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STUDY OF FISH IN THE MAIN CHANNEL OF THE MISSISSIPPI RIVER BETW--ETC(U)

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Ecological Research Associates

STUDY OF FISH IN THE MAIN CHANNEL OF THE MISSISSIPPI RIVER BETWEEN RIVER MILES 500 AND 513.5

FOR: GREAT II FISH AND WILDLIFE MANAGEMENT WORK GROUP
US FISH AND WILDLIFE SERVICE
1830 2ND AVENUE
ROCK ISLAND ILLINOIS 61201
AND
DEPARTMENT OF THE ARMY
ROCK ISLAND DISTRICT
CORPS OF ENGINEERS
ROCK ISLAND ILLNOIS 61201

STUDY OF FISH IN THE MAIN CHANNEL OF THE
MISSISSIPPI RIVER BETWEEN RIVER MILES 500 AND 513.5

FINAL REP[redacted]T.

by

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ABSTRACT

The main channel habitat in Pool 14 (river miles 500 to 513.5) of the upper Mississippi River was sampled to determine the occurrence, distribution and relative abundance of fishes. Gear types used were gill net, trammel net, hoop net, bottom trawl, midwater trawl, seine and electrofisher. Thirty-nine species of fish were caught from May 1979 to April 1980. The most abundant species of 2692 total fish were channel catfish (59.0%,which were mostly YOY), silver chub (12.0%), mooneye (10.3%), shovelnose sturgeon (9.4%), freshwater drum (2.5%), flathead catfish (1.7%), and river darter (1.7%). Catch rates and species compositions varied seasonally; the most fish were caught in July (1027) while the fewest were caught in February (4). The low number in February was due mainly to reduced fishing efforts using only gill and hoop nets. Among the six stations sampled the relative abundances of the common fish were similar and cluster analyses indicated that differences in fish relative abundance among stations were small. Species diversity (Shannon-Weaver) increased with distance upstream ($H''=1.21$ to 1.71) based on annual catches per station. Seasonally, the highest diversity value was in March ($H''=2.23$) and the lowest value was in August ($H''=0.85$).

The bottom trawl was the most effective gear type for catching fish; seining and electrofishing were ineffective. The other gear types were intermediate in effectiveness. The main channel had a more diverse fish population than previously reported but the importance of the fishery resource in the main channel was not quantitatively evaluated.

For future research needs a recommendation was made to perform one or more Adaptive Environmental Assessment Workshops.

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Great River Environmental Action Team

PREFACE

The following study represents a significant addition to our knowledge of the fishery resources of the Upper Mississippi River (UMR). Until now, the main navigation channel of the UMR has often been characterized as a biological desert. This study demonstrates that the main navigation channel harbors certain species in abundance.

Based on the results of this study and the experience of the biologists familiar with the river, the Fish and Wildlife Management Group has concluded:

1. The main channel is an important nursery area for channel catfish-the top commercial (in value) and sport (fishermen preference) fish through much of the GREAT II reach.

2. Channel catfish, silver chub, mooneye, shovelnose sturgeon, freshwater drum, flathead catfish and river darter typify the fishery of the main channel. The importance of this habitat to these species must be evaluated.

3. Absence of white bass, walleye, and sauger in any sizable numbers may indicate that a) bottom trawling is ineffective for these species, or b) for some yet unexplained reason they make extensive use of main channel border but avoid the main channel.

4. Bottom trawling is (to date) the most effective means available to us for sampling the main channel.

5. Bottom trawling in the main channel is an effective economical means of assessing young of the year class strength of channel catfish for use in predictions of future stock available for commercial and sport harvest.

6. Additional studies to improve our understanding of impacts on fish attributable to passage of towboats, recreational craft, dredging and winter navigation need to be incorporated in the long-term resource monitoring plan currently being developed as part of the Upper Mississippi River Basin Commission's Master Plan for the river. (Public Law 95-502).

Fish & Wildlife Management Work Group
GREAT II
November 1980

STUDY OF FISH IN THE MAIN CHANNEL OF THE MISSISSIPPI RIVER BETWEEN RIVER MILES 500 AND 513.5

INTRODUCTION

The continued demands placed on the fish and wildlife resources of the Upper Mississippi River by a variety of man's activities such as dredging, degraded water quality, and commercial and recreational fisheries have resulted in the need for objective scientific data which can be used to make river-use policies as compatible among themselves and as ecologically acceptable as practical.

As provided in the Water Resources Development Act of 1976 (PL94-587), the U.S. Army Corps of Engineers (COE) was authorized to develop a river system management plan for the Upper Mississippi River (St. Paul/ Minneapolis to the confluence of the Ohio River). The resulting Great River Study is a cooperative venture involving state and federal agencies coordinated by the Upper Mississippi River Basin Commission. The program was organized into groups designated as Great River Environmental Action Teams (GREAT) with the Upper Mississippi River divided into three reaches--GREAT I, GREAT II, and GREAT III. GREAT I extended from St. Paul/ Minneapolis to Guttenberg, Iowa; GREAT II from Guttenberg to Saverton, Missouri; and GREAT III from Saverton to the confluence of the Ohio River. The ultimate goal of the Great River Study is to provide a resource management plan that is compatible with economic, social and environmental interests.

The history of the numerous alterations which have been made to the Mississippi River to facilitate transportation over the period from the early 1800's to the present has been summarized by Rasmussen (1979). Of interest, most of the Upper Mississippi River has been significantly altered by the construction and operation of 29 locks and dams. The pools between dams are bisected by a navigation channel maintained at a minimum 9-ft depth. The aquatic habitats within the pools are variable and diverse. Six major habitat types (Sternberg 1971) have been described in an attempt to standardize nomenclature as an aid to research and management. These habitats are (1) main channel; (2) main channel border; (3) tail waters; (4) side channels; (5) river lakes and ponds; and (6) sloughs. Of these, the main channel, which is defined as the portion of the river through which large commercial craft operate, has received less scientific fisheries investigation than any of the other habitats. As a result, the role or importance of the main channel as fish habitat has not been quantified. Whether or not fish utilize the main channel as a feeding or spawning area, for refuge, or as a migration corridor represents a major question needing resolution before the effects of the various management scenarios can be completely projected or evaluated.

Heretofore, much speculation has existed relative to the ecological consequences of man's activities on the fishery resources of the main channel . Even the question as to whether there exists a fishery resource in the main channel has created considerable controversy. The research described below was sponsored by GREAT II and its Fish and Wildlife Management Work Group (FWMWG) for the purpose of increasing knowledge concerning fish utilization of the main channel habitat.

Objectives of this project were to (1) determine species composition and relative abundance of fish communities in the upper Mississippi River between river miles 500 and 513.5, and (2) evaluate effectiveness of the various gear types used to sample fish.

STUDY AREA AND METHODS

Navigation Pool 14 was chosen for investigations of fish use of main channel habitat. Pool 14 was formed by Lock and Dam 14 near Davenport, Iowa at river mile 493.3. The pool extends over 29 mi upstream to Fulton, Illinois. Aquatic habitats represented in this pool are main channel (1,636 ac); main channel border (4,835 ac); side channel (418 ac); and slough-side streams, river lakes and ponds, and submergent and floating vegetation (2,896 ac) (Breitenbach and Peterson 1980).

Six sampling stations were designated in the original Request for Proposal (RFP) within Pool 14 (Fig. 1). Stations were chosen to provide examples of main channel habitat adjacent to or near a variety of river features and other habitats. Also main channel depth was considered when stations were selected. All were located in the navigation channel as delineated by navigation buoys and markers. Locations of sampling stations (stream segments) were as follows:

Station 1 - river miles 500.6-501.3, downstream from Princeton, Iowa;

Station 2 - river miles 501.7-503.0, adjacent to Princeton, Iowa and Cordova, Illinois;

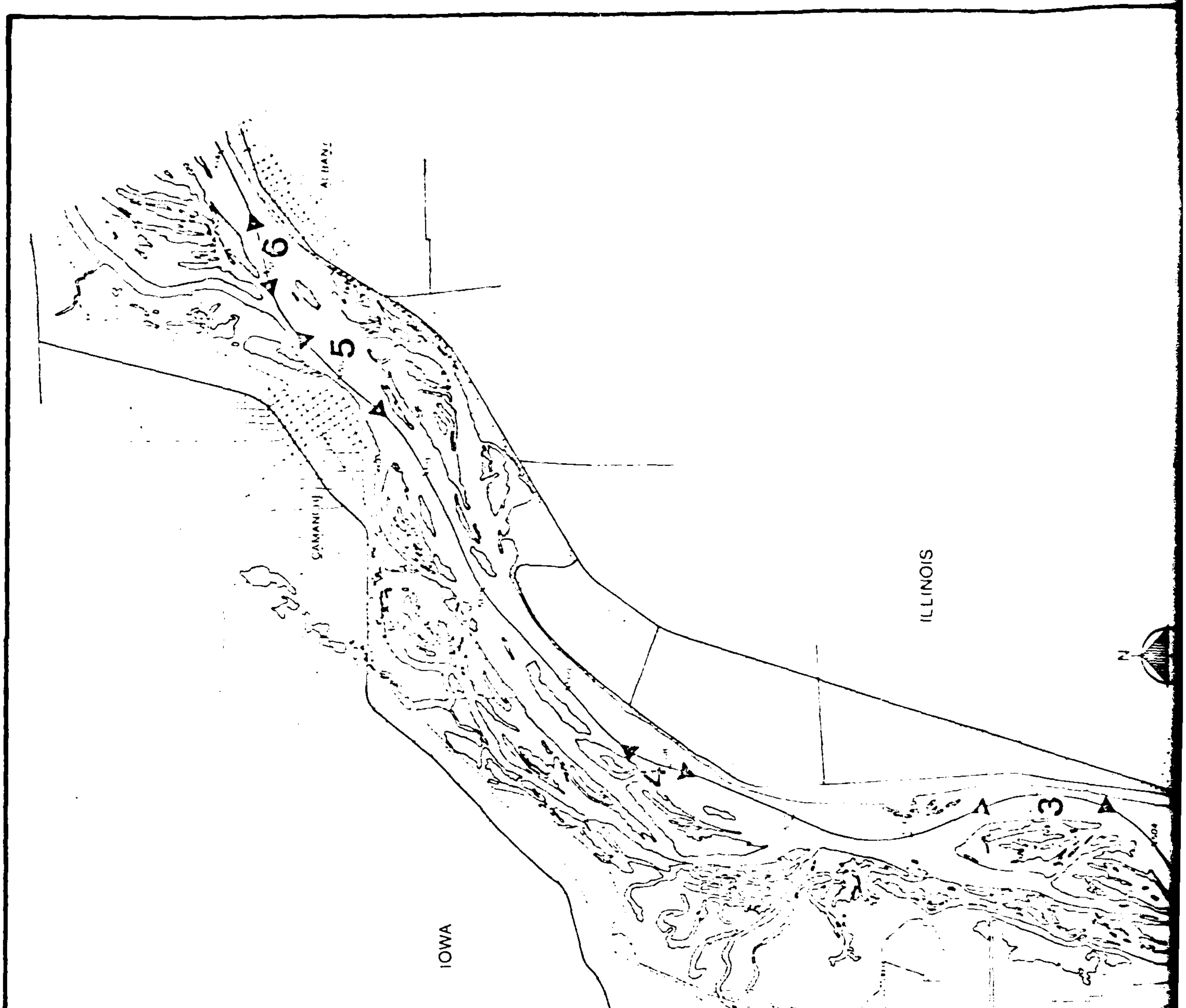
Station 3 - river miles 504.4-505.5, downstream from Cordova Nuclear Plant and mouth of Wapsipincon River;

Station 4 - river miles 507.8-508.4, near Adams Island and Coes Island;

Station 5 - river miles 511.5-512.5, adjacent to Comanche, Iowa; and

Station 6 - river miles 512.8-513.4, adjacent to Albany, Illinois, upstream Beaver Slough.

Eight sampling efforts (described in the original RFP and later modified with approval of FWMWG) were performed during the period May 1979 to April 1980. Six of the efforts were performed during ice-free periods and two (January and February) were conducted during periods characterized by partial iced-over conditions. Sampling trips were designated by the month during which collecting efforts commenced; namely May (31 May-5 June 1979), June (25 June-1 July 1979), July (21-29 July 1979), August (21-28 August 1979), October (3-11 October 1979), January (14-21 January 1980), February (7-12 February 1980), and April (20-30 April 1980).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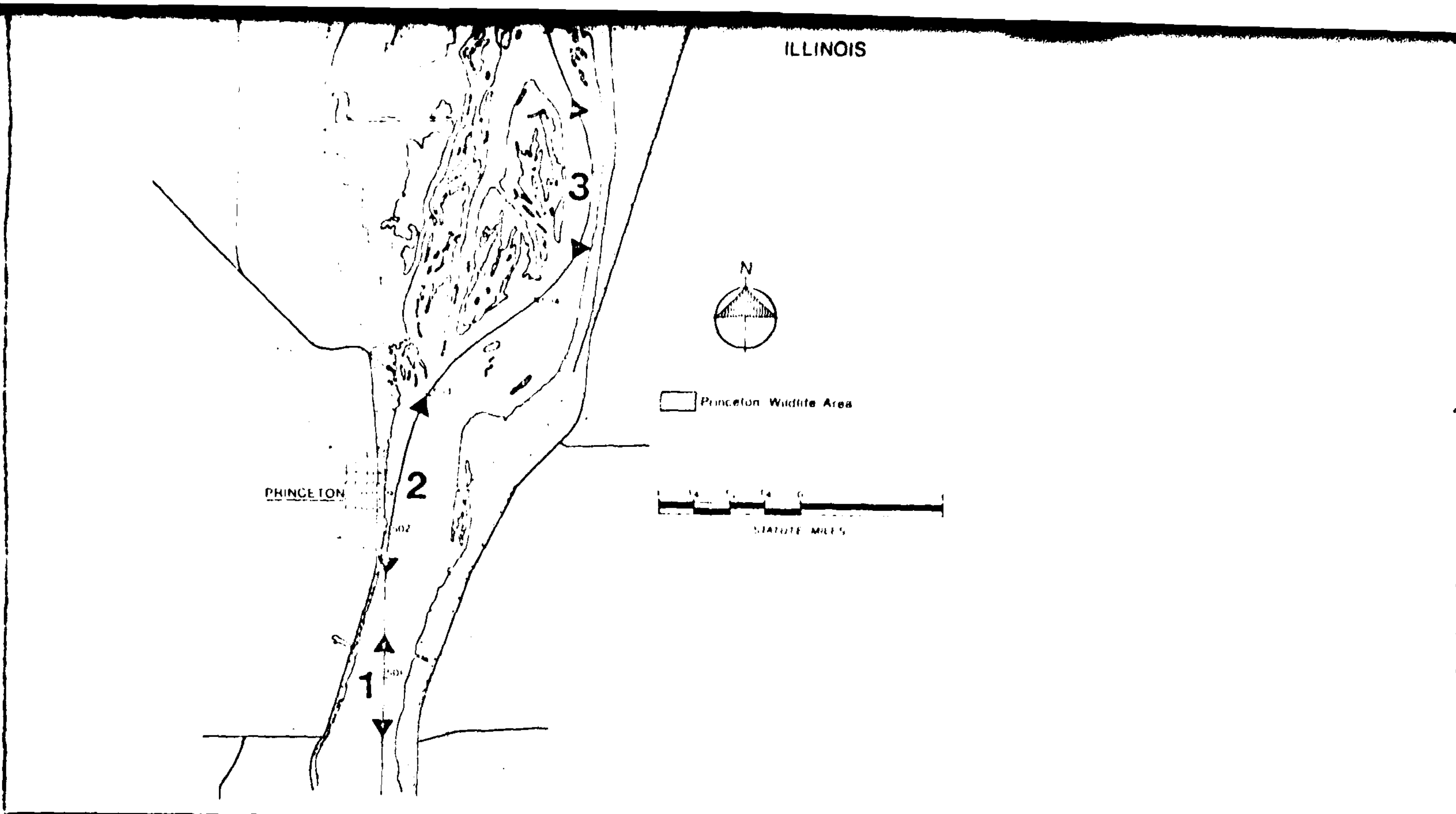

Fig. 1. Location of sampling stations within Pool 14.

(1) Single mesh gill nets (300 ft long, 3 in stretch mesh, monofilament)--surface and bottom sets parallel to current at each station (May-August);

(2) Experimental mesh gill nets (300 ft long, 1½, 2, 2½, 3 and 3½ in stretch mesh sizes, multifilament)--surface and bottom sets parallel to current at each station (October, April);

(3) Trammel nets (300 ft long, 3 in stretch mesh)--3 surface floats (15-30 min) per station (May-April) net floated perpendicular to current;

(4) Hoop nets (7 hoops, 2 throats, 1 in mesh)--3 bottom sets per station (May-April);

(5) Bottom trawl (20 ft bottom trawl with 2 in stretch mesh and ¼ in cod-end liner)--3 10-min upstream tows per station (May, April, June, July, August, October);

(6) Mid-water trawl--3 5-min downstream tows per station (October, April);

(7) Electrofisher--Smith-Root, Type VI-A using AC (May-August) boom mounted electrodes ~ 8 ft long suspended from bow of boat. Boat was backed upstream with auxiliary boat following to net fish. 2 20-min runs per station; and

(8) Seine--500 ft X 20 ft (1½ bar mesh) set in arc with bag at mid point. Seine retrieved into boat in mid-channel. 2 hauls per station.

Under-ice sampling consisted of (1) surface and bottom sets at each station using experimental mesh gill nets and (2) 3 bottom hoop net sets per station. Gill nets (surface and bottom) and a single, bottom hoop net were also used in a diel sampling effort as a means to evaluate capture rates relative to time of day. Each net was checked every 4 h over a 24-h period and any fish caught in the nets were measured and released.

Fish captured by the above methods were measured to the nearest mm (total length), sexed if possible from external characteristics and released. Representative specimens of each species were preserved in formalin for later deposit in the Milwaukee Public Museum.

Various combinations of mechanical and weather-related problems caused the above idealized sampling design to be modified during the course of the study. Also, during a mid-project review, some gears were added and others deleted in an attempt to optimize sampling and test new gear sampling efficiencies. Most changes were recommended by LGL and approved by FWMWG.

A total of 20 channel catfish of various sizes representative of the specimens caught during April 1980, were preserved in formalin and analyzed for food items contained in stomachs. Stomach contents were examined under a dissecting scope and all items were identified and counted.

To facilitate making correlations between stomach contents and benthic prey abundance, a series of benthic grabs was collected in April. Three Petite Ponar grabs (15 cm x 15 cm) were collected at each station. Sediments were visually characterized for particle size and then washed through a No. 30 mesh seive. Sediments and benthos retained on the seive were preserved in formalin. In the laboratory, benthic invertebrates were removed by hand from the sediments and identified to the lowest practical taxon and counted.

Temperature (^{o}C), conductivity (μmhos/cm), dissolved oxygen (mg/ℓ) and turbidity (NTU) were measured at each station during each collecting trip. Temperature, conductivity, and dissolved oxygen were measured at 1-m intervals from surface to bottom. Turbidity was measured from water samples collected at surface and 0.8 maximum depth. Except for turbidity, all measurements were made in situ using a Hydrolab water quality analyzer (Model 4041 or 8000). Turbidity was measured using a Hach 2100A Turbidimeter. Surface-to-bottom profiles of temperature, conductivity, and dissolved oxygen were also made each time nets were checked during diel sampling.

Diversity and Cluster Analysis Methods

Diversity indices and cluster analyses were performed as tools to enable comparisons of fish community structure and composition among stations and sampling trips. These data synthesis and reduction techniques are commonly used to summarize and interpret biological survey data to enable comparisons in space and time (Ward 1978, Sharma et al. 1976).

Diversity indices were calculated using the Shannon-Weaver index as suggested by Pielou (1966a). The index (H") is calculated by the formula:

$$H'' = \sum_{i=1}^{n} \frac{n_i}{N} \ln \frac{n_i}{N}$$

where: n = the number of individuals in the ith species

N = total number of individuals in the collection

The index is reasonably independent of sampling size (Odum 1971) and is normally distributed (Bowman et al. 1970). Because natural logarithms are used in computations, the diversity unit is expressed as a "natural bel" (Pielou 1969).

The evenness component of diversity was computed using Pielou's (1966b) index as follows:

$$J = \frac{H''}{H''\ max} = \frac{H''}{\ln S}$$

where: H" = observed diversity computed in the Shannon-Weaver index

H" max = the maximum diversity value for the number of species present (ln S)

S = number of species present in the collection

Evenness, therefore, represents a ratio of the observed diversity to the maximum possible diversity for the number of species present in the collection.

An additional component of diversity is species richness or variety. This is a measure of the number of species occurring in the community relative to the total number of individuals. Species richness was calculated by the Dahlberg and Odum (1970) model as follows:

$$D = \frac{(S-1)}{\ln N}$$

where: S = number of species in the collection

N = number of individuals in the collection

This index, or course, is dependent upon sample size. However, it provides a useful measure of relative variety among communities.

Fish catch data were clustered using agglomerative hierarchical polythetic clustering as described by Smith (1980). Catch data were initially sorted and clustered using a flexible sorting strategy. Both rows (representing species) and columns (representing collection trips and secondly, stations) of the input matrix were clustered. The Bray-Curtis distance index was used, where the distance between entities I and J is:

$$D_{IJ} = \frac{\sum^{N} \left| X_{KL} - X_{KJ} \right|}{\sum^{N} (X_{KI} + X_{KJ})}$$

where: X = the value of attribute K for entity I and

N = the number of attributes compared

Since the values of the numerator are the absolute sum of differences between two attributes and the denominator is additive using the same values, all values will be positive because the denominator must be at least as large as the numerator. The dissimilarity distance between any two groups has a minimum of 0.00 (same) and a maximum of 1.00 (maximum dissimilarity). Each successive node compares coefficients such that each line attaching successive nodes may not exceed a value of 1.00. Another way of telling how far apart 2 entities are is by counting the number of nodes separating them. This is especially helpful in comparing dendrograms from different indices. For a detailed description of the use of dendrograms and cluster analysis techniques the reader is referred to Clifford and Stephenson (1975) and Sokal and Sneath (1963).

In order to standardize distances and minimize the impact of a few high catches when compared to some zero catches, data were standardized by ranking column values. The maximum column value was set equal to one, and other values were ranked on the scale of zero to one. These standardized values were then used in the cluster analysis. Only species with 10 or more individuals represented in the collection were used in the cluster analysis as a method to reduce clustering related to lack of information.

BIOLOGICAL RESULTS

Complete tabulated results of fishes caught during the study are presented in Appendix I.

Thirty-nine species of fish were identified during this study (Table 1). Historically, about 63 species have been reported to occur in Pool 14 (Rasmussen 1979, Breitenbach and Peterson 1980) (Table 1). Of the species found in this study, grass carp, flathead chub, silverband shiner, highfin carpsucker and stonecat were not included on the above mentioned historical list. Life history accounts for many of the species expected and occurring in Pool 14 were provided by Farabee (1979); these are supplemented by information contained in Appendix II.

Of the 39 species of fish collected during this study, channel catfish were by far the most abundant. Only four other species--silver chub, freshwater drum, mooneye, and shovelnose sturgeon--represented as much as 2% of the total catch (Fig. 2). Most of the other species were either rare throughout the study period or were abundant only during a single collecting trip.

In May, when relatively few fish were caught, the silverband shiner was the most abundant of the 15 species observed. River darter and channel catfish were the only other species caught which occurred in numbers greater than 10, although other species were relatively abundant (Fig. 3). Bottom trawl was the most effective gear type for catching greater numbers of fish (62% of total catch), but more species (8 of 15) were caught in gill nets than in any of the other gears utilized.

The June collections were dominated by freshwater drum and channel catfish which collectively comprised over half of the total catch (Fig. 4). A total of 88 fish were caught among which 11 species were represented. Bottom trawling yielded the greatest diversity and abundance of all gear types (eight species, 50 individuals). Gill nets were the second most effective gear type with five individuals and 21 specimens collected. Hoop nets, trammel nets, seine and electrofishing were basically ineffective (five species and six individuals for all three gear types combined).

