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20. ABSTRACT (Continued).

Collections were made from the Lower Mississippi River near Greenville, Miss., to compare the relative value of four habitat types for fish. Sampling was conducted from April 1979 to September 1980 to describe species diversity, abundance, and distribution of fish from dike fields, revetted banks, natural banks, and an abandoned river channel.

Fish populations differed considerably among the four habitat types investigated. The greatest number of species was captured in the dike field habitat (53), followed in order by the abandoned channel (31), revetted banks (27), and natural banks (24).

The three dike fields were similar at most sampling periods in terms of species composition but were often different in the relative abundances of the constituent species. The two natural banks were generally similar in terms of both indices, while the revetted banks showed greater variability and overall lower similarity.

For comparable gears, numerical catch per unit effort (C/f) was seldom significantly different among habitats. Catches on revetted banks exceeded those on natural banks except during April 1979. The C/f in the abandoned channel was approximately seven times that of any other habitat during November 1979.

Biomass catch per unit effort (C/y) indicated a general ranking by habitat of revetted banks - dike fields - natural banks - abandoned channel, with two exceptions. During April 1979, the C/y of dike fields and natural banks exceeded that of revetted banks. During November 1979, C/y in the abandoned channel was greatest of all habitats.

Condition factors showed no significant differences among habitats or seasons.

Length frequency analysis showed differences in the size ranges of fish utilizing the four habitats. In particular, Age 0 fish of many species were abundant in dike fields, and, to a lesser extent, the abandoned channel. Mostly adult fish were collected at natural and revetted bank habitats.

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PREFACE

The study described in this report was sponsored by the Office, Chief of Engineers, U. S. Army, under the Environmental and Water Quality Operational Studies (EWQOS) Program, Work Units VA, Environmental Impact of Selected Channel Alignment and Bank Revetment Alternatives in Waterways, and VIIB, Waterway Field Studies. The EWQOS Program has been assigned to the U. S. Army Engineer Waterways Experiment Station (WES) under the direction of the Environmental Laboratory (EL).

This report presents results of a study designed to document the distribution and relative abundance of fish associated with four different habitats found within the main-line levees along the Lower Mississippi River. Fish were collected from the river between miles 506 and 566 from April 1979 through September 1980.

The report was prepared by Dr. C. H. Pennington, Mr. John A. Baker, and Miss. Carolyn L. Bond under the supervision of Dr. Thomas D. Wright, Chief, Aquatic Habitat Group; Mr. Bob O. Benn, Chief, Environmental Systems Division; Dr. Jerome L. Mahloch, Program Manager, EWQOS; and Dr. John Harrison, Chief, EL.

Special appreciation is expressed to Dr. Harold L. Schramm, Jr., University of Florida, and Mr. Michael E. Potter, EL, WES, for field support. Dr. Michael P. Farrell, Oak Ridge National Laboratory, is thanked for assistance with data analyses.

The Commanders and Directors of WES during the study and the preparation of this report were COL Nelson P. Conover, CE, and COL Tilford C. Creel, CE. Technical Director was Mr. F. R. Brown.

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CONVERSION FACTORS, U. S. CUSTOMARY TO METRIC (SI)
UNITS OF MEASUREMENT

U. S. customary units of measurement used in this report can be converted to metric (SI) units as follows:

<u>Multiply</u>	<u>By</u>	<u>To Obtain</u>
cubic feet per second	0.02831685	cubic metres per second
cubic yards per day	0.7645549	cubic metres per day
feet	0.3048	metres
feet per second	0.3048	metres per second
inches	25.4	millimetres
miles (U. S. statute)	1.609347	kilometres
pounds (mass)	0.4535924	kilograms

FISHES OF SELECTED AQUATIC HABITATS ON
THE LOWER MISSISSIPPI RIVER

PART I: INTRODUCTION

1. This investigation is part of the Environmental and Water Quality Operational Studies (EWQOS) Program sponsored by the Office, Chief of Engineers, and is being managed by the U. S. Army Engineer Waterways Experiment Station (WES). The basic objective of the EWQOS Program is to provide new or improved technology for the planning, design, construction, and operation of Corps of Engineers (CE) projects in an effort to solve selected environmental quality problems. A key element of EWQOS is the use of field studies to evaluate and document the utility of new or improved methodologies developed within the program.

2. One major problem area identified by CE field offices as being of high priority was the environmental impacts of project activities on waterways (Keeley et al. 1978). Specifically, it was determined that EWQOS research should develop field office guidance to address environmental features of dikes and revetments. Such structures are found in waterways in many parts of the United States, and are very common along the Mississippi River and its tributaries.

Navigation Structures

3. Dikes have been used by the CE for many years to improve navigation on the Nation's major waterways. The principal uses of dikes are to adjust main channel width, depth, and alignment, and to close secondary channels. Dike structures are probably the most effective means of channel alignment and contraction in use today.

4. Dikes are constructed of permeable wooden piles or, more typically in present times, of relatively impermeable stone riprap. Dikes may be singular or placed one after another along a bank forming a dike field. Generally, dikes in the Lower Mississippi River are of the

transverse type, which extend from the bank perpendicular to the current. An extension, or L-head, may be placed at the offshore end of a dike parallel to the current to retard scouring and turbulence. Vane dikes, which are placed in the channel parallel or oblique to the current, are also used.

5. Water is shunted by a dike toward the opposite riverbank and, if this bank is stable, the resulting narrower channel is deepened by scouring. Dikes are typically placed on the convex side, or point bar, in a bendway, or in straight reaches, to achieve some degree of channel sinuosity and resulting contraction. Suspended sediments are deposited downstream of individual dikes due to the reduction of current velocities caused by the structure. In dike fields, sediment accretion may be appreciable, and these accumulated sediments, which may in some instances form a bar, further serve to confine the flow of water. Slackwater pools may be found downstream of transverse dikes at low river stages in cases where sediment accretion has not completely filled in these areas.

6. Revetments are installed along riverbanks to prevent bank caving and erosion. Revetments are often located on the concave bank in bendways, and downstream and across the river from dike fields, where increased currents caused by the dikes promote bank erosion. They are also placed in areas where erosion threatens levees. These structures are of many types, but generally consist of erosion-resistant materials which are placed on a pregraded bank from the top of the bank line to the toe of the channel. Construction materials include stone riprap, asphalt pavement, and articulated concrete mattress. In the past, asphalt was used instead of riprap for bank paving. Willow mats were also used in the distant past.

7. When riverbanks are revetted, much of their natural character is altered. Older revetment structures that have become extensively vegetated with willow and cottonwood trees and a variety of sedges, grasses, and shrubs may have different values as aquatic habitat than new revetments. The type of material composing the revetment may also be an important variable in determining the habitat value of revetment structures. Another factor is the sinuosity of the bank line upon which

the revetment is placed. A sinuous bank would tend to have more variable velocities than would a straight bank line due to eddies and upstream flow.

8. As of 30 September 1980, there were over 400 dikes on the Lower Mississippi River having a combined length of 184 linear miles.* In addition, there are 778 linear miles of revetted bank. Under the Mississippi River and Tributaries (MR&T) Project, the CE has an additional 190 miles of revetment and 112 miles of dikes planned before the MR&T Project completion date of November 1996.

9. Because of the abundance of revetted banks and dikes in many of the major river systems of the United States, information about the environmental effects of these structures is valuable to CE Districts and Divisions for use in impact assessments and for environmentally compatible planning, design, and construction of these structures.

Objectives

10. The primary objective of this report is to quantitatively describe fish species diversity, abundance, and distribution in four habitats found in the Lower Mississippi River. The habitats chosen for study were dike fields, revetted banks, natural banks, and an abandoned river channel. Comparisons are made among the habitats to better understand the role of dikes and revetments to the riverine environment.

* A table of factors for converting U. S. customary units of measurement to metric (SI) units is presented on page 3.

PART II: STUDY AREA

General Description

11. The study area encompassed a 60-mile reach of the Lower Mississippi River (Figure 1) near Greenville, Miss. (river miles 506 to 566). The study area is confined on both sides by main-line levees constructed by the CE for flood-control purposes. Leveed floodplain width ranges from 2 to 6 miles. Backwater habitats between the levees and the main river channel have indirect or seasonal connections with the river and are often submerged during floods. There are no tributaries entering the river within the study area.

12. Average discharge of the river at Vicksburg, Miss.,* is about 561,000 ft³/sec. Recorded discharges have ranged from about 100,000 ft³/sec at extreme low river stage to 2,700,000 ft³/sec at high stages, with a 60-ft difference in water level. The average water velocity within the main channel is from 3 to 6 ft/sec with a maximum recorded velocity of 15 ft/sec during extremely high flows. The average hydrograph for the river at Vicksburg shows highest discharges occurring from February through March and lowest discharges occurring from July through October. The estimated average bed-load transport at Vicksburg is 1,000,000 yd³/day.

13. The climate of the study area and the navigation and flood-control objectives for the Lower Mississippi River are described in detail by Miller (1980).

Sampling Locations

14. Habitats associated with navigation structures and unaltered areas were sampled for fish during 1979 and 1980. The navigation structures included three dike fields and two revetted banks. Other habitats included two natural banks and an abandoned river channel.

* A major gaging and data collection point for the Lower Mississippi River located 65 miles downstream from the study area.

