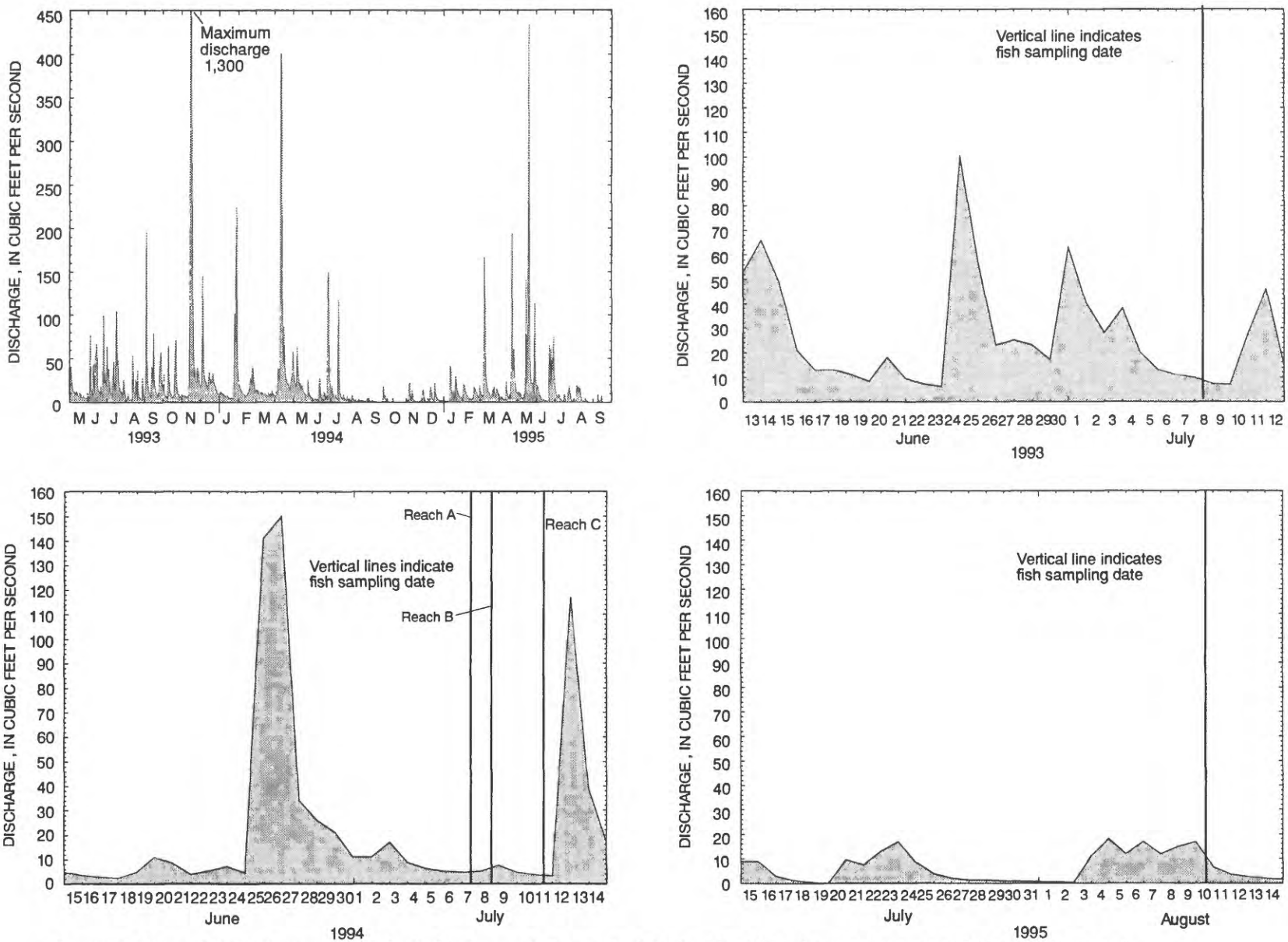


Figure 4. Mean daily discharge at Little Buck Creek near Indianapolis, Ind., for May 1993 through September 1995 and for period preceding and during fish sampling, 1993-95.

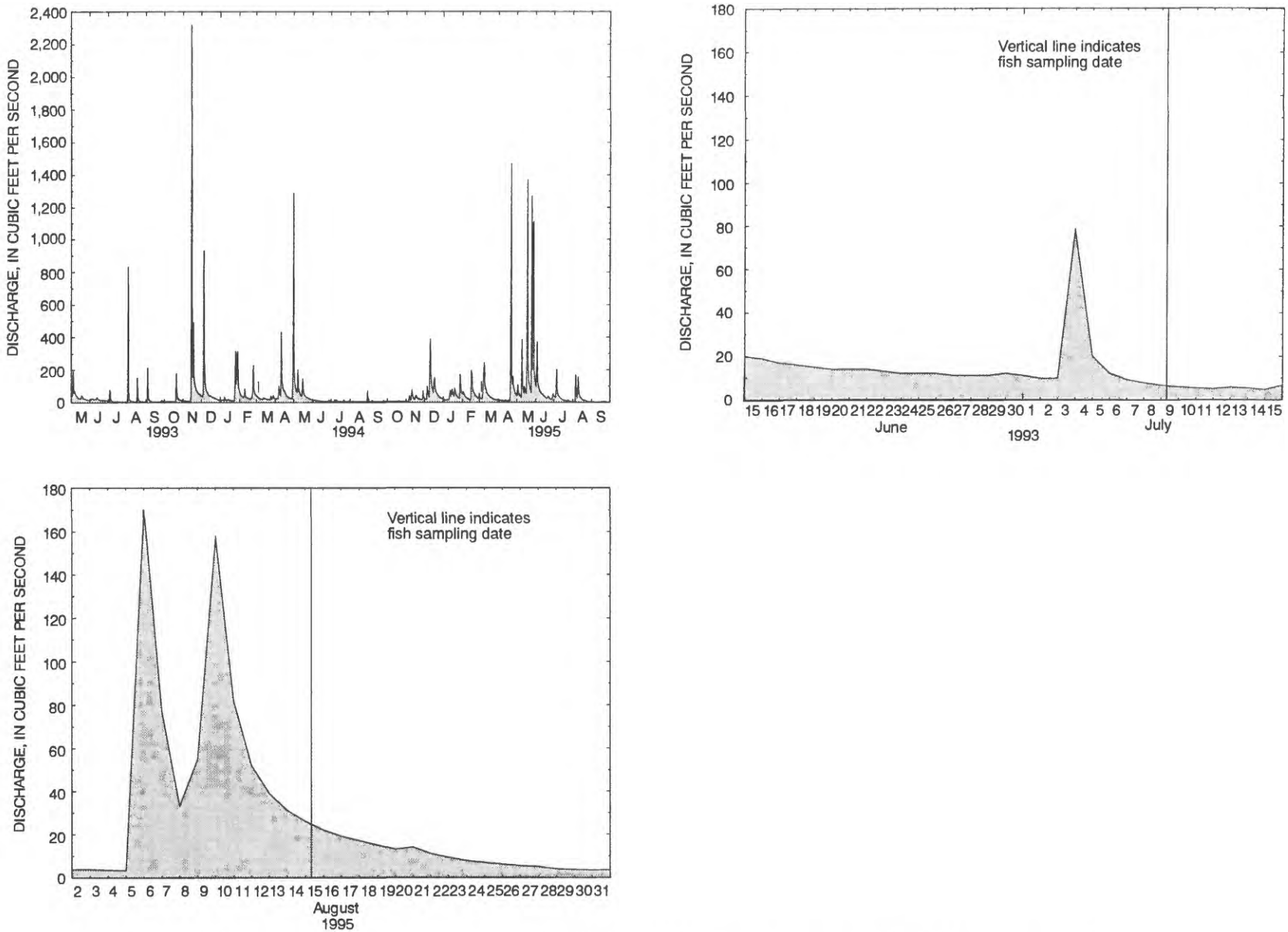


Figure 6. Mean daily discharge at Lost River near Leipsic, Ind., for May 1993 through September 1995 and for period preceding and during fish sampling, 1993 and 1995.

The sampling reach starts 210 ft upstream from the County Road 1000 E. bridge (fig. 7). The sampling reach is 517 ft long with a gradient of 3.9 ft/mi. The reach has two cobble and gravel riffles but mostly contains a continuous run with some small pools.

The bed substrate is predominantly sand and cobble with some sandstone bedrock outcroppings. The silt cover is moderate with extensive coverings of silt in slow water areas. In contrast, the riffle areas have little or no silt covering. The extent of embeddedness is moderate (table 3). The instream cover is moderate and includes undercut banks, overhanging vegetation, shallows in slow water, deep pools, rootwads, boulders, and logs and woody debris. Bank material consists of a clay silt mix. Moderate bank erosion occurs in most places but is heavy in areas with steep banks. There is a moderate to wide riparian vegetation zone within the reach; however, along most of Kessinger Ditch outside the reach, the riparian zone is very narrow to nonexistent. Forested areas are present on both banks of the sampling reach in the flood plain. Most of the flood plain along the rest of the Ditch has open pasture or cropland. The water at the site is nearly always turbid.

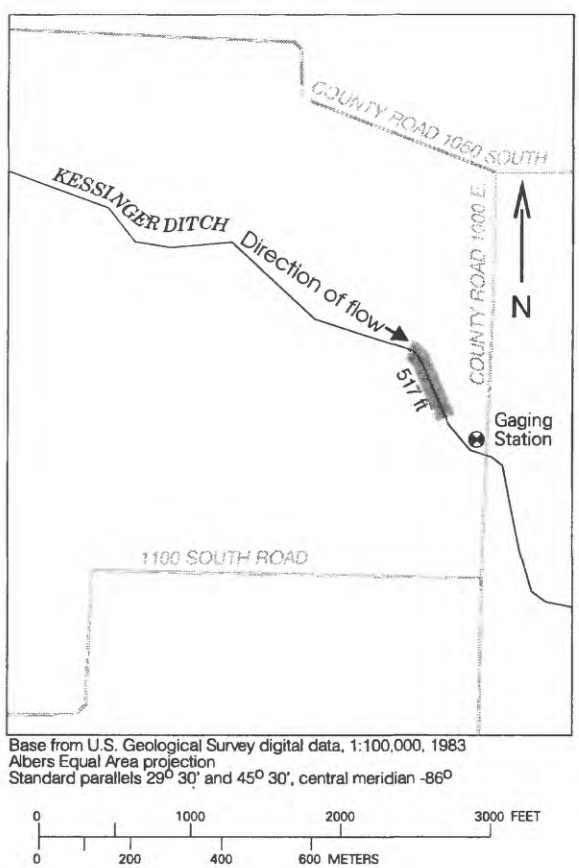


Figure 7. Location of fish sampling reach, Kessinger Ditch near Monroe City, Ind.

The mean channel width for Reach A was 38 ft in 1993 (table 4). Mean channel depth for Reach A was 1.2 ft, and the mean velocity was 0.21 ft/s. Mean bank height was 12 ft, and the mean canopy angle was 10 degrees.

Figure 8 (page 16) shows the mean daily discharge at Kessinger Ditch for May 1993 through September 1995 preceding and during sampling times for 1993 and 1995. A period of relatively high streamflow (680 ft^3/s peak flow) occurred 8 days prior to the 1995 sampling time.

Clifty Creek near Hartsville

Clifty Creek near Hartsville is located 20 river mi upstream from the confluence of Clifty Creek and the East Fork of the White River. The site was selected as an indicator of a predominantly agricultural watershed (98 percent agriculture) in the bedrock lowland and plain hydrogeomorphic region (table 2). The drainage area of the basin is 87.9 mi^2. The mean discharge for 1968 through 1995[2] at the USGS gage (station number 03364500) located about 2 mi downstream from the sampling site (station number 391732085414401) is 98.6 ft^3/s.

The sampling reach begins 150 ft upstream from County Road 1150 E. (fig. 9, page 17). The reach length is 1,031 ft. The reach is composed of several riffle and run geomorphic channel units. The gradient at the site is 12.3 ft/mi.

The bed substrate is predominantly boulder and cobble, with several outcroppings of limestone rock. The silt cover is normal and the extent of embeddedness is low (table 3). The instream habitat cover is extensive and includes undercut banks, overhanging vegetation, shallows in slow water, deep pools, rootwads, boulders, aquatic macrophytes, logs and woody debris. Bank material is predominantly a silt clay mix; however, limestone outcrops also are present on both banks.

[2]The mean discharge for 1968–95 (27 years) was chosen because 8 of the 11 sites had discharge data available for this period, and it was the longest common period for those sites.

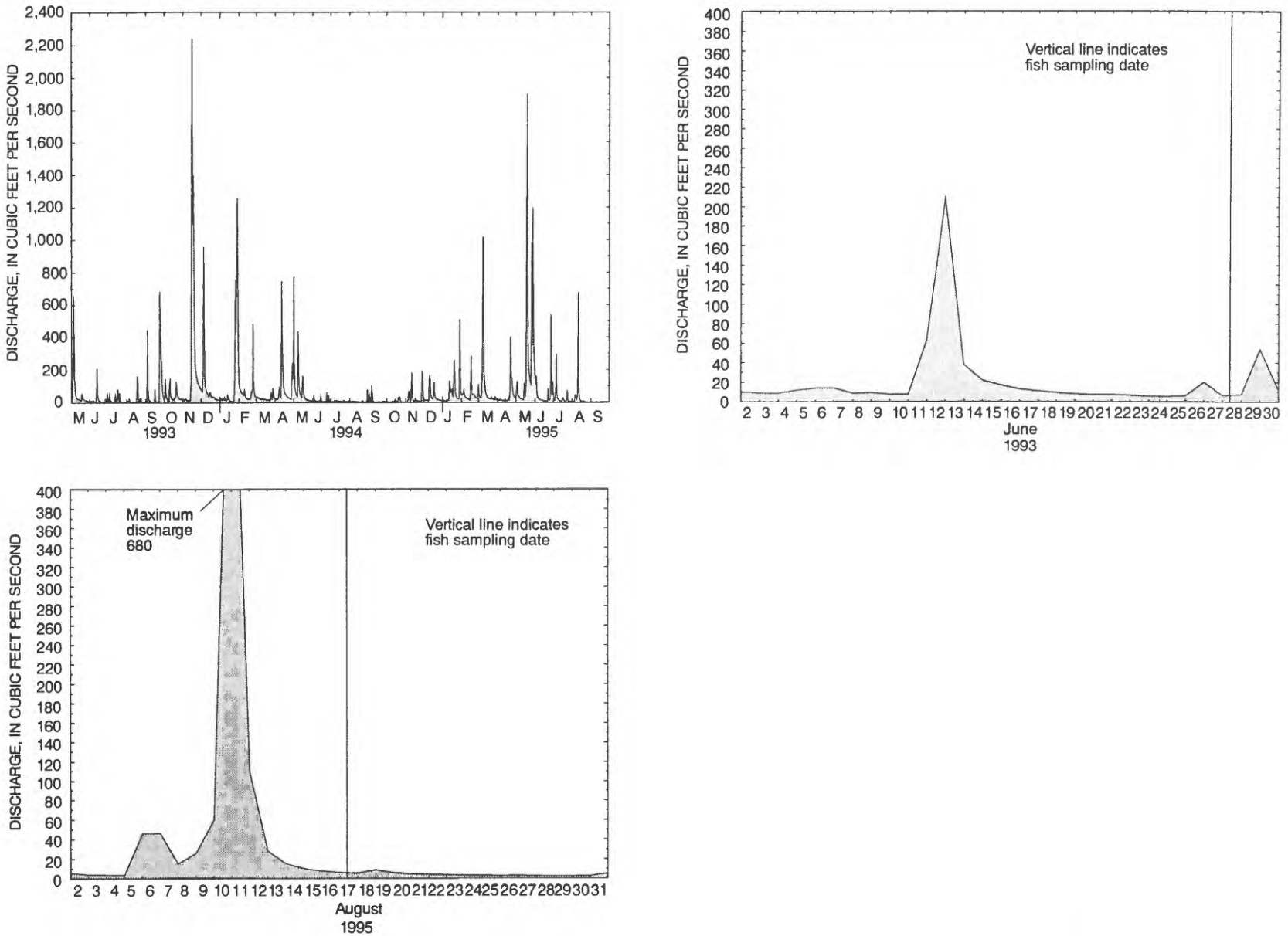


Figure 8. Mean daily discharge at Kessinger Ditch near Monroe City, Ind., for May 1993 through September 1995 and for period preceding and during fish sampling, 1993 and 1995.