During July, over 1,000 fish, which included 24 species, were captured. Over 80% of the total number were channel catfish young-of-the-year (YOY). Other abundant species represented were freshwater drum (9%), shovelnose

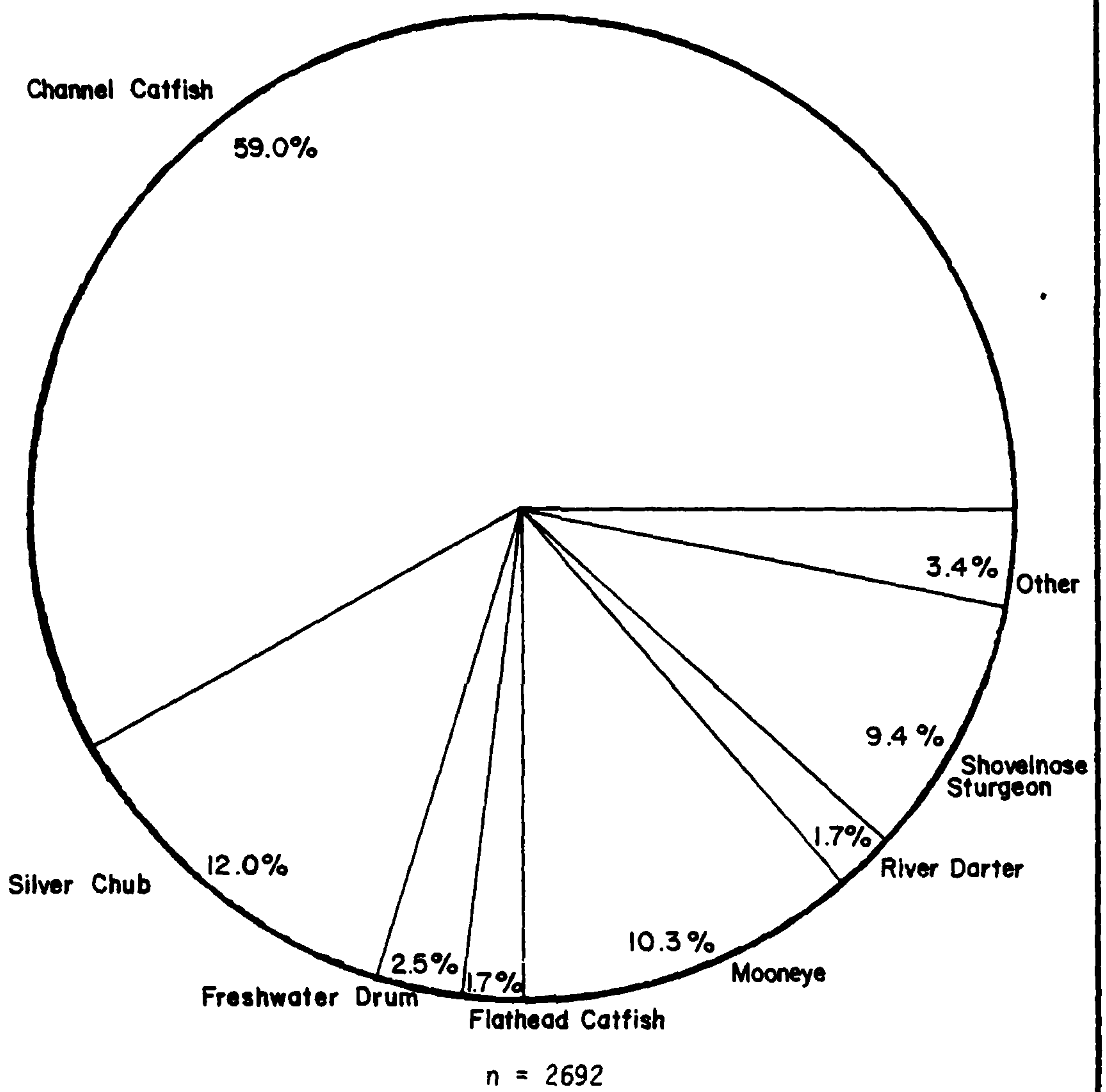

Fig. 2. Relative abundance of fish species collected during 1979-1980. (based on numbers)

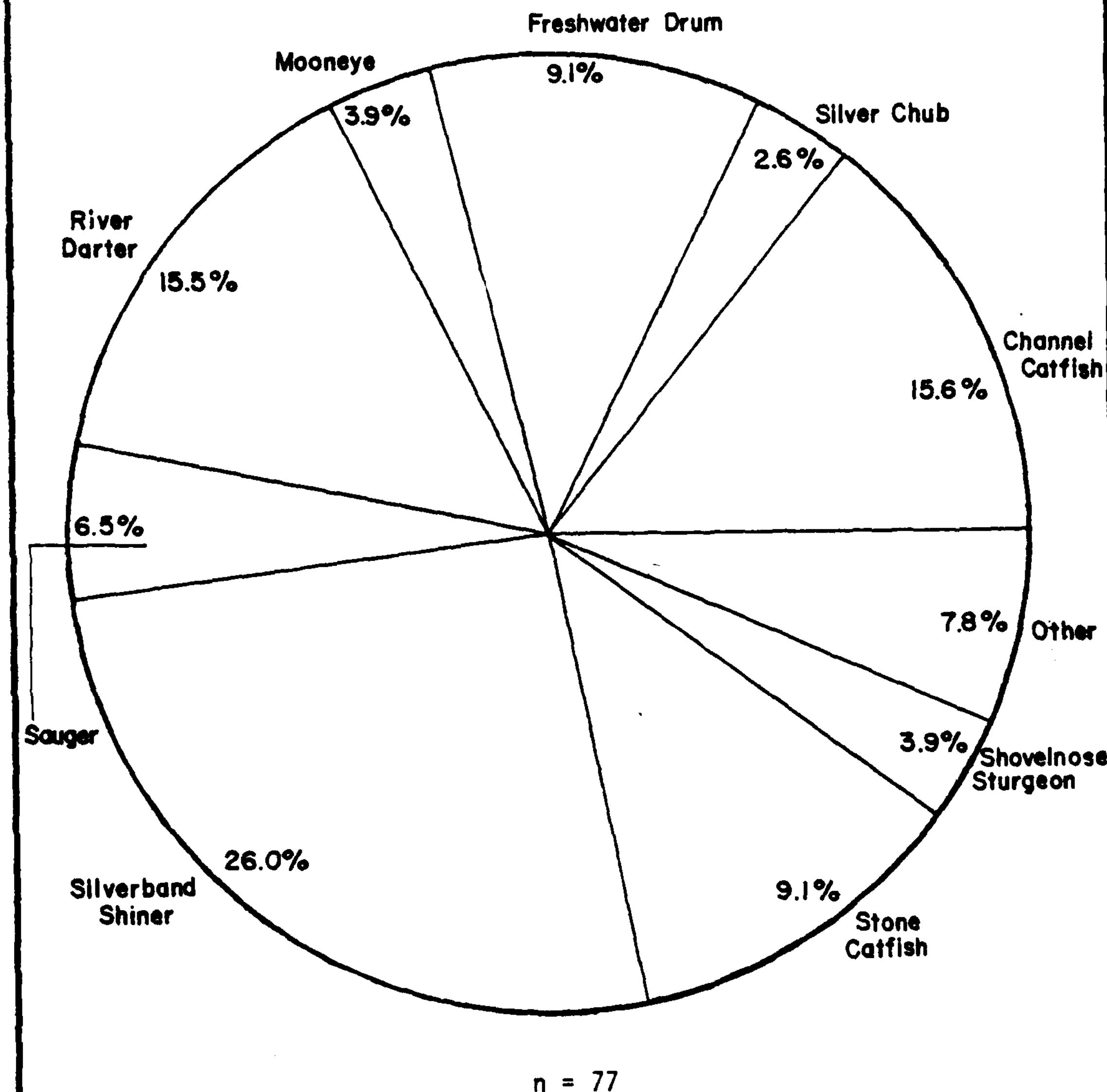

Fig. 3. Relative abundance of fish species collected during May 1979. (based on numbers)

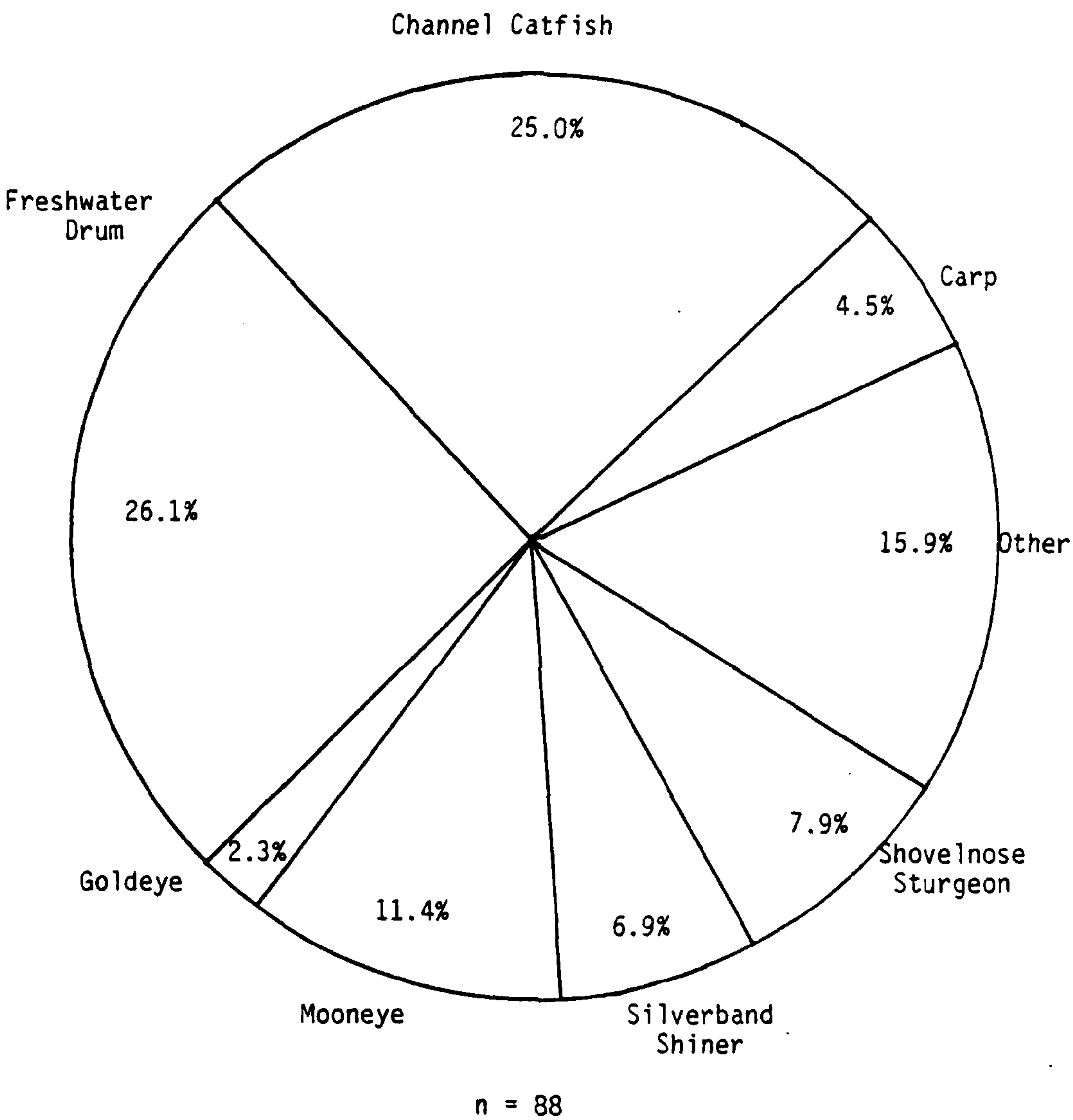

Fig. 4. Relative abundance of fish species collected during June 1979. (based on numbers)

sturgeon (5%), and mooneye (3%) (Fig. 5). Although not a significant percentage of the total catch, two other species were caught in "greater than normal numbers"--flathead catfish and white crappie. All other species were represented by fewer than 10 specimens. The bottom trawl was again the most effective gear type (952 fish, 17 species). Other gear types caught less than 10% of the total caught by trawling, but the numbers of species caught--12, 9, and 9 in trammel, hoop, and gill nets, respectively--were not as greatly reduced. No fish were caught in seines or by electrofishing.

August fish collections were overwhelmingly dominated by YOY channel catfish but freshwater drum, flathead catfish, shovelnose sturgeon, and quillback were also well represented (Fig. 6). As in most previous collections, the majority of fish were caught in the bottom trawl. However, trammel nets caught more species (12) than any other gear type.

October fish collections were characterized by relatively high diversity (21 species) and low abundances. The majority of the fish caught were channel catfish, but freshwater drum, shovelnose sturgeon, mooneye, gizzard shad, and silver chub were common (Fig. 7). During this and subsequent sampling periods, seining and electrofishing were replaced with mid-water trawling. However, bottom trawling continued to yield the most fish (numbers and species). Thirteen of the 16 total species caught during this period and the great majority of specimens were collected by bottom trawling. In descending order of capture in terms of both total individuals and numbers of species were hoop nets, mid-water trawl, gill nets and trammel nets.

During the January sampling effort, the river was characterized by floating ice pans and areas of pack ice. The amount of ice-up and floating ice varied daily. During this period, only a limited amount of sampling was performed. However, the total number of fish caught, as well as the number of species, were not greatly different from previous collections. Because of the floating ice and, perhaps some anchor-ice, which carried away net sets, gill and hoop nets were sparingly used. Bottom and mid-water trawls were used with success until floating ice made towing impractical. Fish abundantly represented in January collections included freshwater drum, channel catfish, mooneye, and silver chub (Fig. 8). These four species accounted for over 90% of the total catch.

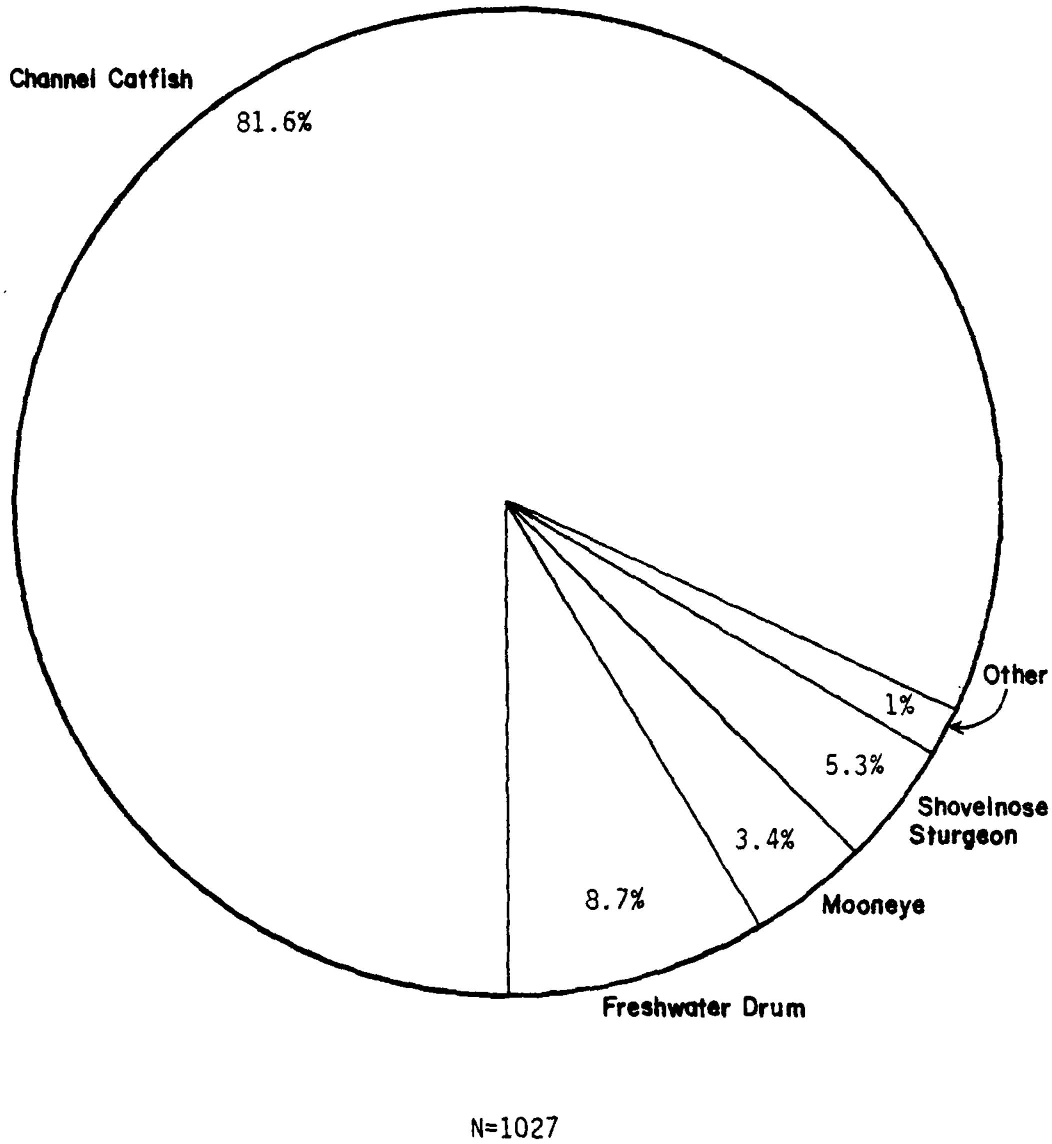

Fig. 5. Relative abundance of fish species collected during July 1979. (based on numbers)

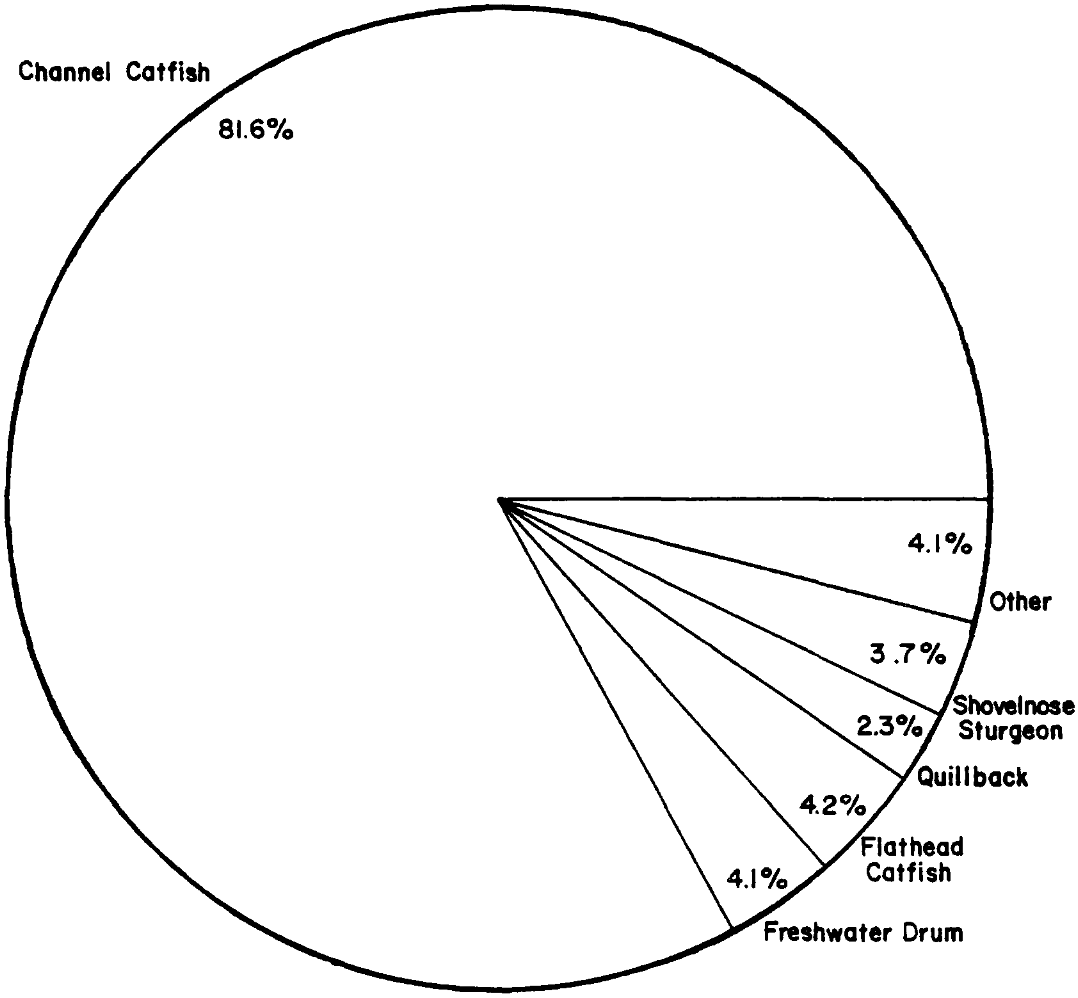

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Fig. 6. Relative abundance of fish species collected during August 1979. (based on numbers)

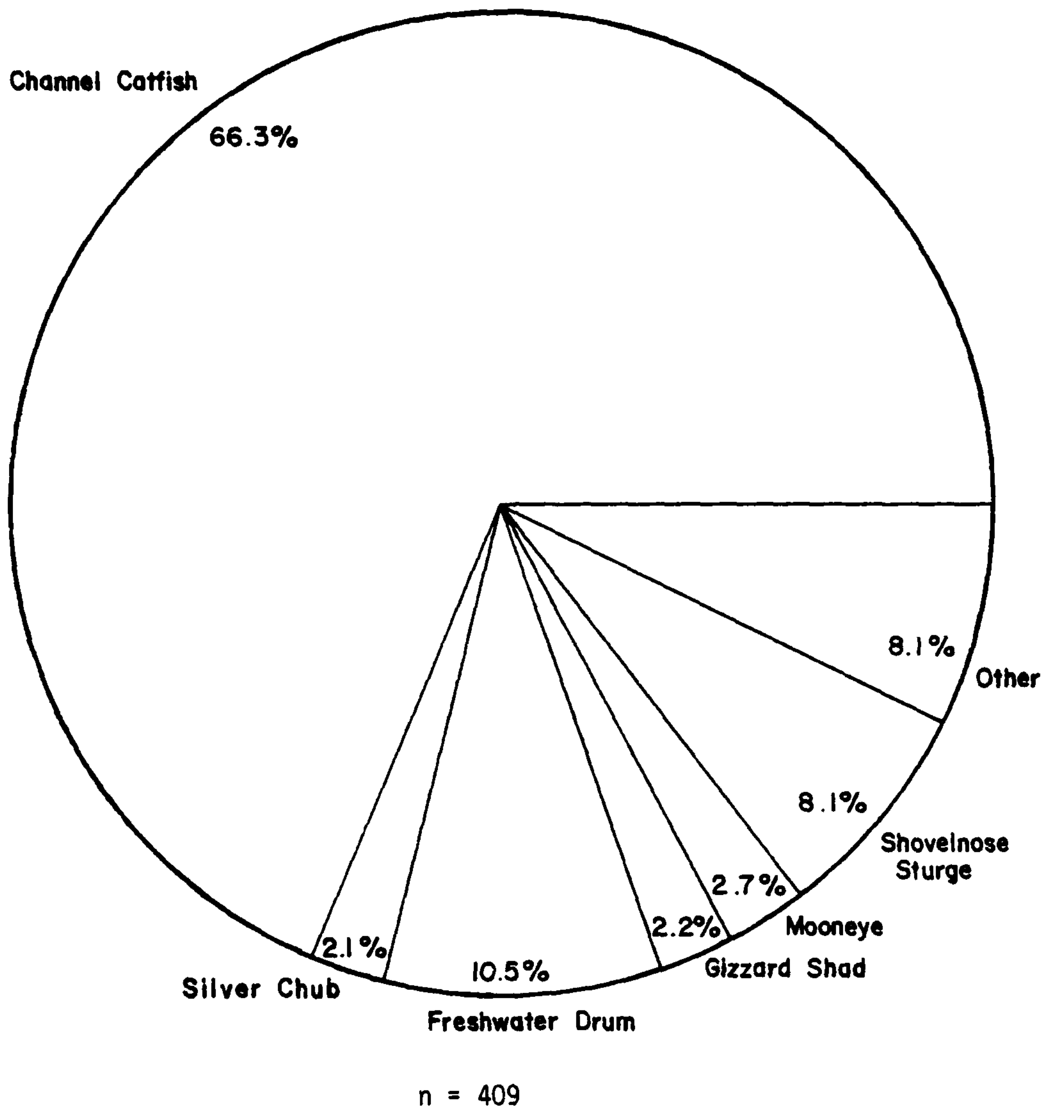

Fig. 7. Relative abundance of fish species collected during October 1979. (based on numbers)