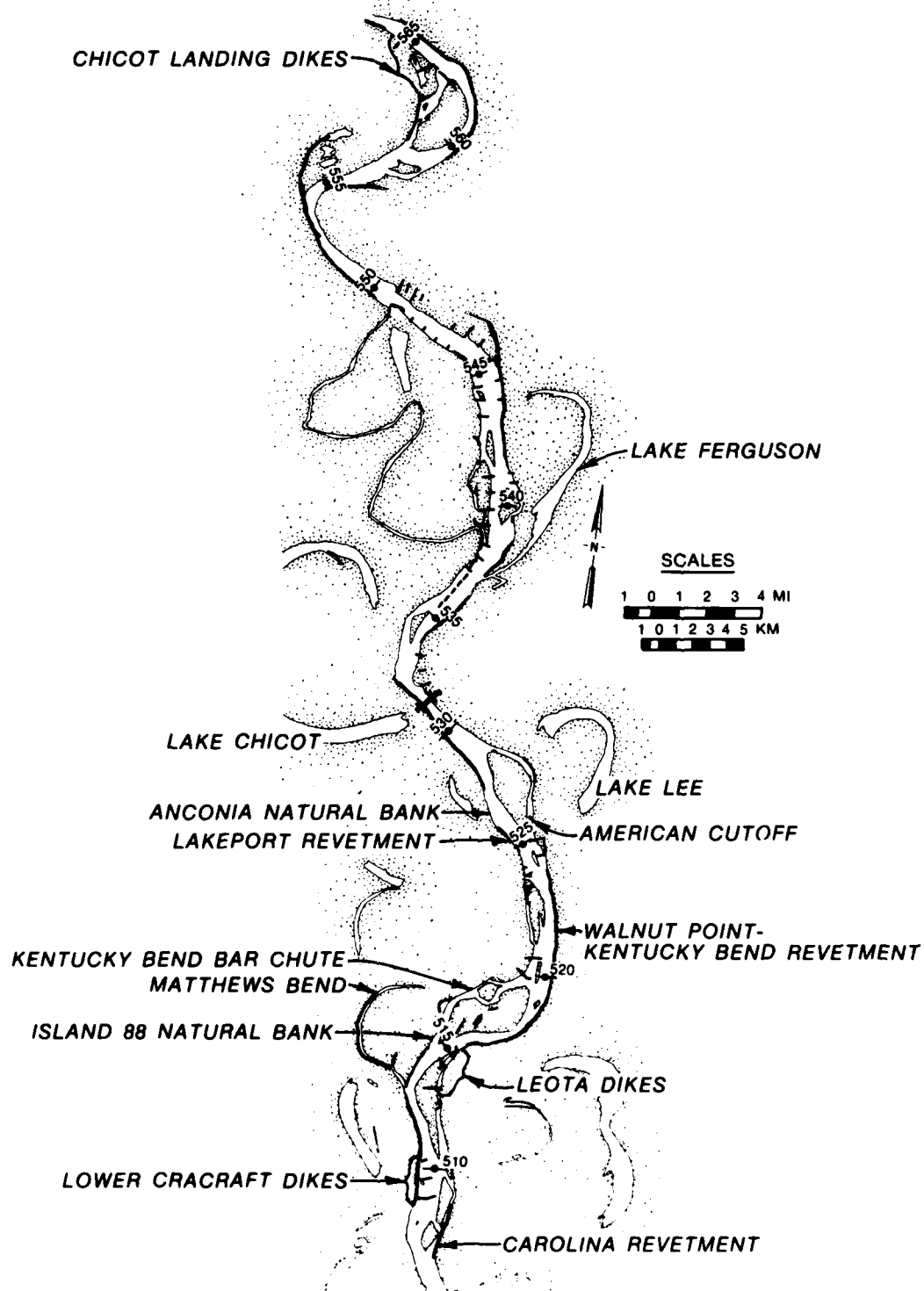


Figure 1. Map of study area

Dike fields

15. A dike field habitat is defined as that portion of the river encompassing a series of transverse and/or vane dikes and the associated pools and sandbars. The border between dike field habitats and the main channel is the 10-ft low-water reference plane (LWRP). Current velocities in dike fields vary from slack at low-water stages to almost as swift as is found in the main channel during high-water stages.

16. The Lower Cracraft Dike Field consists of three transverse, stone dikes (Figure 2). These dikes were constructed for the dual purpose of secondary channel closure and point bar stabilization. This dike field is a stepped-down design. Dike 1* is 1834 ft long with elevations of +20 and +15 ft LWRP at the bank and main channel ends, respectively. Dike 2 is 3620 ft long with elevations of +18 and +13 ft LWRP at the bank and main channel ends, respectively. Dike 3 is 4320 ft long; elevations at the bank and main channel ends are +15 and +10 ft LWRP. Dikes 1 and 2 were constructed in 1971; Dike 3 was constructed in 1972. Extensive sand and gravel middle bars occur between succeeding dikes and over a 3-mile reach of river downstream from the third dike. These middle bars, the main axis of which is parallel to the main channel flow, isolate extensive pools between the riverbank and the middle bars during low-water stages. Isolated areas of willow trees occur on the middle bars. Dense woods along the bank approximately 1 mile below Dike 3 are inundated at higher flows. Substrate types range from mud to coarse sand and gravel. Distribution of substrate types within dike field pools changes with river stage. During high flows, coarse sand and gravel predominate. As water levels drop, mud and fine sand become the most dominant substrate type.

17. The Leota Dike Field consists of three transverse, stone dikes built in 1968 for the dual purpose of secondary channel closure and point bar stabilization (Figure 3). This dike field is also a stepped-down design. Dike 1 is 1080 ft long and has bank and main channel end elevations of +21 and +16 ft LWRP, respectively. Dike 2 is 2340 ft long with

* Dikes are numbered sequentially from upstream to downstream.

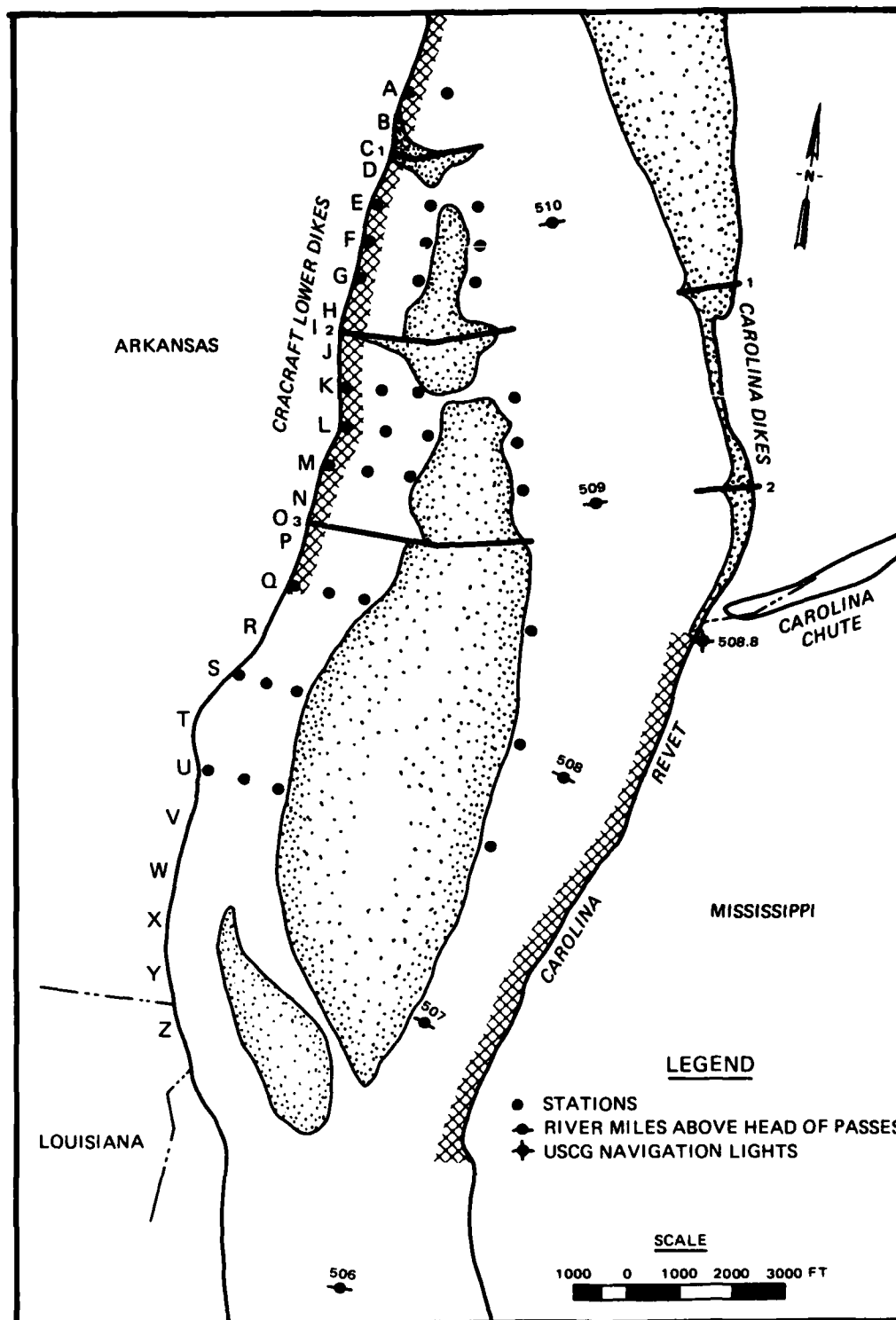


Figure 2. Map of the Lower Cracraft Dike Field
(USCG = U. S. Coast Guard)

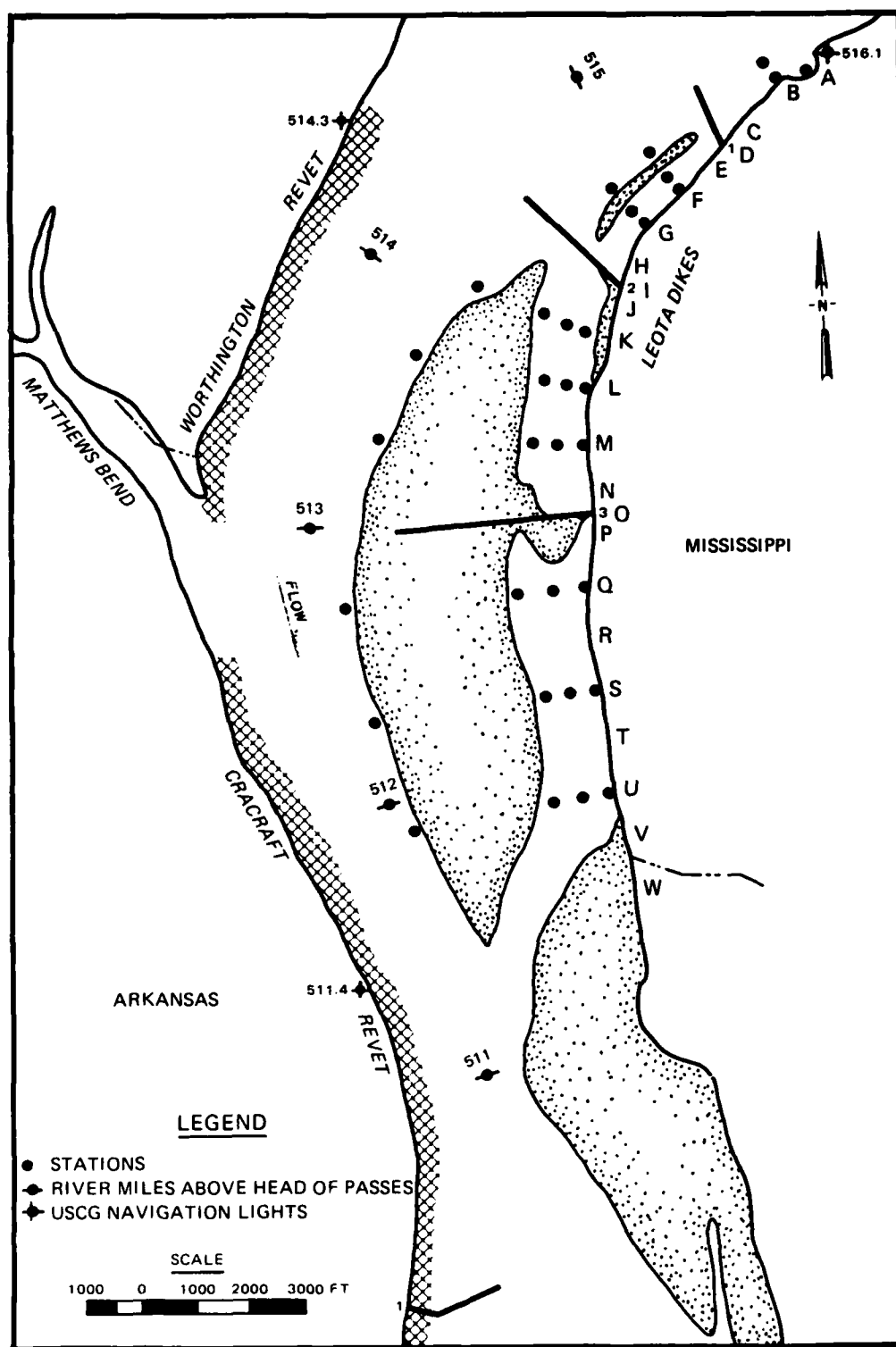


Figure 3. Map of the Leota Dike Field

elevations of +19 and +14 ft LWRP at the bank and channel ends, respectively. Dike 3 is 3720 ft long with elevations of +17 and +11 ft LWRP at the bank and channel ends, respectively. Extensive sand and gravel middle bars parallel the main channel between Dikes 2 and 3. Extreme sedimentation downstream of each dike has resulted in only small, shallow, isolated pools remaining between the dikes at low-water stages. There is, however, one sizable and deep pool below Dike 3 adjacent to a clay bluff. Isolated areas of vegetation, primarily small willow and cottonwood trees, occur on the middle bars and the scattered shallower areas between the dikes. An extensive area of woody vegetation exists on the bank below Dike 3. Substrate types range from mud to coarse sand throughout the dike field. Variations with river stage are similar to those at the Lower Cracraft Dike Field.