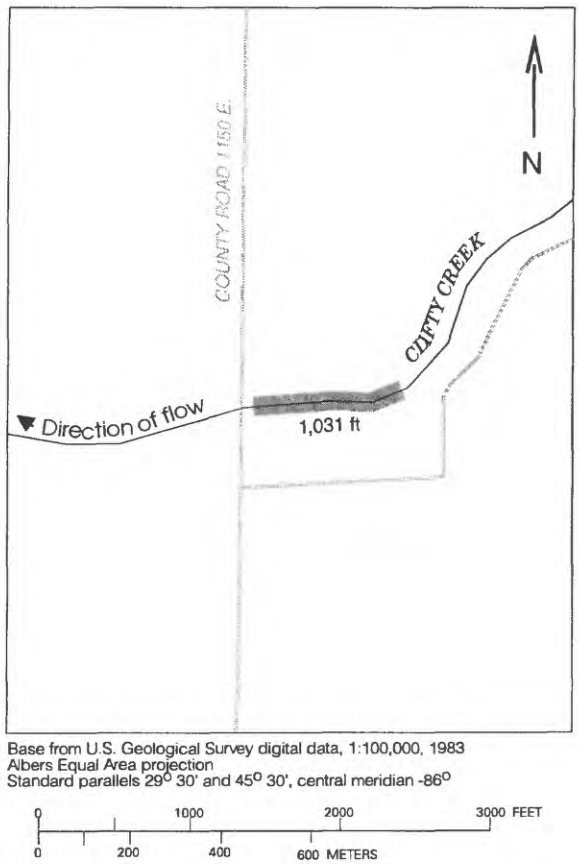


Figure 9. Location of fish sampling reach, Clifty Creek near Hartsville, Ind.

The banks are stable, with little or no erosion occurring along the left bank and moderate erosion occurring along the right bank. The riparian vegetation zone is moderate, and the flood plain is forest along both banks.

The mean channel width for Reach A was 61 ft in 1993 (table 4). Mean channel depth was 1.3 ft, and the mean velocity was 1.16 ft/s. Mean bank height was 8 ft, and the mean canopy angle was 8 degrees.

Figure 10 (page 18) shows the mean daily discharge at Clifty Creek near Hartsville (2 mi downstream from the sampling site) for May 1993 through September 1995 and for the 1993 and 1995 sampling times. Clifty Creek is an intermittent stream that has no flow after sustained periods of low rainfall. A period of relatively high streamflow (2,190 ft^3/s peak flow) occurred 12 days preceding the 1995 sampling date.

Sugar Creek at New Palestine

The Sugar Creek sampling site is located 38 river mi upstream from the confluence of Sugar Creek with the Big Blue River. Land use in the basin is 95 percent agriculture. Sugar Creek was selected to represent a small, predominantly row-crop agriculture basin in the till plain (table 2). The drainage area of the basin is 93.4 mi^2. The mean discharge for the period of record (1968–95) at the USGS gage (station number 03361650) located 1 mi downstream from the sampling site (station number 394340085524601) is 103 ft^3/s.

Three reaches were sampled at Sugar Creek. Reach A was sampled during 1993, 1994, and 1995, and reaches B and C were sampled in 1994. Reach A begins 200 ft upstream from the County Road 400 S. bridge (fig. 11). The mean reach length was 731 ft for measurements made in 1993 through 1995. Several riffle and run geomorphic channel units occur within the reach.

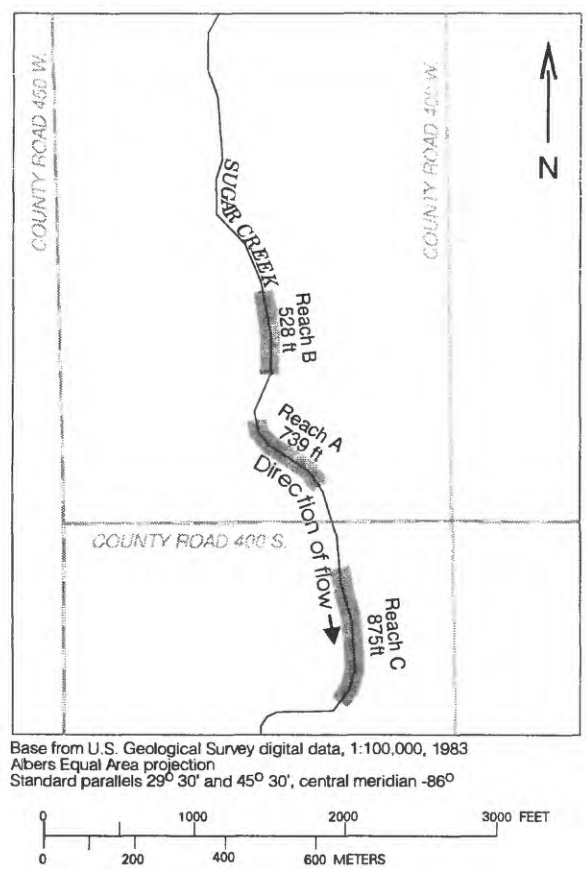
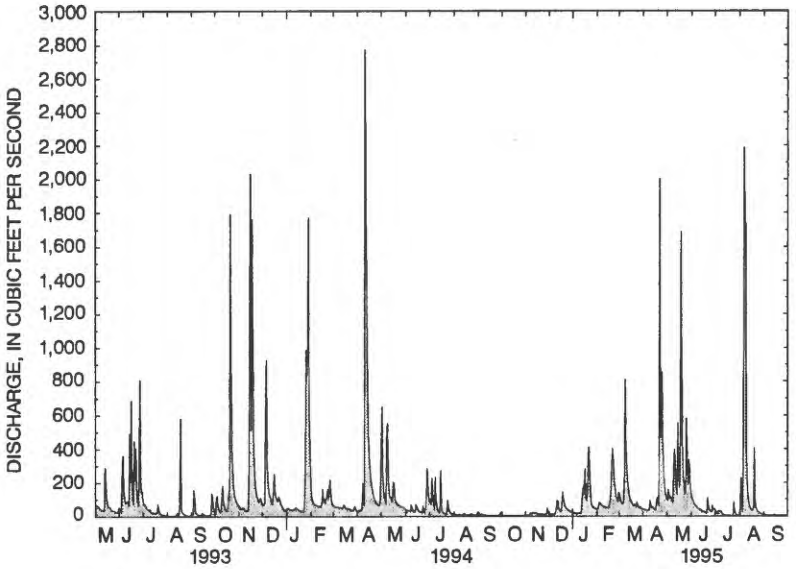
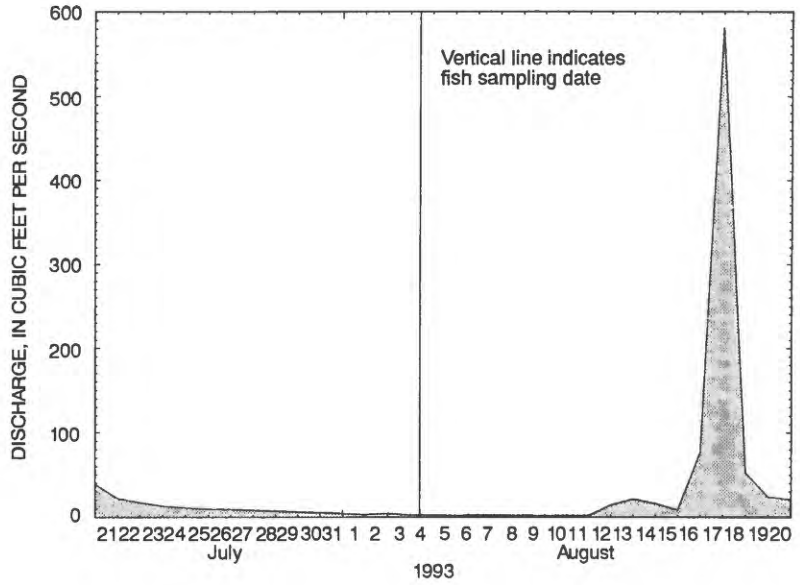


Figure 11. Location of fish sampling reaches, Sugar Creek at New Palestine, Ind.





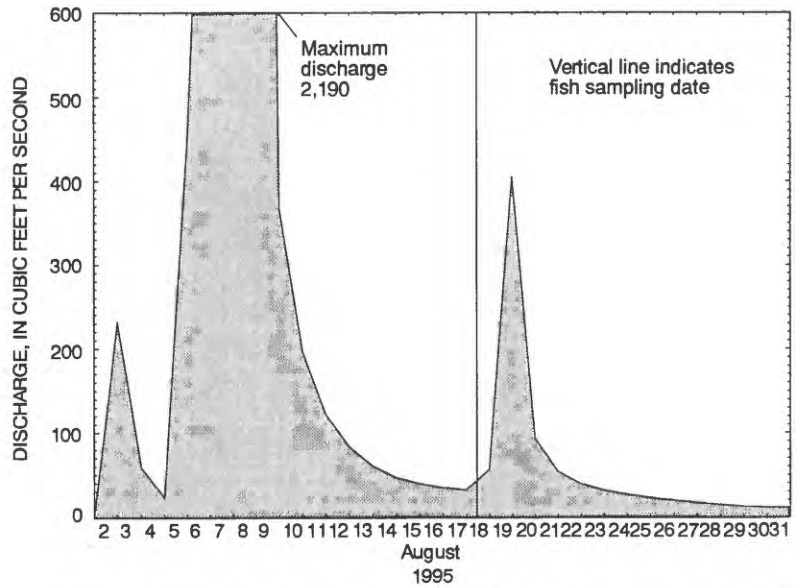


Figure 10. Mean daily discharge at Clifty Creek near Hartsville, Ind., (2 miles downstream from Clifty Creek near Hartsville sampling site) for May 1993 through September 1995 and for period preceding and during fish sampling, 1993 and 1995.

One deep pool is midway through the reach. Reach B starts 344 ft upstream from the upstream end of Reach A. Reach B is 528 ft long. Several riffle-run sequences with a deep pool are at the upstream end of the reach. Reach C starts 240 ft downstream from the County Road 400 S. bridge. The reach is 875 ft long. A long (320 ft), deep (2.4 ft mean depth) run is at the upstream end of the reach. Several riffle-run sequences also occur throughout the reach. The gradient of the creek at the site is 9.8 ft/mi.

The bed substrate is predominantly gravel and sand for all three reaches; however, cobble, boulder, muck, and hardpan substrates are present. The silt cover and the extent of embeddedness are moderate (table 3). Instream cover is moderate. The primary habitat for fish is deep pools, shallows in slow water, boulders, rootwads, logs and woody debris. Undercut banks and overhanging vegetation are present in a few areas and provide some instream habitat for fish. Erosion is moderate on both banks. All three reaches have a moderate riparian vegetation width; however, in several places the vegetation zone is very narrow or nonexistent. The flood plain is predominantly forest on the left bank and residential on the right bank. Cropland is interspersed along most of the flood plain on Sugar Creek.

Mean channel width for Reach A was 44 ft in 1993, 48 ft in 1994, and 50 ft in 1995; mean channel width in 1994 for Reach B was 54 ft and for Reach C was 52 ft (table 4). Mean channel depth for Reach A ranged from 1.5 ft in 1995 to 2.7 ft in 1994; mean channel depth in 1994 was 0.9 ft for Reach B and 1.4 ft for Reach C. Mean velocity for Reach A ranged from 0.49 ft/s in 1993 to 0.80 ft/s in 1995; mean velocity in 1994 was 1.17 ft/s for Reach B and 0.80 ft/s for Reach C. Mean bank height was 4 ft for Reach A for measurements made from 1993 through 1995; mean bank height in 1994 was 3 ft for Reach B and 5 ft for Reach C. The mean canopy angle was 27 degrees for Reach A for measurements made from 1993 through 1995; mean canopy angle in 1994 was 26 degrees for Reach B and 24 degrees at Reach C.

Figure 12 (page 20) shows the mean daily discharge at Sugar Creek at New Palestine for May 1993 through September 1995 and for the 1993, 1994, and 1995 sampling dates. Sampling conditions were about the same for all three sampling dates; however, streamflow was greater prior to sampling for the 1993 and 1994 sampling dates than for the 1995 sampling date.

Muscatatuck River near Deputy

The Muscatatuck River is a major tributary of the East Fork White River, and the site near Deputy is located about 50 river mi upstream from the confluence with the East Fork of the White River. Agriculture is the predominant land use (71percent) (table 2). Land use in the Muscatatuck River Basin is similar to that in Clifty Creek Basin, but the Muscatatuck Basin has considerably more forest. This site was selected to be representative of a row-crop agriculture and forest basin in the bedrock lowland and plain hydrogeomorphic region. The drainage area of the Muscatatuck River Basin at the site is 293 mi^2, which is about three times larger than the Clifty Creek Basin. The mean discharge for 1968 through 1995 at the USGS gage (station number 03366500) located at the site is 360 ft^3/s.

The sampling reach begins 600 ft upstream from the County Road 1550 W. bridge (fig. 13, page 21). The reach is 990 ft long with a gradient of 1.6 ft/mi. The main geomorphic unit is a continuous run with several pools situated adjacent to the shoreline. A small, shallow riffle is located at the downstream end of the reach and a larger, deep riffle is located at the upstream end of the reach.