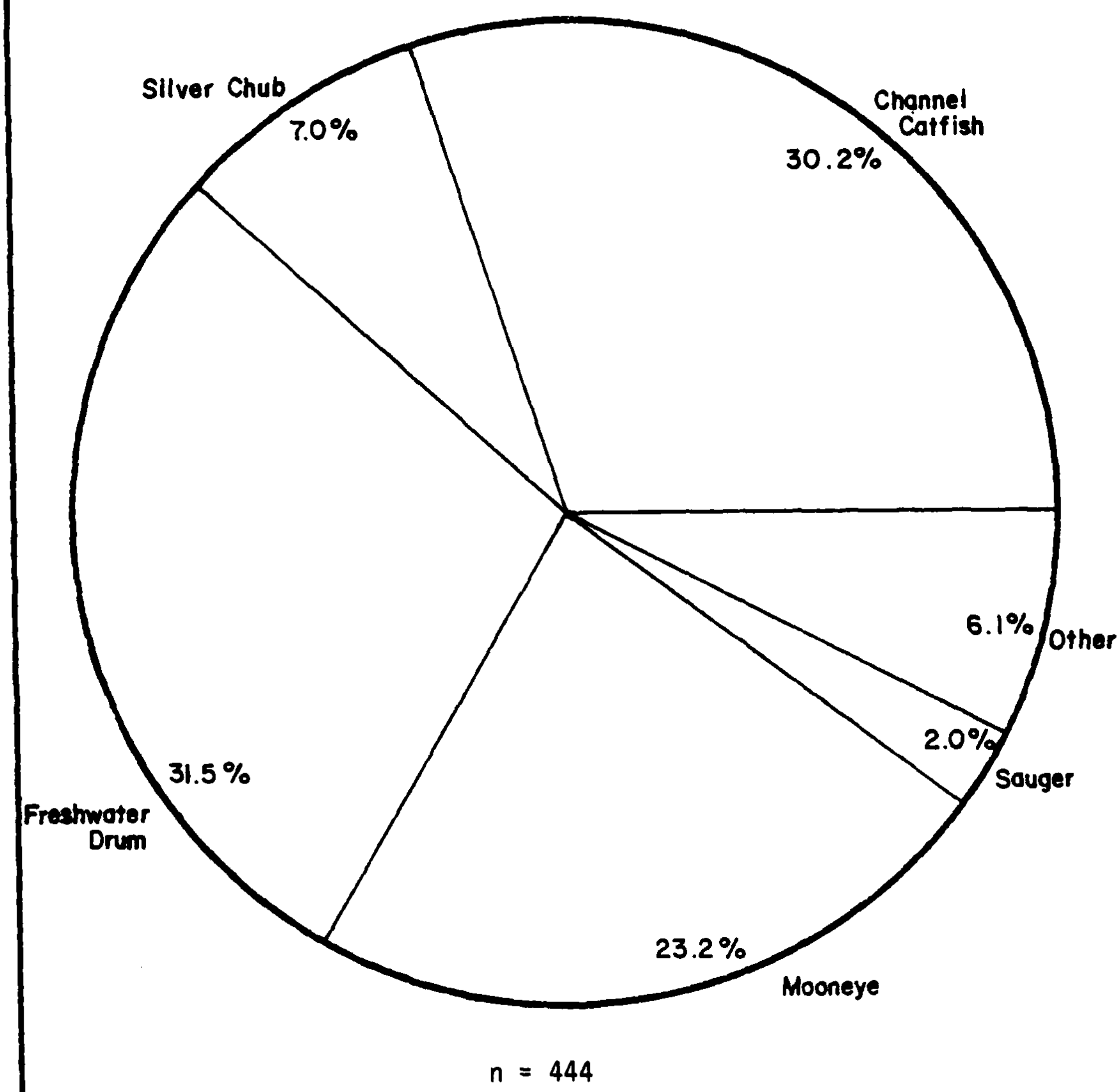

Fig. 8. Relative abundance of fish species collected during January 1980. (based on numbers)

During February sampling was accordingly proposed to be conducted under ice-over conditions and was intended to include only passive gear types. However during this period ice cover was approximately 5-10 cm at stations 4, 5, and 6, but was thinner and dissected by narrow leads of open water at stations 1, 2, and 3. As a consequence gill and hoop nets were effectively fished only at stations 4, 5, and 6, with a total catch of one shovelnose sturgeon, one shortnose gar and two longnose gar.

Collecting efforts in April were expanded to include day and night trawling (bottom and mid-water) in an attempt to better describe diurnal variation in fish utilization of the main channel, and is discussed below in the diel sampling section of this report. An unexpected low number of fish were caught during April in the routine sampling effort--118 specimens representing 11 species. As can be seen in Fig. 9, channel catfish, silver chub, mooneye, and shovelnose sturgeon were the most abundant species. Other species were represented by three or fewer individuals. Bottom trawling efforts accounted for 100 of the 118 fish caught, as well as nine of the 12 species. Use of hoop nets, gill nets, mid-water trawls and trammel nets resulted in the capture of 9, 4, 5, and 0 fish, respectively.

Seasonal differences were apparent but not easily accounted for. Number of fish caught, as well as number of species represented, were erratic with respect to collection date (Table 2). Some of the differences are easily explained by differences in sampling effort (e.g., only gill and hoop nets were deployed at 3 stations in February), but other cases seem to contradict the more effort-more fish relationship. Specifically, only a limited amount of trawling and netting were performed in January but this effort yielded the second greatest number of fish and ranked third in number of species caught. On the other hand, in April when the most intensive sampling was conducted, relatively few fish were captured and low diversity was the result.

The obvious effects of seasonal differences were the presence of several species of YOY fish in May, June, and July. Also, channel catfish abundance increased from May to July and then gradually declined through April.

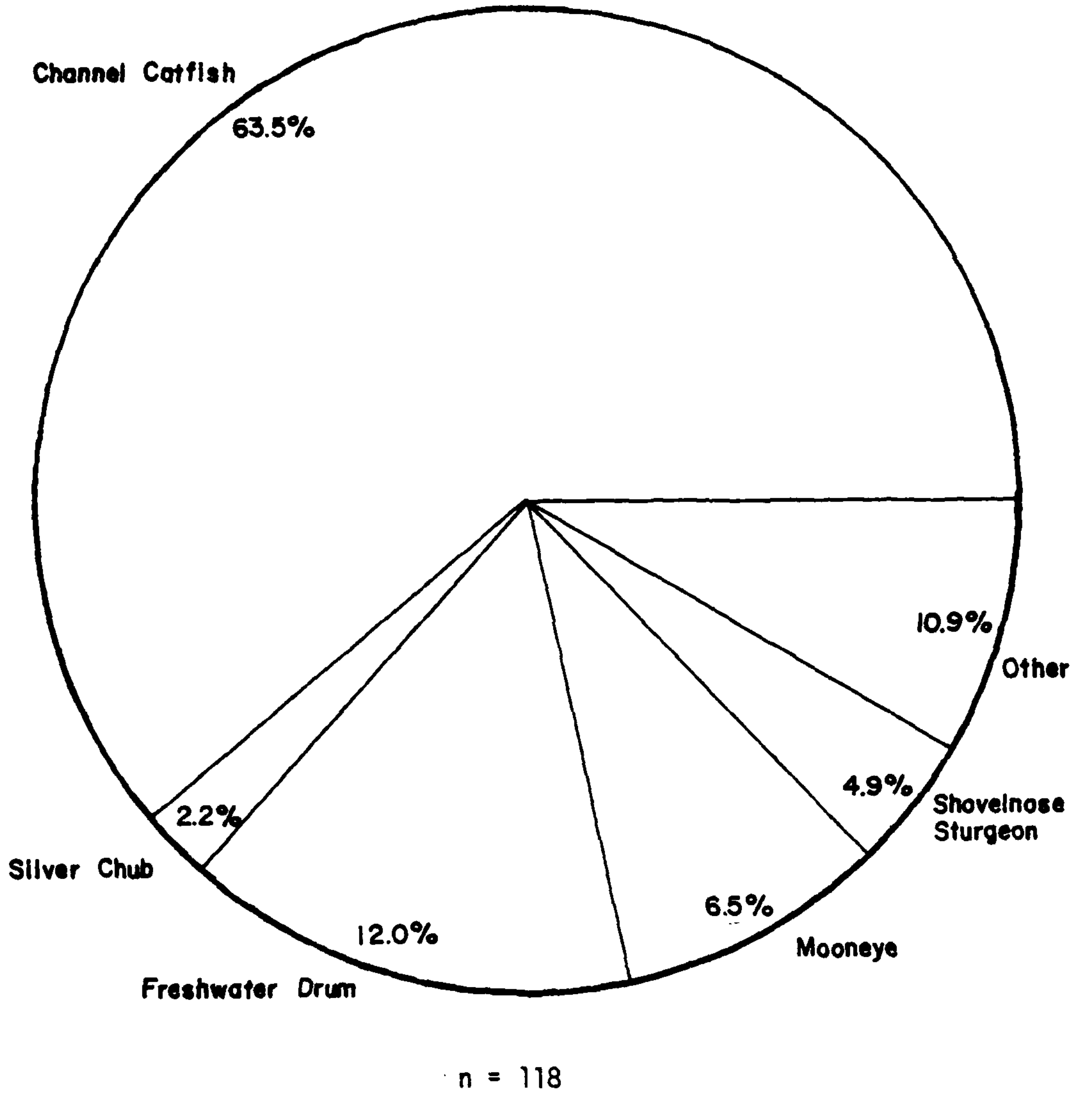

Fig. 9. Relative abundance of fish species collected during April 1980. (based on numbers)

Results of cluster analysis (Fig. 10) showed that May and June catches were somewhat different from those of July, August, October, and April. Two relatively distinct groups were found. May and June were separated from other months. The differences can be attributed to low proportions of channel catfish and silver chub and the absence of other common species during May and June.

Differences among stations were less prominent than season changes. Seventeen to 24 species were caught at each station; sampling efforts at stations 1 and 4 yielded 17 species while similar efforts at the other 4 stations produced 22 to 24 species. Only nine species were observed at all 6 stations--shovelnose sturgeon, mooneye, silver chub, silverband shiner, smallmouth buffalo, channel catfish, flathead catfish, sauger, and freshwater drum. These differences probably reflected the low numbers of fish caught rather than habitat differences. For the species that were caught at all locations, numbers per station were usually similar (Table 3). Relative abundance patterns among stations were similar (Fig. 11). Channel catfish, freshwater drum, mooneye, and shovelnose sturgeon were the dominant species at each station.

Results of cluster analysis performed on species and station associations indicated the observed station differences were weak (Fig. 12). Two clusters (station 1 and 2 vs 3, 4, 5, and 6) were delineated, but the distance measure between the groups was small. That the differences among stations were small was not surprising since other measures (e.g., species composition and relative abundance) also indicated homogeneous trends.

Species diversity indices were also used to compare stations (Fig. 13) and trips (Fig. 14). Station species diversities (H") ranged from 1.21 at station 1 to 1.71 at station 6. Values generally increased from downstream to upstream. Evenness (J) and species richness (D) followed similar trends with differences in richness being somewhat more erratic. Index values based upon trip totals were more variable than the relatively homogeneous station values. The lowest H" value was recorded in August (0.85) while the highest value was in May (2.23).

The monthly changes in values of H" were more affected by the evenness (J) component than the richness aspect (D). This means that although the number of species fluctuated from one collection trip to another, the main effect on H" values was the evenness of the distribution of numbers of

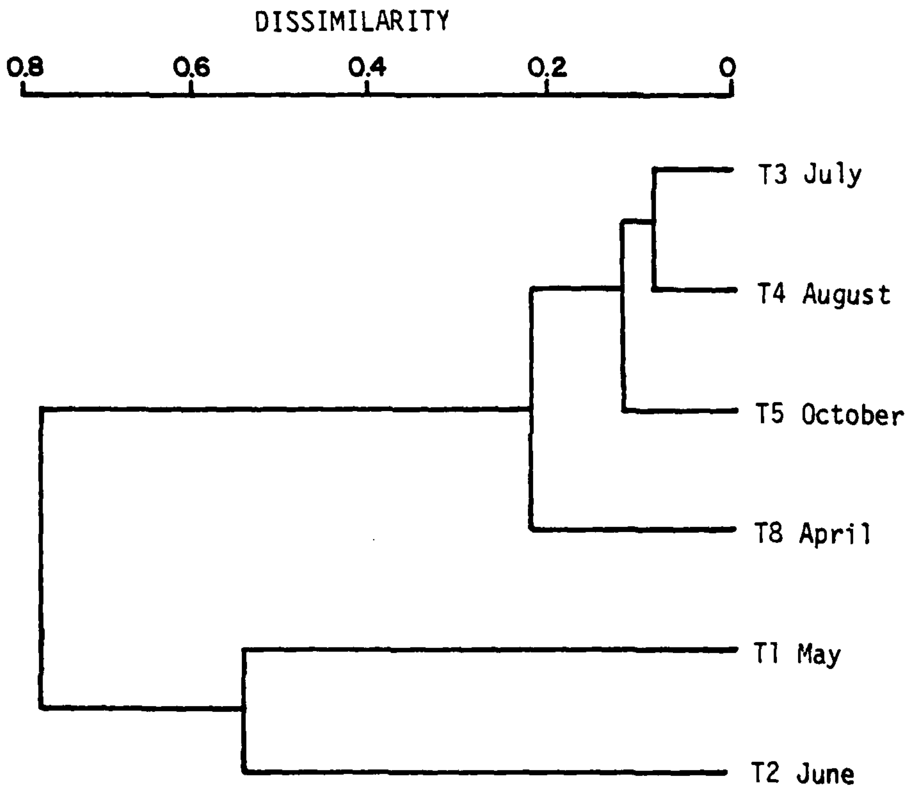

Fig. 10. Cluster analysis dendrogram comparing open water sampling trips.

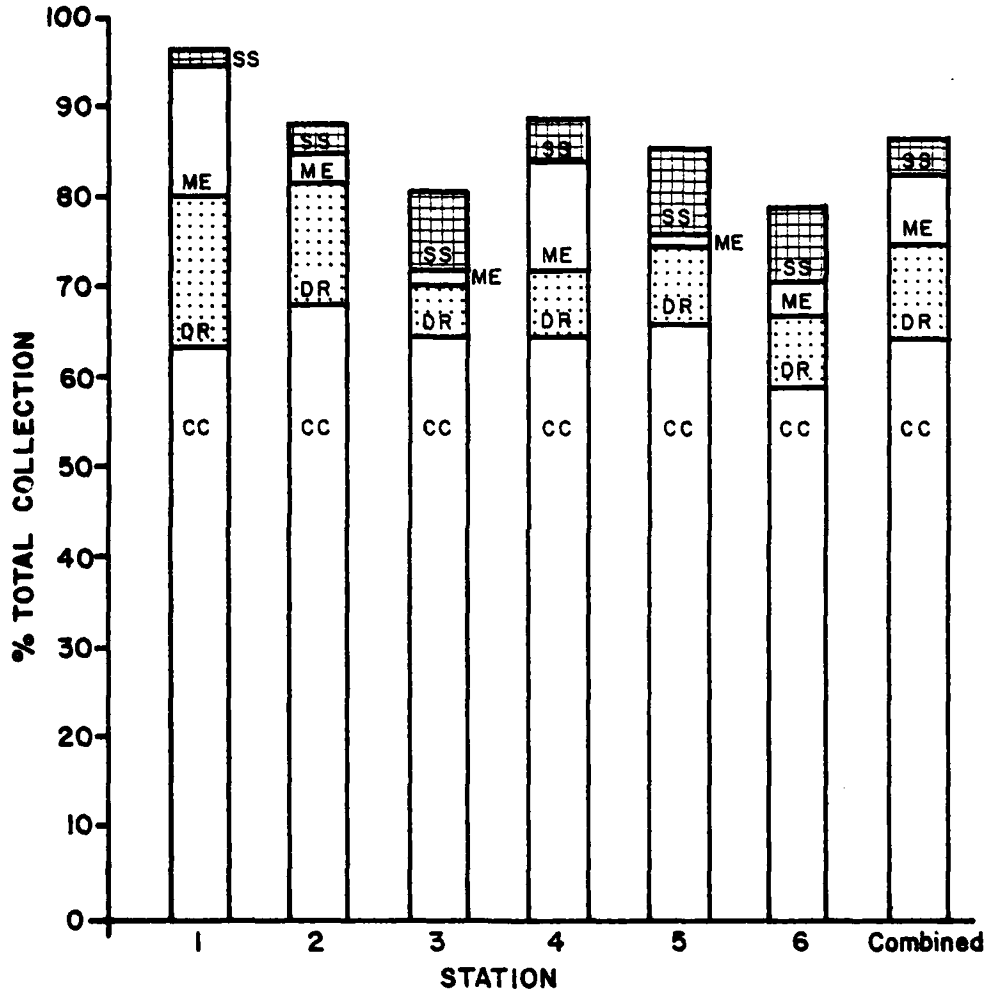

Fig. 11. Relative abundance of channel catfish (CC), freshwater drum (DR), mooneye (ME) and shovelnose sturgeon (SS) at Stations 1-6.

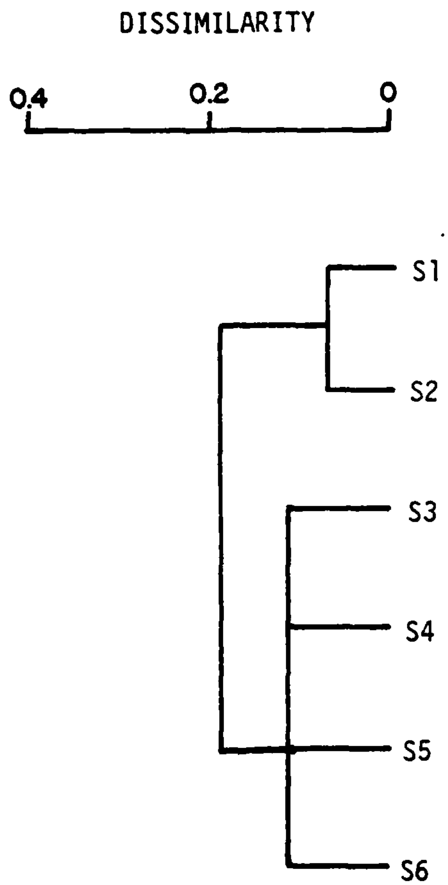

Fig. 12. Cluster analysis dendrogram comparing stations.

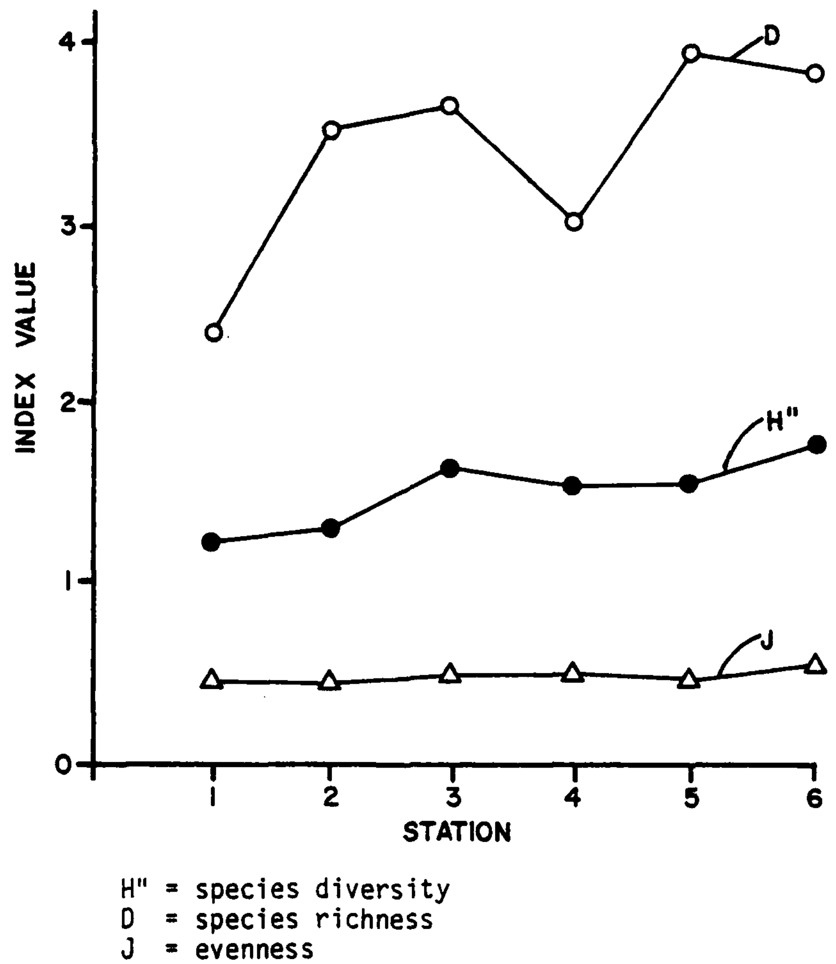

Fig. 13. Values of species diversity indices based on total fish caught at each station.

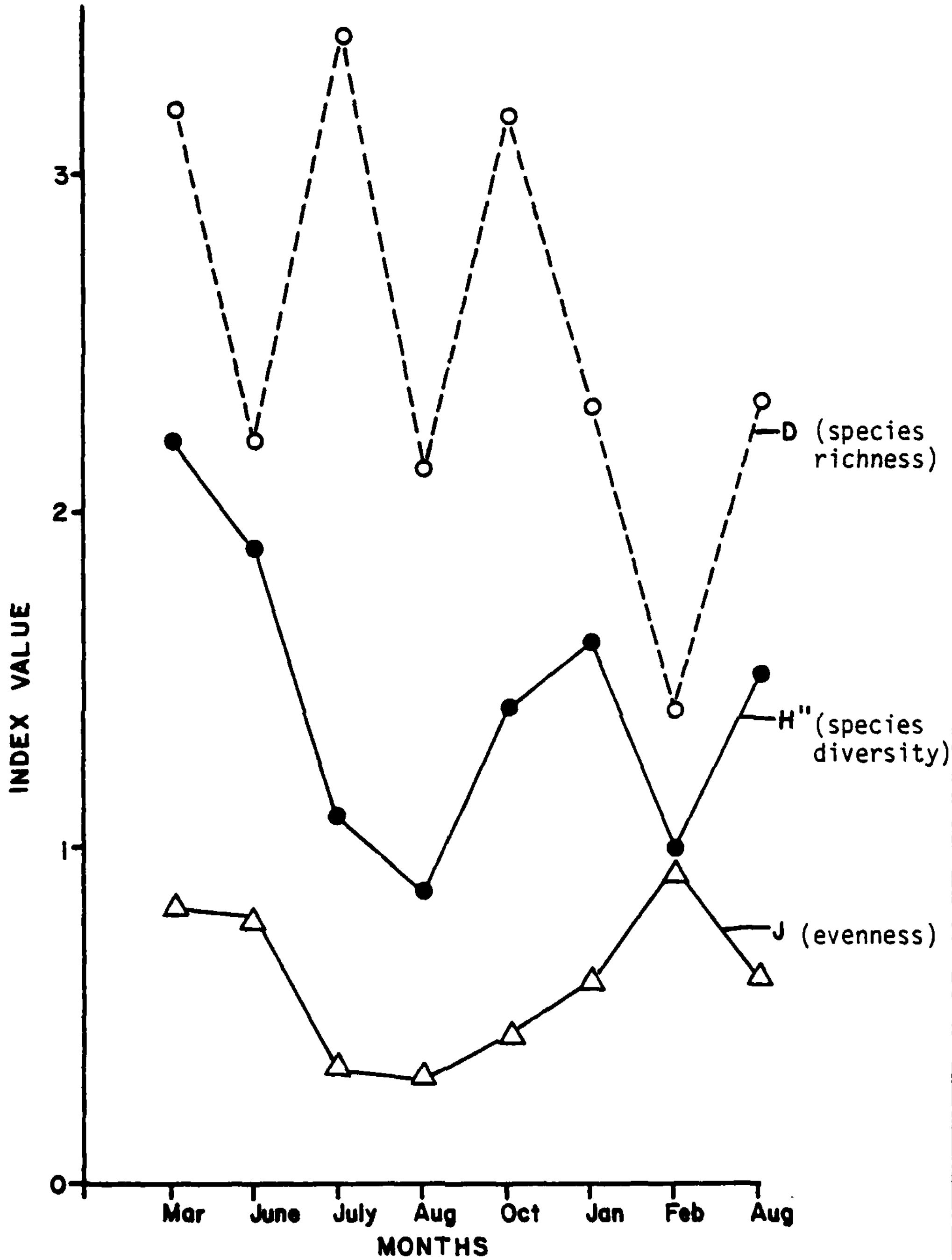

Fig. 14. Values of species diversity indices based on total fish caught per sampling trip.

individuals among the species represented. Large numbers of individuals in a few species tends to lower H" values as does the existence of only a few species. From the data presented in Table 2, it is apparent that the large number of channel catfish (which were YOY size) in July and August caused the H" index values to be lower.