18. The Chicot Landing Dike Field (Figure 4), built in 1967-1969, was constructed to divert secondary channel flow from behind Choctaw Bar. The original structure consisted of three transverse stone dikes and a series of three vane dikes downstream from the third dike. Since original construction, the third dike suffered a breach failure. This sizable notch has been allowed to remain, and controlling rather than diverting the secondary flow is now the primary objective for this area. In 1975, the vane dikes were connected to the third dike and extended downstream so that the third dike is now a large L-head dike with a notch in its transverse portion. Dike 1 is 2200 ft long and has bank and main channel end elevations of +31 and +16 ft LWRP, respectively. Dike 2 is 2800 ft long with elevations of +30 and +14 ft LWRP, respectively. Dike 3 has elevations of +40 ft LWRP at the bank and +20 ft LWRP at either side of the notch. Elevations of the lengthwise portion of the lower dike range from -10 ft to +38 ft LWRP. The area of the dike field above and below the first dike was not sampled in any of the field efforts. Extensive sampling was conducted between Dikes 2 and 3 and in the secondary channel below Dike 3. The pool below Dike 2 is generally shallow with no flow at low river stages. A sandbar separates it from the main channel at all but the lower end of the pool. The secondary channel below Dike 3 is separated from the main channel by Choctaw Bar.

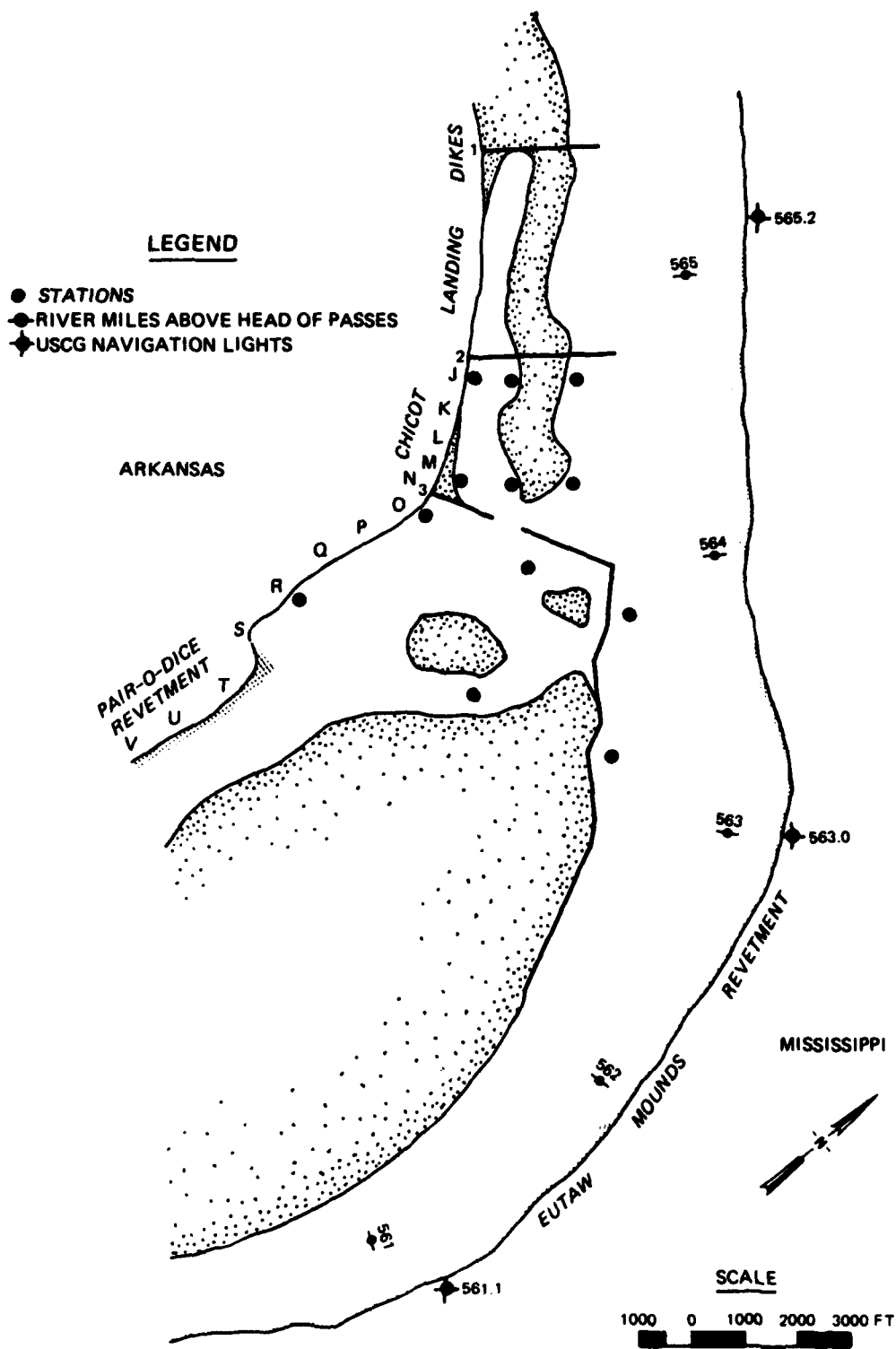


Figure 4. Map of the Chicot Landing Dike Field

19. Stations were established along transects extending from the bank toward the main river channel (Figures 2-4). These imaginary transect lines were marked along the bank in alphabetic order from upstream to downstream. The exact station from which fish were sampled was dependent upon river stage and geomorphology. However, the basic sampling scheme used throughout the study was to sample fish from four stations along predetermined transects. The four stations were positioned along the selected transects as follows:

- a. Adjacent to the steep natural bank.
- b. Adjacent to the inner side of the dike field sandbar.
- c. Midway between stations described in a and b.
- d. Adjacent to the river side of the dike field sandbar.

Revetted banks

20. Two revetted banks within the study area were selected for investigation. The Walnut Point-Kentucky Bend Revetment is approximately 7 miles in length and was constructed during 1944-1968. Lakeport Revetment was constructed during 1961-1962 and is 1.2 miles long. The revetment material at both banks consists of articulated concrete mattress with upper-bank paving material of stone riprap and asphalt. Some vegetation occurs on the upper banks. Substrate consisted generally of the revetting material, but isolated areas of sand and sand/silt overlaying the revetment were encountered. Current speeds along both revetments were high, commonly exceeding 3 ft/sec.

21. Four fish sampling stations (A to D), approximately 1750 ft apart, were established along the Lakeport Revetment (Figure 5). Thirteen stations (A to M) were sampled along the Walnut Point-Kentucky Bend Revetment (Figure 6). Distance between stations was approximately 2600 ft.

Natural banks

22. Two natural bank habitats were sampled in this study. They were a 1-mile stretch of bank along Island 88 and a 1.5-mile reach of bank between Lakeport and Sunnyside-Lakeport Revetment. These banks varied from hard clay and mud to fine sand. Currents were considerably reduced, compared to those in the main channel and along revetted banks,

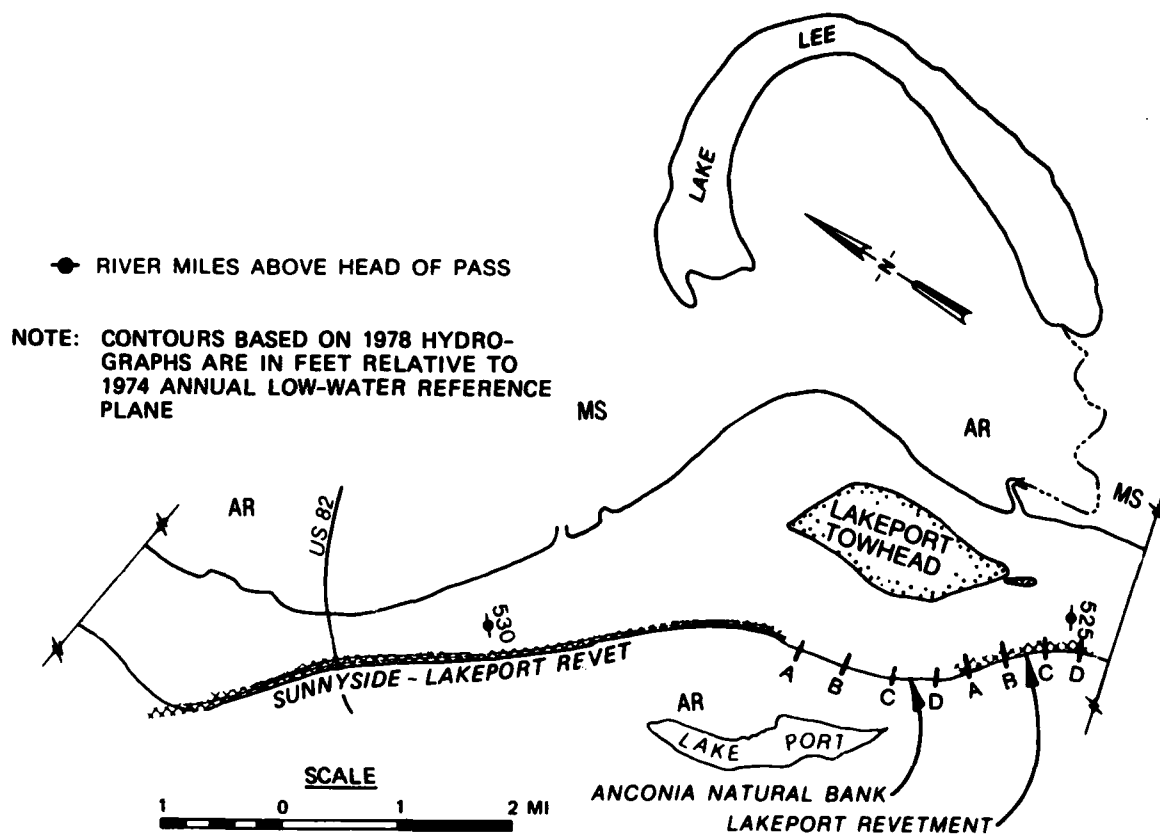


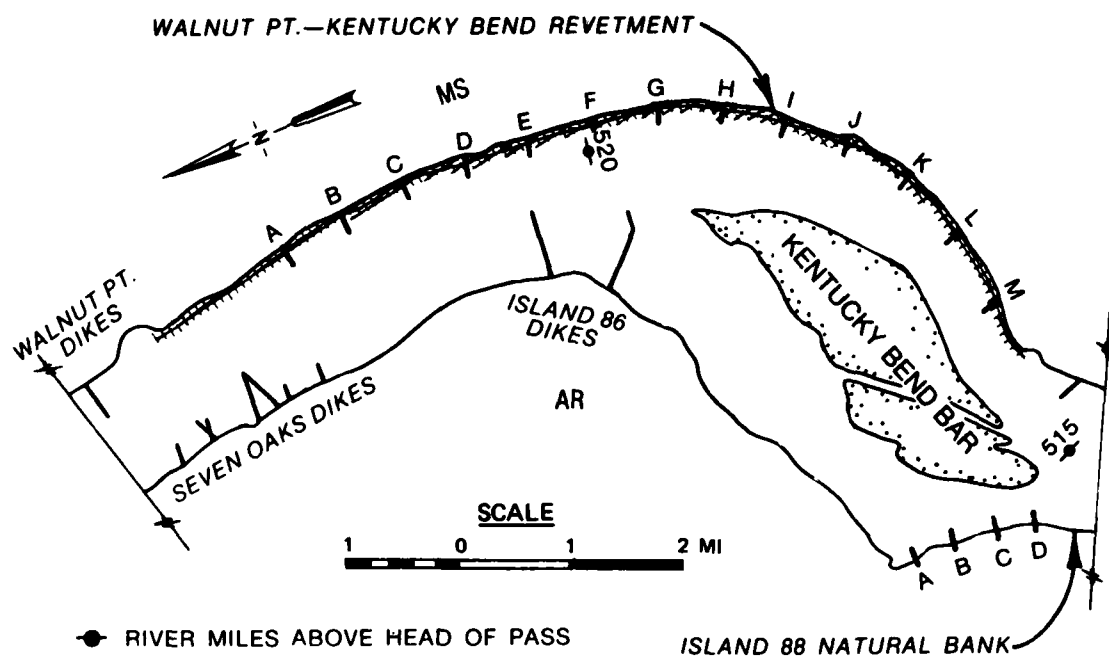
Figure 5. Map of the Lakeport Revetment and Anconia Natural Bank

at all except high-water stages. Typically, fallen trees protruded from the bank as a result of bank caving.