The dominant bed substrate is sand, and the subdominant substrate is gravel. Muck, detritus, and clay substrates also are present in slackwater areas. The amount of silt cover and the extent of embeddedness are moderate (table 3). The extent of instream cover is moderate and consists of undercut banks, overhanging vegetation, shallows in slow water, deep pools, rootwads, and logs and woody debris. Bank material consists of a sandy silt mix. Bank erosion is moderate on both banks. The riparian vegetation zone along most of the reach is either very narrow or nonexistent. Cropland is present in the flood plain along both

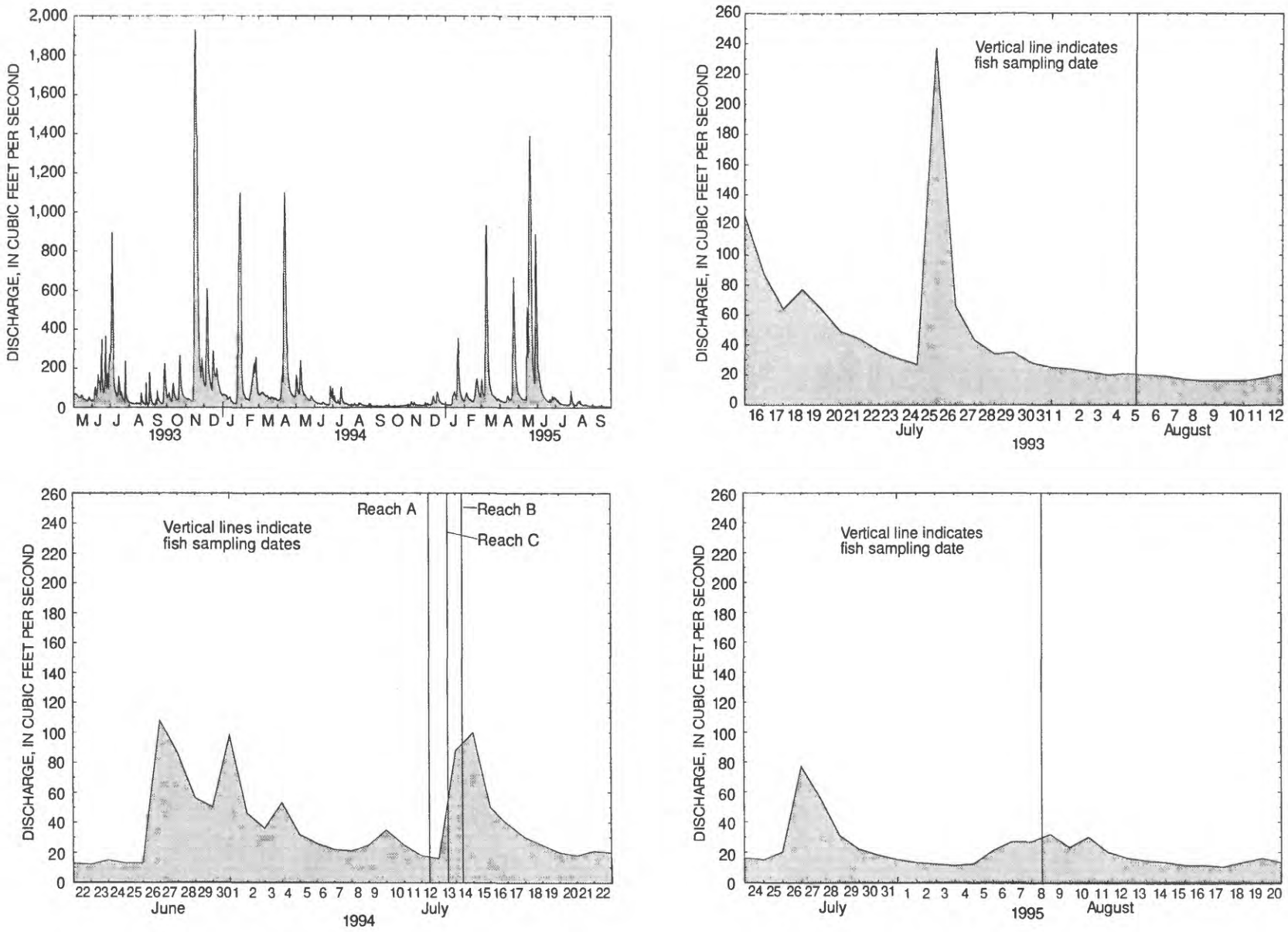


Figure 12. Mean daily discharge at Sugar Creek at New Palestine, Ind., (1 mile downstream from Sugar Creek at New Palestine sampling site) for May 1993 through September 1995 and for period preceding and during fish sampling, 1993-95.

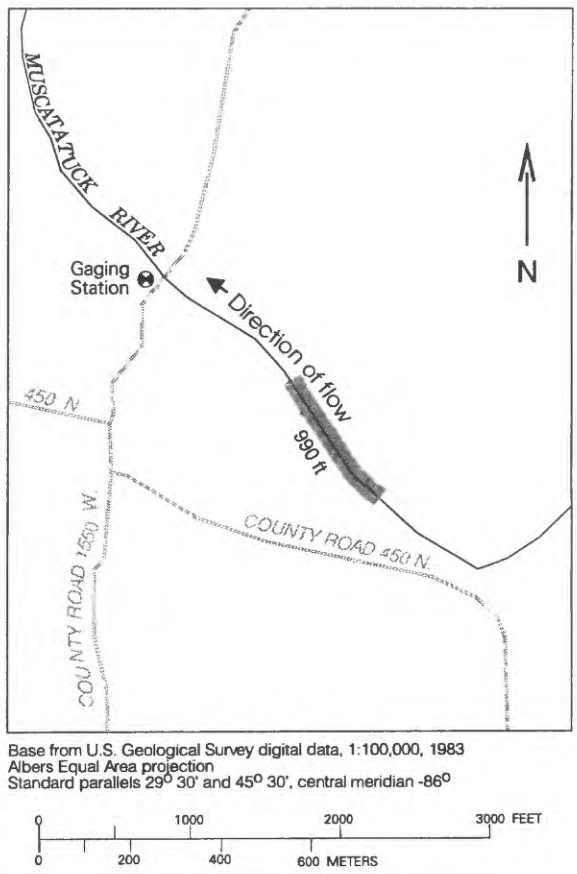


Figure 13. Location of fish sampling reach, Muscatatuck River near Deputy, Ind.

banks. The water at the site is nearly always turbid. Large amounts of organic debris in the water make the water appear black at times.

The mean channel width for Reach A was 64 ft in 1993 (table 4). Mean channel depth for Reach A was 0.9 ft and the mean velocity was 0.36 ft/s. Mean bank height was 20 ft, and the mean canopy angle was 59 degrees.

Figure 14 (page 22) shows the mean daily discharge at the Muscatatuck River near Deputy from May 1993 through September 1995 and the mean daily discharge preceding and during the 1993 and 1995 sampling times. A period of relatively high streamflow (3,340 ft^3/s peak flow) occurred 8 days prior to sampling in 1995.

Big Walnut Creek at Reelsville

Big Walnut Creek at Reelsville is located 5 river mi upstream from the confluence with the Eel River, which is a tributary of the main stem of the White River. Land use in the basin is 83 percent agriculture and 15 percent forest. Land use in this basin is similar to that in the Sugar Creek Basin, but it contains more forest. The site was selected as an indicator of the effects of row-crop agriculture in the till plain (table 2). The Big Walnut Creek Basin has a drainage area of 318 mi^2, which is about three times larger than the Sugar Creek Basin. The mean discharge for 1968 through 1995 at the USGS gage (station number 03357500) located about 1 mi downstream from the sampling site (station number 393306086585201) is 375 ft^3/s.

The sampling reach begins 250 ft upstream from County Road 770 S. bridge (fig. 15). The reach is 740 ft long. The reach is composed of riffle, run, and pool areas. The gradient of the creek at the site is 3.1 ft/mi.

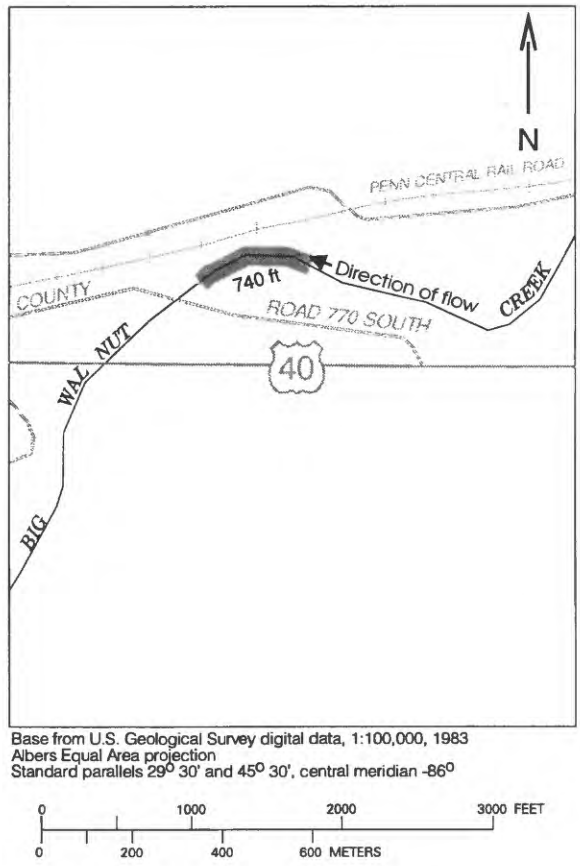
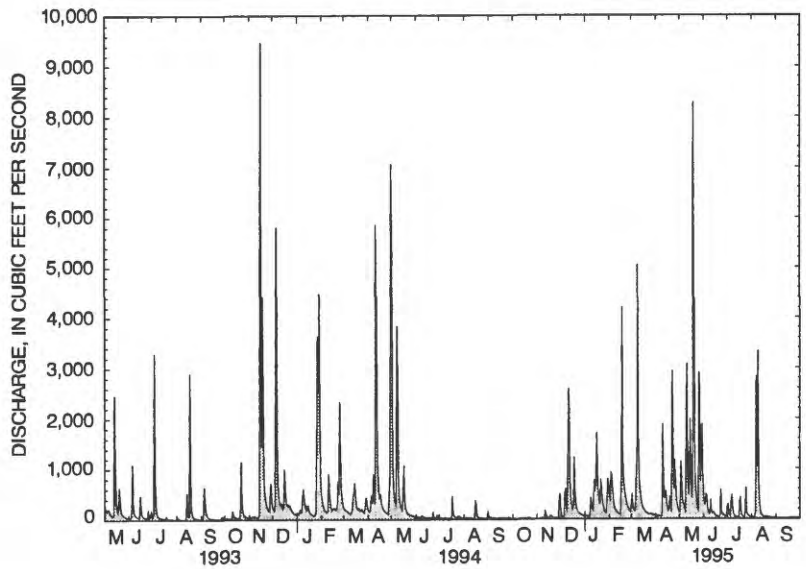
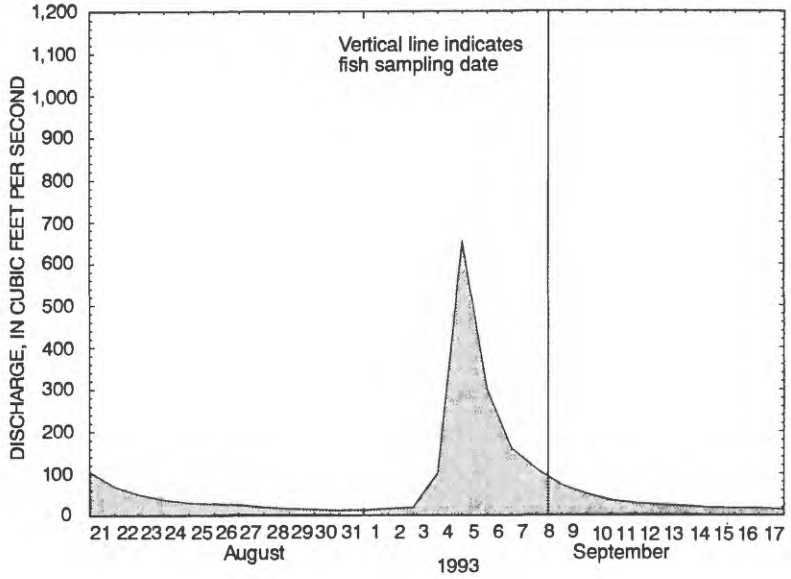


Figure 15. Location of fish sampling reach, Big Walnut Creek at Reelsville, Ind.





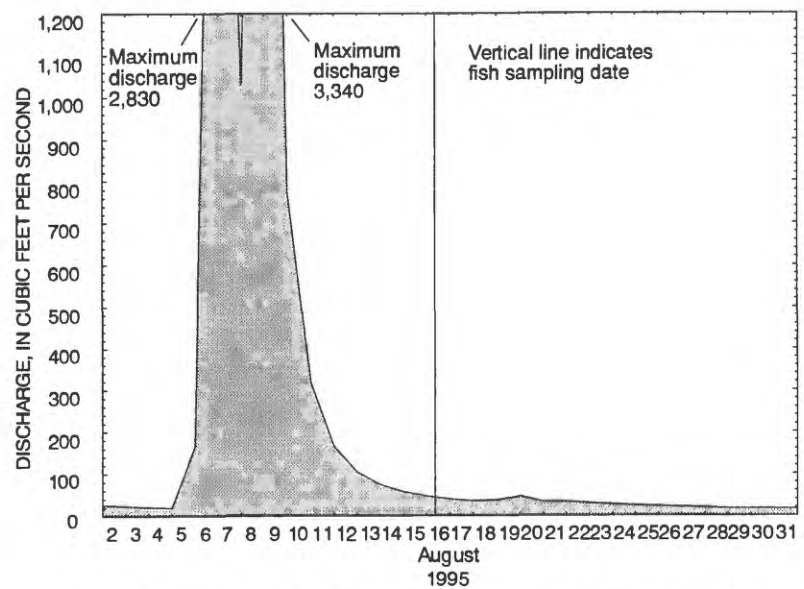


Figure 14. Mean daily discharge at Muscatatuck River near Deputy, Ind., for May 1993 through September 1995 and for period preceding and during fish sampling, 1993 and 1995.

Sand and gravel are the dominant bed substrates but boulders, cobble, muck, bedrock, and detritus are present in the reach. Silt cover is moderate, and the extent of embeddedness is moderate (table 3). Instream cover is moderate, with undercut banks, shallows in slow water, deep pools, boulders, aquatic macrophytes, and logs or woody debris providing habitat for aquatic biota. Banks are fairly stable with little or no erosion in most places and moderate erosion in a few places. There is a narrow riparian vegetation zone along the left bank, and a moderate riparian zone along the right bank. Cropland is present in the flood plain along the left bank and forest is present in the flood plain along the right bank.