Results of diel gill net and hoop net sampling are depicted in Fig. 15. Generally, catch rates of fish were so low as to not enable comparisons between time of day and catch.

In April 1980 bottom and mid-water trawling were conducted during day and night but not every 4 h. Night samples were collected between 2000 and 2300 h. In the bottom trawl a total of 100 fish were captured. Of these 86 were caught at night. Half of the fish caught at night were channel catfish and most were trawled at station 6. Shovelnose sturgeon, channel catfish, river darter and freshwater drum were caught during both day and night while mooneye, silver chub, emerald shiner and silvery minnow were trawled only at night. The single flathead catfish was caught during the daylight hours.

In mid-water trawls only 5 mooneye were captured--3 during the day and 2 at night. No fish were caught in either gill or hoop nets during diel sampling.

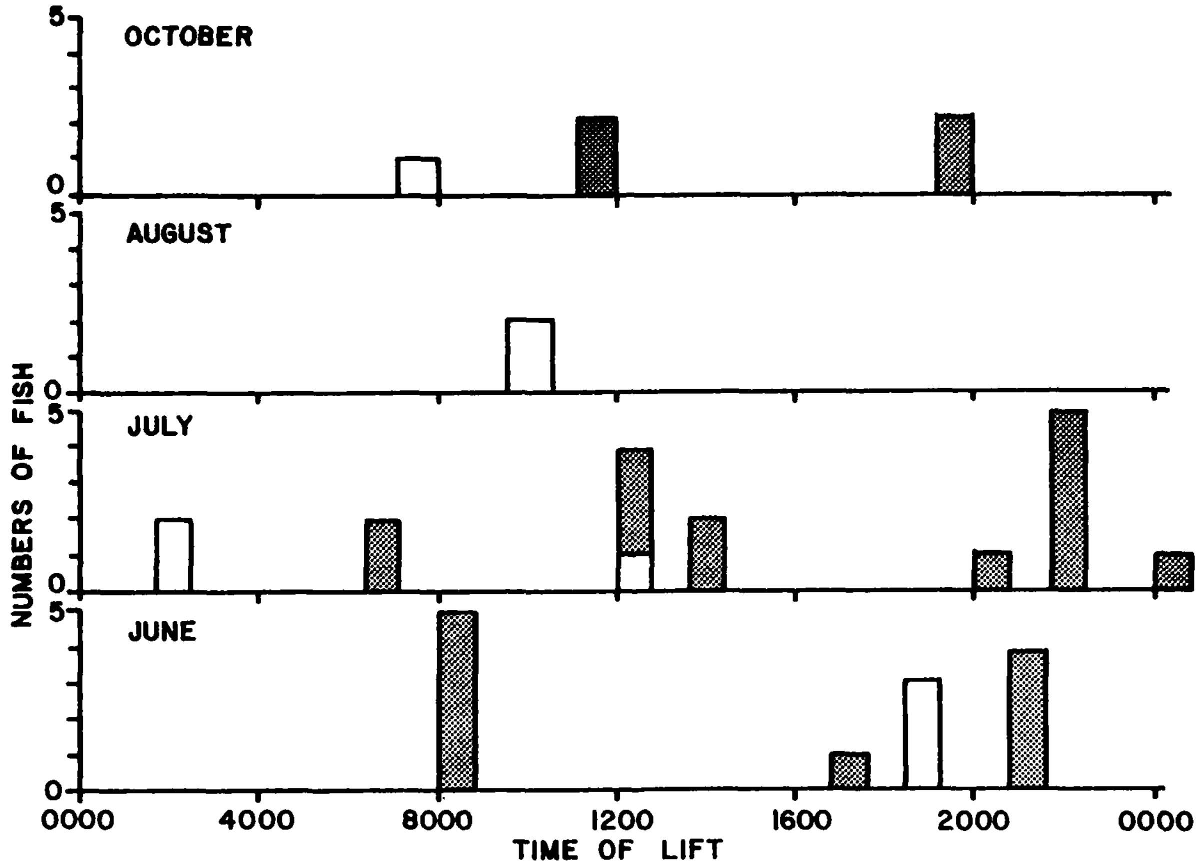

Fig. 15. Numbers of fish caught by hoop nets (open) and gill nets (stipple) during diel studies at Station No. 1 during 28-29 June, 27-28 July, and 27-28 August and 5 October 1979. Fish numbers are recorded during the hour the net was lifted and represent the previous 4-h catch. No fish were caught in April 1980 diel sampling.

Species Accounts

Notes on abundance, distribution, and size distribution of all species collected during this study are briefly described in the following section. Scientific names of species described are listed in Table 1 (p.). Length frequencies for each species are presented in Appendix I, Tables I-33 through I-70.

Shovelnose Sturgeon

Shovelnose sturgeon was one of the more abundant species collected during this study and was the only species collected during all eight sampling trips. Fish collected ranged in size from 8-78 cm total length. Using data provided by Farabee (1979) for average size at maturity (28 in total length = 71 cm) only one specimen was sexually mature. Of all shovelnose sturgeon collected nearly half (43%) were less than 20 cm long and these probably represented YOY (Table I-33). These YOY were taken in collections from June to October. After October, all specimens were 21 cm or greater in length.

Paddlefish

Only 3 paddlefish (28, 62, and 138 cm total length) were collected. The smaller fish were collected in July while the larger fish was caught in a bottom trawl at station 3 in January.

Longnose Gar

Three longnose gar (69, 74, and 75 cm total length) were caught. They were captured in gill nets at stations 2 and 5 in July and at station 5 in February in an under-ice gill net set.

Shortnose Gar

A total of 4 shortnose gar were collected. Three (62, 62, and 58 cm total length) were taken in July while a single specimen (also 58 cm) was collected from an under-ice gill net set at station 5 in January 1980.

American Eel

A single American eel, 95 cm long was collected in October 1979 at station 6 in a hoop net.

Gizzard Shad

Gizzard shad were collected in January and October with total lengths ranging from 9-18 cm. Of the 14 specimens collected, 9 were captured in October. Although not collected at other times, numerous small gizzard shad were observed frozen in nearshore ice during January and February. This species is probably more abundant out of the main channel since quiet-water habitats are preferred (Pflieger 1975).

Goldeye

Three goldeye were caught during this study--1 in May (32 cm total length) and 2 in June (30 and 33 cm total length).

Mooneye

Mooneye comprised approximately 6.5% of the total fish caught. They ranged in size from 5-32 cm total length. Young-of-the-year (5 to 11 cm total length) appeared in May, June and July, and, although catches were small, by January fish in this age class appeared to have grown to 12-16 cm total length (Table I-40). During January, when most mooneye were collected, two brood size classes were apparent, the above-mentioned and fish 21-32 cm total length with most being 27-29 cm long.

Northern Pike

One northern pike (26 cm long) was caught in a gill net during May.

Carp

Fifteen carp, ranging in size from 28 to 59 cm total length, were caught in June, July and August. The majority of these (9) were taken in July.

Grass Carp

A single grass carp was caught in a bottom trawl at station 4 in June 1979. This species has been recently introduced in a number of areas and is likely to extend its range considerably.

Speckled Chub

Eleven speckled chub were caught. Size ranged from 4-9 cm total length. Most were caught in October (5) and January (5) although one was collected in June.

Flathead Chub

Two flathead chubs were collected--one at station 2 (June) and the other at station 6 (July)--by hoop net and bottom trawl, respectively.

Silver Chub

Silver chub was a relatively common fish caught in July, October, January, and April. Sizes ranged from 6-19 cm. Most (67%) were 7-9 cm long and were collected in January and April.

Emerald Shiner

Two emerald shiners were collected in June (station 4) and April (station 6) using a bottom trawl.

River Shiner

Three specimens of river shiner were collected. One (5 cm total length) was taken in August and the other 2 (8 and 10 cm total length) were collected in October.

Silverband Shiner

Silverband shiners were represented in collections made during May, June, and July. Most (20) were found in May, with decreasing numbers observed in June (6) and July (3). Sizes ranged from 5-9 cm.

Silvery Minnow

A single silvery minnow was trawled in April at station 6.

Unidentified Cyprinid

Ten unidentified minnows were collected in June by bottom trawling.

Blue Sucker

The blue sucker is a species which has declined in numbers since 1900 (Pflieger 1975) and in some states is protected as a rare, threatened or endangered species. During this study, four fishw ere observed--one was a small specimen 8 cm long caught in July. The other three were 23, 39, and 61 cm long. These were collected in January, August, and January, respectively.

Smallmouth Buffalo

Twenty-four specimens of this commercially important species were collected. Although not abundant during any season, they were observed in 6 of 8 collections. Sizes ranged from 27 to 52 cm with sizes evenly distributed throughout this range.

River Carpsucker

A total of 5 river carpsuckers ranging in length from 11-43 cm were captured using hoop net, trammel net and bottom trawl. A single specimen was caught at each station except number 2.

Quillback

Quillback were observed during July, August, and October. Smaller fish (26-37 cm total length) predominated in July while larger specimens (38-50 cm) were more common in August. Only one quillback was caught in October.

Highfin Carpsucker

A single (28 cm total length) highfin carpsucker was caught in August.

Golden Redhorse

One golden redhorse was gill netted in May from station 2.

Silver Redhorse

Three silver redhorses (29, 36, and 52 cm total length) were caught in July, October, and August, respectively. Gill nets, trammel nets, and bottom trawls each caught a single silver redhorse.

Shorthead Redhorse

A total of 10 shorthead redhorses was caught with total lengths ranging from 27 to 44 cm. This species was observed in July, August, January and April. The fish were caught in hoop nets, trammel nets, and bottom trawl. The specimen netted in April was a running ripe female.

Channel Catfish

By far the most important fish from both sport and commercial fisheries viewpoints, the channel catfish was also the species best represented in collections made during this study and about which the most distributional and life history information was obtained. Channel catfish were collected by gill net, trammel net, hoop net, and bottom trawl during all collection periods except February.

Length-frequency data are depicted in Table I-58. YOY channel catfish were first observed in June when a single 2-cm long fish was caught.

By July, hundreds of young channel catfish ($\bar{x}$ length = 4 cm: range 2-7 cm) were caught by bottom trawling. In August, the young catfish were 4-10 cm long ($\bar{x}$ = 6.5 cm) and by October, the size range increased from 5-12 cm ($\bar{x}$ = 8 cm). In January, mean length for the year class was approximately 9 cm and, in April, age 0 fish averaged about 8 cm. This evidence suggests that after hatching growth is relatively rapid but is drastically slowed during the colder winter months (water temperature in January and February was between 0 and 1^{o}C). Other distinct size classes were not apparent except during January when near commercial-size fish were bottom trawled at stations 1, 2, and 3. Most fish were 27-32 cm long.

Results of channel catfish stomach contents analysis are shown in Tables 5 and 6. Two size ranges were represented in the collections--small fish (6.4-10.6 cm total length) and large fish 27.9-34.6 cm total length). Stomach contents from small fish included midges (Chironomidae), caddisflies (Hydropsychidae), amphipods, ceratopogonids, and stoneflies (Isoperla sp, Fig. 16). Although midges were numerically dominant, the larger stoneflies and caddisflies were the important biomass components. The large fish obtained had fed upon the same prey items as had the small fish, plus a variety of other foods (Table 6). Stomachs of large fish contained higher percentages of the larger invertebrates such as stoneflies, caddisflies, and mayflies (Fig. 16). The presence of a greater variety of other aquatic invertebrates, vegetable materials, and fish remains indicated the larger fish may have utilized different areas for feeding or perhaps, were able to catch larger prey because of their greater size.

Comparison of catfish stomach contents (Tables 5 and 6) to the benthos collected from the main channel (Table 7) showed few similarities. The benthos in the main channel were neither diverse nor abundant with only species adapted for living in sand and gravel substrates being common (e.g., Robackia sp.). Although the main channel benthos were sparse, tremendous numbers of caddisflies and stoneflies were present as drift. Drift organisms were observed when they collected on hoop nets placed on the bottom.

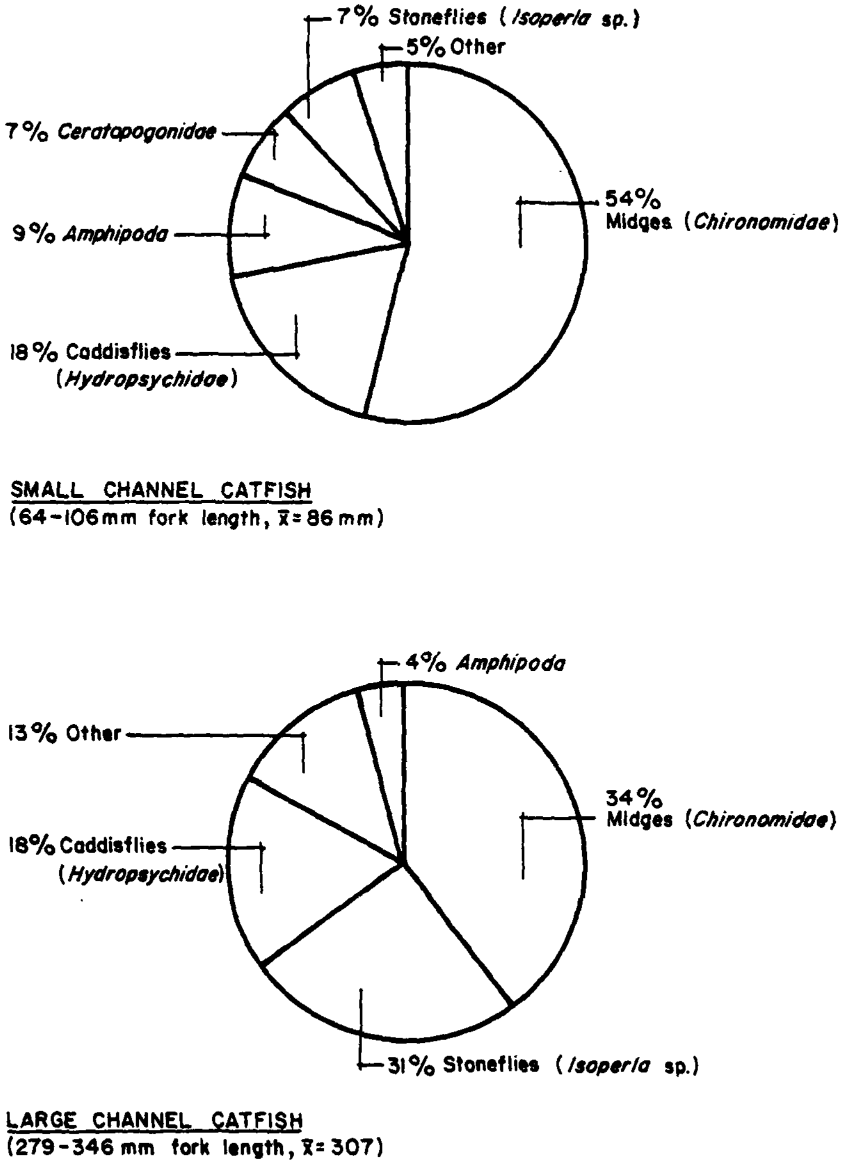

Fig. 16. Stomach contents (%) of channel catfish collected from main channel, April 1980.

Flathead Catfish

Flathead catfish were relatively commonly collected and were represented in July, August, October, and April samples. Most were taken in July and August. Young-of-the-year class fish 3-, 7-, and 8-cm long were collected in July, August, October, and April, respectively. All other specimens were 24 cm or greater in length with the larger flathead catfish being 77-cm long.

Stonecat

Stonecats were collected in May, July, October, and April. Lengths ranged from 3-15 cm. Based on information provided by Breitenbach and Peterson (1980) these collections of stonecats represent a new occurrence record for Pool 14.

White Bass

Two white bass, 11 and 28 cm total length were caught; the smaller in October by hoop net and the other in July by mid-water trawl.

Smallmouth Bass

A single smallmouth bass was caught in a bottom trawl in July at station 5.

Rock Bass

One rock bass was trammel netted at station 3 in July.

White Crappie

Of the 13 white crappie collected, 12 were gill netted at station 2 in July. The other one (8-cm long) was gill netted in May, also at station 2.

Black Crappie

Two black crappie were hoop netted. These fish were collected at stations 3 and 6.

Sauger

Saugers were collected in May, July, October, and January. Fish varied in size from 13 to 46 cm. The 33 sauger caught were captured in a variety of gear types--gill net, hoop net, trammel nets, and bottom trawls.

Walleye

Three walleye (19, 37, and 41 cm total length) were observed in this study. One was captured in July and the other two in October.

River Darter

River darters were caught by bottom trawling during sampling efforts performed in May, July, October, January, and April. The majority (60%) were trawled in May. Characteristically, they were observed more often at stations 3, 5, and 6.

Johnny Darter

One Johnny darter, 6 cm total length, was bottom trawled at station 3 in January.

Freshwater Drum

Freshwater drum were caught during each month sampled except February and were most common in January and July. Young-of-the-year size fish (2-3 cm) were first observed in June and fish of this year class were found in subsequent collections (Table I-70). By January, this size class had grown from 2-5 cm (June-July) to 10-18 cm with most fish 12 to 16 cm long. Farabee (1979) reported first year lengths of 5 in (12.7 cm) for freshwater drum in the Mississippi River. Other fish caught ranged in size from 10-46 cm.

PHYSICOCHEMICAL RESULTS

Values of temperature, dissolved oxygen, and conductivity varied with time of year. No significant vertical stratification patterns were observed during any of the sampling trips (Tables 8 to 15). Mean surface temperatures ranged from 0 to 27^{o}C (Fig. 17). Highest temperature was measured in July (27.9^{o}C) while temperatures in January and February were at or near 0^{o}C.

Dissolved oxygen concentrations were inversely related to temperature with levels near saturation during all sampling times (Fig. 17). Extremes in dissolved oxygen concentrations were 5.6 and 15.5 mg/ℓ indicating stressful conditions for aquatic life were not observed. Conductivity values followed a pattern similar to that observed for dissolved oxygen (Fig. 17). The lowest value was measured in June (310 mmhos/cm) while the maximum was 525 mmhos/cm in October.

Turbidity values (NTU) were variable; a range of 4 to 90 was observed. Differences by station and depth were evident with no apparent causes (Table 16).

Diel measurements of the above variables did not show any significant variations (Tables 17 to 21).

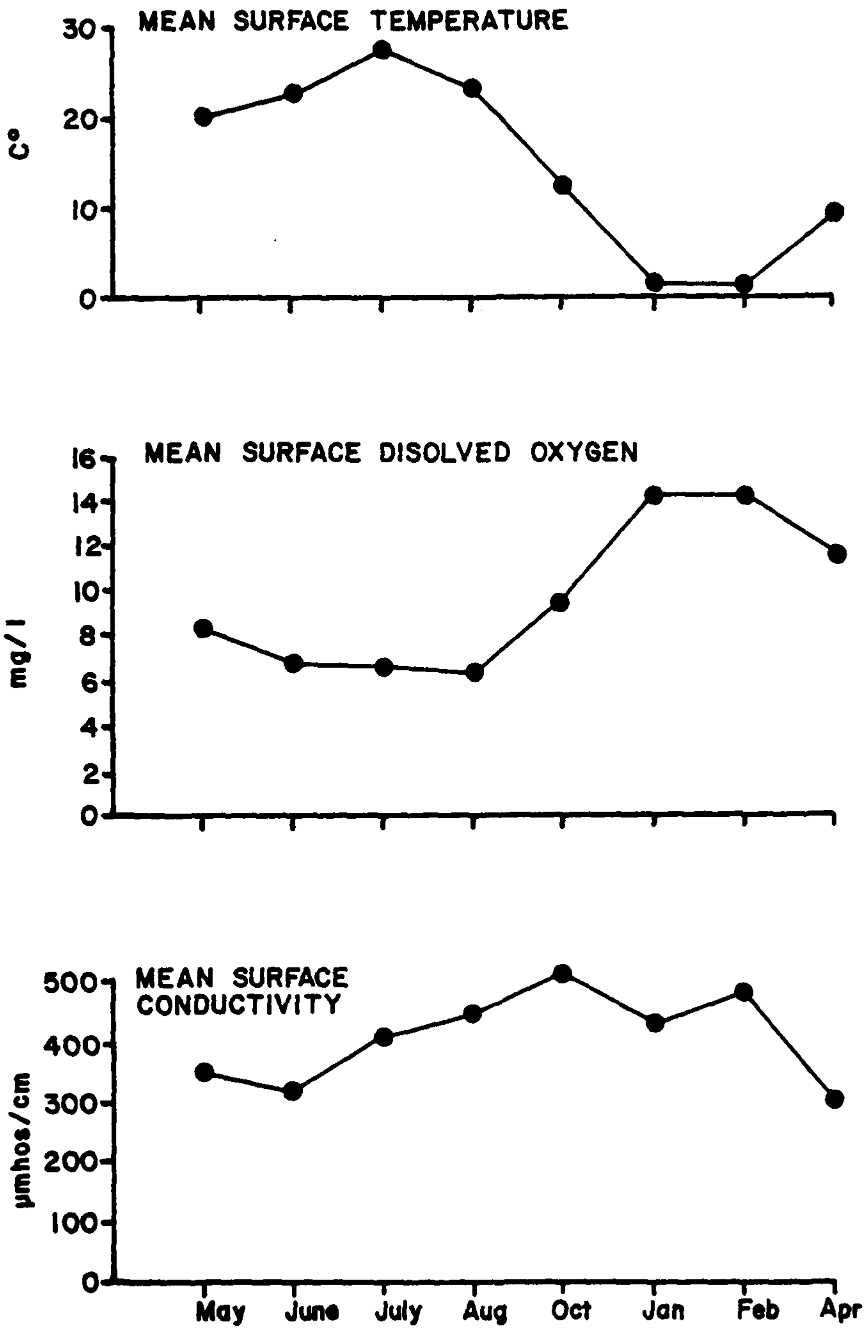

Fig. 17 . Mean surface temperature, dissolved oxygen, and conductivity measured during each collecting trip, May 1979-April 1980.

EVALUATION OF GEAR TYPES

Comparisons of gear effectiveness were made by comparing total catch, total number of species and species selectivity for each gear type (Table 4). Of the individuals caught, bottom trawling accounted for over 81%. Seine, gill net, hoop net, mid-water trawl, trammel net, and electrofishing caught 0.15, 6.1, 7.6, 1.2, 3.5 and 0%, respectively. The pattern for number of species represented was somewhat different, although bottom trawling was still the most effective--70% of all species represented in the various collections were caught by bottom trawling. The percent of total species caught for other gears were as follows: seine, 10%; gill net, 45%; hoop net, 40%; mid-water trawl, 15%; trammel net, 45%; and electrofisher, 0%.

Although sampling intensity, gear selectivity, and the numerous other variables associated with gear type comparisons make any quantitative judgement impractical, it was obvious that seine and electrofisher gears were of little value. Except for some of the rarer species, bottom trawling was most effective. Gill net, hoop net, and trammel net contributed 2-3 species per gear type which were not collected by any of the other methods whereas nine species were unique to bottom trawl samples. Seining (20 ft deep X 500 ft long) and electrofishing efforts were generally time-consuming and ineffective. Fish could, and apparently did, escape underneath and around the ends of the seine while it was being retrieved. Electrofishing was not effective because fish were easily missed by observers because the visibility was poor and water was deep and swift. Electrofishing is more effective in shallow water (usually less than 2 m deep) with slow currents. In the main channel the deep water (greater than 6 m) and swift current made retrieval of stunned fish so ineffectual that no fish were captured by this method. Seining and electrofishing are not recommended methods to be used in the main channel habitat.

Methods that are recommended for studies of this type are bottom trawling and hoop netting. Both of these gear types are usable in a variety of habitats, are easily deployable, and are generally cost-effective. Another advantage of using these gear types is the availability of historical data collected by these methods; this facilitates more valid comparisons between new and old data. Gill net, midwater trawl and trammel net are not recommended for main channel sampling because they either do not fish well in swift water (gill net), are susceptable to destruction by boat traffic (gill net and trammel net) or are generally not as effective in catching fish as are the recommended methods (i.e., hoop netting and bottom trawling).

DISCUSSION

The results of this study provided answers which met the stated objectives of the project. A variety of fish do inhabit the main channel and some such as channel catfish are abundant. Fishing gears were compared and it was shown that an active method such as bottom trawling was the most effective.