23. Four stations (A to D) were established along the bank at each of the sites (Figures 5 and 6). The distance between stations at each bank was approximately 1750 ft.

Abandoned river channel

24. Matthews Bend was the only abandoned river channel sampled in this study. Measured at low water, from its confluence with the main river channel to its head, Matthews Bend was approximately 5 miles long. The depth increased from upstream to downstream. The substrate was predominantly mud. The adjacent floodplain is heavily wooded with living



NOTE: CONTOURS BASED ON 1978 HYDROGRAPHS
ARE IN FEET RELATIVE TO 1974 ANNUAL
LOW-WATER REFERENCE PLANE

Figure 6. Map of Walnut Point-Kentucky Bend Revetment and
Island 88 Natural Bank

and dead trees (primarily willow) and is periodically inundated with
changing river stages.

25. Six sampling stations were established in the abandoned river
channel (Figure 7). Two stations each were sampled in upper, middle,
and lower reaches of Matthews Bend. The two stations in each reach were
on opposite sides of the abandoned river channel.

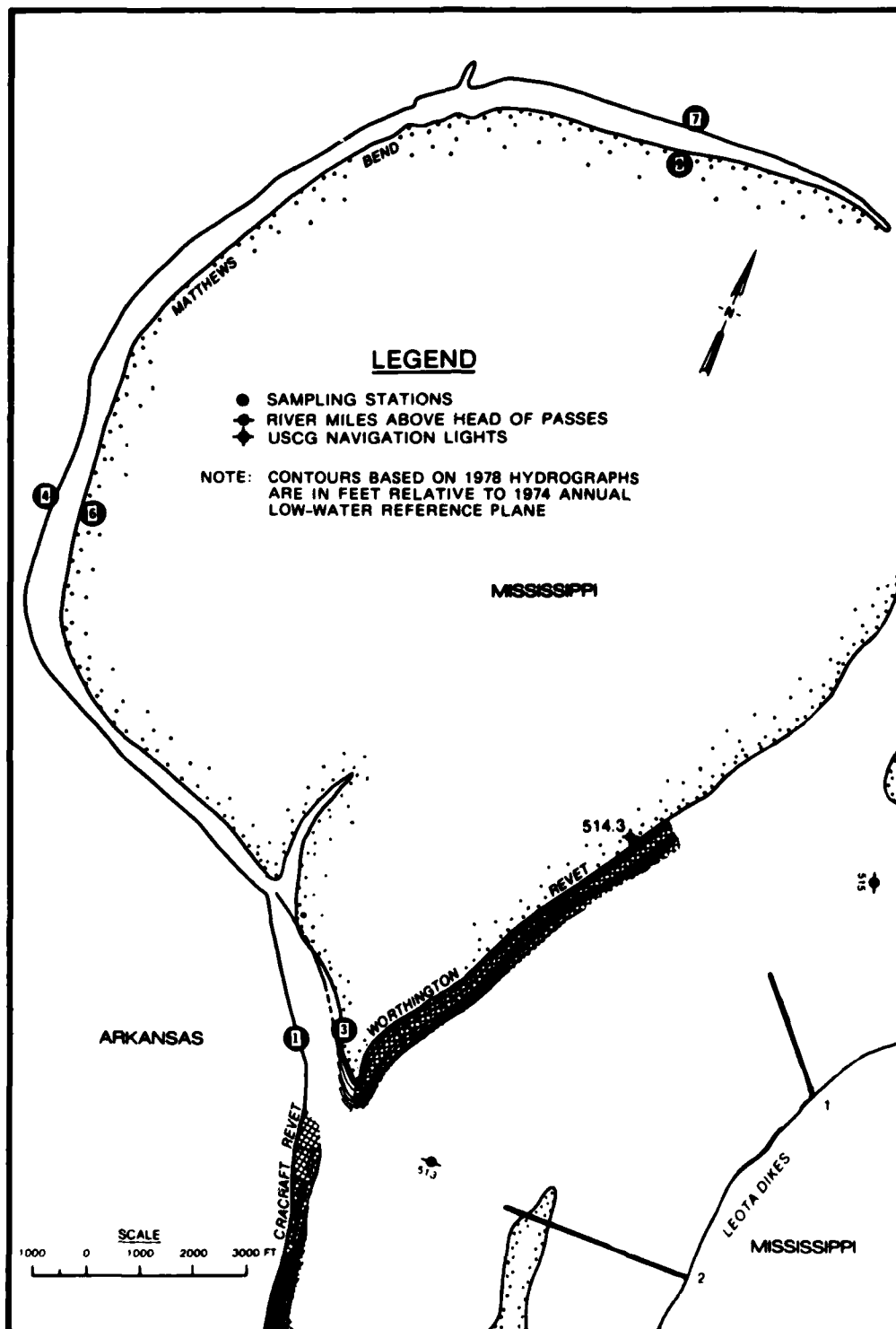


Figure 7. Map of Matthews Bend

PART III: MATERIALS AND METHODS

Description of Gear

26. Previous studies on gear selectivity indicated that, while certain gear types might adequately capture specific species or a certain size range of fish, no one gear is adequate for capturing all sizes of all species found in large river systems (Starrett and Barnickol 1955; Pennington et al. 1980). For this reason, several of the more effective gears were selected for use, and not all gears were used at each study site.

27. Fish were collected with gill nets, hoop nets, electroshocker, seines, and minnow traps. The gill nets used were 150 ft long by 8 ft deep and consisted of six 25-ft-long by 8-ft-deep panels having square mesh sizes of 1 to 3-1/2 in. in 1/2-in. increments. Gill nets were set in the abandoned channel at all flow stages and in the dike fields only during low flow.

28. The double-throated hoop nets were of two diameters (2 and 3 ft), but all had seven fiberglass hoops and 1-in.-square mesh netting. Pairs of hoop nets, one of each size, were set at each station along the revetted and natural banks. They were set singly in the dike field habitat and were not used in the abandoned channel.

29. Electroshocking was conducted with a commercially built, 230-v, pulsed, direct current (d-c), boat-mounted boom shocker. In the dike fields, electroshocking transects were worked along the bank, through the center portion of each pool, along both sides of the middle bar, and along the dikes. In natural and revetted bank habitats, transects were worked with the current between adjacent stations. In the abandoned channel, electroshocking transects were worked along the banks between adjacent stations.

30. A 30-ft-long by 4-ft-deep minnow seine having 1/8-in. delta mesh was used to sample the sandbars found within dike fields. Seine hauls were approximately 100 ft long and were made in the direction of the current, when a current existed.

31. Minnow traps were fished at all feasible dike field stations during 1979. Traps were constructed of coarse-weave cotton cloth stretched over and between 8-in.-diam wire rings to form a cylinder. The baited traps were staked parallel to the banks with the single net throat opening facing downstream.

32. Standard units of fishing effort for each gear type were: 24-hr sets for gill nets and minnow traps; 48-hr sets for hoop nets; individual transects for electroshocking (usually of 10-min duration and approximately 1000 ft long); and a 100-ft haul for the seine. The amount of effort expended in each location with each gear type is shown in Table 1.

33. The larger fishes were identified and processed in the field. Juvenile fishes, minnows, and unusual fishes were preserved in 10-percent formalin for later identification. Total length (in millimetres) and weight (in grams) were recorded for all specimens in good condition.

Sampling Periods

34. Water temperature, riverflow (stage and discharge), and river geomorphology are the major riverine characteristics which interact to produce varying aquatic macrohabitats. These factors contribute to the composition and spatial and temporal abundance patterns of riverine fish and invertebrates. For this reason, rather than conducting routine annual or quarterly sampling, annual riverflow and water temperature regimes were used to define four key sets of environmental conditions during which major sampling efforts were accomplished. The four river seasons vary somewhat between years, but are typically: summer low flow, warmwater season; fall increasing flow, decreasing water temperature season; winter/spring high flow, coldwater season; and spring decreasing flow, rising water temperature season.

35. During the study period of April 1979 to September 1980, there were five major sampling efforts corresponding to the river seasons described above:

- a. 16 April to 4 May 1979, winter/spring high flow.
- b. 19 June to 29 June 1979, spring decreasing flow.
- c. 18 September to 28 September 1979, summer low flow.
- d. 5 November to 19 November 1979, fall increasing flow.
- e. 7 September to 19 September 1980, summer low flow.

During 1979, all habitats except the Chicot Landing Dike Field were sampled in each of the four river seasons. Chicot Dike Field was sampled in 1979 only at the low flow river stage (September). During 1980, all habitats except Matthews Bend were sampled only during the low flow stage.

Analytical Methods

36. Mean numerical catch per unit of effort (C/f),* mean total weight of fish per unit of effort (C/y), and mean number of species per unit of effort were calculated for each habitat and each gear type except minnow traps during each sampling period. A one-way analysis of variance (ANOVA) by gear type was used to determine whether significant differences existed among habitats during a sampling period. Data were transformed as $\log(X + 1)$ prior to analysis, as is generally appropriate for species abundances (Green 1979). Subsequent to the ANOVA, Duncan's New Multiple Range Test was used to examine the pattern of differences. A nested ANOVA by gear type was used to determine if significant differences existed among habitats during a sampling period. The 5-percent significance level was used in all analyses.

37. Similarity and dissimilarity coefficients were calculated for each habitat pair at each sampling date using data from all gear types. The similarity coefficient (coefficient of community) is based on the presence-absence component of the data while the dissimilarity (percentage similarity) coefficient incorporates species densities (Boesch 1977). For ease of comparison, dissimilarity values were subtracted from 1.0 to convert them to similarities (Boesch 1977).

* See Appendix A for a glossary of terms.

38. Species diversity values (base 10) were calculated from data collected by all gear types using the Shannon formula (Peet 1974).

39. Condition factors (Ricker 1971) were calculated for gizzard shad, freshwater drum, channel catfish, blue catfish, flathead catfish, and river carpsucker.* Condition factors were compared using Duncan's New Multiple Range Test.

* Scientific names are given in Table 2.

PART IV: RESULTS

40. During this investigation, a total of 14,537 fish weighing 5,482 lb were captured. Fifty-seven species and nineteen families were represented (Table 2). Gizzard shad were the most numerically abundant (35.3 percent of the total) and most abundant by weight (16.4 percent of the total biomass). Two other species comprised at least 5 percent of the numeric catch: river shiner (10.1 percent) and the silverband shiner (5.9 percent). Carp ranked seventeenth in numerical abundance (1.3 percent of the total) but second in weight (14.1 percent of the total biomass). Flathead catfish and blue catfish comprised 14.0 and 9.3 percent of the total weight, respectively.