The mean channel width for Reach A was 102 ft in 1993 (table 4). Mean channel depth for Reach A was 2.5 ft, and the mean velocity was 2.81 ft/s. Mean bank height was 10 ft, and the mean canopy angle was 49 degrees.

Figure 16 (page 24) shows the mean daily discharge at Big Walnut Creek at Reelsville (1 mi downstream from the sampling site) for May 1993 through September 1995 and for the 1993 and 1995 sampling times. Streamflow was much greater preceding and during the 1993 sampling date than during the 1995 sampling date.

Integrator Sites

The integrator sites, White River near Centerton, White River near Elnora, East Fork White River at Shoals, and White River at Hazleton, represent the effects of multiple land uses and hydrogeomorphic settings (table 2).

White River near Centerton

The White River near Centerton is located on the main stem about 30 river mi south of Indianapolis and about 200 mi upstream from the mouth of the White River. Land use upstream from this site is predominantly row-crop agriculture but, from its source to the Centerton site, the White River flows through several cities, including Muncie, Anderson, and Indianapolis. About 75 percent of the population of the basin lives upstream from the site. The land use in the basin is 82 percent agriculture, 14 percent urban, and 3 percent forest. The site was selected to integrate the effects of urban and agricultural areas in the till plain on the quality of the river. The drainage area is 2,444 mi^2. The mean discharge for 1968 through 1995 at the USGS gage (station number 03354000) at the site is 2,681 ft^3/s.

The sampling reach begins 450 ft upstream from the Blue Bluff Road bridge (fig. 17). The sampling reach is 2,510 ft long with a gradient of 2.9 ft/mi. The reach is composed primarily of runs with several small pools.

The substrate is a thick, loose, and frequently shifting gravel and sand with localized outcroppings of bedrock. The silt cover is normal, and the embeddedness is low (less than 25 percent of the substrate is covered by fine material) (table 3). The extent of instream cover is moderate

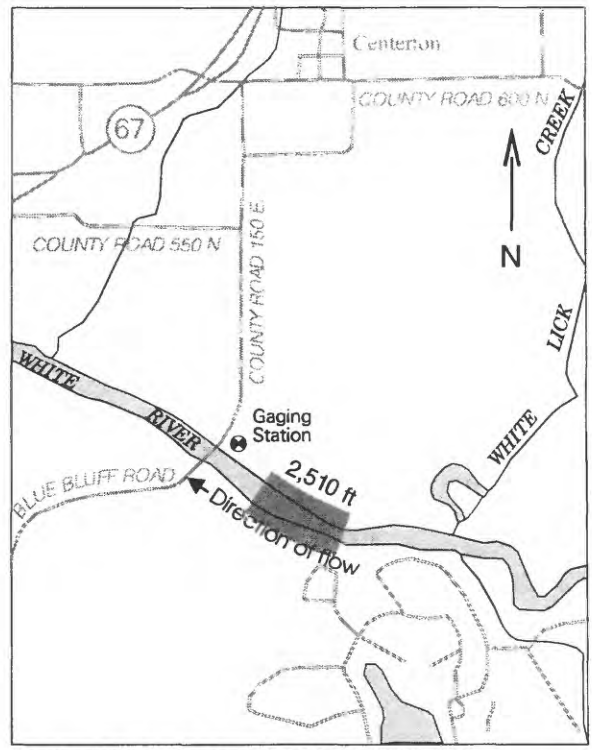


Figure 17. Location of fish sampling reach, White River near Centerton, Ind.

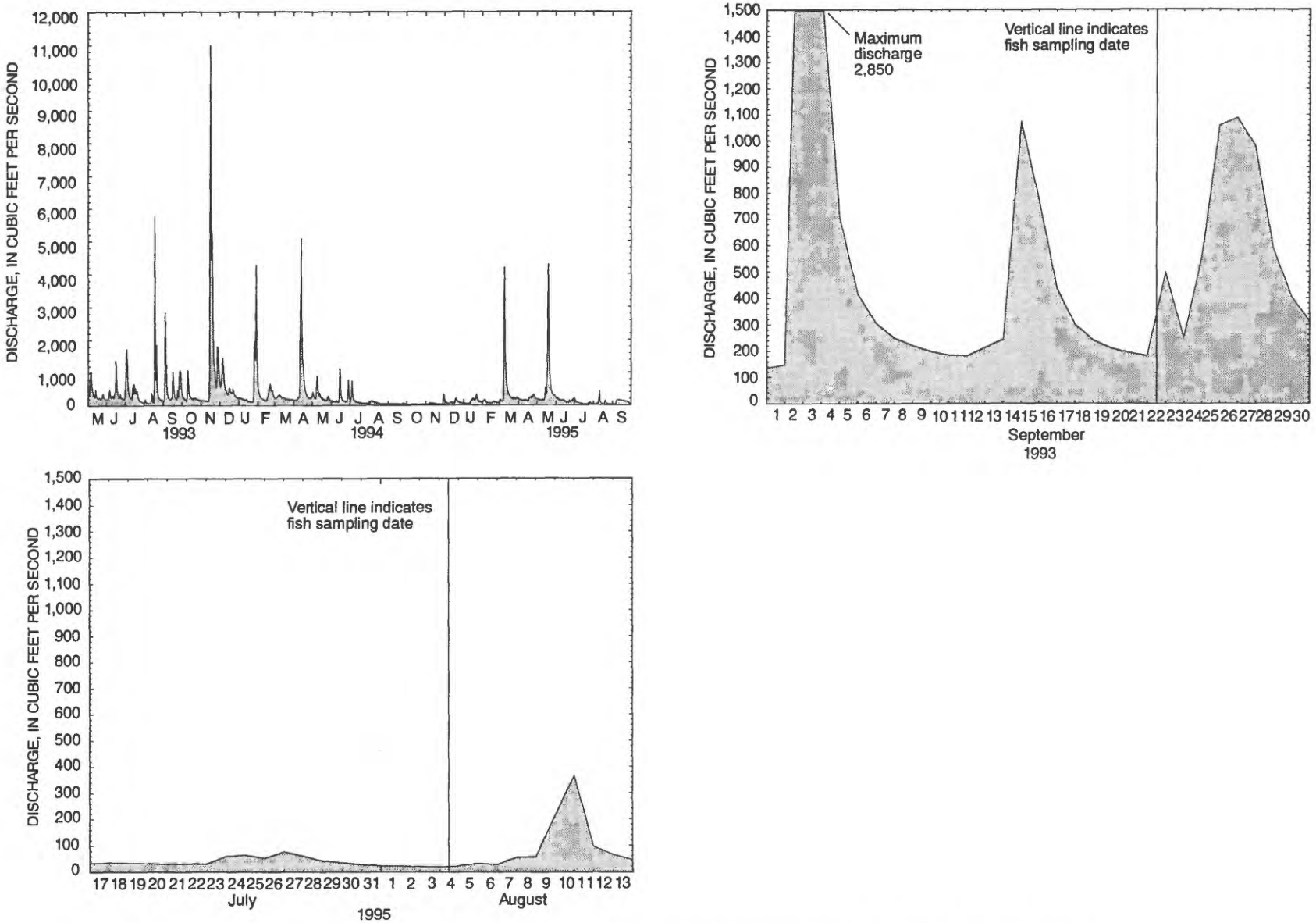


Figure 16. Mean daily discharge at Big Walnut Creek at Reelsville, Ind., (1 mile downstream from Big Walnut Creek at Reelsville sampling site) for May 1993 through September 1995 and for period preceding and during fish sampling, 1993 and 1995.

and consists of undercut banks, shallows in slow water, deep pools, rootwads, and logs or woody debris. Banks show little or no erosion. A moderate (30–150 ft) riparian vegetation zone occurs along the left bank, and a narrow (15–30 ft) riparian zone occurs along the right bank. The flood plain is forested on the left bank and is cropland on the right bank.

The mean channel width for Reach A was 190 ft in 1993 (table 4). Mean channel depth for Reach A was 6.9 ft, and the mean velocity was 3.7 ft/s. Mean bank height was 7 ft, and the mean canopy angle was 103 degrees.

Figure 18 (page 26) shows the mean daily discharge at the White River near Centerton for May 1993 through September 1995 and for the 1993 and 1995 sampling times. The discharge was greater preceding and during sampling times in 1993 than in 1995.

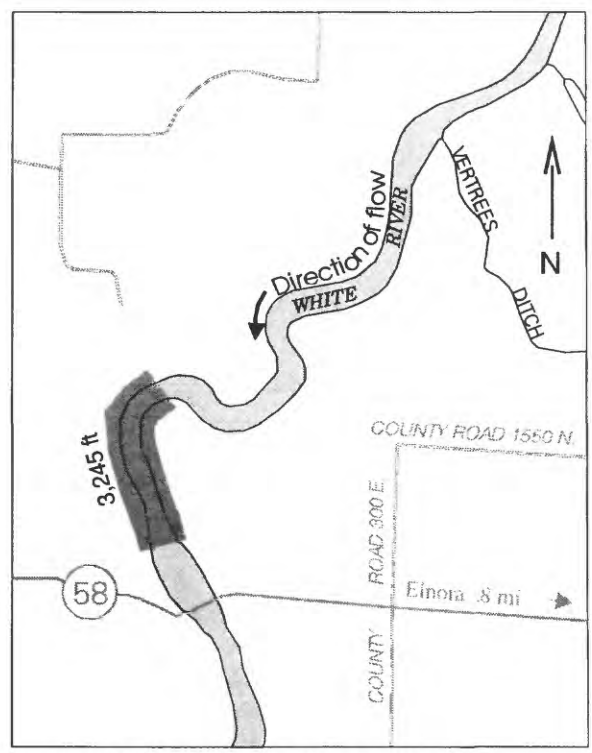
White River near Elnora

The White River near Elnora is located about 105 river mi upstream from the mouth on the main stem. Land use in the basin is 71 percent agriculture, 19 percent forest, and 8 percent urban. The site was selected to integrate the effects of processes occurring on the main stem of the White River (table 1). The drainage area of the basin at the Elnora site is 4,793 mi^2. The mean discharge for 1968 through 1995 at the USGS gage (station number 03360500) at Newberry, 8 mi upstream from the Elnora site (station number 385234087071801) is 5,413 ft^3/s.

The sampling reach begins about 1,700 ft upstream from the State Highway 58 bridge near Elnora and continues upstream for 3,245 ft (fig. 19). The reach is a single run with no riffles and some deeper pooled areas. The gradient of the river at the site is 1.4 ft/mi.

Sand is the dominant bed substrate, and gravel is the subdominant substrate. The riverbed also contains areas of muck and detritus. The silt cover is normal, and the extent of embeddedness is low (table 3). The extent of instream cover is sparse, and the area of habitat protection provided by overhanging vegetation is small relative to the width of the river. The primary habitat for fish is from shallows in slow water, deep pool areas, rootwads, fallen trees and woody debris in the water. The bank material is a sand, silt, and gravel mix with areas of pure sand. Bank erosion is generally moderate; however, erosion is heavy on some banks, especially where riparian vegetation is nonexistent and row crops are tilled to the bank edge. The riparian vegetation zone is very narrow to nonexistent on both banks. The flood plain has cropland on both sides of the river.

The mean channel width for Reach A was 321 ft in 1993 (table 4). Mean channel depth for Reach A was 11.1 ft, and the mean velocity was 3.02 ft/s. Mean bank height was 5 ft, and the mean canopy angle was 150 degrees.



Base from U.S. Geological Survey digital data, 1:100,000, 1983
Albers Equal Area projection
Standard parallels 29° 30' and 45° 30', central meridian -86°

0 0.5 1 MILE
0 0.5 1 KILOMETER

Figure 19. Location of fish sampling reach, White River near Elnora, Ind.

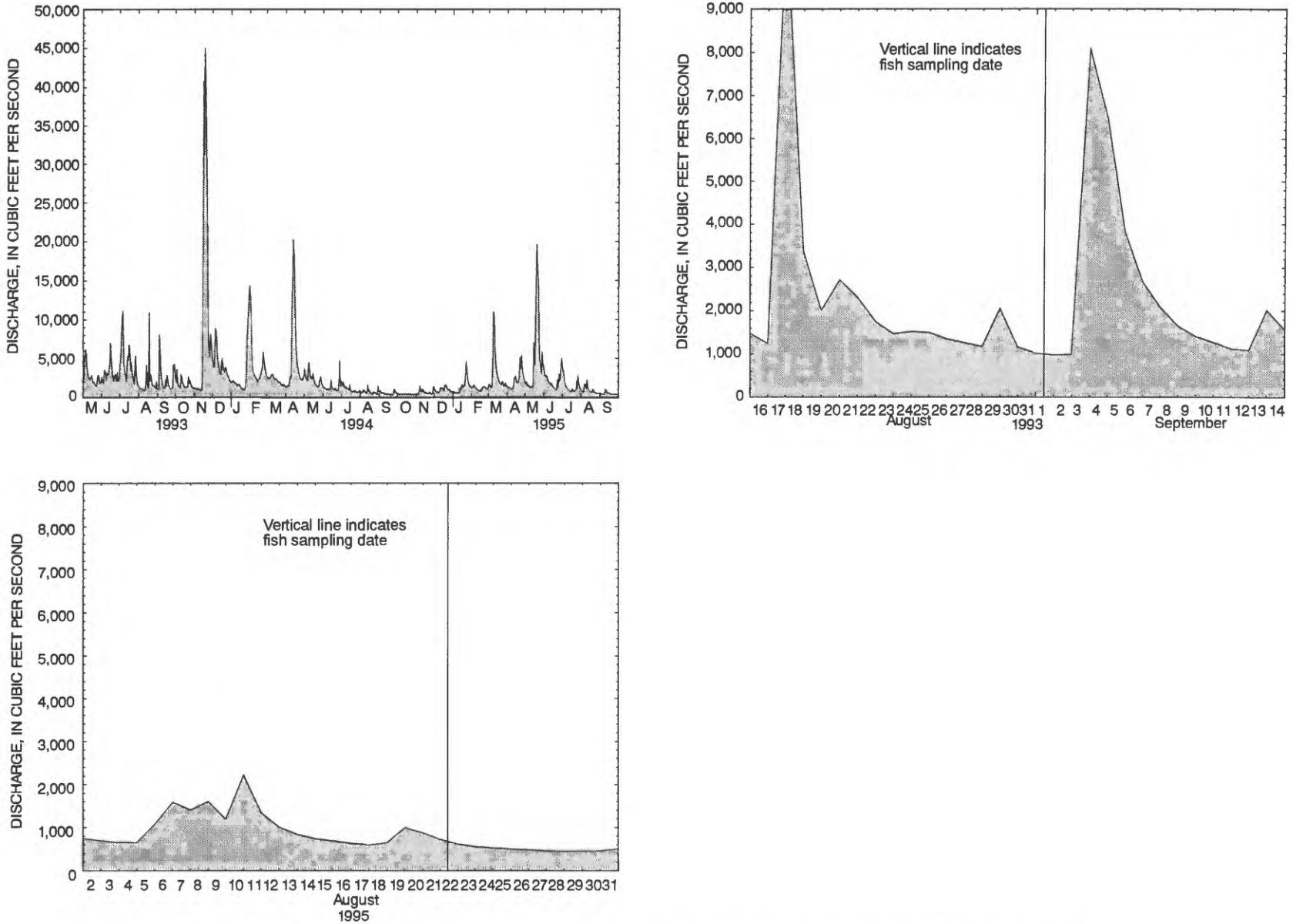


Figure 18. Mean daily discharge at White River near Centerton, Ind., for May 1993 through September 1995 and for period preceding and during fish sampling, 1993 and 1995.