Aside from the project objectives one concern that has been apparent throughout the study is the question of the "importance" of the main channel habitat. The following text is put forth as a platform to try to answer some of the aspects of importance as well as stimulate more discussions.

This study documented that a number of fish species (some of which are commercially and recreationally important) are found in the main channel. Because no synoptic sampling was performed in other habitats using comparable methods the relative importance of this habitat can be only postulated based on a general knowledge of fish life-histories and habitat requirements.

Several lines of evidence other than the analysis of the data from this study indicate that the main channel may be less important to the fishery than are adjacent shallow water habitats. Discussions of these follow.

Most commercial fishing activities are conducted outside the naviga-channel. Intuitively this indicates that marketable fish are not as readily obtainable, and thus presumably not as abundant, in the main channel as in sloughs, backwater areas, etc. (This concept does not preclude the possibility that other sizes of fish such as YOY do not use or depend on the habitat.) This assumption admittedly minimizes differences in logistics problems or traditional fishing practices associated with working in the main channel.

Data collected by other investigators in the study area and vicinity indicate that many fish utilize habitats other than the main channel. Probably the most useful information of this type is provided by the past and on-going baseline and monitoring studies performed for the Quad-Cities nuclear generating facility near Cordova. The plant is located between river miles 506 and 507 and is situated between stations 3 and 4 of this study. A variety of studies have been performed since the early 1970's as a consequence of the power plant; these include electrofishing, seining; and trawling in the main channel at locations corresponding to stations 3 and 4 of this study and in areas adjacent to the power plant; and hoop netting in offchannel areas.

Electroshocking was performed in habitats other than the main channel, and from 1971-1979, 50 taxa of fish were captured. The annual number of species collected ranged from 27 to 35. The high number is almost identical to the number of species collected by all methods in the main channel during this study (39 species). In contrast, the species composition of fishes collected in non-main-channel habitat was quite different from results obtained in this study.

Comparison of most abundant fish species caught by electrofishing (1971-1979) (Commonwealth Edison Company 1980) and by all methods used in this study are ranked below based on numerical abundance (1 = most abundant):

Species	This Study (Main Channel)	Electrofishing (Not Main Channel)
Gizzard shad	13	1
Carp	12	2
Blue gill	0	3
River carpsucker	19	4
Freshwater drum	2	5
Largemouth bass	0	6
Sauger	7	7
Black crappie	30	8
White crappie	0	9
Channel catfish	1	10

As can be seen in the above table the composition of the fish communities are different. This reflects the difference due to habitat features and to a lesser degree sampling methods. Where similar methods were employed a radical difference is noted. In this study only 4 fish were caught in numerous seine hauls (500 ft seine) in the mid-channel whereas as many as 448, 2294, and 137 fish were caught in a side channel, slough and altered slough, respectively, using a 1000 ft haul seine in 1979 (Commonwealth Edison Company 1980).

Results of hoop netting performed in side channel, main channel border, and slough habitat in 1971 and 1972 as summarized by Gerhold (1977) resulted in the capture of 21-25 species of fish with black crappie and white crappie the most abundant species. In the main channel (this study) 16 species were caught and channel catfish, freshwater drum and flathead catfish were the most abundant species. Typical abundant non-main-channel species were longnose gar, shortnose gar, white bass, bluegill, black crappie and white crappie. These were rarely collected in the main channel by any method.

Using similar bottom trawling techniques in the main channel Gerhold (1977) reported the relative abundance of the most common species caught trawling near Quad-Cities Station from 1971-1975. Most abundant fish were channel catfish (67.5-80.3% of total catch), freshwater drum (7.0-14.2% total catch), silver chub (2.3-8.3% total catch) and shovelnose sturgeon (1.4-4.6% total catch). In this study the most common bottom trawled fish were channel catfish (71.2%), freshwater drum (10.0%), shovelnose sturgeon (4.8%), mooneye (4.7%) and silver chub (2.6%). The similarities are apparent.

The above comparisons are obviously based on data which are not directly comparable and conclusions reached are indeed speculative. However they do provide one means to stimulate more thought and discussion and give some indication of the problem facing anyone trying to make these comparisons using existing data.

RECOMMENDATIONS FOR FUTURE RESEARCH

It is clear that the results of this investigation have generated important questions about potential conflicts between man's activities in the river main channel and productivity of the fishery. For example, the heretofore unexpected abundance of young channel catfish using the main channel suggests possible links between the quality of main channel habitats and recruitment to the catfish fishery. Moreover, several other species were found to inhabit the main channel in appreciable numbers at some time during the year, suggesting that they too might be affected by some of the activities related to maintenance and/or expansion of the main channel as a shipping route.

As discussed, the purpose of this study was not to compare the importance of the main channel to other river habitats in terms of relative importance to the fishery, nor was it to predict impacts of development. However, the importance of these issues is self-evident, and in our view, dictates the direction of further research. Following is a rationale for and discussion of what should, we think, be the next steps toward designing and conducting productive research in response to these issues.

In our experience, the design of ecological research that provides the best answers for policy decisions in a situation such as this, where several resource users are involved, is a very complex problem. It requires appropriate input from user groups, decisions about what the most critical ecological questions are, and identification of the data gaps that need to be filled to answer these questions.

We believe that the issues that must be clarified before the next impact-oriented research is planned requires careful consideration. We can recommend research for answering specific questions we currently view as critical: e.g., Are channel catfish populations dependent on the main channel habitats for a particular portion of their life? If so, what are the likely effects of dredging to deepen the channel by X number of feet during Y months? But without having much more detailed information about which aspects of the fishery are deemed most important and what are the specific activities, in time and space, planned for development in the river, research we propose is likely to be largely irrelevant to the real problems.

It is our understanding that the Great II team is responsible for sorting out these issues and establishing appropriate priorities for research. But we also suspect that, unless the Great II team functions far more effectively than similar other coordinating teams we have worked with, they encounter severe problems in sorting real research priorities from proposed "pet projects" or conventional research approaches that provide little impact-oriented answers. We therefore suggest that the further research we have recommended be ignored for the moment, and that an adaptive environmental assessment (AEA) (see Holling 1978) or similar strategy be employed to design research based on real priorities. A brief description of AEA follows.

Adaptive environmental assessment is a strategy for managing and designing scientific investigations of impact assessment problems. It is a term most often associated with the University of British Columbia's Institute of Animal Resource Ecology, where the concept was developed and originally applied (see Holling 1978). It was developed in response to an array of problems associated with conventional approaches to impact assessment. Important among these problems were:

(1) Conventionally, studies provided masses of information not relevant to assessing impacts or making predictions; they failed to identify the key environmental questions before studies were designed.

(2) The studies that did address specific problems used the conventional approach of collecting only descriptive data; information describing ecological functioning, so necessary for evaluating ecosystem responses to perturbations, received little attention.

(3) Studies were conducted on a strictly disciplinary basis, without regard for the needs or findings of other disciplines. There was no integrative force to coordinate programs that required multidisciplinary cooperation.

(4) Studies were designed and conducted largely in isolation from decision makers and other data users; the usefulness of the data in formulating policy was accordingly limited.

The purpose of AEA is to circumvent these problems, i.e., to insure that data collected are relevant, to use research approaches that will clarify ecosystem responses to perturbation, and to design and manage research studies so that other disciplines and/or policy makers receive data relevant to their needs.

Intensive workshops are the core of adaptive assessment. These workshops revolve around a small group of people (the "managers or methodologists") that interact with (1) disciplinary specialists and (2) decision-makers. The methodologists are familiar with the techniques of the analysis procedure, which often involve modeling. The disciplinary specialists are recognized experts in the several facets of the problem at issue; they may include such as biologists familiar with the ecological problems, engineers familiar with the proposed development, and physical process scientists (hydrologists, etc.) familiar with important abiotic attributes of the ecosystem. The decision-makers are the individuals who use the findings of research to influence regulatory decision; they may be a team or group of people to whom research results must be communicated.

These workshops serve one or more of three basic functions. First they assemble the relevant individuals (the experts and the data users) in an atmosphere structured by the workshop managers such that the problems are clearly defined, the existing data are critically examined, and an impact-prediction scheme is developed. Second, they may, if desired, form the backbone of a longer-term, in-depth analysis to maintain research focus and to evaluate alternative development schemes. Finally, they are an extremely effective and concise mode of communicating the results of research to the data users.

A more detailed description of AEA methodology is beyond the scope of our recommendations. In summary, however, we should review the proposed AEA strategy in light of the immediate issues and point out its potential benefits to the Great II team. First, a small core group trained in AEA or similar methodologies must manage and structure the proceedings. Second the Great II team must function both as decision-makers (data users) and as disciplinary specialists. Other specialists may be required for specific problems. The benefits to Great II are:

(1) A structure for resolving uncertainties about research direction and priorities would be established. (It is frequently difficult within a coordinating agency to objectively resolve critical points.)

(2) A productive mode of integrating multidisciplinary studies, or of evaluating the interrelationships of completed studies done by several disciplines would be established.

(3) A strategy for predicting ecological responses to development would be established. In most cases this would involve conceptual, and perhaps quantitative, models of systems or subsystems.

SUMMARY OF SIGNIFICANT FINDINGS

1. Thirty-nine species of fish were caught in the main channel from May 1979 to April 1980 using gill nets, trammel nets, hoop nets, bottom trawl, midwater trawl, seine, and electrofisher.
2. Most abundant species of the 2692 total fish caught were channel catfish (59.0%), silver chub (12.0%), mooneye (10.3%), shovelnose sturgeon (9.4%), freshwater drum (2.5%), flathead catfish (1.7%) and river darter (1.7%).
3. Channel catfish were collected in greatest numbers as young-of-the-year in summer and fall 1979 and in January 1980 when most specimens were 25-35 cm long.
4. Of all gear types used, bottom trawling was the most effective considering both fishing success and cost.
5. All six stations were shown to be similar with respect to the fish fauna present at each location. Comparisons included species occurrence, relative abundance, species diversity indices and cluster analysis.
6. The main channel habitat was shown to support greater numbers and varieties of fish than was previously though by some.

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Table 1. Fishes reported and/or documented in this study to occur in Pool 14.

Common Name	Scientific Name	Literature Record	Documented This Study
Silver lamprey	*Ichthyomyzon unicuspis*	x	
Shovelnose sturgeon	*Scaphirhynchus platorhynchus*	x	x
Paddlefish	*Polyodon spathula*	x	x
Longnose gar	*Lepisosteus osseus*	x	x
Shortnose gar	*L. platostomus*	x	x
Bowfin	*Amia calva*	x	
American eel	*Anguilla rostrata*	x	x
Gizzard shad	*Dorosoma cepedianum*	x	x
Goldeye	*Hiodon alosoides*	x	x
Mooneye	*H. tergisus*	x	x
Northern pike	*Esox lucius*	x	x
Carp	*Cyprinus carpio*	x	x
Grass carp	*Ctenopharyngodo idella*		x
Silvery minnow	*Hybognathus nuchalis*	x	x
Speckled chub	*Hybopsis aestivalis*	x	x
Flathead chub	*H. gracilis*		x
Silver chub	*H. storeriana*	x	x
Golder shiner	*Notemigonus crysoleucas*	x	
Emerald shiner	*Notropis atherinoides*	x	x
River shiner	*N. blennius*	x	x
Ghost shiner	*N. buchanani*	x	
Bigmouth shiner	*N. dorsalis*	x	
Pugnose shiner	*N. emiliae*	x	
Spottail shiner	*N. hudsonius*	x	
Silverband shiner	*N. shumardi*		x
Spotfin shiner	*N. spilopterus*	x	
Sandshiner	*N. stramineus*	x	
Bluntnose minnow	*Pimephales notatus*	x	
Fathead minnow	*P. promelas*	x	
Bullhead minnow	*P. vigilax*	x	
River carpsucker	*Carpiodes carpio*	x	x
Quillback	*C. cyprinus*	x	x
Highfin carpsucker	*C. velifer*		x
Blue sucker	*Cycleptus elongatus*	x	x
Smallmouth buffalo	*Ictiobus bubalus*	x	x
Bigmouth buffalo	*I. cyprinellus*	x	
Black buffalo	*I. niger*	x	
Spotted sucker	*Minytrema melanops*	x	
Silver redhorse	*Moxostoma anisurum*	x	x
Golden redhorse	*M. erythrurum*	x	x
Shorthead redhorse	*M. macrolepidotum*	x	x
Blue catfish	*Ictalurus furcatus*	x	
Black bullhead	*I. melas*	x	
Channel catfish	*I. punctatus*	x	x
Stonecat	*Noturus flavus*		x
Tadpole madtom	*N. gyrinus*	x	

Table 1. (cont'd)

Common Name	Scientific Name	Literature Record	Documented This Study
Flathead catfish	*Pylodictis olivaris*	x	x
Brook silverside	*Labidesthes sicculus*	x	
White bass	*Morone chrysops*	x	x
Yellow bass	*M. mississippiensis*	x	
Rock bass	*Ambloplites rupestris*	x	x
Green sunfish	*Lepomis cyanellus*	x	
Pumpkinseed	*L. gibbosus*	x	
Warmouth	*L. gulosus*	x	
Orangespotted sunfish	*L. humilis*	x	
Bluegill	*L. macrochirus*	x	
Smallmouth bass	*Micropterus dolomieui*	x	x
Largemouth bass	*M. salmoides*	x	
White crappie	*Pomoxis annularis*	x	x
Black crappie	*P. nigromaculatus*	x	x
Western sand darter	*Ammocrypta clara*	x	
Johnny darter	*Etheostoma nigrum*	x	x
Yellow perch	*Perca flavescens*	x	
Logperch	*Percina caprodes*	x	
River darter	*P. shumardi*	x	x
Sauger	*Stizostedion canadense*	x	x
Walleye	*S. vitreum*	x	x
Freshwater drum	*Aplodinotus grunniens*	x	x

Table 2. Numbers of fishes caught by all gear types at all stations from May 1979 to April 1980.

Species	1979					1980			Total
	May	June	July	August	October	January	February	April	
Shovelnose sturgeon	3	7	54	16	33	5	1	11	130
Paddlefish	0	0	2	0	0	1	0	0	3
Longnose gar	0	0	1	0	0	0	2	0	3
Shortnose gar	0	0	3	0	0	0	1	0	4
American eel	0	0	0	0	1	0	0	0	1
Gizzard shad	0	0	0	0	9	5	0	0	14
Goldeye	1	2	0	0	0	0	0	0	3
Mooneye	3	10	35	1	11	103	0	12	175
Northern pike	1	0	0	0	0	0	0	0	1
Carp	0	4	9	2	0	0	0	0	15
Grass carp	0	1	0	0	0	0	0	0	1
Speckled chub	0	1	0	0	5	5	0	0	11
Flathead chub	0	1	1	0	0	0	0	0	2
Silver chub	2	0	3	0	9	31	0	14	59
Emerald shiner	0	1	0	0	0	0	0	1	2
River shiner	0	0	0	1	2	0	0	0	3
Silverband shiner	20	6	3	0	0	0	0	0	29
Silvery minnow	0	0	0	0	0	0	0	1	1
Unidentified cyprinid	0	0	10	0	0	0	0	0	10

Table 2. (cont'd)

Species	1979 May	1979 June	1979 July	1979 August	1979 October	1980 January	1980 February	1980 April	Total
Blue sucker	0	0	1	1	0	2	0	0	4
Smallmouth buffalo	1	0	11	6	2	3	0	1	24
River carpsucker	0	0	2	1	1	1	0	0	5
Quillback	0	0	12	10	1	0	0	0	23
Highfin carpsucker	0	0	0	1	0	0	0	0	1
Silver redhorse	0	0	1	1	1	0	0	0	3
Golden redhorse	1	0	0	0	0	0	0	0	1
Shorthead redhorse	0	0	8	4	0	1	0	1	14
Channel catfish	12	22	838	355	271	134	0	69	1701
Flathead catfish	0	0	14	18	4	0	0	2	38
Stonecat	7	0	1	0	2	0	0	1	11
White bass	0	0	1	0	1	0	0	0	2
Smallmouth bass	0	0	1	0	0	0	0	0	1
Rock bass	0	0	1	0	0	0	0	0	1
White crappie	1	0	12	0	0	0	0	0	13
Black crappie	0	0	0	0	2	0	0	0	2
Sauger	5	0	13	0	6	9	0	0	33
Walleye	0	0	1	0	2	0	0	0	3
River darter	12	0	1	0	2	3	0	2	20

Table 2. (cont'd)

Species	1979 May	1979 June	1979 July	1979 August	1979 October	1980 January	1980 February	1980 April	Total
Johnny darter	0	0	0	0	0	1	0	0	1
Freshwater drum	7	23	89	18	44	140	0	3	324
Total	77	78	1027	435	409	444	4	118	2692
No. of Species	15	11	25	14	20	15	3	12	
Species Diversity (H")	2.23	1.86	1.12	0.85	1.37	1.63	1.05	1.45	
Richness (D)	0.82	0.78	0.35	0.32	0.46	0.60	0.95	0.59	
Evenness (J)	3.22	2.30	3.42	2.14	3.16	2.30	1.44	2.31	

Table 3. Numbers of fishes caught at sampling stations 1-6 by all gear types, May 1979 to April 1980.

Species	Station 1	2	3	4	5	6	Total
Shovelnose sturgeon	10	13	20	18	44	25	130
Paddlefish	1	2	0	0	0	0	3
Longnose gar	0	1	0	0	2	0	3
Shortnose gar	2	0	0	1	1	0	4
American eel	0	0	0	0	0	1	1
Gizzard shad	7	4	1	0	2	0	14
Goldeye	0	0	1	0	1	1	3
Mooneye	103	15	4	37	4	12	175
Northern pike	0	1	0	0	0	0	1
Carp	4	1	4	1	5	0	15
Grass carp	0	0	0	1	0	0	1
Speckled chub	0	3	1	3	2	2	11
Flathead chub	0	1	0	0	0	1	2
Silver chub	8	14	12	8	2	15	59
Emerald shiner	0	1	0	0	0	1	2
River shiner	0	0	2	0	0	1	3
Silverband shiner	0	1	0	3	10	15	29
Silvery minnow	0	0	0	0	0	1	1
Unidentified cyprinid	0	0	0	6	2	2	10
Blue sucker	0	2	1	0	1	0	4
Smallmouth buffalo	3	3	4	6	4	4	24
River carpsucker	1	0	1	1	1	1	5
Quillback	1	0	4	6	9	3	23
Highfin carpsucker	0	0	0	0	1	0	1
Silver redhorse	0	0	0	2	1	0	3
Golden redhorse	0	1	0	0	0	0	1
Shorthead redhorse	0	2	1	1	6	4	14
Channel catfish	493	331	200	214	286	177	1701
Flathead catfish	5	3	10	7	9	4	38
Stonecat	1	0	5	0	5	0	11

Table 3. (cont'd)

Species	Station 1	2	3	4	5	6	Total
White bass	1	1	0	0	0	0	2
Smallmouth bass	0	0	0	0	1	0	1
Rock bass	0	0	1	0	0	0	1
White crappie	0	13	0	0	0	0	13
Black crappie	0	0	1	0	0	1	2
Sauger	7	10	6	2	2	6	33
Walleye	2	0	0	0	0	1	3
River darter	0	1	14	0	2	3	20
Johnny darter	0	0	1	0	0	0	1
Freshwater drum	142	65	22	27	47	21	324
Total	791	489	316	344	450	302	2692
Number of Species	17	23	22	17	24	22	
Species Diversity (H")	1.21	1.33	1.58	1.50	1.50	1.71	
Richness (J)	0.43	0.43	0.52	0.52	0.47	0.55	
Evenness (D)	2.40	3.55	3.65	2.91	3.93	3.85	

Table 4. Numbers of fishes caught in each gear type deployed, May 1979 to April 1980.

Species	Gear Type							
	Seine	Gill Net	Hoop Net	Mid-water Trawl	Trammel Net	Electrofisher	Bottom Trawl	Total
Shovelnose sturgeon	0	19	0	0	5	0	106	130
Paddlefish	0	1	0	0	0	0	2	3
Longnose gar	1	2	0	0	0	0	0	3
Shortnose gar	0	3	0	0	1	0	0	4
American eel	0	0	1	0	0	0	0	1
Gizzard shad	0	0	0	10	0	0	4	14
Goldeye	0	0	0	0	3	0	0	3
Mooneye	0	50	1	9	12	0	103	175
Northern pike	0	1	0	0	0	0	0	1
Carp	0	2	4	0	5	0	4	15
Grass carp	0	0	0	0	0	0	1	1
Speckled chub	0	0	0	0	0	0	11	11
Flathead chub	0	0	1	0	0	0	1	2
Silver chub	0	0	1	0	2	0	56	59
Emerald shiner	0	0	0	0	0	0	2	2
River shiner	0	0	0	0	0	0	3	3
Silverband shiner	0	0	0	0	0	0	29	29
Silvery minnow	0	0	0	0	0	0	1	1
Unidentified cyprinid	0	0	0	0	0	0	10	10

Table 4. (cont'd)

Species	Gear Type: Seine	Gill Net	Hoop Net	Mid-water Trawl	Trammel Net	Electrofisher	Bottom Trawl	Total
Blue sucker	0	0	0	0	1	0	3	4
Smallmouth buffalo	1	0	5	2	6	0	10	24
River carpsucker	0	0	1	0	2	0	2	5
Quillback	1	3	1	0	12	0	6	23
Highfin carpsucker	0	0	0	0	1	0	0	1
Silver redhorse	0	1	0	0	1	0	1	3
Golden redhorse	0	1	0	0	0	0	0	1
Shorthead redhorse	0	4	3	0	6	0	1	14
Channel catfish	0	15	96	4	24	0	1562	1701
Flathead catfish	0	1	28	0	1	0	8	38
Stonecat	0	1	0	0	0	0	10	11
White bass	0	0	1	1	0	0	0	2
Smallmouth bass	0	0	0	0	0	0	1	1
Rock bass	0	0	0	0	1	0	0	1
White crappie	0	1	12	0	0	0	0	13
Black crappie	0	0	2	0	0	0	0	2
Sauger	0	12	2	0	4	0	15	33
Walleye	0	2	0	0	0	0	1	3
River darter	0	0	0	0	0	0	20	20

Table 4. (cont'd)

Species	Gear Type							
	Seine	Gill Net	Hoop Net	Mid-water Trawl	Trammel Net	Electrofisher	Bottom Trawl	Total
Johnny darter	0	0	0	0	0	0	1	1
Freshwater drum	1	45	46	6	7	0	219	324
Total Catch	4	164	205	32	94	0	2193	2692
No. of Species	4	18	16	6	18	0	28	

Table 5. Numbers of food items contained in channel catfish stomachs, April 1980.

Food Item	Fork Length (mm) 64	75	75	82	85	89	91	94	95	106	Total
Chironomidae	5	2	3		2	3	3	2	3	7	30
Hydropsychidae	2		3		2		2	1			10
Amphipoda	1		1	1		1			1		5
Ceratopogonidae		1	2		1						4
Unidentified		*									*
Cladocera			1								1
Isoperla sp.			1			2		1		P	4P
Hexogenia limbata		1									1
Simuliidae					1						1
Total	8	3*	12	1	6	6	5	4	4	7P	56*P

*present

P=parts

Table 6. Numbers of food items contained in channel catfish stomachs, April 1980.

Food Item	Fork Length (mm) 279	282	285	305	308	309	324	333	342	346	Total
Chironomidae	49	3		4P	3	8P		1	6	19	93P
Hydropsychidae	6	3		3	4	2	6	1	3	22	50
Amphipoda	1			1		6			1	1	10
Ceratopogonidae	5										5
Unidentified	*										*
Cladocera				1							1
Isoperla sp.	2	4		4	2	17	2	23	1	31	86
Hexagenia limbata	1	1		1	1	2	1	1		1	9
Simuliidae											
Figh egg	2										2
Coleoptera	P					1					1P
Diptera	1										1
Chironomidae (adult)	1			2							3
Fish		P			P				P		P
Hirudinea				1							1
Robackia sp.				1							1
Odonata				P							P
Isopoda				1		2				1	4
Zygoptera						1					1
Oligochaeta						3					3
Tricoptera						1					1
Pentagenia vittigera									1		1
Helius sp.									1		1
Corn kernels										P	P
Sialis sp.										1	1
Coleoptera (non-aquatic)										1	1
Total	68*P	11P	0	19P	10P	43	9	26	13	77	276

*present

P=parts

Table 7. Numbers of macrobenthos collected from Mississippi River sampling stations, Pool 14, on 26-27 April 1980 (3 petite ponar, 15x15 cm, grabs per station).