41. A review of the species and numbers of fish taken at each habitat is presented in this section. Other general comments regarding the fish populations and gear efficiency also are given.

Dike Field Habitat

Lower Cracraft Dike Field

42. A total of 5405 fish representing 45 species were captured at this dike field. The number of species collected during a sampling period ranged from 12 in April 1979 to 37 in June 1979. Gizzard shad and river shiner were numerically dominant in all collections except September 1979, when gizzard shad comprised only 3.1 percent of the catch, and during April 1979, when the river shiner was not collected (Table 3). Because high river stages prevented the use of seines during April, the absence of river shiners from the collections (and other Cyprinidae as well) does not necessarily imply absence from the habitat. Other species constituting significant relative percentages were emerald and silverband shiners, silvery minnow, and inland silversides.

43. Sport-commercial species collectively comprised 18.6 percent of the total number of individuals (Table 3). Blue catfish, flathead catfish, and channel catfish ranked third, eighth, and twelfth, respectively; these species together constituted just over 10 percent relative

abundance. River carpsucker and freshwater drum were also numerically important sport-commercial species.

44. Gizzard shad dominated the catch by weight (Table 4) at Cracraft. Flathead, blue, and channel catfishes ranked second, third, and sixth, totaling over one third of the weight. Carp comprised only 0.4 percent of the numbers but accounted for 10.4 percent by weight. Together, the 10 dominant species constituted 86.8 percent of the total weight.

45. Diversity at Lower Cracraft Dike Field ranged from 0.89 during April 1979 to 2.72 during June 1979 (Figure 8). With the exception of the April 1979 high-water collection, diversity was lower here than in any other dike field.

Leota Dike Field

46. Forty-six species totaling 3397 fish were collected from Leota Dike Field during the five sampling efforts (Table 5). The number of individuals (161) and species (12) was lowest during the April 1979 high-water period. The greatest number of species (36) was collected during June 1979, and the number of fish collected (1446) was greatest during September 1980.

47. Gizzard shad and river shiner dominated the catch numerically (Table 5), together comprising over one third of the total number of individuals. Two other forage species, emerald shiner (7.0 percent) and blacktail shiner (6.7 percent), also made up appreciable percentages of the ichthyofauna at Leota. Sport-commercial species were more abundant at Leota than at any other dike field, comprising 23.4 percent of the total (Table 5). Channel, flathead, and blue catfishes were abundant, together accounting for 11.7 percent. River carpsucker (4.0 percent) and freshwater drum (2.9 percent) also contributed significantly at this habitat. Four sport species were numerous here relative to most other habitats: white bass (1.3 percent), sauger (1.0 percent), bluegill (0.9 percent), and white crappie (0.7 percent).

48. Carp, flathead catfish, and river carpsucker dominated the catch by weight at Leota Dike Field (Table 6). Four other sport-commercial species (channel catfish, smallmouth buffalo, blue catfish,

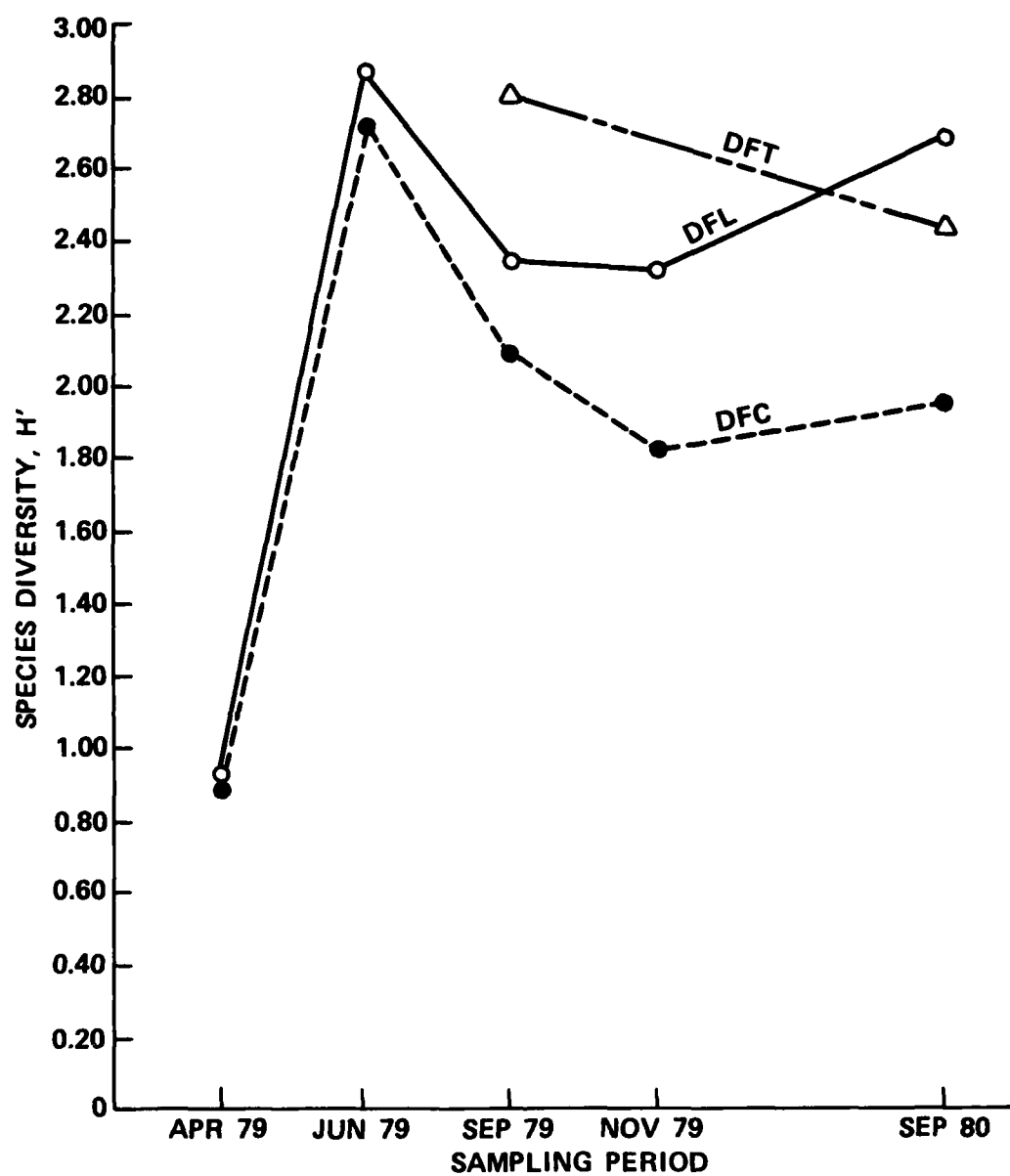


Figure 8. Species diversity of three Mississippi River dike fields. DFC = Lower Cracraft Dike Field; DFL = Leota Dike Field; DFT = Chicot Landing Dike Field

and freshwater drum) accounted for an additional 25.4 percent. Gizzard shad, numerically dominant at this location, ranked fourth by weight (11.4 percent).

49. Species diversity at Leota ranged from 0.93 during April 1979 to 2.88 during June 1979 (Figure 8). Values at Leota always exceeded those for Cracraft, and exceeded those for Chicot Landing Dike Field during September 1980.

Chicot Landing Dike Field

50. A total of 42 species and 2339 fish were captured during the two summer low-water collections at Chicot Landing Dike Field (Table 7). Thirty-eight species and 766 fish were collected during September 1979, and 33 species and 1573 fish during September 1980.

51. The family Cyprinidae (minnows and shiners) numerically dominated the catch at Chicot, accounting for over 57 percent of the total number of individuals (Table 7). Silverband and blacktail shiners comprised 27.4 percent and 13.1 percent, respectively. Three other cyprinids, river shiner, emerald shiner, and bullhead minnow, collectively accounted for an additional 17 percent. Gizzard shad constituted only 8.2 percent of the catch at Chicot. Sport-commercial species were also relatively less abundant at this location, making up only 16.2 percent. Blue catfish, bluegill, river carpsucker, freshwater drum, and channel catfish comprised the majority of the sport-commercial species, ranging in descending order from 3.8 percent to 1.8 percent.

52. By weight, blue catfish made up nearly 31 percent of the catch at Chicot Landing Dike Field, ranking second in September 1979 and first in 1980 (Table 8). River carpsucker and gizzard shad ranked second and third, respectively. Together these three species comprised over 62 percent of the total weight of fish. The 10 highest ranking species by weight made up over 93 percent (Table 8); approximately 70 percent was accounted for by species in the sport-commercial category.

53. Chicot Landing had the highest species diversity of all dike field locations during September 1979 (Figure 8). Diversity decreased during September 1980.

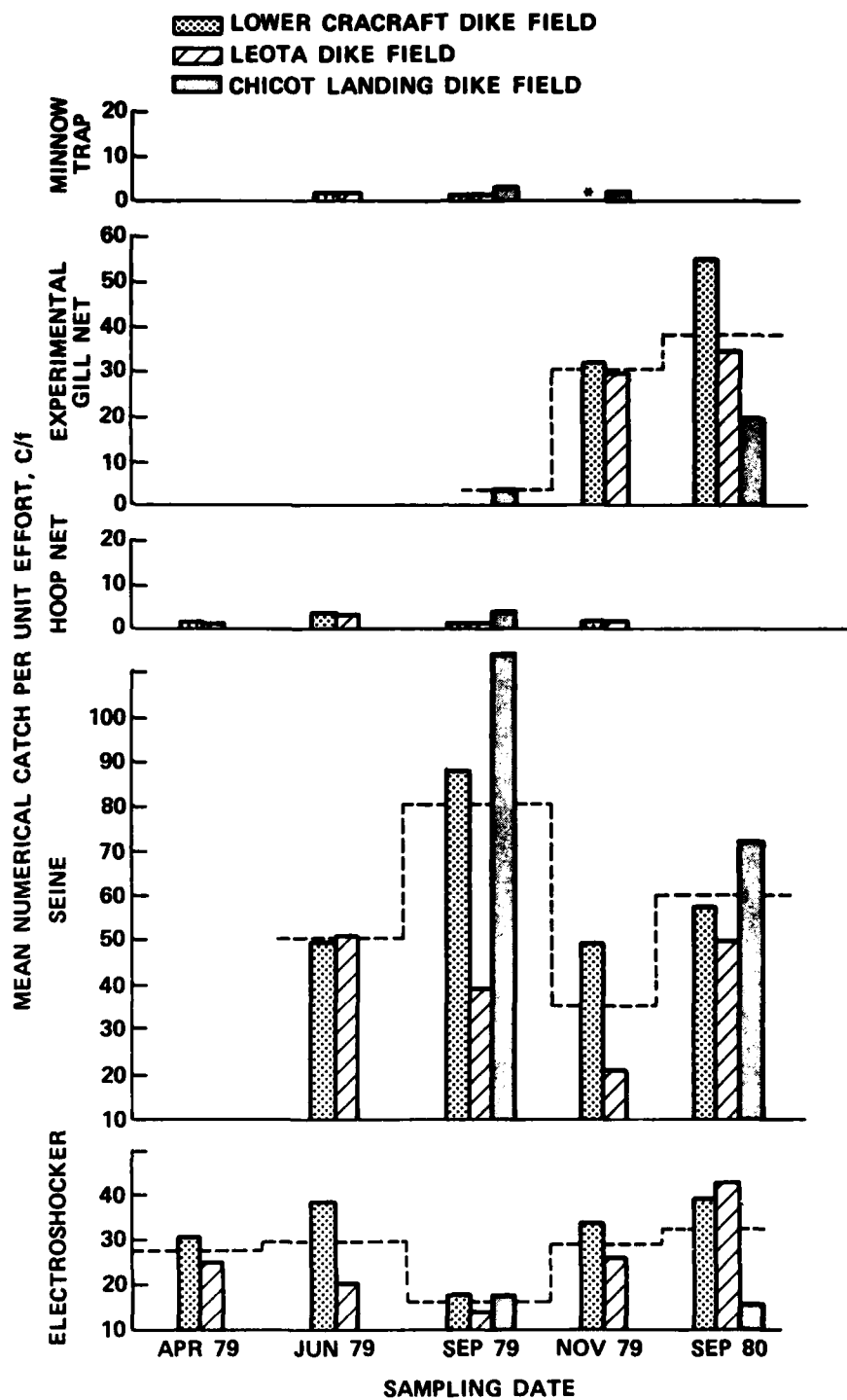
Dike field comparisons

54. The ichthyofaunas of the dike fields were quite similar in terms of overall species occurrence, seasonal species composition, and relative abundance. The combined list for the three dike fields totaled 53 species. Forty-two of these species were recorded for Chicot, although it was sampled only twice; 45 and 46 species occurred at Cracraft and Leota, respectively.