Figure 20 (page 28) shows the mean daily discharge for the White River at Newberry (8 mi upstream from Elnora) from May 1993 through September 1995 and for the 1993 and 1995 sampling times. The streamflow preceding and during the 1993 sampling time was greater than the streamflow for the 1995 sampling time.

East Fork White River at Shoals

The East Fork White River at Shoals site is located about 50 river mi upstream from the confluence with the main fork White River and integrates the effects of processes occurring in the East Fork of the White River. The East Fork White River at Shoals is located in the bedrock upland but integrates the effects of processes occurring in streams from four hydrogeomorphic regions (till, bedrock lowland and plain, bedrock upland, and karst), and three land uses (agriculture, 69 percent; forest, 25 percent; and urban, 5 percent) (table 2). The drainage area of the basin at Shoals is 4,927 mi^2. The mean discharge for 1968 through 1995 at the USGS gage (station number 03373500) located at the site is 5,874 ft^3/s.

The sampling reach is located 1,200 ft upstream from the U.S. Highway 50 bridge in Shoals (fig. 21). The sampling reach is 2,905 ft long and is almost entirely a continuous run with several small pools. The gradient of the river at the site is 0.9 ft/mi. A lowhead dam occurs downstream from the beginning of the reach. A public boat ramp is located in the reach, and a small area around the ramp has been deepened to allow boat launching.

The substrate is predominantly bedrock; considerable amounts of clay (hardpan) and, to a lesser extent, sand exist. The silt cover is normal, and the extent of embeddedness is moderate. A moderate amount of habitat cover (25–75 percent) is present in the reach (table 3). Instream cover consists of undercut banks, overhanging vegetation, shallows in slow water, deep pools, rootwads, boulders, and logs or woody debris. Bank material is a clay/silt mix. Bank erosion is moderate. A narrow riparian zone occurs along most of the left bank, and a moderate riparian vegetation zone occurs along most of the right bank. The flood plain has cropland on the left bank and forest on the right bank.

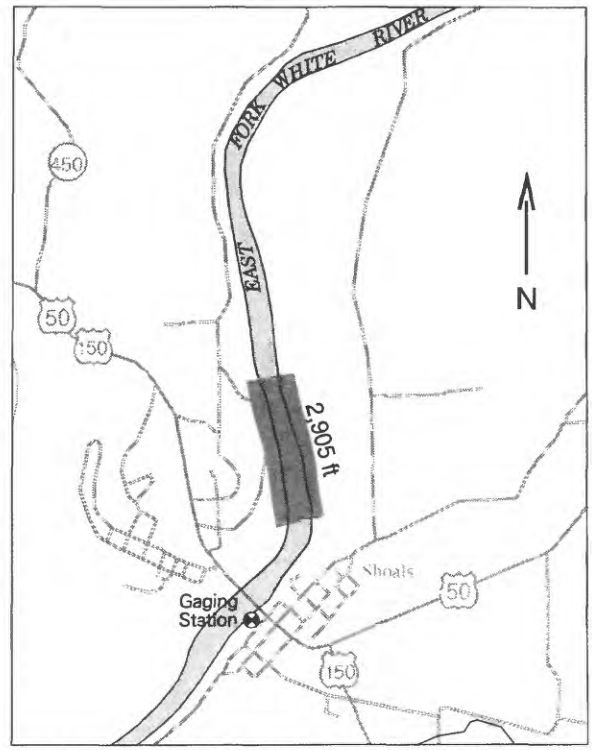


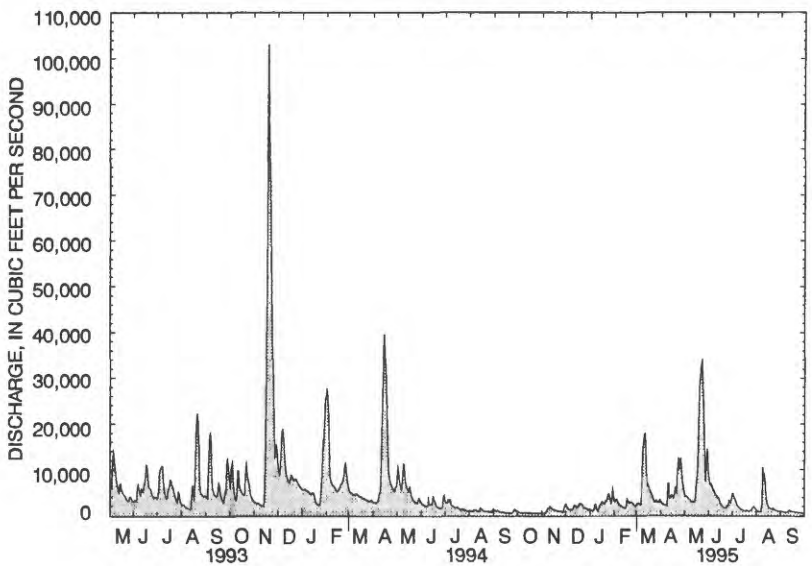
Figure 21. Location of fish sampling reach, White River at Shoals, Ind.

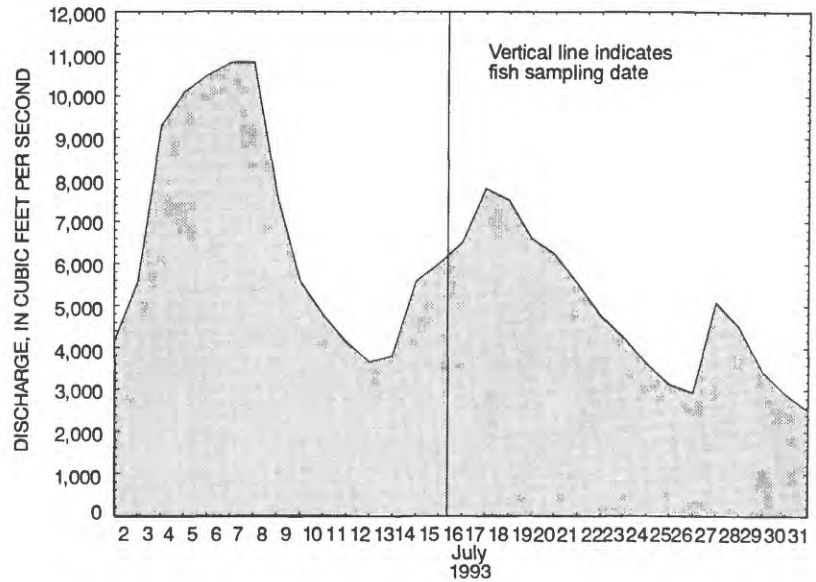
The mean channel width for Reach A was 330 ft in 1993 (table 4). Mean channel depth for Reach A was 7 ft, and the mean velocity was 0.3 ft/s. Mean bank height was 19 ft, and the mean canopy angle was 70 degrees.

Figure 22 (page 29) shows the mean daily discharge for the East Fork White River at Shoals from May 1993 through September 1995 and for the 1993 and 1995 sampling times. Streamflow was much higher preceding and during the 1993 sampling time than during the 1995 sampling time.

White River at Hazleton

The White River at Hazleton is located about 21 river mi upstream from the confluence of the White and Wabash Rivers. Land use for the basin is 70 percent agriculture, 22 percent forest, and 6 percent urban. The site was selected because it





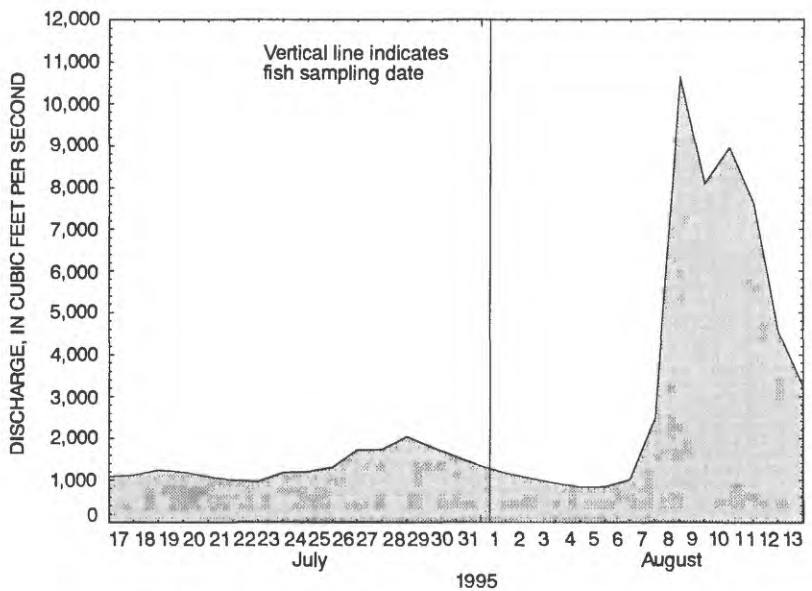


Figure 20. Mean daily discharge at White River at Newberry, Ind., (8 miles upstream from White River near Elnora sampling site) for May 1993 through September 1995 and for period preceding and during fish sampling, 1993 and 1995.

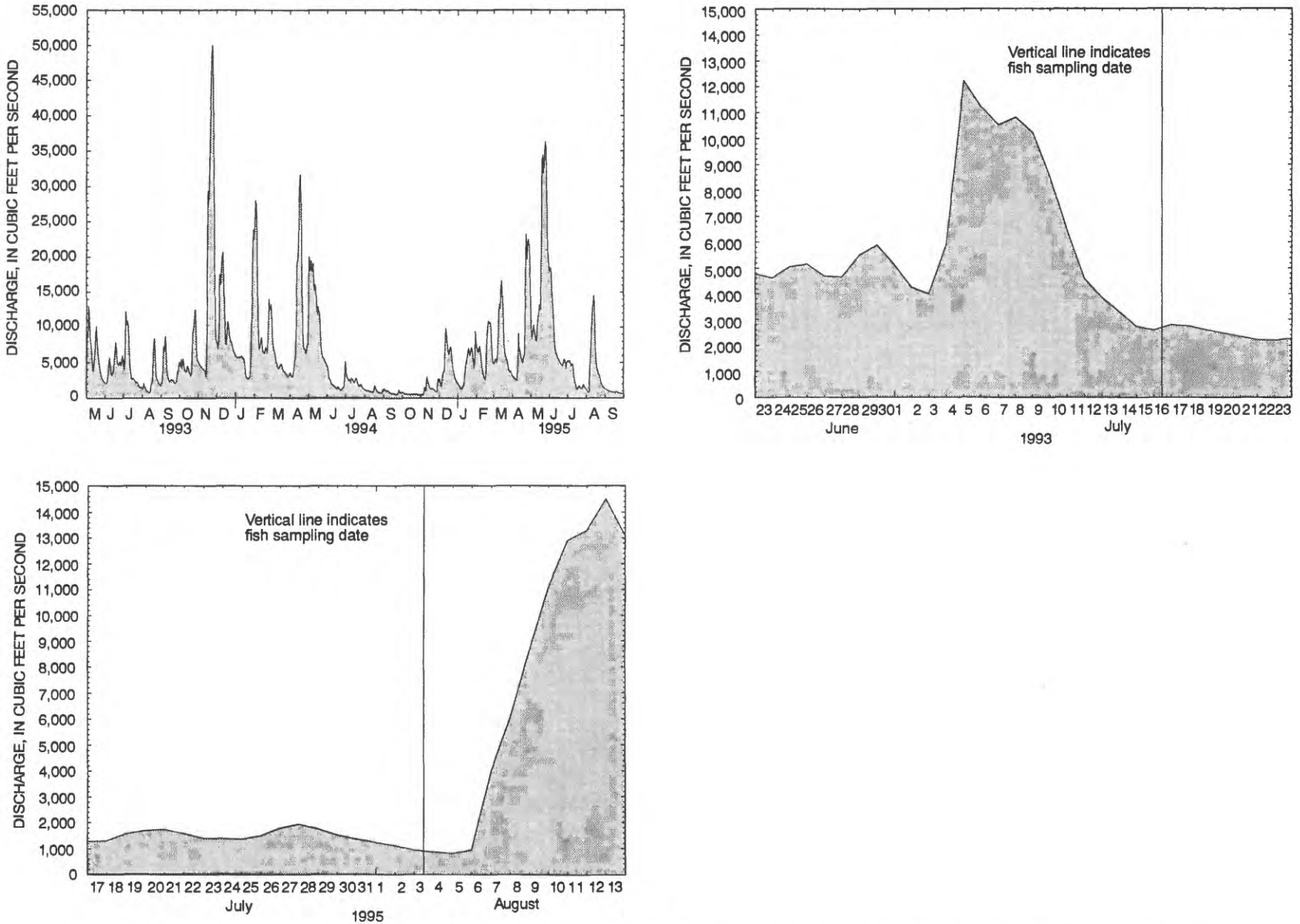
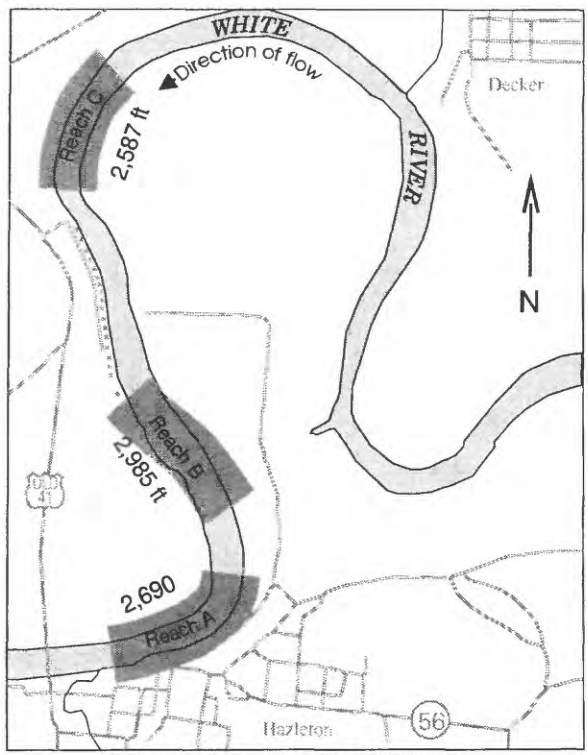


Figure 22. Mean daily discharge at East Fork White River at Shoals, Ind., for May 1993 through September 1995 and for period preceding and during fish sampling, 1993 and 1995.

integrates the effects of processes occurring in the entire White River Basin (table 2). The drainage area of the basin at the Hazleton site is 11,305 mi^2. The mean discharge for 1968 through 1995 at the USGS gage (station number 03374000) at Petersburg 24 mi upstream from Hazleton (station number 03374100) is 12,000 ft^3/s (Stewart and others, 1996).