Taxon	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6	Total
Hirudinea							
Unidentified leech			1			1	2
Ephemeroptera							
Hexagenia limbata						1	1
Tricoptera							
Potamyia flava				1	1		2
Diptera							
Unidentified ceratopogonid						1	1
Paratendipes sp.		2			2		4
Robackia sp.	1	2		12	5	5	25
TOTAL	1	4	1	13	8	8	35
Area sampled (m^2)	0.0675	0.0675	0.0675	0.0675	0.0675	0.0675	0.405
No./m^2	14.8	59.3	14.8	192.6	118.5	118.5	86.4

Table 8. Temperature (°C), dissolved oxygen (mg/ℓ), and conductivity (μmhos/cm) profiles measured from 1-4 June 1979.

	Station																	
	1			2			3			4			5			6		
Depth (m)	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.
Surface	19.5	9.27	340	21.1	9.34	340	20.5	9.14	340	21.2	8.19	360	21.3	8.43	370	21.5	8.47	360
1	19.5	8.96	340	21.1	8.94	340	20.5	8.74	340	21.1	8.19	360	21.2	8.19	360	21.5	8.47	360
2	19.5	8.99	340	21.2	8.93	340	20.5	8.79	340	21.1	8.19	360	21.2	8.23	360	21.6	8.44	360
3	19.5	8.96	350	21.2	8.94	350	20.5	8.74	340	21.1	8.20	360	21.2	8.22	360	21.5	8.44	360
4	19.5	8.89	340	21.2	8.94	350	20.4	8.75	340	21.1	8.14	360	21.2	8.23	360	21.6	8.23	360
5	19.5	8.90	350	21.2	8.94	340	20.5	8.78	340	21.1	8.12	360	21.2	8.22	360	21.5	8.41	360
6				21.2	8.96	340	20.5	8.88	340	21.1	8.13	360	21.2	8.22	360	21.5	8.38	360
7				21.1	9.00	350				21.1	8.04	360	21.2	8.29	400	21.5	8.39	360
8				21.2	9.03	350												
9				21.2	9.09	350												
10				21.2	9.16	350												

Table 9. Temperature (°C), dissolved oxygen (mg/ℓ), and conductivity (μmhos/cm) profiles measured from 27-30 June 1979.

	Station																	
	1			2			3			4			5			6		
Depth (m)	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.
Surface	23.5	6.58	310	23.7	6.75	370	23.9	6.66	300	23.1	7.00	310	23.0	6.83	310	22.8	6.52	310
1	23.5	6.30	320	23.6	6.45	370	23.8	5.75	310	22.9	6.26	310	22.9	5.68	310	22.8	5.73	310
2	23.5	6.28	320	23.6	6.41	360	23.8	5.85	310	23.0	6.26	310	22.9	5.66	310	22.8	5.75	310
3	23.5	6.31	310	23.7	6.52	380	23.8	5.82	310	23.0	6.27	310	22.9	5.62	310	22.8	5.76	310
4	23.5	6.26	320	23.7	6.51	380	23.8	5.82	310	23.0	6.27	310	22.9	5.62	310	22.8	5.76	310
5	23.4	6.33	310	23.6	6.52	370	23.9	5.86	310	23.0	6.25	310	22.9	5.67	310	22.8	5.75	310
6	23.5	6.37	310	23.5	6.39	360	23.9	5.88	310				22.9	5.68	310	22.8	5.86	310
7													22.9	5.75	310			
8													23.0	5.81	310			

Table 10. Temperature (°C), dissolved oxygen (mg/ℓ), and conductivity (µmhos/cm) profiles *measured from 27-29 July 1979.*

	Station																	
	1			2			3			4			5			6		
Depth (m)	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.
Surface	27.4	6.06	420	27.8	6.61	410	27.9	6.50	400	27.2	6.58	410	26.9	6.57	410	27.0	6.27	410
1	27.4	6.01	420	27.9	6.58	410	27.9	6.50	400	27.3	6.40	410	27.0	6.21	410	26.9	6.25	410
2	27.4	6.01	420	27.9	6.55	400	27.9	6.48	400	27.3	6.43	410	27.0	6.15	410	26.9	6.26	410
3	27.4	6.00	420	27.9	6.55	410	27.9	6.51	410	27.3	6.44	410	27.0	6.14	410	26.9	6.25	410
4	27.4	6.03	420	27.9	6.56	410	27.9	6.49	400	27.3	6.51	410	27.0	6.24	410	26.9	6.23	410
5	27.4	6.01	420	27.9	6.51	400	27.9	6.49	400				27.0	6.32	410	26.9	6.27	420
6				27.9	6.56	400							26.9	6.40	410			
7				27.8	6.58	410												

Table 11. Temperature (°C), dissolved oxygen (mg/ℓ), and conductivity (μmhos/cm) profiles measured from 25-28 August 1979.

	Station																	
	1			2			3			4			5			6		
Depth (m)	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.
Surface	24.0	6.37	440	23.4	6.10	440	23.7	6.41	450	23.0	6.46	440	23.2	6.03	440	22.4	6.20	440
1	24.0	6.40	440	23.4	6.10	440	23.7	6.41	450	23.0	6.53	440	23.1	6.09	440	22.4	6.21	440
2	24.0	6.35	440	23.4	6.10	440	23.7	6.40	450	23.0	6.50	440	23.1	6.10	440	22.4	6.16	440
3	23.9	6.33	440	23.4	6.08	440	23.7	6.41	450	23.1	6.45	440	23.0	6.12	440	22.4	6.17	440
4	23.8	6.30	440	23.4	6.04	440	23.7	6.37	450	23.1	6.49	440	23.0	6.10	440	22.4	6.17	440
5	23.8	6.33	440	23.4	6.02	440	23.7	6.43	450	23.1	6.49	440	23.0	6.10	440	22.4	6.17	440
6	23.7	6.24	440	23.4	6.02	440	23.7	6.40	450				23.1	6.04	440	22.4	6.23	440
7	23.8	6.23	440	23.4	6.01	440												
8	23.7	6.21	440	23.4	5.90	440												
9	24.0	6.22	440	23.4	6.00	440												

Table 12. Temperature (°C), dissolved oxygen (mg/ℓ), and conductivity (μmhos/cm) profiles measured on 5 and 10 October 1979.

	Station																	
	1			2			3			4			5			6		
Depth (m)	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.
Surface	15.1	8.6	524	13.7	9.8	492	13.9	10.0	489	13.1	10.1	488	13.0	10.0	487	12.7	10.1	491
1	15.2	8.5	524	13.7	9.8	492	13.7	10.0	488	13.1	10.0	488	13.0	10.0	487	12.7	10.0	492
2	15.1	8.5	524	13.7	9.8	493	13.7	10.0	489	13.1	10.0	488	13.0	10.0	487	12.7	10.0	492
3	15.1	8.5	525	13.7	9.8	493	13.8	10.0	490	13.1	10.1	488	13.0	10.0	487	12.7	10.0	492
4	15.1	8.5	525	13.7	9.8	492				13.1	10.0	488	13.0	10.0	487	12.7	10.0	492
5	15.0	8.6	525	13.7	9.8	492							13.0	10.0	487	12.7	10.0	492
6				13.6	9.7	492												

Table 13. Temperature (°C), dissolved oxygen (mg/ℓ), and conductivity (µmhos/cm) profiles measured on 19-20 January 1980.

	Station																	
	1			2			3			4			5			6		
Depth (m)	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.
Surface	0.0	14.1	442	0.0	14.2	433	0.0	13.9	431	0.0	13.5	420	0.1	14.2	432	0.2	14.1	428
1	0.0	14.1	443	0.0	14.2	440	0.0	14.2	432	0.0	13.6	424	-0.1	14.4	433	0.1	14.1	430
2	0.0	14.2	443	0.0	14.2	440	-0.0	14.2	432	0.0	13.7	425	-0.1	14.4	436	0.1	14.2	432
3	0.0	14.2	443	0.0	14.2	440	-0.0	14.1	433	0.0	13.7	427	-0.1	14.4	437	0.1	14.2	434
4	0.0	14.2	443	0.0	14.2	440	-0.1	14.1	433	+0.0	13.9	432				0.0	14.2	434
5	0.0	14.2	442	-0.0	14.2	439	-0.1	14.2	432	+0.0	13.9	433						
6	0.0	14.2	442				-0.1	14.1	432	-0.0	13.9	433						
7	0.0	14.2	442															
8	0.0	14.2	440															
9	0.0	14.2	440															
10	0.0	14.2	440															

Table 14. Temperature (°C), dissolved oxygen (mg/ℓ), and conductivity (μmhos/cm) profiles measured on 11-12 February 1980.

	Station																	
	1			2			3			4			5			6		
Depth (m)	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.
Surface	0.0	13.2	491	-0.2	13.2	503	-0.1	15.0	484	-0.3	15.5	426	-0.3	15.0	443	0.0	15.0	461
1	0.0	13.2	491	-0.2	13.1	503	-0.1	14.7	484	-0.3	15.5	427	-0.3	15.0	444	0.0	14.9	465
2	-0.0	13.2	492	-0.1	13.0	503	-0.1	14.6	484	-0.3	15.5	427	-0.3	15.0	445	0.0	14.9	465
3	-0.0	13.3	493							-0.3	15.5	427				-0.1	14.9	465
4	-0.0	13.2	493							-0.3	15.5	427						
5	-0.0	13.1	494							-0.3	15.5	427						

Table 15. Temperature (°C), dissolved oxygen (mg/ℓ), and conductivity (μmhos/cm) profiles measured on 20 April 1980.

	Station																	
	1			2			3			4			5			6		
Depth (m)	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.
Surface	10.7	11.3	286	10.7	11.4	287	10.8	11.5	289	10.8	11.5	287	11.1	11.5	289	11.7	11.9	289
1	10.7	11.4	285	10.7	11.4	287	10.8	11.5	289	10.8	11.5	287	11.0	11.6	289	11.4	11.9	289
2	10.7	11.4	285	10.7	11.4	286	10.8	11.6	288	10.8	11.5	287	11.0	11.6	288	11.4	12.0	289
3	10.7	11.4	285	10.7	11.4	287	10.8	11.6	288	10.8	11.6	287	11.0	11.5	288	11.4	12.0	289
4	10.7	11.4	285	10.7	11.4	286	10.7	11.5	287	10.8	11.6	287	11.0	11.5	288	11.2	12.1	290
5	10.7	11.5	285	10.7	11.4	286	10.7	11.5	287	10.8	11.6	287	11.0	11.5	288	11.3	12.0	290
6	10.7	11.5	285	10.7	11.4	286	10.7	11.5	287	10.8	11.6	287	11.0	11.5	288	11.2	12.0	290
7	10.7	11.5	284	10.7	11.5	286							11.0	11.5	288	11.2	12.1	290
8	10.7	11.5	284	10.7	11.5	285							11.0	11.5	288			
9	10.7	11.4	284										11.0	11.5	288			
10	10.7	11.5	284										11.0	11.5	287			

Table 16. Turbidity (NTU) measurements for sampling stations 1-6, 1980.

Station	Depth	January	February	April
1	Surface	40	5.2	16
	Bottom	90	4.9	28
2	Surface	18	4.0	25
	Bottom	40	7.4	25
3	Surface	-	18	14
	Bottom	44	15	13
4	Surface	21	14	21
	Bottom	28	12	21
5	Surface	-	10	18
	Bottom	-	12	23
6	Surface	-	13	15
	Bottom	-	9	15

Table 17. Diel temperature (°C), dissolved oxygen (mg/ℓ), and conductivity (μmhos/cm) profiles measured at Station 1 from 28-29 June 1979.

	Time								
	2400-0450			0450-0900			1310-1800		
Depth (m)	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.
Surface	23.4	5.66	310	23.6	6.03	320	23.5	6.58	310
1	23.4	5.67	310	23.6	5.88	310	23.5	6.30	320
2	23.4	5.57	320	23.6	5.86	320	23.5	6.28	320
3	23.3	5.30	320	23.6	5.87	320	23.5	6.31	310
4				23.6	5.84	310	23.5	6.26	320
5	23.6	5.84	310	23.5	6.33	310			
6				23.6	5.78	320	23.5	6.37	310

Table 18. Diel temperature (°C), dissolved oxygen (mg/ℓ), and conductivity (μmhos/cm) profiles measured at Station 1 from 27-28 July 1979.

	Time																	
	1200			1350			1954			2200			0200			0600		
Depth (m)	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.
Surface	27.4	6.06	420	27.7	6.34	420	28.0	7.08	420	27.6	6.77	420	27.1	6.46	420	26.8	6.38	420
1	27.4	6.01	420	27.7	6.20	420	28.1	6.91	410	27.6	6.63	420	27.1	6.35	420	26.9	6.10	420
2	27.4	6.01	420	27.7	6.22	420	28.1	6.93	420	27.6	6.63	420	27.1	6.35	420	26.9	6.10	420
3	27.4	6.00	420	27.7	6.21	420	28.1	6.94	420	27.6	6.65	420	27.1	6.37	420	26.9	6.11	420
4	27.4	6.03	420	27.7	6.20	420	28.1	6.95	410	27.6	6.66	410	27.1	6.40	420	26.9	6.11	420
5	27.4	6.01	420	27.7	6.23	420	28.1	6.96	410	27.6	6.68	430	27.1	6/42	420	26.9	6.38	420
6				27.7	6.18	420												

Table 19. Diel temperature (°C), dissolved oxygen (mg/ℓ), and conductivity (μmhos/cm) profiles measured at Station 1 from 27-28 August 1979.

	Time														
	2255			0130			0535			1045			1425		
Depth (m)	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.
Surface	23.0	6.54	440	23.0	6.48	440	23.4	6.32	440	23.7	6.34	440	23.8	6.39	440
1	23.1	6.52	440	23.0	6.43	440	23.4	6.32	440	23.6	6.40	440	23.8	6.41	440
2	23.1	6.53	440	23.0	6.44	440	23.4	6.28	440	23.6	6.32	440	23.8	6.37	440
3	23.1	6.46	440	23.0	6.45	440	23.4	6.32	440	23.6	6.40	440	23.8	6.39	440
4	23.1	6.46	440	23.0	6.45	440	23.4	6.30	440	23.6	6.32	440	23.8	6.39	440
5	23.1	6.51	440	23.0	6.46	440	23.4	6.30	440	23.6	6.30	440	23.8	6.41	440
6	23.1	6.55	440	23.0	6.50	440	23.4	6.32	440	23.6	6.33	440	23.8	6.37	440
7							23.4	6.34	440						

Table 20. Diel temperature (°C), dissolved oxygen (mg/ℓ), and conductivity (μmhos/cm) profiles measured at Station 1 from 4-5 October 1979.

	Time																	
	1905			2240			0305			0710			1104			1500		
Depth (m)	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.	Temp.	D.O.	Cond.
Surface	16.4	8.6	380	16.2	8.4	524	15.9	8.6	525	15.5	8.2	529	15.1	8.6	524	15.3	8.9	517
1	16.5	8.5	515	16.2	8.5	525	16.0	8.5	524	15.5	8.2	530	15.2	8.5	524	15.3	8.9	517
2	16.6	8.5	515	16.2	8.5	524	15.9	8.5	524	15.5	8.1	529	15.1	8.5	524	15.3	8.8	516
3	16.5	8.5	514	16.1	8.5	525	16.0	8.5	525	15.4	8.2	529	15.1	8.5	525	15.2	8.7	518
4	16.6	8.4	515	16.1	8.4	525	16.0	8.5	525	15.4	8.2	530	15.1	8.5	525	15.2	8.7	517
5	16.6	8.5	515	16.2	8.4	525	15.9	8.4	525	15.1	8.4	530	15.0	8.6	525	15.2	8.7	517
6	16.6	8.4	515	16.1	8.4	525	15.9	8.4	526							15.2	8.9	518
7	16.6	8.5	514															

Table 21. Diel temperature (°C), dissolved oxygen (mg/ℓ), and conductivity (μmhos/cm) profiles measured at Station 1 from 27-28 April 1980.

	Time																	
	1200						1600						2000					
	Temp.		D.O.		Cond.		Temp.		D.O.		Cond.		Temp.		D.O.		Cond.	
Replicate:	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Depth (m)																		
Surface	15.0	15.0	12.7	13.1	319	319	14.9	14.8	12.5	12.6	317	317	14.7	14.6	12.3	12.6	319	319
1	15.0	15.0	12.8	13.1	319	319	14.9	14.8	12.5	12.5	316	317	14.7	14.6	12.3	12.5	319	319
2	15.0	15.0	13.0	13.0	319	319	14.9	14.8	12.5	12.5	317	317	14.7	14.6	12.4	12.5	319	320
3	14.0	15.0	13.0	13.0	319	319	14.9	14.8	12.5	12.5	317	317	14.6	14.6	12.4	12.5	319	320
4	15.0	15.0	13.0	13.0	319	319	14.8	14.8	12.5	12.5	317	317	14.6	14.6	12.4	12.4	319	320
5	15.0	15.0	13.0	13.0	319	319	14.8	14.8	12.5	12.5	317	317	14.6	14.6	12.4	12.4	319	319
6	15.0	15.0	13.0	13.0	319	319	14.8	14.8	12.5	12.5	317	317	14.6	14.6	12.4	12.5	319	319
7	15.0	15.0	13.0	12.9	319	319	14.8	14.8	12.5	12.5	317	317	14.6	14.6	12.4	12.4	319	320
8							14.8	14.8	12.5	12.5	317	317	14.6	14.6	12.4	12.4	319	319

	Time																	
	0000						0400						0800					
	Temp.		D.O.		Cond.		Temp.		D.O.		Cond.		Temp.		D.O.		Cond.	
Replicate:	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
Depth (m)																		
Surface	14.3	(14.3)	12.5	(12.5)	324	(323)	14.6	(14.7)	13.3	(13.3)	323	(322)	14.9	(15.0)	13.6	(13.6)	322	(318)
1	14.3	(14.3)	12.5	(12.5)	325	(323)	14.6	(14.7)	13.3	(13.3)	323	(323)	14.9	(15.0)	13.6	(13.6)	321	(319)
2	14.3	(14.3)	12.5	(12.5)	324	(323)	14.6	(14.7)	13.3	(13.3)	322	(322)	14.9	(15.0)	13.6	(13.6)	321	(319)
3	14.3	(14.3)	12.5	(12.5)	324	(323)	14.6	(14.7)	13.3	(13.3)	322	(322)	14.9	(15.0)	13.6	(13.6)	321	(320)
4	14.3	(14.3)	12.5	(12.5)	324	(323)	14.6	(14.7)	13.3	(13.3)	322	(322)	15.0	(15.0)	13.6	(13.5)	321	(320)
5	14.3	(14.3)	12.5	(12.5)	324	(322)	14.6	(14.7)	13.3	(13.3)	322	(322)	14.9	(15.0)	13.5	(13.6)	321	(319)
6	14.3	(14.3)	12.5	(12.5)	324	(323)	14.7	(14.7)	13.3	(13.3)	322	(321)	15.0	(15.0)	13.5	(13.6)	321	(320)
7	14.3	(14.3)	12.5	(12.5)	323	(323)	14.7	(14.7)	13.3	(13.3)	322	(322)	15.0	(15.0)	13.5	(13.5)	320	(320)
8							14.7	(14.7)	13.3	(13.3)	322	(321)						

APPENDIX I

Numbers of fishes caught by trip and gear type at each station, and length frequencies of fishes caught, May 1979-April 1980.

Table I-1. Numbers of fishes caught in gill nets during May 1979 sampling.

Species	Gill Net Station 1	2	3	4	5	6	Total
Shovelnose sturgeon	1	0	0	0	1	1	3
Mooneye	0	3	0	0	0	0	3
Northern pike	0	1	0	0	0	0	1
Golden redhorse	0	1	0	0	0	0	1
Channel catfish	0	3	0	0	0	0	3
White crappie	0	1	0	0	0	0	1
Sauger	0	4	0	0	1	0	5
Freshwater drum	0	5	0	1	0	0	6
Total	1	18	0	1	2	1	23

Table I-2. Numbers of fishes caught in hoop nets during May 1979 sampling.

Species	Hoop Net Station 1	2	3	4	5	6	Total
Channel catfish	0	0	0	1	0	0	1
Total	0	0	0	1	0	0	1

Table I-3. Numbers of fishes caught in trammel nets during May 1979 sampling.

Species	Trammel Net Station 1	2	3	4	5	6	Total
Goldeye	0	0	1	0	0	0	1
Silver chub	0	0	1	0	0	1	2
Channel catfish	0	0	0	0	0	1	1
Freshwater drum	0	0	0	0	0	1	1
Total	0	0	2	0	0	3	5

Table I-4. Numbers of fishes caught in trawls during May 1979 sampling.

Species	Trawl Station 1	2	3	4	5	6	Total
Flathead chub	0	0	0	0	0	1	1
Silverband shiner	0	1	0	3	5	11	20
Smallmouth buffalo	0	0	0	0	0	1	1
Channel catfish	1	0	0	3	2	1	7
Stone cat	0	0	4	0	3	0	7
River darter	0	0	10	0	1	1	12
Total	1	1	14	6	11	15	48

Table I-5. Numbers of fishes caught in gill nets during June 1979 sampling.

Species	Gill Net Station 1	2	3	4	5	6	Total
Shovelnose sturgeon	1	0	0	0	2	0	3
Mooneye	0	5	0	0	0	0	5
Carp	2	0	0	0	0	0	2
Channel catfish	2	1	0	0	0	0	3
Freshwater drum	8	9	0	0	1	0	18
Total	13	15	0	0	3	0	31

Table I-6. Numbers of fishes caught in hoop nets during June 1979 sampling.

Species	Hoop Net Station 1	2	3	4	5	6	Total
Flathead chub	0	1	0	0	0	0	1
Channel catfish	1	0	1	0	0	0	2
Freshwater drum	1	0	0	0	0	0	1
Total	2	1	1	0	0	0	4

Table I-7. Numbers of fishes caught in trammel nets during June 1979 sampling.

Species	Trammel Net Station 1	2	3	4	5	6	Total
Goldeye	0	0	0	0	1	1	2
Mooneye	0	0	1	0	0	0	1
Total	0	0	1	0	1	1	3

Table I-8. Numbers of fishes caught in trawls during June 1979 sampling.

	Trawl						
	Station						
Species	1	2	3	4	5	6	Total
Shovelnose sturgeon	0	4	0	0	0	0	4
Mooneye	4	0	0	0	0	0	4
Carp	2	0	0	0	0	0	2
Grass carp	0	0	0	1	0	0	1
Speckled chub	0	0	0	0	1	0	1
Emerald shiner	0	1	0	0	0	0	1
Silverband shiner	0	0	0	0	2	4	6
Channel catfish	5	5	2	4	1	0	17
Freshwater drum	0	0	0	3	1	0	4
Unidentified cyprinids	0	0	0	6	2	2	10
Total	11	10	2	14	7	6	50

Table I-9. Numbers of fishes caught in seines during July 1979 sampling.

	Seine						
	Station						
Species	1	2	3	4	5	6	Total
Longnose gar	0	1	0	0	0	0	1
Total	0	1	0	0	0	0	1

Table I-10. Numbers of fishes caught in gill nets during July 1979 sampling.

Species	Gill Net Station 1	2	3	4	5	6	Total
Shovelnose sturgeon	0	0	1	0	2	1	4
Paddlefish	1	0	0	0	0	0	1
Shortnose gar	1	0	0	1	0	0	2
Quillback	0	0	0	1	0	1	2
Silver redhorse	0	0	0	1	0	0	1
Shorthead redhorse	0	2	0	1	1	0	4
Channel catfish	3	0	1	1	0	0	5
Sauger	3	1	0	0	0	0	4
Freshwater drum	9	1	1	0	1	1	13
Total	17	4	3	5	4	3	36

Table I-11. Numbers of fishes caught in hoop nets during July 1979 sampling.

Species	Hoop Net Station 1	2	3	4	5	6	Total
Carp	0	0	1	1	2	0	4
Smallmouth buffalo	0	0	1	0	0	1	2
Shorthead redhorse	0	0	0	0	0	2	2
Channel catfish	1	0	4	3	0	2	10
Flathead catfish	2	0	5	1	0	3	11
White bass	0	1	0	0	0	0	1
White crappie	0	12	0	0	0	0	12
Sauger	1	0	1	0	0	0	2
Freshwater Drum	4	1	2	5	23	2	37
Total	8	14	14	10	25	10	81

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STUDY OF FISH IN THE MAIN CHANNEL OF THE MISSISSIPPI RIVER BETW--ETC(U)

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Table I-12. Numbers of fishes caught in trammel nets during July 1979 sampling.