55. Except during April, coefficient of community values for the Leota-Cracraft pair were high and consistent throughout the year (Table 9). The low April coefficient may have been due to sampling constraints imposed by the high spring water levels. Percentage similarity of these dike fields, however, declined steadily from April to November 1979, and was also relatively low during September 1980. This suggests that as river levels decline during the summer, the Leota and Lower Cracraft Dike Fields become sufficiently differentiated from each other to cause shifts in relative species abundances.

56. Gizzard shad was the most abundant species overall (Tables 3, 5, and 7). Several cyprinids, principally river, blacktail, silverband, and emerald shiners, also comprised significant percentages of the overall dike field fauna. Blue, flathead, and channel catfishes were generally the most abundant sport-commercial species. Carp, river carpsucker, smallmouth buffalo, freshwater drum, and gizzard shad, together with the above three species of catfish, constituted most of the catch by weight in the dike fields. At two locations (Leota and Chicot), shortnose and longnose gar also accounted for a relatively high percentage.

57. The relative C/f for the three dike fields varied widely across seasons and gear types (Figure 9). The C/f for seining indicated higher densities of fish during September 1979 and generally lower densities during November 1979. Overall ranking of dike fields (high to low densities) was indicated as Chicot-Cracraft-Leota. Electroshocking C/f, opposite to that of seining, indicated very low fish densities during September 1979. High numbers of fish were found during September 1980, however. For electroshocking, dike field ranking was



* GEAR EMPLOYED BUT NO CATCH RECORDED

Figure 9. Mean C/f by gear type for three Mississippi River dike fields. Dotted line indicates the mean of all dike fields at each sampling effort

Cracraft-Leota-Chicot. Experimental gill net samples indicated a ranking similar to that for electroshocking.

58. The C/y showed no consistent ranking of dike fields (Figure 10). The C/y was generally lower during the two September sampling periods than at other times.

59. Fish species diversity at Leota Dike Field was consistently higher than at Lower Cracraft Dike Field, and the difference increased over time (Figure 8). The low diversity value at both the dike fields during April was due, in part, to the fact that researchers were unable to adequately sample during high flows. Diversity at Chicot Landing Dike Field was highest of all dike fields during September 1979 but declined during September 1980 (Figure 8). All five gear types were used during 1979 (Table 1), but two of these (hoop nets, minnow traps) were not used during 1980. During September 1979 these two gears accounted for five species not collected by any other gear, which may help explain the decline in diversity in this dike field between September 1979 and September 1980.

Low-water season comparisons

60. The number of species collected during the summer low-water period of both September 1979 and 1980 are given in Tables 3, 5, and 7. During September 1979, hoop nets, electroshocking, minnow traps, and seines were used at all three dike fields (Table 1). At Chicot Landing, gill nets were also employed. Seven species were captured with the gill net; however, of these seven species only longnose gar was unique to the gear type. Therefore, it was concluded that the greater number of species collected at Chicot Landing at that time reflected a real difference among the locations, and was not due to gear differences.

61. Gear type use was consistent among dike field habitat locations during September 1980 (Table 1). At this time, both Chicot Landing and Leota had 33 species, and Cracraft only 28; this suggests a real, though relatively small, difference among these habitat locations.

62. Chicot Landing Dike Field yielded 38 species in 1979 and 33 in 1980. The differences may have been due to gear type use. Two additional gears, hoop nets and minnow traps, were used in 1979 that were

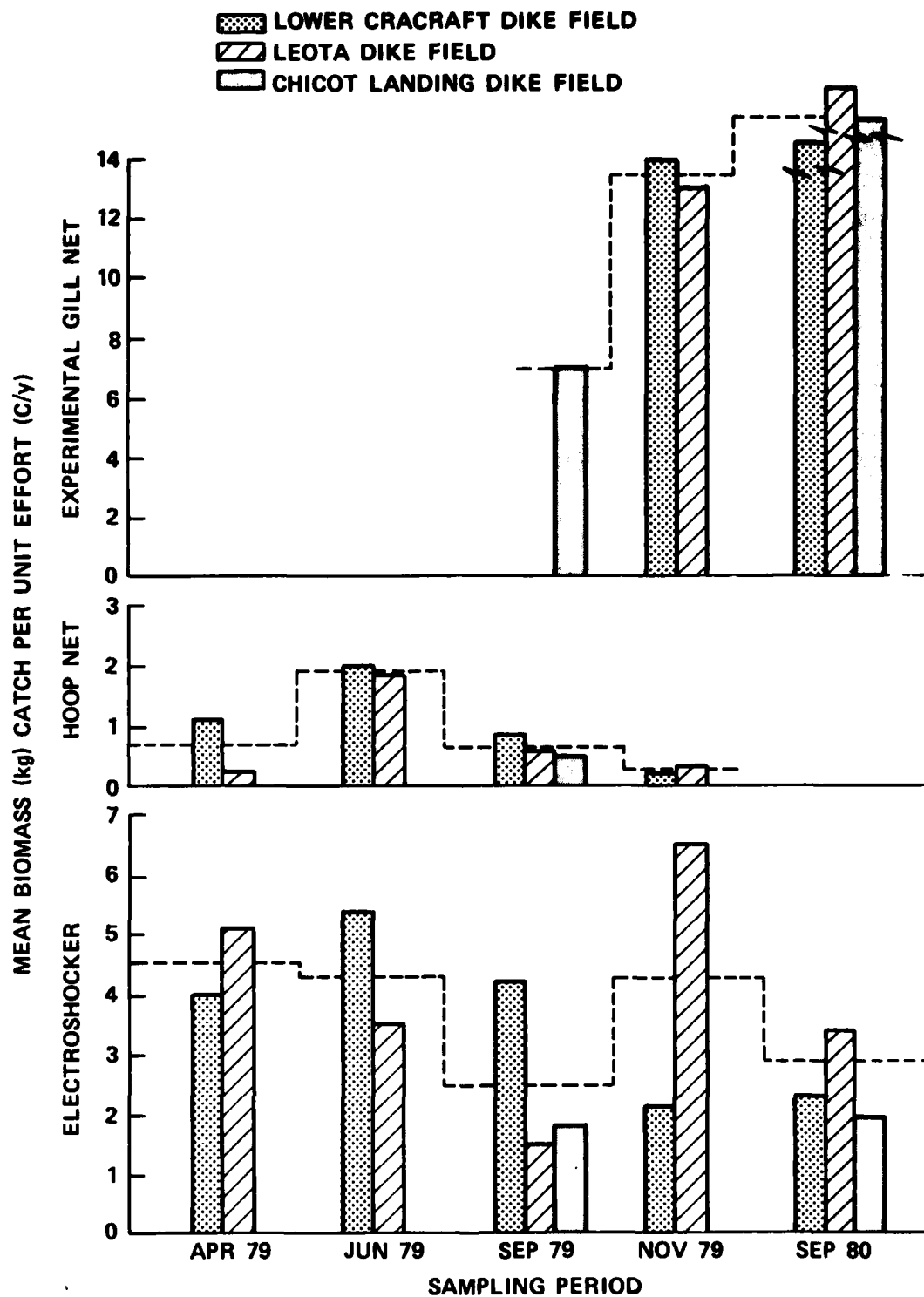


Figure 10. Mean C/y by gear type for three Mississippi River dike fields. Minnow trap and seine data are not plotted due to the small weight of fish captured by these gears. Dotted line indicates the mean of all dike fields at each sampling effort

not used in 1980. During 1979, these two gears accounted for five species not collected by other methods. If these species are assumed to be present (but undetected) during 1980, the total number of species collected at that time would be the same as 1979. This difference in gear deployment might also have contributed to the decrease in diversity at Chicot Landing between September 1979 and September 1980.

63. At Lower Cracraft and Leota Dike Fields, hoop nets, electroshocking, minnow traps, and seines were used during September 1979; during 1980, hoop nets and minnow traps were replaced by gill nets (Table 1). Thus, only electroshocking and seine collections can be compared between these two locations over time. Twenty-eight species were captured at Leota by electroshocking and seining in September 1979, and 27 in 1980. The number of species collected by these gears at Cracraft dropped precipitously from 1979 to 1980 (32 versus 18). This decrease is not apparent when all gear types are combined. The difference resulted from 10 additional species being collected by gill nets, raising the total count to 28.

64. Relative similarities (all gear types combined) across the 1979 and 1980 low-water samples varied greatly among dike field locations (Table 9). Chicot Landing was most consistent between years with two thirds of its species being collected in both years. Leota was intermediate in year-to-year similarity, and Lower Cracraft had fewer than one half of its species complement common to both 1979 and 1980 low-water samples.

Bank Habitat

Revetted banks

65. Walnut Point-Kentucky Bend Revetment. The number of species collected at Walnut Point ranged from 11 in September to 19 in April and June (Table 10). The total number of species collected from this habitat was 26, greatest of all bank habitats. The number of individuals captured during a sampling period ranged from 131 in September 1979 to 305 in November 1979 and totaled 860.

66. Gizzard shad comprised 50.7 percent numerical abundance at Walnut Point. Sport-commercial species accounted for nearly 42 percent, of which catfishes made up over 18 percent. Freshwater drum, carp, blue sucker, smallmouth buffalo, and river carpsucker collectively comprised an additional 23 percent.

67. Carp comprised 20.7 percent of the weight of fish collected at this revetment (Table 11), although they represented less than 5 percent of the number of individuals. Other sport-commercial species contributing significantly to the biomass at Walnut Point included flathead and blue catfish, blue sucker, smallmouth buffalo, freshwater drum, channel catfish, and river carpsucker. Gizzard shad was the dominant nonsport-commercial species.

68. Diversity at Walnut Point Revetment was relatively high and variable (mean = 1.62). Extremes of diversity were reached during June and November (Figure 11).

69. Lakeport Revetment. Only 16 species were collected during the four sampling efforts at Lakeport Revetment (Table 12), with a maximum of 12 (June) and a minimum of 5 (September). The number of individuals collected was very low during April, September, and November (16-19 fish), and relatively high during June (221).