Three stream reaches were sampled at the White River at Hazleton in 1993, 1994, and 1995. Reaches B and C were sampled in 1994. Sampling reach A begins about 1,200 ft upstream from the abandoned old Highway 41 bridge and continues upstream 2,690 ft around a bend in the River (fig. 23). Reach B begins 1,135 ft upstream from the end of reach A; the reach length is 2,985 ft.



Base from U.S. Geological Survey digital data, 1:100,000, 1983
Albers Equal Area projection
Standard parallels 29° 30' and 45° 30', central meridian -86°

0 0.5 1 MILE
0 0.5 1 KILOMETER

Figure 23. Location of fish sampling reaches, White River at Hazleton, Ind.

Reach C begins about 3,400 ft from the end of Reach B; the reach length is 2,587 ft. The three reaches are characterized by a single run with no riffles and only a few deeper pools in slack water areas. The gradient of the river at the site is 0.8 ft/mi.

The bed substrate for all reaches is predominantly sand, but some areas of bedrock outcrop are present. The silt cover is normal, and there is no embeddedness of the substrate because it is predominantly sand (table 3). The extent of instream cover is sparse, with cover present in less than 25 percent of the stream margins. The area of habitat protection provided by overhanging vegetation is small relative to the width of the river. There are some undercut banks, shallows, deep pools, and rootwads; however, the primary habitat for fish is from logs and woody debris. Bank material is a sandy, silt mix except in the bedrock area where a clay component is present. Artificial substrate (chunks of concrete, bricks, and trash) covers the entire right bank in Reach C. Bank erosion is moderate, with equal areas of erosion and deposition. A riparian vegetation zone of trees is at least 50 ft wide on both banks of the entire length of the reach. The flood plain has cropland on both banks.

Mean channel width for Reach A was 350 ft in 1993, 445 ft in 1994, and 361 ft in 1995; mean channel width in 1994 for Reach B was 573 ft and for Reach C was 428 ft (table 4). Mean channel depth for Reach A was 10.6 ft in 1993 and 7.0 ft in 1995. Mean velocity for Reach A was 2.19 ft/s in 1993 and 0.55 ft/s in 1995. Mean bank height was 11 ft for Reach A for measurements made in 1993–95; mean bank height in 1994 was 13 ft for Reach B and 18 ft for Reach C. The mean canopy angle was 135 degrees for Reach A for measurements made in 1993 through 1994; mean canopy angle in 1994 was 131 degrees for Reach B and 140 degrees at Reach C.

Figure 24 shows the mean daily discharge at the White River at Petersburg (24 mi upstream from Hazleton) for May 1993 through September 1995 and for the 1993, 1994, and 1995 sampling times. Streamflow was higher during the 1993 sampling time than during the 1994 and 1995 sampling times.

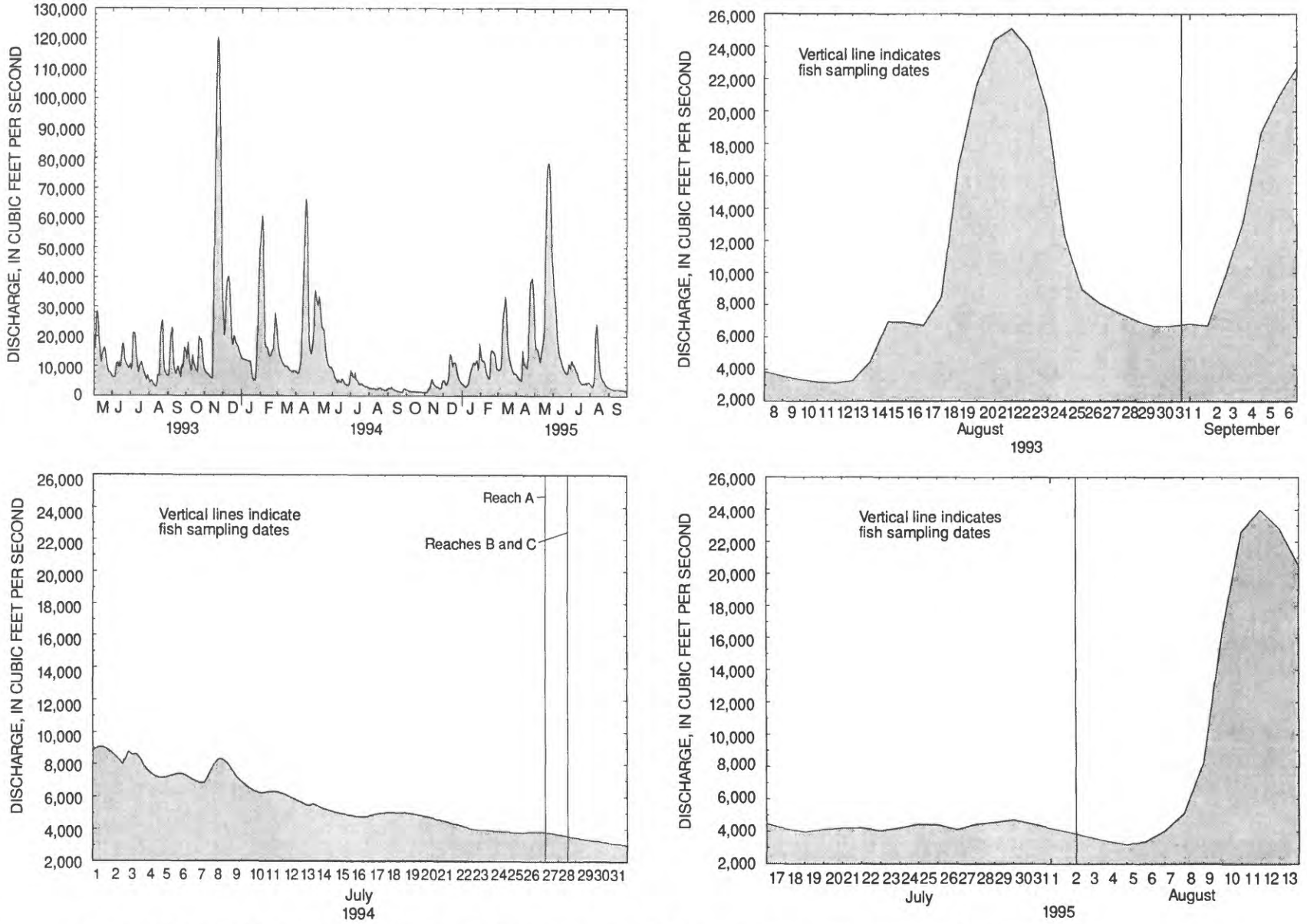


Figure 24. Mean daily discharge at White River at Petersburg, Ind., (24 miles upstream from White River at Hazleton sampling site) for May 1993 through September 1995 and for period preceding and during fish sampling, 1993 -1995.

FISH COMMUNITY DATA

The fish community structure at a sampling reach can be described by several measures including species presence, abundance (table 5, page 34), species diversity, species and family richness, and the composition of functional groups such as feeding guild and spawning method. Functional group designations are useful for characterizing the patterns within the community structure at a sampling reach and the spatial and temporal patterns in the community structure throughout the basin. The abundance of lithophilic spawners in streams can be used as an indication of the amount of silt in streams. Berkman and Rabeni (1987) observed an inverse correlation between simple lithophilic spawners and the proportion of silt in streams. Fish community composition at sampling sites includes abundance of fish collected; species and family richness; "family" composition (sport, minnow, sucker, sunfish, and darter species); feeding guild (carnivores, piscivores, insectivores, herbivores, and omnivores) and the presence of lithophilic spawners (table 6, page 40). The classification of species for each functional group as described by the Ohio Environmental Protection Agency for the purpose of calculating the Index of Biological Integrity metrics (Ohio Environmental Protection Agency, 1987) is listed in table 7 (page 42).

Ninety-one species from 18 families of fish were collected in the 3 years of sampling. Two of the species caught were so large they could not be brought onto the boat—the paddlefish (*Polyodon spathula*) at White River near Elnora and the alligator gar (*Lepisosteus spatula*) at White River at Hazleton; their distinctive head shapes allowed for the identification of the fish. The numbers of fish collected increased every year at all sites except Sugar Creek and White River at Hazleton, both of which showed fewer fish collected in Reach A during 1995 than in 1994 (table 6). Very low numbers of fish were collected at all boat sites (White River near Centerton, White River near Elnora, White Rjver at Hazleton, and East Fork White River at Shoals) in 1993.

The total number of fish collected for each reach is shown in table 6. The number of fish collected was generally lower at nonwadable sites than wadable sites (table 6). The number of fish collected at every site was lower in 1993 than in 1994 or 1995. The highest number (2,172) of fish was collected at Little Buck Creek (Reach C) in 1994. Large numbers of fish were collected at Clifty Creek (1993 and 1995), Big Walnut Creek (1995), and Sugar Creek (1994).

Sugar Creek (34, 34), Big Walnut Creek (23, 30), and Clifty Creek (27, 30) showed the highest species richness (table 6). Thirty-four different species were collected at Sugar Creek (Reaches B and C) in 1994. Thirty species were collected at Big Walnut Creek and Clifty Creek in 1995. The White River at Hazleton (Reach A) showed the highest family richness with representatives from 11 families collected in 1995 and 10 families collected in 1994 (Reach B and C).

The largest number of sport fish (50 juveniles) from two species was collected at Little Buck Creek in 1995 (Reach A) (table 6). At the Sugar Creek site, 48 sport fish from 4 species were collected in 1994 (Reach C); 43 sport fish from 4 species were collected at the White River at Hazleton in 1994 (Reach C). Large numbers of minnows and minnow species were collected at Little Buck Creek, Clifty Creek, Big Walnut Creek, and Sugar Creek. Large numbers of suckers were collected at Little Buck Creek, Clifty Creek, Big Walnut Creek, and Sugar Creek. Large numbers of sunfish were collected at Clifty Creek, Sugar Creek, Muscatatuck River, and Lost River. The largest number of darters was found at Clifty Creek and Sugar Creek.

The highest percentage of carnivores and piscivores was collected at big river sites. Large numbers of insectivores and herbivores were collected at the nonwadable sites (table 6). The largest number of omnivores (435 fish from 2 species) was collected at Clifty Creek in 1995 (table 6). The largest number of lithophilic spawners was collected at Clifty Creek and Sugar Creek.

One species showed an extension into new range. The alligator gar can be found in the Ohio River (Etnier and Starnes, 1993) but, until this study, was undocumented in the White River. This species also has been recorded in the Wabash River near New Harmony, Ind., in the late 1800's (Hay, 1894).

The rosefin shiner (*Lythrurus ardens*), typically found in the southwest and south-central region of Ohio in Ohio River drainages (Trautman, 1981), was collected in the Lost River Basin in 1993. Although this species has been documented in the White River Basin, (Pearson, 1977; Lockhard and Winters, 1965) no vouchers were kept and the presence of this species has been questioned (Seegert, 1985). For this study, however, voucher specimens were kept and identified by Thomas P. Simon, U.S. Environmental Protection Agency, Environmental Sciences Division, Chicago, Ill.

SUMMARY

Ninety-one species from 18 families of fish were collected in the White River Basin over a 3-year sampling period. The numbers of fish collected increased every year at all sites except Sugar Creek and White River at Hazleton. Very low numbers of fish were collected at all boat sites (White River near Centerton, White River near Elnora, White River at Hazleton, and East Fork White River at Shoals) in 1993. One species of fish showed an extension into new range—an alligator gar (*Lepisosteus spatula*), previously undocumented in the basin, was identified at the White River at Hazleton in 1993.

Sugar Creek, Big Walnut Creek, and Clifty Creek showed the highest species richness. The White River at Hazleton showed the highest family richness with fish from 11 families collected at Reach A in 1995 and 10 families collected at Reach B and C in 1994. The number of species collected at a site ranged from 9 at the East Fork White River at Shoals in 1993 to 34 at Sugar Creek (Reaches B and C) in 1994. The number of individuals collected ranged from 24 at the White River at Hazleton in 1993 (Reach A) to 2,172 at Little Buck Creek in 1994 (Reach C). The largest number of sport fish (50 juveniles) from two species was collected at Little Buck Creek in 1995 (Reach A). At the Sugar Creek site, 48 sport fish from 4 species were collected in 1994 (Reach C); 43 sport fish from 4 species were collected at the White River at Hazleton in 1994 (Reach C).

Habitat characteristics vary according to the conditions present at each site. Typically, indicator sites contain a variety of geomorphic channel units, substrates, and instream covers for fish habitat. The nonwadable, large river integrator sites consist of a continuous-run geomorphic channel unit with limited varieties of substrates and instream covers for fish habitat. In general, channel width, depth, velocity, and canopy angle increased as basin size increased. The width of the riparian vegetation zone was very narrow at the Muscatatuck River near Deputy and the White River near Elnora and along sections of the reach at the Lost River near Leipsic. Open areas (pasture and row-crop agriculture) and forest occurred within the flood plain on at least one bank at most sites. The only residential area within the flood plain at White River Basin sites was Sugar Creek at New Palestine. Moderate bank erosion occurred at most sites, while heavy bank erosion occurred on one bank at Kessinger Ditch near Monroe City and the White River near Elnora. Little or no bank erosion occurred along one bank of Clifty Creek near Hartsville and Big Walnut Creek at Reelsville, and little or no bank erosion occurred along both banks of the White River near Centerton.