Species	Trammel Net Station 1	2	3	4	5	6	Total
Shovelnose sturgeon	0	0	0	0	1	2	3
Shortnose gar	1	0	0	0	0	0	1
Mooneye	0	0	0	0	2	2	4
Carp	0	1	2	0	0	0	3
Smallmouth buffalo	1	0	1	0	0	1	3
River carpsucker	0	0	1	0	0	1	2
Quillback	0	0	1	1	0	2	4
Shorthead redhorse	0	0	0	0	0	2	2
Channel catfish	1	0	1	1	3	11	17
Rock bass	0	0	1	0	0	0	1
Sauger	0	0	2	0	0	1	3
Freshwater drum	0	1	1	1	0	1	4
Total	3	2	10	3	6	23	47

Table I-13. Numbers of fishes caught in trawls during July 1979 sampling.

	Trawl Station						
Species	1	2	3	4	5	6	Total
Shovelnose sturgeon	4	4	4	7	21	7	47
Paddlefish	0	1	0	0	0	0	1
Mooneye	0	0	0	31	0	0	31
Carp	0	0	1	0	1	0	2
Flathead chub	0	0	0	0	0	1	1
Silver chub	0	0	0	3	0	0	3
Silverband shiner	0	0	0	0	3	0	3
Blue sucker	0	0	1	0	0	0	1
Smallmouth buffalo	0	0	2	2	2	0	6
Quillback	0	0	2	2	2	0	6
Channel catfish	221	179	116	58	201	31	806
Flathead catfish	0	0	1	0	2	0	3
Stone cat	0	0	0	0	1	0	1
Smallbouth bass	0	0	0	0	1	0	1
Sauger	1	0	0	2	1	0	4
Walleye	0	0	0	0	0	1	1
River darter	0	0	1	0	0	0	1
Freshwater drum	5	5	9	5	6	5	35
Total	231	189	137	110	241	45	953

Table I-14. Numbers of fishes caught in seines during August 1979 sampling.

Species	Seine Station 1	2	3	4	5	6	Total
Smallmouth buffalo	0	0	0	1	0	0	1
Quillback	0	0	0	1	0	0	1
Freshwater drum	0	0	0	1	0	0	1
Total	0	0	0	3	0	0	3

Table I-15. Numbers of fishes caught in gill nets during August 1979 sampling.

Species	Gill Net Station 1	2	3	4	5	6	Total
Channel catfish	0	1	0	0	0	0	1
Flathead catfish	0	0	0	1	0	0	1
Total	0	1	0	1	0	0	2

Table I-16. Numbers of fishes caught in hoop nets during August 1979 sampling.

Species	Hoop Net Station 1	2	3	4	5	6	Total
Smallmouth buffalo	0	1	0	0	0	0	1
Quillback	0	0	0	0	1	0	1
Channel catfish	33	22	0	0	0	1	56
Flathead catfish	1	2	4	4	2	1	14
Freshwater drum	0	1	0	1	2	2	6
Total	34	26	4	5	5	4	78

Table I-17. *Numbers of fishes caught in trammel nets during August 1979 sampling.*

Species	Trammel Net Station 1	2	3	4	5	6	Total
Shovelnose sturgeon	0	0	0	1	1	0	2
Mooneye	0	0	0	0	0	1	1
Carp	0	0	0	0	2	0	2
Blue sucker	0	0	0	0	1	0	1
Smallmouth buffalo	0	0	0	2	1	0	3
Quillback	0	0	1	1	6	0	8
Highfin carpsucker	0	0	0	0	1	0	1
Silver redhorse	0	0	0	0	1	0	1
Shorthead redhorse	0	0	0	0	4	0	4
Channel catfish	0	0	0	0	4	2	6
Flathead catfish	0	0	0	1	0	0	1
Freshwater drum	0	0	0	1	1	0	2
Total	0	0	1	6	22	3	32

Table I-18. Numbers of fishes caught in trawls during August 1979 sampling.

Species	Trawl Station 1	2	3	4	5	6	Total
Shovelnose sturgeon	1	0	7	5	1	0	14
River shiner	0	0	0	0	0	1	1
Smallmouth buffalo	0	0	0	0	0	1	1
River carpsucker	0	0	0	1	0	0	1
Channel catfish	39	0	46	128	22	57	292
Flathead catfish	0	0	0	0	2	0	2
Freshwater drum	0	0	1	5	0	3	9
Total	40	0	54	139	25	62	320

Table I-19. Numbers of fishes caught in gill nets during October 1979 sampling.

Species	Gill Net Station 1	2	3	4	5	6	Total
Shovelnose sturgeon	0	0	0	0	1	5	6
Quillback	1	0	0	0	0	0	1
Channel catfish	0	0	0	0	0	3	3
Sauger	1	0	0	0	0	2	3
Walleye	2	0	0	0	0	0	2
Freshwater drum	0	0	0	0	2	0	2
Total	4	0	0	0	3	10	17

Table I-20. Numbers of fishes caught in hoop nets during October 1979 sampling.

Species	Hoop Net Station 1	2	3	4	5	6	Total
American eel	0	0	0	0	0	1	1
Smallmouth buffalo	0	1	0	0	0	0	1
River carpsucker	0	0	0	0	1	0	1
Channel catfish	0	1	0	0	18	0	19
Flathead catfish	1	0	0	0	1	0	2
Black crappie	0	0	1	0	0	1	2
Freshwater drum	0	0	1	0	1	0	2
Total	1	2	2	0	21	2	28

Table I-21. Numbers of fishes caught in mid-water trawls during October 1979 sampling.

Species	Mid-water Trawl Station 1	2	3	4	5	6	Total
Gizzard shad	6	1	0	0	2	0	9
Mooneye	0	0	1	0	1	1	3
White bass	1	0	0	0	0	0	1
Freshwater drum	0	0	0	2	1	3	6
Total	7	1	1	2	4	4	19

Table I-22. Numbers of fishes caught in trammel nets during October 1979 sampling.

Species	Trammel Net Station 1	2	3	4	5	6	Total
Mooneye	0	0	0	0	0	6	6
Sauger	0	0	0	0	0	1	1
Total	0	0	0	0	0	7	7

Table I-23. Numbers of fishes caught in trawls during October 1979 sampling.

Species	Trawl Station 1	2	3	4	5	6	Total
Shovelnose sturgeon	2	3	5	2	12	3	27
Mooneye	0	0	0	2	0	0	2
Speckled chub	0	0	0	3	1	1	5
Silver chub	0	0	2	5	0	2	9
River shiner	0	0	2	0	0	0	2
Smallmouth buffalo	0	0	0	1	0	0	1
Silver redhorse	0	0	0	1	0	0	1
Channel catfish	157	34	14	5	33	6	249
Flathead catfish	1	0	0	0	1	0	2
Stone cat	1	0	0	0	1	0	2
Sauger	0	0	0	0	0	2	2
River darter	0	0	0	0	1	1	2
Freshwater drum	15	2	5	2	7	3	34
Total	176	39	28	21	56	18	338

Table I-24. Numbers of fishes caught in gill nets during January 1980 sampling.

Species	Gill Net Station 1	2	3	Total
Mooneye	42	0	0	42
Freshwater drum	5	0	0	5
Total	47	0	0	47

Table I-25. Numbers of fishes caught in hoop nets during January 1980 sampling.

Species	Hoop Net Station 1	2	3	Total
Mooneye	1	0	0	1
Channel catfish	3	0	0	3
Total	4	0	0	4

Table I-26. Numbers of fishes caught in mid-water trawls during January 1980 sampling.

Species	Mid-water Trawl Station 1	2	Total
Gizzard shad	1	0	1
Mooneye	1	0	1
Smallmouth buffalo	2	0	2
Channel catfish	4	0	4
Total	8	0	8

Table I-27. Numbers of fishes caught in trawls during January 1980 sampling.

Species	Trawl Station 1	2	3	6	Total
Shovelnose sturgeon	0	1	1	3	5
Paddlefish	0	1	0	0	1
Gizzard shad	0	3	1	0	4
Mooneye	52	6	0	1	59
Speckled chub	0	3	1	1	5
Silver chub	4	14	6	7	31
Blue sucker	0	2	0	0	2
Smallmouth buffalo	0	1	0	0	1
River carpsucker	1	0	0	0	1
Shorthead redhorse	0	0	1	0	1
Channel catfish	18	85	2	22	127
Sauger	1	5	3	0	9
River darter	0	1	2	0	3
Johnny darter	0	0	1	0	1
Freshwater drum	95	40	0	0	135
Total	171	162	18	34	385

Table I-28. Numbers of fishes caught in gill nets during February 1980 sampling.

Species	Gill Net Station 4	5	6	Total
Shovelnose sturgeon	1	0	0	1
Longnose gar	0	2	0	2
Shortnose gar	0	1	0	1
Total	1	3	0	4

Table I-29. Numbers of fishes caught in gill nets during April 1980 sampling.

Species	Gill Net Station 3	4	5	Total
Shovelnose sturgeon	0	1	1	2
Stonecat	1	0	0	1
Freshwater drum	0	0	1	1
Total	1	1	2	4

Table I-30. Numbers of fishes caught in hoop nets during April 1980 sampling.

Species	Hoop Net Station 3	4	5	Total
Silver chub	1	0	0	1
Smallmouth buffalo	0	0	1	1
Shorthead redhorse	0	0	1	1
Channel catfish	1	2	2	5
Flathead catfish	0	0	1	1
Total	2	2	5	9

Table I-31. Numbers of fishes caught in mid-water trawls during April 1980 sampling.

Species	Mid-water Trawl Station 1	2	3	4	5	Total
Mooneye	1	1	1	1	1	5
Total	1	1	1	1	1	5

Table I-32. Numbers of fishes caught in trawls during April 1980 sampling.

Species	Trawl Station 1	2	3	4	5	6	Total
Shovelnose sturgeon	1	1	2	1	1	3	9
Mooneye	2	0	1	3	0	1	7
Silver chub	4	0	2	0	2	5	13
Emerald shiner	0	0	0	0	0	1	1
Silvery minnow	0	0	0	0	0	1	1
Channel catfish	4	0	12	8	0	40	64
Flathead catfish	0	1	0	0	0	0	1
River darter	0	0	1	0	0	1	2
Freshwater drum	0	0	2	0	0	0	2
Total	11	2	20	12	3	52	100

Note: In the following tables total number of fish with lengths may not coincide with total number of fish caught as shown in Tables 2-4 because either (1) length was not taken or (2) length was recorded illegibly and not reportable.

Table I-33. Length frequencies of shovelnose sturgeon collected by all gear types, 1979-1980.

	Sampling Trip												
	1979								1980				
Length Interval (cm)	May	June	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
8		1											1
9			2			1							3
10			9										9
11		3	10			1							14
12			1										1
13			1										1
14			2			1							3
15			2	1									3
16			3	1		1							5
17			4	3		1							8
18				3									3
19			2			2							4
20													
21												1	1
22			2						1			2	5
23						4							4
24				2		4							6
25				5								4	9
26						2			1				3
27						2			1				3
28						2							2
29						1						1	2
30						4							4
31						1							1
32						1							1
33						1							1
34													
35												1	1
36												1	1
37		1											1
38													
39													
40													
41													
42													
43			2										2
44													
45			1										1
46													
47			1										1
48						1			1				2
49			1							1			2
50						1							1
51													
52									1				1
53		1											1
54													
55													
56													
57													
58													
59	1	1	1										3
60													
61			2										2
62			2										2
63			1										1
64												1	1
65			1										1
66			1	1									2
67	1					1							2
68	1												1
69			1										1
70													
71													
72													
73						1							1
74													
75													
76													
77													
78			1										1
Total	3	7	54	16		33			5	1		11	130

Table I-34. Length frequencies of paddlefish collected by all gear types, 1979-1980.

	Sampling Trip		
	1979	1980	
Length Interval (cm)	July	January	Total
28	1		1
62	1		1
138		1	1
Total	2	1	3

Table I-35. Length frequencies of longnose gar collected by all gear types, 1979-1980.

	Sampling Trip		
	1979	1980	
Length Interval (cm)	July	February	Total
69		1	1
74		1	1
75	1		1
Total	1	2	3

Table I-36. Length frequencies of shortnose gar collected by all gear types, 1979-1980.

	Sampling Trip		
	1979	1980	
Length Interval (cm)	July	February	Total
58	1	1	2
62	2		2
Total	3	1	4

Table I-37. Length frequencies of American eel collected by all gear types, 1979-1980.

	Sampling Trip	
	1979	
Length Interval (cm)	October	Total
95	1	1
Total	1	1

Table I-38. Length frequencies of gizzard shad collected by all gear types, 1979-1980.

	Sampling Trip		
	1979	1980	
Length Interval (cm)	October	January	Total
9		1	1
11		1	1
12		1	1
14	1	1	2
15	3		3
16	3	1	4
17	1		1
18	1		1
Total	9	5	14

Table I-39. Length frequencies of goldeye collected by a.l gear types, 1979-1980.

	Sampling Trip		
	1979		
Length Interval (cm)	May	June	Total
30		1	1
32	1		1
33		1	1
Total	1	2	3

Table I-40. Length frequencies of mooneye collected by all gear types, 1979-1980.

	Sampling Trip												
	1979								1980				
Length Interval (cm)	May	June	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
5		3											3
6		1											1
7													
8			6										6
9			14										14
10			3										3
11	1		2										3
12	1								1			1	3
13	1								10			2	13
14						5			21			4	30
15									10			4	14
16									1				1
17													
18													
19			1										1
20													
21									3			1	4
22									1				1
23									2				2
24													
25									2				2
26		1				1			4				6
27		3		1					16				20
28			4			5			15				24
29		1							9				10
30									5				5
31									1				1
32		1							2				3
Total	3	10	35	1		11			103			12	175

Table I-41. Length frequencies of northern pike collected by all gear types, 1979-1980.

	Sampling Trip	
	1979	
Length Interval (cm)	May	Total
26	1	1
Total	1	1

Table I-42. Length frequencies of carp collected by all gear types, 1979-1980.

	Sampling Trip 1979			
Length Interval (cm)	June	July	August	Total
28		1		1
33		1		1
40		1		1
41		1		1
42			1	1
43		1		1
44		1		1
48	3			3
49		2		2
58			1	1
59	1	1		2
Total	4	9	2	15

Table I-43. Length frequencies of speckled chub collected by all gear types, 1979-1980

	Sampling Trip			
	1979		1980	
Length Interval (cm)	June	October	January	Total
4		1		1
5		1		1
6	1	1	1	3
7		1	1	2
8			2	2
9		1		1
Total	1	5	4	10

Table I-44. Length frequencies of flathead chub collected by all gear types, 1979-1980.

Length Interval (cm)	Sampling Trip 1979 May	Total
5	1	1
Total	1	1

Table I-45. Length frequencies of silver chub collected by all gear types, 1979-1980.

Length Interval (cm)	Sampling Trip 1979 July	Oct	1980 Jan	Apr	Total
6			1	1	2
7		1	8	3	12
8			11	7	18
9		1	6	1	8
10		2	1		3
11	1		1		2
13		2			2
14	1	2	2		5
15		1		2	3
16			1		1
19	1				1
Total	3	9	31	14	57

Table I-46. Length frequencies of emerald shiner collected by all gear types, 1979-1980.

	Sampling Trip 1979	
Length Interval (cm)	June	Total
9	1	1
Total	1	1

Table I-47. Length frequencies of river shiner collected by all gear types, 1979-1980.

	Sampling Trip 1979		
Length Interval (cm)	August	October	Total
5	1		1
8		1	1
10		1	1
Total	1	2	3

Table I-48. Length frequencies of silverband shiner collected by all gear types, 1979-1980.

	Sampling Trip			
	1979			
Length Interval (cm)	May	June	July	Total
5	1			1
6	3	1		4
7	6	1	1	8
8	2	2	2	6
9	6	2		8
Total	18	6	3	27

Table I-49. Length frequencies of silvery minnow collected by all gear types, 1979-1980.

	Sampling Trip	
	1980	
Length Interval (cm)	April	Total
9	1	1
Total	1	1

Table I-50. Length frequencies of blue sucker collected by all gear types, 1979-1980.

	Sampling Trip 1979		1980	
Length Interval (cm)	July	August	January	Total
8	1			1
23			1	1
39		1		1
61			1	1
Total	1	1	2	4

Table I-51. Length frequencies of smallmouth buffalo collected by all gear types, 1979-1980.

	Sampling Trip 1979				1980		
Length Interval (cm)	May	July	Aug	Oct	Jan	Apr	Total
27		1					1
28		1					1
31		1					1
32		1	1				2
33		1					1
34			1				1
37		1					1
38		1					1
39			1				1
40	1	2	1				4
44		1		1			2
45					1	1	2
46			1				1
48			1	1			2
49		1					1
51					1		1
52					1		1
Total	1	11	6	2	3	1	24

Table I-52. Length frequencies of river carpsucker collected by all gear types, 1979-1980.

	Sampling Trip			
	1979		1980	
Length Interval (cm)	July	October	January	Total
11			1	1
30	1			1
35		1		1
43	1			1
Total	2	1	1	4

Table I-53. Length frequencies of quillback collected by all gear types, 1979-1980.

	Sampling Trip			
	1979			
Length Interval (cm)	July	August	October	Total
26	1			1
32	1	1		2
33	2			2
35	2			2
36	3	1		4
37	1			1
38		2		2
39	1	1		2
43	1	2		3
45		2		2
50		1		1
54			1	1
Total	12	10	1	23

Table I-54. Length frequencies of highfin carpsucker collected by all gear types, 1979-1980.

	Sampling Trip 1979	
Length Interval (cm)	August	Total
28	1	1
Total	1	1

Table I-55. Length frequencies of golden redhorse collected by all gear types, 1979-1980.

	Sampling Trip 1979	
Length Interval (cm)	May	Total
36	1	1
Total	1	1

Table I-56. Length frequencies of silver redhorse collected by all gear t pes, 1979-1980.

	Sampling Trip			
	1979			
Length Interval (cm)	July	August	October	Total
29	1			1
36			1	1
52		1		1
Total	1	1	1	3

Table I-57. Length frequencies of shorthead redhorse collected by all gear types, 1979-1980.

	Sampling Trip				
	1979		1980		
Length Interval (cm)	July	Aug	Jan	April	Total
27	1				1
33	1				1
34	1				1
37		1			1
40	1				1
41			1		1
42		2			2
43		1			1
44				1	1
Total	4	4	1	1	10

Table I-58. Length frequencies of channel catfish collected by all gear types, 1979-1980.

	Sampling Trip												
	1979								1980				
Length Interval (cm)	May	June	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
2		1	8										9
3			155										155
4			310	18									328
5			233	57		1							291
6			54	81		30			1				166
7			1	60		58			1			11	131
8				46		53						21	120
9	1			20		49			1			16	87
10	4	2		7		31			1			7	52
11		1				13			1			3	18
12	3	3				5			1				12
13	1	2	1										4
14		1	2										3
15	1	1											2
16			2	1									3
17													
18		1				2							3
19			1			1			2				4
20													
21									1				1
22									1				1
23				1		1			3				5
24			1						1				2
25		2	1	2					3			1	9
26			1	4					6				11
27	1	1	3			1			15				21
28			3	6		5			12			1	27
29			6	6					15			2	29
30		2	5	5		2			13				27
31			6	6		4			16			3	35
32			5	7		5			13				31
33		2	3	7		4			8			1	25
34			8	6		1			4			1	20
35		1	9	4		1			2			2	19
36		1	7	5					3				16
37	1		5						1				7
38			1	4		1			2				8
39		1	1						1				3
40									1				1
41				1					1				2
42			3	1					2				6
43						1							1
44			1										1
45			1										1
46									1				1
56									1				1
73			1										1
Total	12	22	838	355		270			134			69	1700

Table I-59. Length frequencies of flathead catfish collected by all gear types, 1979-1980.

	Sampling Trip				
	1979			1980	
Length Interval (cm)	July	Aug	Oct	Apr	Total
3	3				3
7		2			2
8			1	1	2
24		1		1	2
25			1		1
30	1				1
31		2			2
34		1			1
35		1			1
37	1				1
38		1			1
39	1	2	1		4
40	2	1			3
41	1	2			3
44	1	2	1		4
45	1				1
47		1			1
49		1			1
50	1				1
57	1				1
61		1			1
77	1				1
Total	14	18	4	2	38

Table I-60. Length frequencies of stonecat collected by all gear types, 1979-1980.

	Sampling Trip				
	1979			1980	
Length Interval (cm)	May	July	October	April	Total
3	1				1
6			1		1
8	3				3
9	1				1
10	1				1
11			1		1
12		1			1
15	1			1	2
Total	7	1	2	1	11

Table I-61. Length frequencies of white bass collected by all gear types, 1979-1980.

	Sampling Trip		
	1979		
Length Interval (cm)	July	October	Total
11		1	1
28	1		1
Total	1	1	2

Table I-62. Length frequencies of smallmouth bass collected by all gear types, 1979-1980.

	Sampling Trip 1979	
Length Interval (cm)	July	Total
6	1	1
Total	1	1

Table I-63. Length frequencies of rock bass collected by all gear types, 1979-1980.

	Sampling Trip 1979	
Length Interval (cm)	July	Total
20	1	1
Total	1	1

Table I-64. Length frequencies of white crappie collected by all gear types, 1979-1980.

	Sampling Trip 1979		
Length Interval (cm)	May	July	Total
8	1		1
16		2	2
18		1	1
19		3	3
21		2	2
22		1	1
23		1	1
25		1	1
32		1	1
Total	1	12	13

Table I-65. Length frequencies of black crappie collected by all gear types, 1979-1980

	Sampling Trip 1979	
Length Interval (cm)	October	Total
20	1	1
30	1	1
Total	2	2

Table I-66. Length frequencies of sauger collected by all gear types, 1979-1980.

	Sampling Trip				
	1979			1980	
Length Interval (cm)	May	July	Oct	Jan	Total
13				1	1
15	3				3
16				3	3
17				2	2
18	1			1	2
19				1	1
21				1	1
25			1		1
27		1	1		2
29		1			1
30		2	1		3
31			2		2
32		1			1
33		1			1
34		1			1
36		1			1
38		1			1
39	1	1			2
42		1			1
44			1		1
45		1			1
46		1			1
Total	5	13	6	9	33

Table I-67. Length frequencies of walleye collected by all gear types, 1979-1980.

Length Interval (cm)	Sampling Trip 1979 July	Sampling Trip 1979 October	Total
19		1	1
37	1		1
41		1	1
Total	1	2	3

Table I-68. Length frequencies of river darter collected by all gear types, 1979-1980.

Length Interval (cm)	Sampling Trip 1979 May	Sampling Trip 1979 July	Sampling Trip Oct	Sampling Trip 1980 Jan	Sampling Trip 1980 April	Total
4		1				1
5	1					1
6	6		2		1	9
7	3			3	1	7
8	2					2
Total	12	1	2	3	2	20

Table 1-69. Length frequencies of johnny darter collected by all gear types, 1979-1980.

Length Interval (cm)	Sampling Trip 1980 January	Total
6	1	1
Total	1	1

Table I-70. Length frequencies of freshwater drum collected by all gear types, 1979-1980.

	Sampling Trip												
	1979								1980				
Length Interval (cm)	May	June	Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
2		3	2										5
3		1	3										4
4			5	1									6
5			3										3
6						1							1
7													
8						1							1
9				2		4							6
10	3			2		4			2				11
11	2			3		5			4				14
12				1		6			19				26
13						8			36				44
14						2			35			2	39
15						5			19				24
16						2			15				17
17													
18									1				1
19			4										4
20			3										3
21			4										4
22			7										7
23	1	1	6										8
24		1	4	1		1							7
25		2	3			1							6
26		4	5			1							10
27		1	13										14
28		3	11	2					2				18
29			4	1					1				6
30		3	1	3									7
31		2	2	1		2			1				8
32									1				1
33			4						1				5
34		1	2	1					1				5
35			1						1				2
36			1						1				2
37													
38													
39	1		1										2
40		1											1
41													
42													
43													
44													
45												1	1
46													
Total	7	23	39	18		43			140			3	323

APPENDIX II

Life history summaries for fishes not previously described by Farabee (1979) expected or known to be common in Navigation Pool 14 of the upper Mississippi River.

Chestnut Lamprey
Ichthyomyzon castaneus

Description

The chestnut lamprey is an eel-like fish, tan colored dorsally grading to a yellowish-green belly, with no gill covers and a shallowly notched, undivided dorsal fin. Metamorphosis is at approximately 6" and adults may reach 12" in length (Pflieger 1975).