70. Gizzard shad was the numerically dominant species (58.9 percent). Lakeport Revetment was the only bank habitat at which channel catfish were numerically abundant (17.1 percent). This species was collected during only two sampling periods, however, and 46 of the 47 total channel catfish were collected during June. Catfishes collectively accounted for nearly 24 percent of the total number of individuals. Other sport-commercial species, principally freshwater drum, shovelnose sturgeon, and blue sucker, comprised an additional 13.8 percent, for a total sport-commercial catch exceeding 38 percent.

71. Over 80 percent of the weight of fishes collected at Lakeport Revetment was attributable to sport-commercial species (Table 11). Channel catfish accounted for nearly 40 percent of the total, although they were abundant only during a single collection (June). Blue sucker, flathead catfish, shovelnose sturgeon, blue catfish, gizzard shad, and

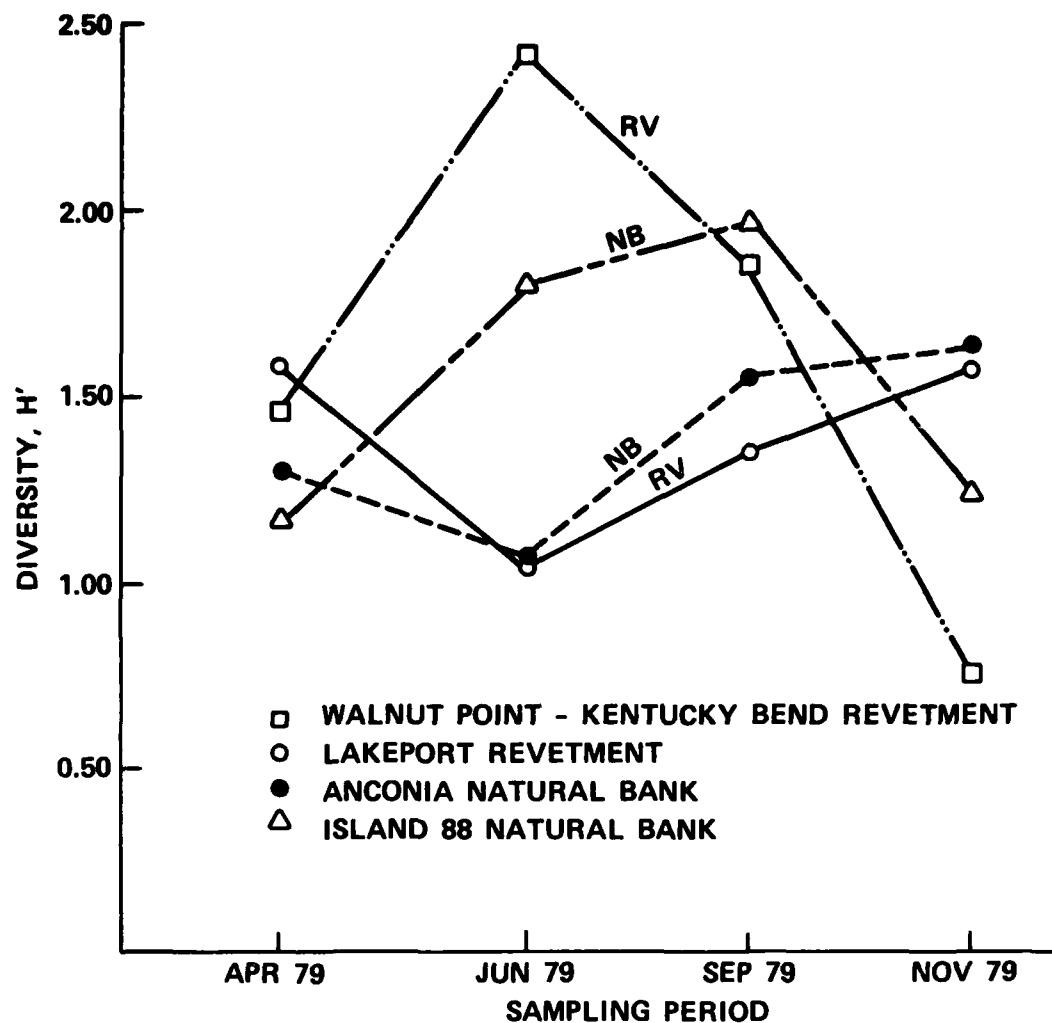


Figure 11. Species diversity for revetted (RV) and natural bank (NB) habitats in the Mississippi River

freshwater drum also contributed significantly to the biomass at this location.

72. Mean diversity at Lakeport Revetment was 1.40. Diversities ranged from 1.07 to 1.59 (Figure 11).

Natural banks

73. Anconia Natural Bank. Twenty-two species of fish were collected from Anconia Natural Bank over the four sampling dates. From 6 to 11 species, and from 21 to 108 individuals, occurred at any single sampling effort (Table 13). Gizzard shad, threadfin shad, and skipjack

herring comprised 71.5 percent of the total number of individuals. Just over one fourth (26.6 percent) of the fish were in the sport-commercial category. Catfishes, primarily flathead and blue, accounted for over 14 percent, and freshwater drum comprised 4.5 percent. The remaining 16 species were each represented by two or fewer individuals (less than 0.9 percent).

74. Sport-commercial species comprised over two thirds of the weight of fishes (68.4 percent) collected at Anconia Natural Bank (Table 11). Flathead catfish, bigmouth buffalo, blue sucker, blue catfish, and freshwater drum ranked first, and third through sixth in weight, respectively. Gizzard shad and skipjack herring ranked second and seventh, respectively, and together accounted for 24.6 percent by weight. The rank by weight of bigmouth buffalo in this habitat is somewhat misleading, however, as it represents only two individuals.

75. Species diversity at Anconia ranged from 1.08 during June to 1.64 in November (Figure 11). The mean diversity over all four sampling periods was 1.39.

76. Island 88 Natural Bank. Twenty species of fish were represented in collections from Island 88 Natural Bank, with the number collected at any single sampling date ranging from 7 to 11 (Table 14). The number of individuals ranged from only 19 to 67.

77. Gizzard shad was least dominant here of all bank habitats (42.7 percent). Sport-commercial species were very abundant, accounting for nearly one half (48.7 percent) of the total number of individuals. Freshwater drum, the three species of catfishes, bluegill, and white crappie comprised most of this category.

78. Seven sport-commercial species (Table 11) comprised 69.6 percent of the weight at Island 88. Flathead catfish and freshwater drum accounted for much of this total. Gizzard shad and two gar species constituted approximately 21 percent.

79. Diversity was considerably lower during April and November than during June and September (Figure 11), reflecting the trend in relative abundance of gizzard shad. Mean diversity for the four sampling periods was 1.55.

80. Comparisons of bank habitats. Thirty species of fish, totaling 1506 individuals, were collected from the four bank habitats. Four species (gizzard shad, flathead catfish, blue catfish, and freshwater drum) numerically dominated the catch in all bank habitats. These species accounted for 69.8 percent (Lakeport Revetment) to 80.1 percent (Anconia Natural Bank) of the total number of individuals. Gizzard shad was the single most abundant species, ranging in relative abundance from 42.7 to 62.0 percent. Flathead catfish, blue catfish, and freshwater drum ranged from 2.6 to 10.7 percent, 4.4 to 7.0 percent, and 4.0 to 17.3 percent, respectively. In addition to these species, channel catfish and shovelnose sturgeon were relatively abundant at Lakeport Revetment, and carp and smallmouth buffalo were common at Walnut Point Revetment. Blue sucker was moderately abundant in both revetted bank habitats. Skipjack herring and threadfin shad were relatively abundant at Anconia Natural Bank.

81. Over all bank habitats, sport-commercial species comprised most of the biomass. Species in this category comprised a greater proportion of the biomass in revetted bank habitats than in natural bank habitats, where shad and gar were relatively more important. Flathead catfish, gizzard shad, blue catfish, and freshwater drum contributed significantly to the biomass in all bank habitats, while carp, blue sucker, and bigmouth and smallmouth buffalo were important in three of the four bank habitats. Seven additional species contributed significantly to the weight of fish collected in only one or two habitats (Table 11).

82. Mean C/f for the four bank habitats showed no consistent ranking (Figure 12). Seasonally, June values were highest overall and September values lowest. The C/f at Walnut Point exceeded that at Lakeport at all sampling periods except June, when unusually large numbers of gizzard shad and channel catfish were collected at Lakeport. The relative C/f at Anconia Natural Bank and Island 88 Natural Bank was more variable. Mean C/f for the two revetted banks combined exceeded that for the natural banks at all sampling periods except April.

83. Mean C/y in revetted bank habitats was highest during June

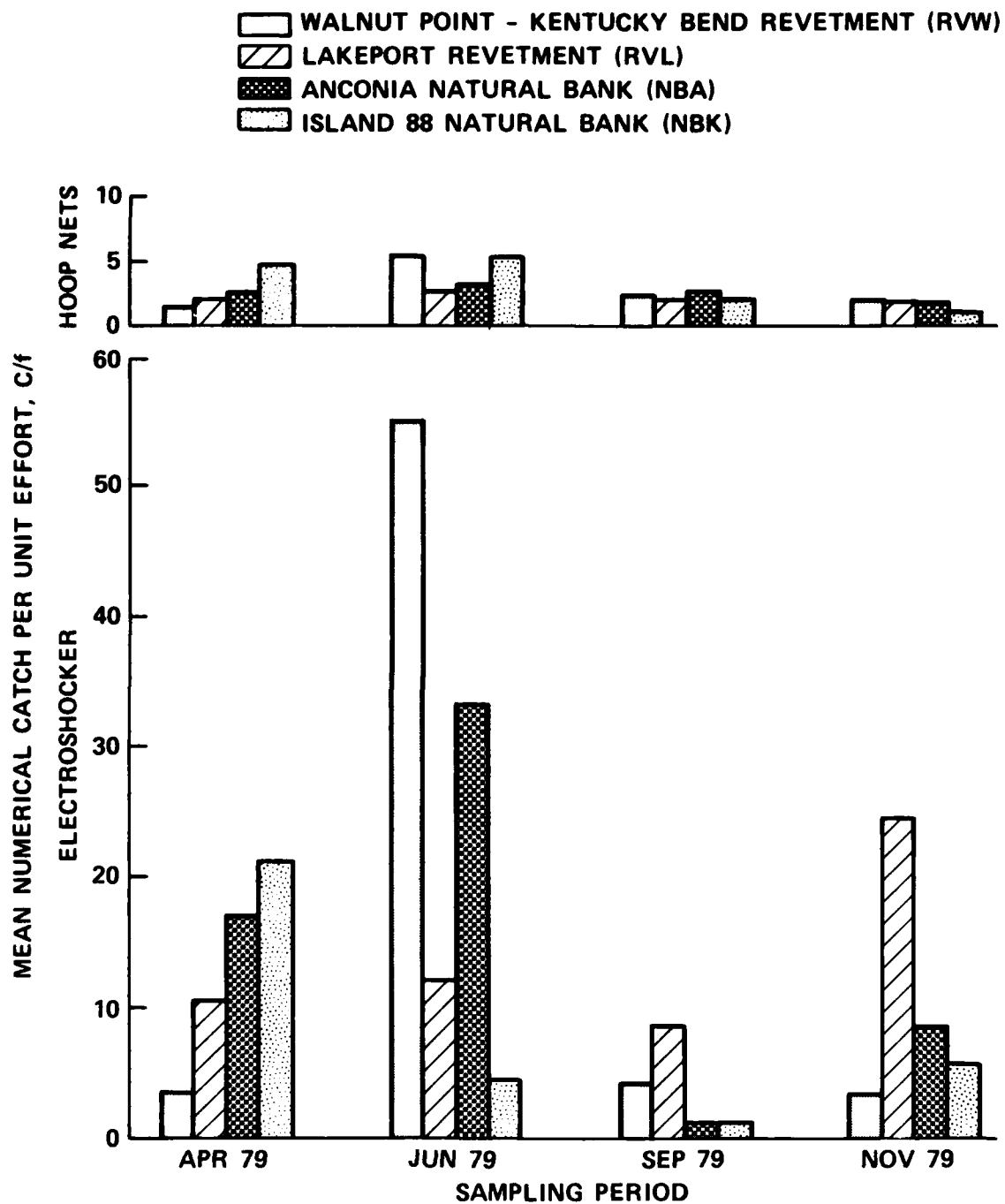


Figure 12. Mean C/f for revetted and natural bank habitats in the Mississippi River

and September for both hoop netting and electroshocking (Figure 13). For the natural bank habitats, the highest hoop net C/y occurred during June, and the highest electroshocking C/y occurred during April. Walnut Point Revetment had the highest electroshocking C/y of all bank habitats during all sampling periods except April, when Anconia Natural Bank had the highest C/y. The mean C/y at Walnut Point equaled or exceeded that at Lakeport in all except June hoop net collections when large numbers of channel catfish were caught at Lakeport. The electroshocking C/y at Anconia exceeded that at Island 88 in all except September collections; hoop net C/y was more variable. With the exception of April, C/y values for both revetted banks combined exceeded those of the natural banks.