Table 5. Fish species at selected sites in the White River Basin, Ind., 1993–95

['93, 1993; '94, 1994; '95, 1995; A, B, C, sampling reach; --, no fish of this species caught]

Scientific name	Common name	Number of fish per species by station, year, and reach								
		Little Buck Creek					Lost River		Kessinger Ditch	
		'93 A	'94 A	'94 B	'94 C	'95 A	'93 A	'95 A	'93 A	'95 A
Acipenseridae (sturgeons)										
Scaphirhynchus platorynchus (Rafinesque, 1820)[1]	Shovelnose sturgeon	--	--	--	--	--	--	--	--	--
Polyodontidae (paddlefishes)										
Polyodon spathula (Walbaum, 1792)	Paddlefish	--	--	--	--	--	--	--	--	--
Lepisosteidae (gars)										
Lepisosteus oculatus (Winchell, 1864)	Spotted gar	--	--	--	--	--	--	--	--	--
Lepisosteus osseus (Linneaus, 1758)	Longnose gar	--	--	--	--	--	--	--	--	--
Lepisosteus platostomus Rafinesque, 1820	Shortnose gar	--	--	--	--	--	--	--	1	1
Lepisosteus spatula Lacepede, 1803	Alligator gar	--	--	--	--	--	--	--	--	--
Hiodontidae (mooneyes)										
Hiodon tergisus Lesueur, 1818	Mooneye	--	--	--	--	--	--	--	--	--
Anguillidae (freshwater eels)										
Anguilla rostrata (Lesueur, 1817)	American eel	--	--	--	--	--	--	--	--	--
Clupeidae (herrings)										
Dorosoma cepedianum (Lesueur, 1818)	Gizzard shad	--	--	--	--	--	--	--	15	16
Cyprinidae (carps, minnows)										
Campostoma anomalum (Rafinesque, 1820)	Central stoneroller	310	680	542	1,093	921	69	125	1	--
Carassius auratus (Linneaus, 1758)	Goldfish	--	--	--	--	--	--	--	--	--
Ctenopharyngodon idella (Valenciennes, 1844)	Grass carp	--	--	--	--	--	--	--	--	--
Cyprinella spiloptera (Cope, 1868)	Spotfin shiner	1	--	1	--	9	--	--	2	25
Cyprinella whipplei Girard, 1856	Steelcolor shiner	--	--	1	--	--	--	--	--	3
Cyprinus carpio Linneaus, 1758	Common carp	--	--	--	--	1	--	--	1	1
Hybognathus nuchalis Agassiz, 1855	Mississippi silvery minnow	--	--	--	--	--	1	--	--	158
Luxilus chrysocephalus Rafinesque, 1820	Striped shiner	25	40	40	10	24	65	136	2	--
Lythrurus ardens (Cope, 1868)	Rosefin shiner	--	--	--	--	--	13	--	--	--
Lythrurus umbratilis (Girard, 1856)	Redfin shiner	--	--	--	--	--	2	26	4	6
Macrhybopsis storeriana (Kirtland, 1847)	Silver chub	--	--	--	--	--	--	--	--	--
Nocomis biguttatus (Kirtland, 1840)	Hornyhead chub	--	--	--	--	--	13	19	--	--
Nocomis micropogon (Cope, 1865)	River chub	--	--	--	--	--	16	20	--	--
Notemigonus crysoleucas (Mitchill, 1814)	Golden shiner	--	--	--	--	--	--	--	--	1
Notropis amblops (Rafinesque, 1820)	Bigeye chub	--	--	--	--	--	--	--	--	--
Notropis atherinoides Rafinesque, 1818	Emerald shiner	--	--	--	--	--	--	--	--	--
Notropis blennius (Girard, 1856)	River shiner	--	--	--	--	--	--	--	--	--
Notropis boops Gilbert, 1884	Bigeye shiner	--	--	--	--	--	--	--	--	--
Notropis buccatus (Cope, 1865)	Silverjaw minnow	28	42	13	156	173	--	--	--	4
Notropis photogenis (Cope, 1865)	Silver shiner	--	--	--	--	--	--	--	--	--
Notropis rubellus (Agassiz, 1855)	Rosyface shiner	--	--	--	--	3	--	--	--	--
Notropis shumardi (Girard, 1856)	Silverband shiner	--	--	--	--	--	--	--	--	7

[1] Authority and date of the original published proposal of the scientific name. The author's name follows the specific name directly and without punctuation if the species, when originally described, was assigned to the same genus in which it appears; if the species was described in another genus, the author's name appears in parentheses (Robins and others, 1991).

Table 5. Fish species at selected sites in the White River Basin, Ind., 1993–95—Continued

Number of fish per species by station, year, and reach																					
Clifty Creek		Sugar Creek					Muscatatuck River		Big Walnut Creek		White River near Centerton		White River near Elnora		East Fork White River at Shoals		White River at Hazleton				
'93 A	'95 A	'93 A	'94 A	'94 B	'94 C	'95 A	'93 A	'95 A	'93 A	'95 A	'93 A	'95 A	'93 A	'95 A	'93 A	'95 A	'93 A	'94 A	'94 B	'94 C	'95 A
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	1	1	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--	5	3	--	--	4	--	1	--	1
--	--	--	--	--	--	--	--	--	--	--	--	--	1	3	--	1	7	19	10	2	4
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	1	--
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--
--	--	--	--	--	--	--	--	3	2	6	14	30	--	24	11	94	1	30	6	19	32
210	198	8	210	155	700	52	6	--	18	235	--	--	--	--	--	--	--	--	--	--	--
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9	12	7	32	--	10	--	1	5	22	444	4	400	--	45	--	16	--	19	35	46	16
--	--	--	--	9	5	7	--	10	17	251	--	--	--	--	--	4	--	2	--	--	31
--	--	--	--	--	2	1	--	--	--	2	13	6	2	11	--	1	1	8	25	9	7
--	--	--	--	--	--	--	--	--	--	--	--	--	--	278	--	1	--	10	4	3	32
299	189	23	155	123	255	147	16	--	19	--	1	--	--	--	--	--	--	2	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
3	--	1	3	6	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--
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9	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
--	136	7	22	27	19	17	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
9	72	--	7	24	12	12	--	2	--	--	--	--	--	--	--	--	--	5	--	--	--
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17	30	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
--	1	--	21	10	25	4	--	6	3	91	--	--	--	--	--	--	--	1	--	--	--
10	4	3	--	2	--	25	3	--	--	--	--	--	--	--	--	--	--	--	--	1	--
34	31	6	32	--	--	3	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--
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Table 5. Fish species at selected sites in the White River Basin, Ind., 1993–95—Continued

Scientific name	Common name	Number of fish per species by station, year, and reach								
		Little Buck Creek					Lost River		Kessinger Ditch	
		'93 A	'94 A	'94 B	'94 C	'95 A	'93 A	'95 A	'93 A	'95 A
Cyprinidae (carps, minnows)—Continued										
Notropis stramineus (Cope, 1865)	Sand shiner	42	26	12	51	290	--	--	2	--
Notropis voucellus (Cope, 1865)	Mimic shiner	--	--	--	--	--	--	--	--	--
Phenacobius mirabilis (Girard, 1856)	Suckermouth minnow	17	--	--	--	27	--	--	16	24
Pimephales notatus (Rafinesque, 1820)	Bluntnose minnow	14	5	14	23	42	3	42	7	25
Pimephales vigilax (Baird and Girard, 1856)	Bullhead minnow	--	--	--	--	--	--	--	--	--
Rhinichthys aratulus (Hermann, 1804)	Blacknose dace	3	47	--	43	2	--	--	--	--
Semotilus atromaculatus (Mitchill, 1818)	Creek chub	66	269	95	507	247	9	20	5	--
Catostomidae (suckers)										
Carpiodes carpio (Rafinesque, 1820)	River carpsucker	--	--	--	--	--	--	--	--	1
Carpiodes cyprinus Lesueur, 1817	Quillback	--	--	--	1	--	--	--	1	--
Carpiodes velifer (Rafinesque, 1820)	Highfin carpsucker	--	--	--	--	--	--	--	--	--
Catostomus commersoni (Lacepede, 1803)	White sucker	3	77	63	226	83	8	10	2	--
Cycleptus elongatus (Lesueur, 1817)	Blue sucker	--	--	--	--	--	--	--	--	--
Erimyzon oblongus (Mitchill, 1814)	Creek chubsucker	--	--	--	--	--	--	--	--	--
Hypentelium nigricans (Lesueur, 1817)	Northern hog sucker	--	12	13	8	8	5	37	--	--
Ictiobus bubalus (Rafinesque, 1818)	Smallmouth buffalo	--	--	--	--	--	--	--	--	--
Ictiobus cyprinellus (Valenciennes, 1844)	Bigmouth buffalo	--	--	--	--	--	--	--	--	--
Ictiobus niger (Rafinesque, 1819)	Black buffalo	--	--	--	--	--	--	--	--	--
Minytrema melanops (Rafinesque, 1820)	Spotted sucker	--	--	--	--	--	--	--	1	--
Moxostoma anisurum (Rafinesque, 1820)	Silver redhorse	--	--	--	--	--	--	--	--	--
Moxostoma carinatum (Cope, 1870)	River redhorse	--	--	--	--	--	--	--	--	--
Moxostoma duquesnei (Lesueur, 1817)	Black redhorse	--	--	--	--	--	--	--	--	--
Moxostoma erythrurum (Rafinesque, 1818)	Golden redhorse	--	--	--	--	--	--	--	--	1
Moxostoma macrolepidotum (Lesueur, 1817)	Shorthead redhorse	--	--	--	--	--	--	--	--	--
Ictaluridae (bullhead catfishes)										
Ameiurus melas (Rafinesque, 1820)	Black bullhead	--	--	--	--	--	--	--	--	--
Ameiurus natalis (Lesueur, 1819)	Yellow bullhead	--	--	--	--	7	1	5	5	4
Ictalurus punctatus (Rafinesque, 1818)	Channel catfish	--	--	--	--	--	--	--	1	5
Noturus flavus Rafinesque, 1818	Stonecat	--	--	--	--	--	--	--	--	--
Noturus miurus Jordan, 1877	Brindled madtom	--	--	--	--	--	--	--	--	--
Noturus nocturnus Jordan and Gilbert, 1886	Freckled madtom	--	--	--	--	--	--	--	--	1
Pylodictis olivaris (Rafinesque, 1818)	Flathead catfish	--	--	--	--	--	--	--	--	--
Aphredoderidae (pirate perches)										
Aphredoderus sayanus (Gilliams, 1824)	Pirate perch	--	--	--	--	--	--	--	1	--
Cyprinodontidae (killifishes)										
Fundulus notatus (Rafinesque, 1820)	Blackstripe topminnow	--	--	--	--	--	--	1	3	--

Table 5. Fish species at selected sites in the White River Basin, Ind., 1993–95—Continued

Number of fish per species by station, year, and reach																					
Clifty Creek		Sugar Creek					Muscatatuck River		Big Walnut Creek		White River near Centerton		White River near Elnora		East Fork White River at Shoals		White River at Hazleton				
'93 A	'95 A	'93 A	'94 A	'94 B	'94 C	'95 A	'93 A	'95 A	'93 A	'95 A	'93 A	'95 A	'93 A	'95 A	'93 A	'95 A	'93 A	'94 A	'94 B	'94 C	'95 A
--	--	2	7	6	5	3	2	--	13	443	1	3	--	--	--	--	--	--	--	--	--
--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	3	15	--	1	--	--	--	--	--	1	4	1	--
211	433	40	47	19	35	45	83	26	13	60	--	71	--	--	--	1	--	3	--	--	--
--	--	--	--	--	--	--	--	--	--	--	2	34	--	10	--	--	--	41	17	30	6
--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
23	3	1	42	46	104	25	--	--	6	2	--	2	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	1	7	15	12	14	--	6	2	11	5	7	4
--	--	--	--	--	1	--	--	--	--	--	--	--	2	--	--	--	--	1	--	1	--
--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	--	--	--	--	--	--
--	2	8	65	35	139	19	2	--	1		--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	1
1	1	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
16	44	23	62	66	161	42	8	3	9	120	--	2	--	--	--	8	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--	3	2	1	--	1	--	--	--	--
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--	--	1	1	--	4	4	18	--	--	--	--	--	--	1	1	2	--	--	--	--	--
--	--	1	--	24	--	13	6	--	--	1	--	1	--	--	--	--	--	--	--	--	--
--	--	--	2	--	--	--	--	1	--	--	--	--	--	--	--	--	--	1	2	--	--
15	63	19	19	26	43	10	2	3	5	10	4	8	--	--	--	1	--	--	--	--	--
8	8	17	37	25	57	12	34	15	4	19	4	7	--	--	--	2	--	--	--	--	--
--	--	--	--	2	1	--	--	1	6	9	1	1	--	--	--	14	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--
1	1	--	1	1	1	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--
1	1	--	--	1	1	--	1	--	1	3	12	4	1	2	--	--	1	2	3	2	3
8	15	--	--	2	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
--	4	--	--	--	1	--	--	--	--	3	--	--	--	--	--	--	--	--	--	--	--
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Table 5. Fish species at selected sites in the White River Basin, Ind., 1993–95—Continued

Scientific name	Common name	Number of fish per species by station, year, and reach								
		Little Buck Creek					Lost River		Kessinger Ditch	
		'93 A	'94 A	'94 B	'94 C	'95 A	'93 A	'95 A	'93 A	'95 A
Poecillidae (livebearers)										
Gambusia affinis (Baird and Girard, 1853)	Western mosquitofish	--	1	--	--	1	--	--	--	--
Atherinidae (silversides)										
Labidesthes sicculus (Cope, 1865)	Brook silverside	--	--	--	--	--	--	--	--	--
Cottidae (sculpins)										
Cottus bairdi Girard, 1850	Mottled sculpin	--	1	--	--	--	--	--	--	--
Cottus carolinae (Gill, 1861)	Banded sculpin	--	--	--	--	--	3	42	--	--
Percichthyidae (temperate basses)										
Morone chrysops (Rafinesque, 1820)	White bass	--	--	--	--	--	--	--	--	--
Centrarchidae (sunfishes)										
Ambloplites rupestris (Rafinesque, 1817)	Rock bass	--	--	--	--	--	69	94	--	--
Lepomis cyanellus Rafinesque, 1819	Green sunfish	11	5	14	17	12	--	1	47	22
Lepomis gulosus (Cuvier, 1829)	Warmouth	--	--	--	--	--	--	--	2	1
Lepomis humilis (Girard, 1858)	Orangespotted sunfish	--	--	--	--	--	--	--	--	--
Lepomis macrochirus Rafinesque, 1819	Bluegill	--	--	9	1	1	1	14	11	15
Lepomis megalotis (Rafinesque, 1820)	Longear sunfish	1	--	1	--	--	168	198	28	26
Lepomis microlophus (Gunther, 1859)	Redear sunfish	--	--	--	--	--	--	--	3	--
Micropterus dolomieu Lacepede, 1802	Smallmouth bass	--	--	--	--	--	11	20	--	--
Micropterus punctulatus (Rafinesque, 1819)	Spotted bass	5	13	23	20	49	--	3	3	9
Micropterus salmoides (Lacepede, 1802)	Largemouth bass	--	--	--	--	1	--	--	2	--
Pomoxis annularis Rafinesque, 1818	White crappie	--	--	--	--	--	--	--	1	--
Pomoxis nigromaculatus (Lesueur, 1829)	Black crappie	--	--	--	--	--	--	--	--	--
Lepomis macrochirus X *Lepomis megalotis*	Bluegill X longear sunfish	1	--	--	--	--	--	--	--	--
Lepomis macrochirus X *Lepomis cyanellus*	Bluegill X green sunfish	--	--	--	--	--	--	--	--	--
Lepomis spp.	Sunfish species	--	--	--	--	--	--	--	--	--
Percidae (perches)										
Etheostoma asprigene (Forbes, 1878)	Mud darter	--	--	--	--	--	--	--	--	--
Etheostoma blennioides Rafinesque, 1819	Greenside darter	--	--	--	--	--	--	--	--	--
Etheostoma caeruleum Storer, 1845	Rainbow darter	--	--	--	--	9	2	--	--	--
Etheostoma flabellare Rafinesque, 1819	Fantail darter	--	--	--	--	--	--	--	--	--
Etheostoma nigrum Rafinesque, 1820	Johnny darter	--	1	--	2	10	--	--	--	--
Etheostoma spectabile (Agassiz, 1854)	Orangethroat darter	--	6	5	14	9	--	7	--	--
Percina caprodes (Rafinesque, 1818)	Logperch	--	--	--	--	--	--	--	--	--
Percina maculata (Girard, 1859)	Blackside darter	--	--	--	--	--	--	--	--	--
Percina phoxocephala (Nelson, 1876)	Slenderhead darter	--	--	--	--	--	--	--	--	--
Percina sciera (Swain, 1883)	Dusky darter	--	--	--	--	--	--	--	--	--
Etheostoma caeruleum X *Etheostoma spectabile*	Rainbow X orangethroat	--	--	--	--	--	--	--	--	--
Sciaenidae (drums)										
Aplodinotus grunniens Rafinesque, 1819	Freshwater drum	--	--	--	--	--	--	--	1	--