Distribution and Habitat

No verified reports of this species occurring in Pool 14 were available, however, it has been reported in Rock Island County (Smith 1979) and several commercial fishermen have commented on its occurrence (H. Mordhorst pers. comm.).

The chestnut lamprey is an inhabitant of large and small rivers and is most commonly encountered in the winter by commercial fishermen, as it parasitizes many commercially taken fish species (Pflieger 1975).

Larval lampreys require clear moving waters with stable silt and sand bars for completion of their life history.

Life History

Adult lampreys spawn in the spring in "pits excavated in the upper ends of gravelly riffles" (Pflieger 1975). Many lampreys participate in the excavation and death follows spawning. Larval development in the chestnut lamprey requires 2-3 years during which individuals lie buried in the mud feeding on organic matter in the water and sediment. Metamorphosis takes place by November but the parasitic life stage does not begin until the following spring (Pflieger 1975). At this time the adults migrate to lakes and large rivers where they attach themselves to other fishes to obtain a blood meal. They remain attached for several days and then drop off.

Silver Lamprey
Ichthyomyzon unicuspis

Description

The silver lamprey is similar in appearance to the chestnut lamprey, being told from the latter by fewer myomeres (49-52 vs 52-56) and the innermost disk teeth having a single point. Colors are similar to those of the chestnut lamprey and adults reach 14-15" at maturity (Pflieger 1975).

Distribution and Habitat

Smith (1979) reports no records for Pool 14 but silver lampreys were found both above and below Pool 14. Ammocetes inhabit medium size streams and adults inhabit large rivers and lakes.

Life History

Adult silver lampreys ascend medium sized streams to spawn, excavate a nest site, spawn communally, and die. Duration of the larval stage is unknown and the parasitic stage only lasts one year (Pflieger 1975). Spawning is in April or May.

Like the chestnut lamprey, these fish are found most commonly during winter and early spring when encountered by commercial fishermen as they parasitize commercial fish species.

The importance of the main channel to this species is probably similar to that for the chestnut lamprey.

Longnose Gar
Lepisosteus osseus

Description

The longnose gar is a primative bony fish with a long narrow snout the width of which (at the nostrils) is less than the eye diameter. The non-overlapping scales are arranged in oblique rows providing an armored appearance (Pflieger 1975, Smith 1979). The upper parts are dark brown or olive, grading to white on the belly (Pflieger 1975). This species may attain a length of 3 ft.

Distribution and Habitat

The longnose gar is found in sluggish sections of large rivers. Adults are usually found in the larger, deeper pools in rivers (Pflieger 1975). Young gar typically can be found associated with emergent aquatic vegetation in shallow water.

Life History

Gar are piscivorous fishes, the young feeding mostly on minnows and adults largely on shad (Pflieger 1975). Spawning takes place in the spring. A single female is usually accompanied by one or more males. Spawning occurs over a gravel substrate and the adhesive eggs hatch in 6-8 days (Pflieger 1975). The larvae have an attachment organ on the snout by which they are affixed to the substrate until their yolk-sac is absorbed.

The importance of the main channel to this species in not known, however their preferred prey is seldom encountered in the main channel.

Shortnose Gar
Lepisosteus platostomus

Description

The shortnose gar has a short, broad bill with a single row of teeth in the upper jaw. It can be told from the spotted gar by the absence of spots on the head and paired fins. Life colors vary from brownish or olive above to white below.

Distribution

Shortnose gar can be found along major rivers in large permanent pools, oxbow lakes and quiet backwaters. Their occurrence was documented in Pool 14 by this study. Pflieger (1975) states that they are more tolerant of high turbidity than other gars.

Life History

It was reported by Pflieger (1975) that shortnose gar are less specialized in their food habits than are other gars.

Spawning takes place in the spring and timing appears to be dependent on an array of environmental factors. A female fish accompanied by one or more males, broadcasts eggs over vegetation and submerged objects in shallow water. The eggs hatch in about 8 days. The young are fast growing (Pflieger 1975).

Shortnose gar are probably largely dependent on the main channel for passage and feeding.

Gizzard Shad
Dorosoma cepedianum

Description

The gizzard shad is a slab-sided silvery fish with a saw-toothed keel between the paired fins. The dorsal fin has an elongated last ray that is distinctive and this species also has a triangular shaped dot dorso-posterior to the opercle. Specimens over 200 mm are rare (Smith 1979).

Distribution and Habitat

Gizzard shad have been shown to be among the most abundant fish in the Mississippi River (Bertrand 1971, Pflieger 1975, Smith 1979). Gizzard shad prefer quiet-water habitats and can tolerate a wide range of turbidities (Pflieger 1975).

Life History

The gizzard shad reaches maturity in the second or third year. Spawning occurs in early spring, often in shallow water, where demersal adhesive eggs are released by the female in concert with milt from males. The eggs sink and adhere to the first object touched, hatching after 4 days. Young become free-moving after 5 days (Smith 1979).

The gizzard shad is a filter-feeding, schooling fish obtaining food from the water column. Foods consist of algae, small crustaceans and insect larvae (Pflieger 1975).

The most critical activity engaged in by the gizzard shad in the main channel is likely passage. Their occurrence in Pool 14 navigation channel has been documented in this study.

Goldeye
Hiodon alosoides

Description

Goldeye superficially resemble both gizzard shad and mooneye in that they are silvery, slab-sided fish. Unlike the gizzard shad there is no elongated last dorsal ray or dark spot posterior to the opercle. In addition the iris of the eye is a metallic golden color. The goldeye differs from the mooneye in the placement of the dorsal fin relative to the origin of the anal fin. The anterior origin of the goldeye dorsal fin is posterior to the anterior origin of the anal fin. The mooneye's is anterior to the anterior anal fin origin. The goldeye also has a nearly fully keeled midline whereas the mooneye is keeled only from the base of the pelvic fins to the vent.

Distribution and Habitat

Goldeye are found in the Mississippi River drainage as well as the upper Missouri River basin and represent a glacial relic in this area. They have a high tolerance for turbidity and can be found in areas considered unsuitable for many species. Main channel habitats are suitable to this species (Pflieger 1975).

Life History

Goldeye spawn in early spring just after breakup and usually during a rising water level regime (Summers 1978). They have semibuoyant eggs and larvae. Maturity is variable and appears to be size related as opposed to age related and can occur at from 3 to 7 years. Goldeye are strong year class formers--a fact which may delay maturity due to severe competition and slow growth rates (Kristensen and Summers 1978). Sexual dimorphism is apparent after maturity, the anterior rays of the anal fin on male goldeye elongating into a convex lobe while females have slightly sicle-shaped anal fins.

Mooneye
Hiodon tergisus

Description

Mooneye are silvery slab-sided fish reaching lengths of 15 or more inches. They resemble goldeye but are distinguished by the partly keeled midline and more anterior position of the dorsal fin.

Distribution and Habitat

The mooneye is reported to be more common than the goldeye over much of its northern Mississippi River range (Pflieger 1975). It inhabits quieter, less turbid portions of rivers, and is likely encountered more often as a result.

Life History

It can be speculated, that, as with the goldeye, maturity is reached between age 3 and 7. Spawning is thought to occur during early spring (Pflieger 1975). Little is known of their spawning behavior but growth is said to be rapid--young reaching a length of 8 in during their first year.

Grass Carp
Ctenopharyngodon idella

Description

The grass carp can be distinguised from other cyprinids by the posterior placement of the anal fin, seven soft dorsal rays and a subterminal unspecialized mouth (Smith 1979).

Distribution and Habitat

The grass carp was introduced from eastern Asia into waters of Arkansas in 1963 (Pflieger 1975). They have subsequently dispersed to many waters suitable to their habitat needs. They were found only as far north in the Mississippi River as Pool 15 prior to 1978 (Rasmussen 1979) but have now been recorded in Pool 14 of the Mississippi River. This fish is reported to be a large river inhabitant.

Life History

Spawning in the grass carp occurs from April to August. Fecundity is very high and the hundreds to thousands of eggs produced by the female are bouyant and float, until they hatch (Smith 1979). Growth is rapid, some individuals growing over 20 in. in a year. No information on age at maturity is available, however, it may be expected that most fish are mature at age 3 (24-34 in) (Pflieger 1975).

Food items taken consist largely of plant materials, however, both Pflieger (1975) and Smith (1979) speculate that these fish may also scavenge, feeding on dead animal matter as well as plant matter.

Golden Shiner
Notemigonus crysoleucas

Description

The golden shiner is a slab-sided golden fish with a sickle-shaped anal fin and downward curve of the lateral line. It has a fleshy, scaleless keel from the anus to the pelvic fins (Pflieger 1975).

Distribution and Habitat

Quiet or still water, well vegetated habitats are the preference of the golden shiner, this species showing a marked avoidance of current. They are widely distributed in the Mississippi River drainage but only occur in quieter tributary waters and slack water lakes of the larger rivers (Smith 1979). Their presence in the main channel would likely be incidental due to high flows.

Life History

The golden shiner is a spring spawner, does not build nests and broadcasts adhesive eggs over a vegetated substrate. Eggs hatch in 4 days at 70°F and maturity is reached at age 2.

Food habits studies indicate these fish are generalized opportunists, feeding on both plant and animal matter (Pflieger 1975).

Speckled Chub
Hybopsis aestivalis

Description

The speckled chub is a small chub, tanish in color and having roundish black spots on back and sides, small eyes and a conical barbel at the corner of the mouth.

Distribution and Habitat

This species is a common large-river species and can be found in areas of variable turbidity over a bottom of fine sand or gravel. It can tolerate a wide range of velocities and is likely to occur in main channel habitats (Pflieger 1975, Smith 1979).

Life History

Spawning takes place over a long period from mid-spring to late summer over deep water, and the slightly negatively bouyant eggs develop in 25-28 h as they are carried along by the current (Pflieger 1975). Maturity is reached at age 1 and longevity is short; about 1½ years (Pflieger 1975).

The diet of the speckled chub consists largely of immature aquatic insects, crustaceans and some plant matter (Pflieger 1975).

Silver Chub
Hybopsis storeriana

Description

The silver chub is a silvery barbeled minnow with a large eye and a dorsal fin set relatively far forward (Smith 1979).

Distribution and Habitat

The silver chub is a bottom dweller and is most commonly found in quiet waters. It is distributed throughout the tributaries of the Mississippi River and may inhabit the slip layer near the bottom in main channel habitats.

Life History

The silver chub is probably a spring spawner but its spawning behavior is not known.

Food habits of this species, as well, are not known.

Emerald Shiner
Notropis atherinoides

Description

The emerald shiner is a slender minnow with a terminal oblique mouth and the dorsal fin located closer to the tail than to the front of the eye (Pflieger 1975).

Distribution and Habitat

The emerald shiner is found throughout the Mississippi River drainage and is reported to be the system's most common minnow (Pflieger 1975). This minnow lives in open channels of large rivers with low to moderate gradients (Pflieger 1975, Smith 1979). In northern Alberta, Canada, this species shows a marked preference for backwater sloughs and lakes off main river systems (Summers 1978). It is highly tolerant of turbidity.

Life History

Spawning occurs in late spring to mid-summer in the north over substrates of vegetated mud bottoms where the eggs hatch in 24-36 h (Pflieger 1975). The fry remain 3-4 days on the bottom after which they congregate on the surface in schools. Maturity is reached at age 1.

Diet of the young consists largely of algae while adults consume largely aquatic crustaceans and insect larvae (Smith 1979).

River Shiner
Notropis blennius

Description

The river shiner is a slender minnow with a dusky, lateral band, a uniform dorsal stripe and, commonly, seven anal rays.

Distribution and Habitat

This fish is a common inhabitant of the Mississippi River system, second in abundance only to the emerald shiner. The river shiner frequents open channel habitats in areas of slower currents (Pflieger 1975).

Life History

The river shiner is a summer spawner (Pflieger 1975) but little is known of the particular spawning mode of this species. Pflieger (1975) states that because of its mixed species schooling tendencies its food habits are likely similar to those of the emerald shiner and silverband shiner with which it is commonly associated. Sexual maturity is probably reached at age 1 and spawning is likely communal over a substrate of sand and gravel.

Spottail Shiner
Notropis hudsonius

Description

The spottail shiner is a robust, deep, slab-sided minnow with large eyes and a slightly subterminal oblique mouth. It has a distinct spot on the caudum and a distinct dusky stripe along the back.

Distribution and Habitat

Smith (1979) states that this species is abundant in lakes and rivers of the Mississippi River drainage but is commonly found in schools near shorelines in shallower waters. It has not been recorded for Pool 14 but is abundant both to the north and south (Smith 1979).

Life History

Spawning in this species occurs during spring and summer often in aggregate schools with emerald shiners over firm mud, vegetated substrate (Summers 1978). Maturity is reached at age 1. Animal life appears to be more important to the diet of the spottail than other components.

Sand Shiner
Notropis stramineus

Description

In life the sand shiner is an olive-backed, silvery minnow with large eyes and a small oblique mouth (Pflieger 1975). The back scales are prominently dark edged and the dorsal fin is located equidistant between the front of the eye and the base of the caudal fin. The sand shiner may possess an obscure dot at the base of the caudum.

Distribution and Habitat

The sand shiner is common to prairie streams tributary to the Mississippi River but is not commonly found in large rivers. This species is often found over sand bottom substrates (Pflieger 1975).

Life History

The sand shiner is a midwater schooling fish, maturity occurs at age 2 or 3 and spawning occurs spring through fall. Not much is known of the spawning behavior (Smith 1979). Microflora, crustaceans and aquatic insects comprise most of the diet of the sand shiner (Smith 1979).

Bluntnose Minnow
Pimephales notatus

Description

The bluntnose minnow is a short, slender fish with a rounded head and short, rounded fins (Pflieger 1975). The anal fin has 7 rays, the dorsal fin has a first short ray separate from the first principal ray. The lining of the body cavity is black.

Distribution and Habitat

The bluntnose minnow is found in quiet water habitats of medium to large size rivers over substrates which are moderately well-vegetated. Swift, deep water is most often avoided and occurrence of this species in the main channel is likely incidental to high flows.

Life History

Spawning in this species occurs from May to August peaking in late May and June. Nests are constructed by excavating a shallow dish in sand or gravel beneath a suitable flat under-surfaced object. A single male attends the nest guarding against all other fish except ripe female bluntnose minnows. The nest is attended thusly until the eggs hatch. Maturity is reached at age 1 or 2 (Pflieger 1975, Smith 1979).

Bullhead Minnow
Pimephales vigilax

Description

This minnow is stout-bodied with a rounded snout and rounded short fins. A dense spot is present at the base of the tail and a dusky blotch near the front of the dorsal fin.

Distribution and Habitat

The bullhead minnow is distributed throughout the Mississippi River drainage and is common in the quiet-water areas of large rivers but avoids excessive current (Pflieger 1975). This minnow is also very tolerant of turbidity.

Life History

The bullhead minnow spawns in late spring and early summer in cavities excavated beneath benthic habitat features. Eggs adhere to the underside of the object and are guarded by the male until hatching after 4½ days (Pflieger 1975). Maturity is reached by at least age 2.

Bullhead minnows feed near the bottom and their diet consists mostly of insects.

Blue Sucker
Cycleptus elongatus

Description

The blue sucker is a distinctive sucker which can be confused with no other sucker. It is a cylindrical terete fish with a small head. It has a blue-green back, pigmented fins with a diagnostic, darker, lower caudal lobe.

Distribution and Habitat

The blue sucker is an inhabitant of large rivers but migrates up tributaries of the larger rivers and was found there in some numbers in past times (Smith 1979). It is widespread but rare in the Mississippi River in the upper sections. Apparently blue sucker numbers have suffered due to dam construction and construction of riverways. Their preferred habitat is the deep, swift channels of large rivers having a sand, gravel or rock substrate.

Life History

Spawning is reported to occur in May or June in the Mississippi River but little is known of the spawning mode of this species. Pflieger (1975) speculates that the blue sucker probably feeds on larval insect life taken from the bottom.

River Carpsucker
Carpiodes carpio

Description

The river carpsucker is a heavy, slabsided sucker with a nipple-like protrusion on the center, lower jaw; the subopercle is broadest below the middle. It can be told from the quillback by the shorter snout (the snout length being less than the distance from the rear margin of the eye to the upper end of the quill opening) (Pflieger 1975). The first principle ray of the dorsal fin of the river carpsucker is shorter than that of the highfin carpsucker, reaching at most to the middle of the dorsal fin when depressed (Pflieger 1975).

Distribution and Habitat

The river carpsucker is distributed throughout the upper and central Mississippi River region. It is common in large rivers only in turbid backwater sloughs and oxbows (Smith 1979), occurrence in main channel habitats likely being transitory.

Life History

The river carpsucker is reported to spawn intermittantly from early May through late August (Bucholtz 1957 in Smith 1979, Pflieger 1975). Smith reports that the female "merely broadcasts eggs over the bottom", which is assumedly composed of sand, silt and fine gravel. Female river carpsuckers may mature at age 2 but general maturity is thought to occur at a higher age.

Growth is not rapid; the average size for a 1-year-old river carpsucker being 3.2 in (Purkett 1958). Diet of the river carpsucker consists of bottom ooze, algae, and small crustaceans as well as insect larvae (Smith 1979).

Quillback
Carpiodes cyprinus

Description

A deep, thick sucker with a long, sickle-shaped dorsal fin, the first principal ray of which extends back at least 3/4 the length of the dorsal fin. Quillbacks have no nipple-like projection on the lower lip and longer snouts than the river carpsucker (Pflieger 1975).

Distribution and Habitat

The quillback is fairly common in the upper Mississippi and prefers the clearer water of the prairie streams (Pflieger 1975). This species prefers a substrate of gravel and other coarse material.

Life History

Spawning in the quillback occurs in April and May when adults congregate near the lower ends of deep, gravelly, riffles (Pflieger 1975) where eggs are broadcast over the bottom (Smith 1979). No information is available on food habits of this species.

Golden Redhorse
Moxostoma erythrurum

Description

The golden redhorse is a terete sucker having a short, slightly sickle-shaped, dorsal fin, olive colored caudal fin and lower lip broken into folds and forming a V-shape posteriorly (Pflieger 1975).

Distribution and Habitat

The golden redhorse is reported to frequent medium-sized rivers, not preferring large turbid rivers (Pflieger 1975, Smith 1979). It is common in most Mississippi River tributary streams where adequate water quality and substrate requirements exist.

Life History

Spawning in the golden redhorse occurs from April to mid-June over shallow riffles of rubble, gravel and sand substrate. Males drift backwards from deeper water over the spawning area, establishing small territories. Females then enter the spawning area, are quickly crowded by two or more males and spawning commences. Violent vibrations clean silt from the sand and eggs are subsequently deposited in the sand. Eggs hatch in about 18-20 da at 50^{o}F (Pflieger 1975).

Food habits include benthic crustaceans and insect larvae in the adult and free swimming crustaceans when young.

Shorthead Redhorse
Moxostoma macrolepidotum

Description

The shorthead redhorse is a cylindrical, moderately terete sucker possessing a reddish tail fin, and a short dorsal fin and can be told from other redhorses by its shorter head (its length going more than 4.2 times into standard length) (Pflieger 1975).

Distribution and Habitat

The shorthead redhorse is often a resident of large rivers having a permanent, strong flow and a substrate of gravel or rock (Pflieger 1975, Smith 1979). It can stand a wide range of turbidities and water temperatures and is somewhat adaptable in its habitat requirements (Pflieger 1975).

Life History

Spawning in this species is concurrent with, and similar to, that of the golden redhorse. Pflieger (1975) states that spawning groups appear to remain species specific even when spawning over the same riffle. Diet reported by Pflieger (1975) was entirely comprised of immature aquatic insects.

White Sucker
Catostomus commersoni

Description

The white sucker is a fine-scaled sucker with scales enlarging posteriorly. The lips of this fish are papillinaceous and the dorsal fin is short (Smith 1979).

Distribution and Habitat

White suckers are distributed throughout the small clear prairie stream region. They prefer clear water over firm, sandy or gravelly substrates (Pflieger 1975). They are reported, however, to have a wide tolerance range for turbidity and siltation (Smith 1979).

Life History

Spawning in the white sucker takes place in the early spring and the spawning mode is similar to that described for the golden redhorse.

Food habits vary with state of maturity. Fingerlings eat largely free-swimming surface invertebrates while adults develop an entirely benthic feeding pattern, feeding on crustaceans and larval aquatic insects.

Flathead Catfish
Pylodictis Olivaris

Description

The flathead catfish is a robust, dark, often mottled catfish with a protruding lower jaw, backwards extensions on the maxillary toothed pad, a free posterior edge on the adipose fin and a lighter upper lobe, on the caudal fin. The flattened, broad head is also diagnostic.

Distribution and Habitat

The flathead catfish is a large, low-gradient-river species. Young flatheads can be found in riffles in company of madtoms and stonecats while adults seek habitat features such as submerged logs, in fast-flowing river habitat (Smith 1979).

Life History

Spawning in the flathead catfish occurs in June and July. A shallow cavity near a submerged habitat structure is excavated by both spawning partners. The parents remain on the nest until the eggs are hatched, aerating and keeping the eggs silt-free. Young group together for a few days after which they disperse (Pflieger 1975). Maturity is reached at age 4 or 5 when the fish is about 18 in. in length.

Food habits of the adult flathead catfish include fish and crayfish while the young feed largely on immature aquatic insects (Pflieger 1975). These fish are dormant during the daylight hours only becoming active at night.

Stonecat
Noturus flavus

Description

The stonecat is a small, yellowish-brown catfish with the posterior margin of the adipose fin fused to the back and crescent-shaped posterior extensions on the maxillary tooth pad. The squarish caudal fin has light-colored lobes and darker center (Pflieger 1975).

Distribution and Habitat

The stonecat is a large river species and is the most common madtom in most large prairie rivers. It is found in swift to moderate current over sandy bottoms (Pflieger 1975, Smith 1979).

Life History

The stonecat probably spawns during April or May, and, as with other catfish the eggs are attended by one of the parent fish (Pflieger 1975).

Food habits of the stonecat include immature insects and occasional riffle-dwelling fish.

Rock Bass
Ambloplites rupestris

Description

The rock bass is a heavy-bodied centrarchid with 6 anal fin spines and 12 dorsal fin spines. It is a greenish-brown fish with a bronzy-metallic reflection and having an anal fin much shorter than the dorsal fin (Smith 1979).

Distribution and Habitat

The rock bass appears to be absent from large stretches of the Mississippi River between central Missouri and central Illinois. Smith does record it in the general vicinity of the study area and this species was collected in this study.

Although reported to prefer small, clear streams (Pflieger 1975), this species is apparently adaptable to a wide range of turbidities and habitat types; most often being found near submerged habitat features and submerged aquatic vegetation.

Life History

Rock bass spawn as early as early April and as late as early June. The male fans out a depression in coarse sand or gravel in shallow water of a depth of from 1-5 feet (Pflieger 1975) usually near some submerged habitat feature. The male remains to guard the eggs and nest after spawning is complete (Pflieger 1975).

Diet of the rock bass includes mature and immature insects, fish and crayfish (Smith 1979).

Logperch
Percina caprodes

Description

The logperch is a large river darter, cylindrical in shape, with 15-20 alternately long and short vertical bars dorsally, a distinct overhanging snout and a small black spot at the base of the tail (Pflieger 1975).

Distribution and Habitat

The logperch prefers clear, silt-free habitats over a substrate of sand, but appears to have a wide tolerance to turbidities under some circumstances. It is found most often in large pools with permanent flow (Smith 1979).

Life History

Spawning occurs in April and May--males and females forming separate agregations with ripe females venturing amongst the males only when ready to spawn. The male and female then vibrate vigorously into the sand where the spawning act actually occurs. Maturity is reached at age one and the mean maximum age is three years (Pflieger 1975).

River Darter
Percina shumardi

Description

The river darter is a stout fish with a dusky vertical bar beneath the eye, and 2 spots in the spinous dorsal fin, one anterior and one on the base of the last three spines. This species has a fully-scaled cheek and nearly bare nape (Pflieger 1975). Males have a greatly enlarged anal fin.

Distribution and Habitat

"The river darter is the most common darter in the Mississippi River" according to Pflieger (1975). It prefers a substrate of coarse gravel or rock (Pflieger 1975) but may be found in association with empty clam shell debris.

Life History

River darters are reported to spawn in April and May (Pflieger 1975) though nothing is known of the mode.

Foods of the river darters include the larvae of midges and caddisflies (Pflieger 1975).

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