Table 5. Fish species at selected sites in the White River Basin, Ind., 1993–95—Continued

Number of fish per species by station, year, and reach																					
Clifty Creek		Sugar Creek					Muscatatuck River		Big Walnut Creek		White River near Centerton		White River near Elnora		East Fork White River at Shoals		White River at Hazleton				
'93 A	'95 A	'93 A	'94 A	'94 B	'94 C	'95 A	'93 A	'95 A	'93 A	'95 A	'93 A	'95 A	'93 A	'95 A	'93 A	'95 A	'93 A	'94 A	'94 B	'94 C	'95 A
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30	25	2	18	16	21	19	3	7	4	5	--	--	--	--	--	--	--	--	--	--	--
1	2	--	3	2	2	2	2	7	--	2	--	2	--	--	--	1	--	2	1	2	4
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--	--	--	--
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	2	1	4
--	4	--	10	1	5	1	92	40	--	2	--	7	--	4	--	3	--	7	15	7	--
125	108	57	174	83	144	64	32	230	7	43	2	21	--	--	9	51	--	9	1	1	7
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	1	--	--
6	24	10	34	7	9	5	1	1	10	21	--	19	--	--	1	1	2	--	--	--	--
1	--	5	1	8	38	3	14	34	1	23	1	5	--	3	3	12	1	10	12	15	4
--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	2	--	--	2	--	--	--
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62	54	10	34	69	90	35	4	--	4	15	--	--	--	--	--	--	--	--	--	--	--
17	15	3	9	27	14	--	1	--	1	1	--	--	--	--	--	--	--	--	--	--	--
11	10	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
--	3	--	16	13	17	4	4	--	--	2	--	--	--	--	--	--	--	--	--	--	--
14	13	--	--	--	--	6	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
--	--	4	6	7	2	8	1	10	--	--	--	--	--	--	--	1	--	--	--	--	--
--	--	--	1	--	--	6	4	--	--	--	--	--	--	--	--	--	--	--	--	--	1
--	--	--	--	--	--	--	--	1	--	--	--	--	--	--	--	--	--	--	--	--	1
--	--	1	1	2	2	--	3	1	--	6	--	--	--	1	--	1	--	--	5	--	--
--	--	--	--	--	--	4	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
--	--	--	--	--	2		--	--	--	--	--	--	1	9	4	6	3	29	10	19	13

Table 6. Composition of fish communities at selected sites in the White River Basin, Ind., 1993–95

[Fish community classifications were developed by the Ohio Environmental Protection Agency (1987) for use in calculating the Index of Biological Integrity of streams; A, B, C, stream sampling reach]

Fish community composition	Number of fish per species by station, year, and reach										
	Little Buck Creek					Lost River		Kessinger Ditch		Clifty Creek	
	1993 A	1994 A	1994 B	1994 C	1995 A	1993 A	1995 A	1993 A	1995 A	1993 A	1995 A
Total number of fish caught	529	1,225	847	2,172	1,929	459	820	169	356	1,160	1,506
Number of species	13	15	15	15	22	18	19	27	22	27	30
Number of families	3	6	4	4	6	6	7	9	6	5	5
Family composition											
Number of sport fish	5	13	23	20	50	11	23	6	14	8	25
Number of sport species	1	1	1	1	2	1	2	3	2	3	2
Number of minnows	506	1,109	719	1,883	1,738	191	388	40	253	835	1,109
Number of minnow species	9	7	8	7	10	9	7	8	9	11	11
Number of suckers	3	89	76	235	91	13	47	4	2	40	118
Number of sucker species	1	2	2	3	2	2	2	3	2	4	5
Number of sunfish	14	5	24	18	13	238	307	89	64	156	139
Number of sunfish species	2	1	3	2	2	3	4	5	4	3	4
Number of darters	0	7	5	16	28	2	7	0	0	104	95
Number of darter species	0	2	1	2	3	1	1	0	0	4	5
Feeding guild composition											
Number of carnivores	5	13	23	20	50	80	117	6	11	37	49
Number of carnivore species	1	1	1	1	2	2	3	3	2	3	2
Number of piscivores	0	0	0	0	0	0	0	1	1	0	0
Number of piscivore species	0	0	0	0	0	0	0	1	1	0	0
Number of insectivores	125	134	110	259	583	289	506	115	139	678	776
Number of insectivore species	7	9	10	8	14	11	12	13	13	21	23
Number of herbivores	310	680	542	1,093	921	70	125	1	158	210	198
Number of herbivore species	1	1	1	1	1	2	1	1	1	1	1
Number of omnivores	17	82	77	250	126	11	52	24	43	209	435
Number of omnivore species	2	2	2	3	3	2	2	5	4	1	2
Breeding guild composition											
Number of lithophilic spawners	48	182	122	301	165	93	190	21	25	502	525
Number of lithophilic spawning species	4	5	4	5	8	5	4	4	2	11	12

Table 6. Composition of fish communities at selected sites in the White River Basin, Ind., 1993–95—Continued

Number of fish per species by station, year, and reach																			
Sugar Creek					Muscatatuck River		Big Walnut Creek		White River near Centerton		White River near Elnora		East Fork White River at Shoals		White River at Hazleton				
1993 A	1994 A	1994 B	1994 C	1995 A	1993 A	1995 A	1993 A	1995 A	1993 A	1995 A	1993 A	1995 A	1993 A	1995 A	1993 A	1994 A	1994 B	1994 C	1995 A
266	1,099	947	2,022	624	346	405	171	1,838	69	647	37	416	33	241	24	283	222	210	189
26	29	34	34	32	27	20	23	30	16	23	13	19	9	26	12	29	28	24	26
5	6	6	7	5	6	5	6	6	5	6	7	8	4	8	7	9	10	10	11
15	35	16	48	8	16	34	12	48	14	30	6	8	11	14	4	14	21	43	17
2	2	3	4	2	3	2	3	4	3	4	3	3	3	3	3	3	3	4	4
98	553	429	1,159	342	112	49	116	1,541	506	511	3	334	0	31	0	146	109	96	86
10	10	13	9	12	7	5	10	8	4	6	1	4	0	5	0	11	6	7	5
69	186	178	406	100	70	23	25	160	16	34	19	18	3	35	3	13	10	9	5
6	6	6	7	6	6	5	5	6	4	6	4	4	3	7	2	3	4	3	2
60	203	102	172	86	129	284	11	52	3	31	0	4	9	57	0	20	21	11	16
3	4	4	4	4	4	4	2	4	2	4	0	1	1	5	0	5	5	4	4
18	66	118	125	63	17	12	5	24	0	0	0	1	0	2	0	0	4	0	2
4	5	5	5	6	6	3	2	4	0	0	0	1	0	2	0	0	1	0	2
17	53	31	68	27	18	42	15	50	1	24	0	13	6	16	3	12	12	16	19
3	3	3	3	3	3	3	4	3	1	2	0	1	3	3	1	2	1	2	1
0	0	0	1	0	0	0	0	1	1	2	11	10	0	2	12	22	17	28	15
0	0	0	1	0	0	0	0	1	1	1	4	4	0	2	3	3	3	3	4
191	683	659	967	455	236	332	115	1,443	17	458	6	55	12	115	1	102	118	72	72
18	22	25	22	24	20	15	14	19	7	12	2	7	4	14	1	13	16	11	12
8	210	155	700	52	6	0	18	235	0	0	0	278	0	1	0	21	8	7	32
1	1	1	1	1	1	0	1	1	0	0	0	1	0	1	0	1	1	1	1
48	112	78	177	65	85	29	15	69	37	156	18	59	11	102	4	94	53	66	49
2	2	2	4	3	2	2	3	4	4	5	4	4	1	4	3	6	4	5	4
119	423	454	766	348	102	37	54	196	10	20	3	2	1	38	0	52	55	11	4
13	12	14	11	16	13	9	9	9	4	6	1	2	1	8	0	5	6	3	4

Table 7. Classifications of fish species collected at selected sites in the White River Basin, Ind., 1993–95

[Fish species classifications were developed by the Ohio Environmental Protection Agency (1987) for use in calculating the Index of Biological Integrity metrics;--, no designation for this species]

Common name	Family composition	Functional group	
		Feeding guild	Simple lithophilic spawner
Sturgeons			
Shovelnose sturgeon	--	Insectivore	Yes
Paddlefishes			
Paddlefish	--	--	Yes
Gars			
Spotted gar	--	Piscivore	No
Longnose gar	--	Piscivore	No
Shortnose gar	--	Piscivore	No
Alligator gar	--	Piscivore	No
Mooneyes			
Mooneye	--	Insectivore	No
Freshwater eels			
American eel	--	Carnivore	No
Herrings			
Gizzard shad	--	Omnivore	No
Carps, minnows			
Central stoneroller	Minnows	Herbivore	No
Goldfish	Carp/Goldfish	Omnivore	No
Grass carp	Exotic	--	No
Spotfin shiner	Minnows	Insectivore	No
Steelcolor shiner	Minnows	Insectivore	No
Common carp	Carp/Goldfish	Omnivore	No
Mississippi silvery minnow	Minnows	Herbivore	No
Striped shiner	Minnows	Insectivore	No
Redfin shiner	Minnows	Insectivore	No
Silver chub	Minnows	Insectivore	No
Hornyhead chub	Minnows	Insectivore	No
River chub	Minnows	Insectivore	No
Golden shiner	Minnows	Insectivore	No
Bigeye chub	Minnows	Insectivore	Yes
Emerald shiner	Minnows	Insectivore	Yes
River shiner	Minnows	Insectivore	Yes
Bigeye shiner	Minnows	Insectivore	Yes
Silverjaw minnow	Minnows	Insectivore	No
Silver shiner	Minnows	Insectivore	Yes
Rosyface shiner	Minnows	Insectivore	Yes
Silverband shiner	Minnows	Insectivore	No
Sand shiner	Minnows	Insectivore	No
Mimic shiner	Minnows	Insectivore	No
Suckermouth minnow	Minnows	Insectivore	Yes
Bluntnose minnow	Minnows	Omnivore	No
Bullhead minnow	Minnows	Omnivore	No
Blacknose dace	Minnows	--	Yes
Creek chub	Minnows	--	No
Suckers			
River carpsucker	Sucker	Omnivore	No
Quillback	Sucker	Omnivore	No
White sucker	Sucker	Omnivore	Yes
Blue sucker	Sucker	Insectivore	Yes
Creek chubsucker	Sucker	Insectivore	No
Northern hog sucker	Sucker	Insectivore	Yes
Smallmouth buffalo	Sucker	Insectivore	No
Bigmouth buffalo	Sucker	Insectivore	No
Black buffalo	Sucker	Insectivore	No
Spotted sucker	Sucker	Insectivore	Yes
Silver redhorse	Sucker	Insectivore	Yes
River redhorse	Sucker	Insectivore	Yes
Black redhorse	Sucker	Insectivore	Yes
Golden redhorse	Sucker	Insectivore	Yes
Shorthead redhorse	Sucker	Insectivore	Yes
Bullhead catfishes			
Black bullhead	--	Insectivore	No
Yellow bullhead	--	Insectivore	No
Channel catfish	Sport species	--	No
Stonecat	--	Insectivore	No
Brindled madtom	--	Insectivore	No
Freckled madtom	--	Insectivore	No
Flathead catfish	Sport species	Piscivore	No
Pirate perches			
Pirate perch	--	Insectivore	No
Killifishes			
Blackstripe topminnow	--	Insectivore	No
Live-bearers			
Western mosquitofish	Exotic	Insectivore	No
Silversides			
Brook silverside	--	Insectivore	No
Sculpins			
Mottled sculpin	Sculpin	Insectivore	No
Banded sculpin	Sculpin	Insectivore	No
Temperate basses			
White bass	Sport species	Piscivore	No
Sunfishes			
Rock bass	Sunfish	Carnivore	No
Green sunfish	Sunfish	Insectivore	No
Warmouth	Sunfish	Carnivore	No
Orangespotted sunfish	Sunfish	Insectivore	No
Bluegill	Sunfish	Insectivore	No
Longear sunfish	Sunfish	Insectivore	No
Redear sunfish	Exotic	Insectivore	No
Smallmouth bass	Sport species	Carnivore	No
Spotted bass	Sport species	Carnivore	No
Largemouth bass	Sport species	Carnivore	No
White crappie	Sunfish	--	No
Black crappie	Sunfish	--	No
Perches			
Mud darter	Darters	Insectivore	--
Greenside darter	Darters	Insectivore	Yes
Rainbow darter	Darters	Insectivore	Yes
Fantail darter	Darters	Insectivore	No
Least darter	Darters	Insectivore	No
Johnny darter	Darters	Insectivore	No
Orangethroat darter	Darters	Insectivore	Yes
Logperch	Darters	Insectivore	Yes
Gilt darter	Darters	Insectivore	Yes
Blackside darter	Darters	Insectivore	Yes
Slenderhead darter	Darters	Insectivore	Yes
Dusky darter	Darters	Insectivore	Yes
Drums			
Freshwater drum	--	--	No

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