84. Diversity was generally greater at Walnut Point Revetment and Island 88 Natural Bank than at Lakeport Revetment and Anconia Natural Bank (Figure 11). There was no apparent overall seasonal pattern to the magnitudes or variabilities of the diversities. The diversities at Lakeport and Anconia were similar, and they covaried across seasons, as did the diversities of Walnut Point and Island 88.

85. The mean number of species at the four bank habitats was greater during April (12.0) and June (13.2) than during September (8.2) and November (8.0). The number of species collected at Walnut Point Revetment was apparently greater than at the other bank habitats. This is likely attributable to the larger number of samples collected there per sampling period, however. When the number of samples was randomly reduced to equal those collected elsewhere, the number of species occurring at Walnut Point Revetment was estimated to be similar to that of the other bank habitats at all seasons (Figure 14).

86. Similarity comparisons involving Walnut Point Revetment are biased, and may be minimum estimates due to the larger number of samples collected there than at other bank habitats. Despite this bias, some patterns are apparent (Table 15). Two factors were suggested as important in determining location similarities: habitat type, and proximity. The fish populations of the two natural bank locations were very similar in species composition at all seasons (Table 15). With the exception of June, abundance composition values were also high. In contrast, the

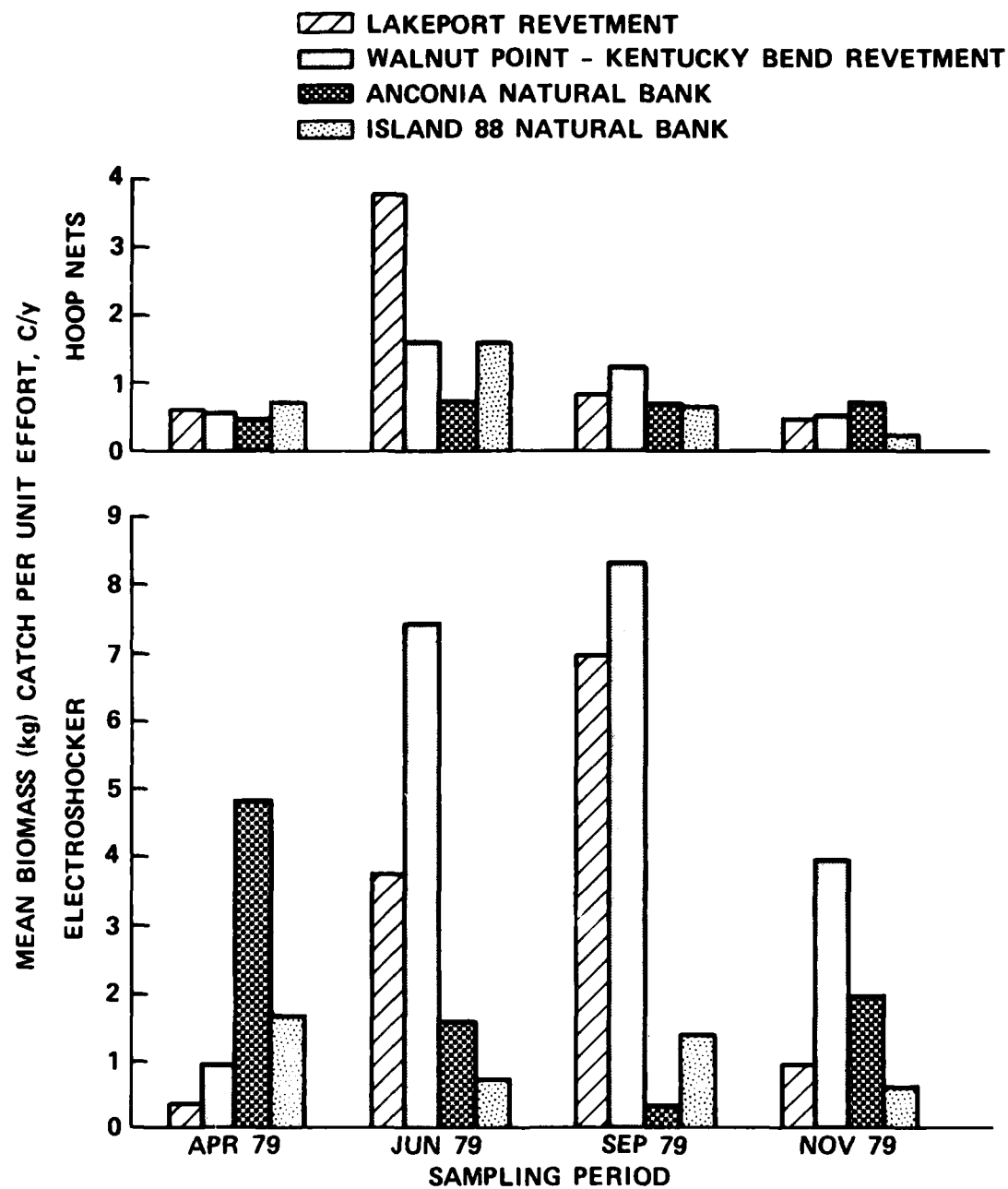


Figure 13. Mean C/y for revetted and natural bank habitats in the Mississippi River

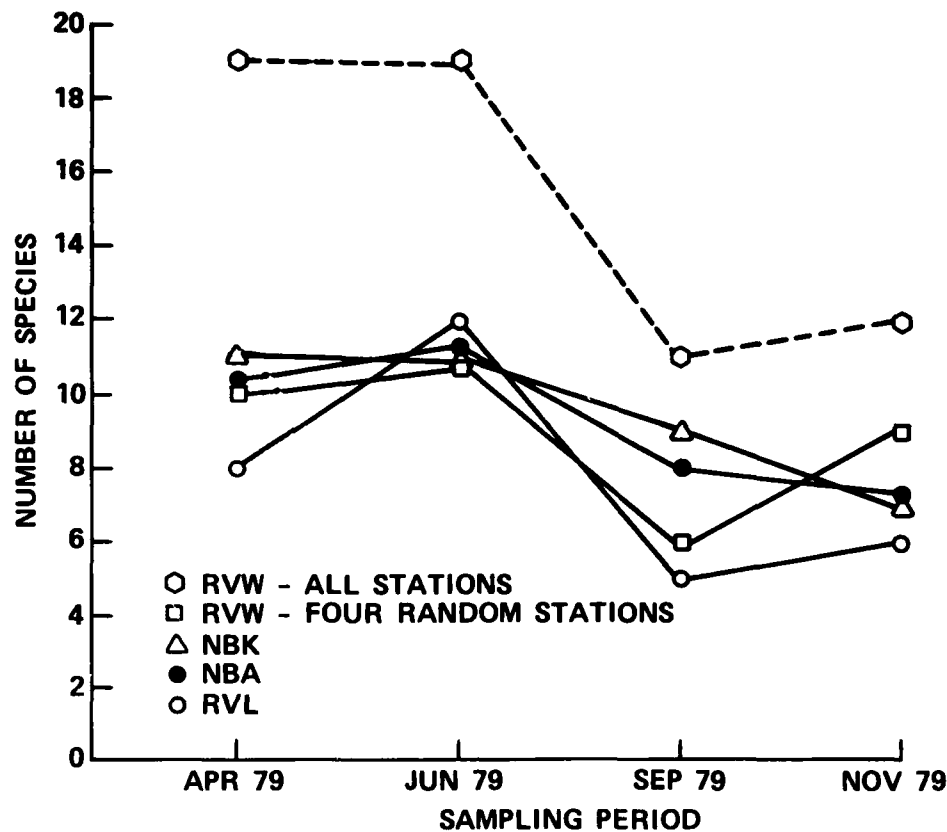


Figure 14. Number of fish species collected at revetted and natural bank habitats in the Mississippi River

habitat similarity effect was less pronounced for revetted banks. Their ichthyofaunas showed a lower and more variable degree of similarity. In fact, Walnut Point was often more similar in species composition to Island 88 Natural Bank than to Lakeport Revetment.

87. The importance of proximity was inferred from the pattern of similarity relationships in natural bank--revetted bank comparisons (Table 15). Generally, Walnut Point was more similar in species composition to Island 88, the nearest natural bank, than to Anconia. Mean coefficient of community for Walnut Point-Island 88 comparisons was 0.54, compared to 0.42 for Walnut Point-Anconia comparisons. The relationship of Lakeport Revetment to the two natural banks was variable in terms of the coefficient of community. However, the percentage similarity index indicated that Lakeport was more similar, on the average, to Anconia.

Mean percentage similarity for this pair was 0.48, compared to 0.32 for Lakeport-Island 88. Overall, less common species tended to occur in adjacent locations at a given sampling period (e.g. shortnose gar, American eel). For more abundant species, such as gizzard shad and freshwater drum, high or low numbers tended to be collected in adjacent areas.

Abandoned Channel Habitat

88. Thirty-one species of fish were collected from Matthews Bend from April to November 1979 (Table 16). Three species, spotted sucker, yellow bullhead, and orangespotted sunfish, were unique to this habitat. All were collected only during November and were represented by two or fewer individuals. The numerical catch at Matthews Bend varied widely across sampling periods, from 7 species and 33 fish during April to 28 species and 1059 fish during November (Table 16). Numbers of species and individuals were intermediate during June and September.

89. Gizzard shad dominated the abandoned channel ichthyofauna at all sampling periods and accounted for over 62 percent of the total number of individuals collected. No other species comprised more than approximately 6.5 percent. Sport-commercial species accounted for nearly 20 percent of the catch, with freshwater drum (5.1 percent), bluegill (3.7 percent), and river carpsucker (2.4 percent) being most abundant.

90. Ten species comprised the majority of the catch by weight at Matthews Bend (Table 17). These species accounted for from 81.9 to 91.6 percent of the biomass of fish collected in all months except April. During April a single longnose gar of nearly 30 lb comprised 65.5 percent. The numerically dominant species, gizzard shad, also ranked first by weight, but its dominance was less pronounced. Two species of gar constituted over 19 percent of the weight. Six sport-commercial species collectively comprised 36.4 percent, with carp (16.3 percent) accounting for nearly one half of this total.

91. The mean C/f and C/y varied considerably across sampling periods (Figure 15). For both gears, C/f and C/y were lowest during April. Gill net C/f peaked during June at 71.3 fish per 24-hr set, double that

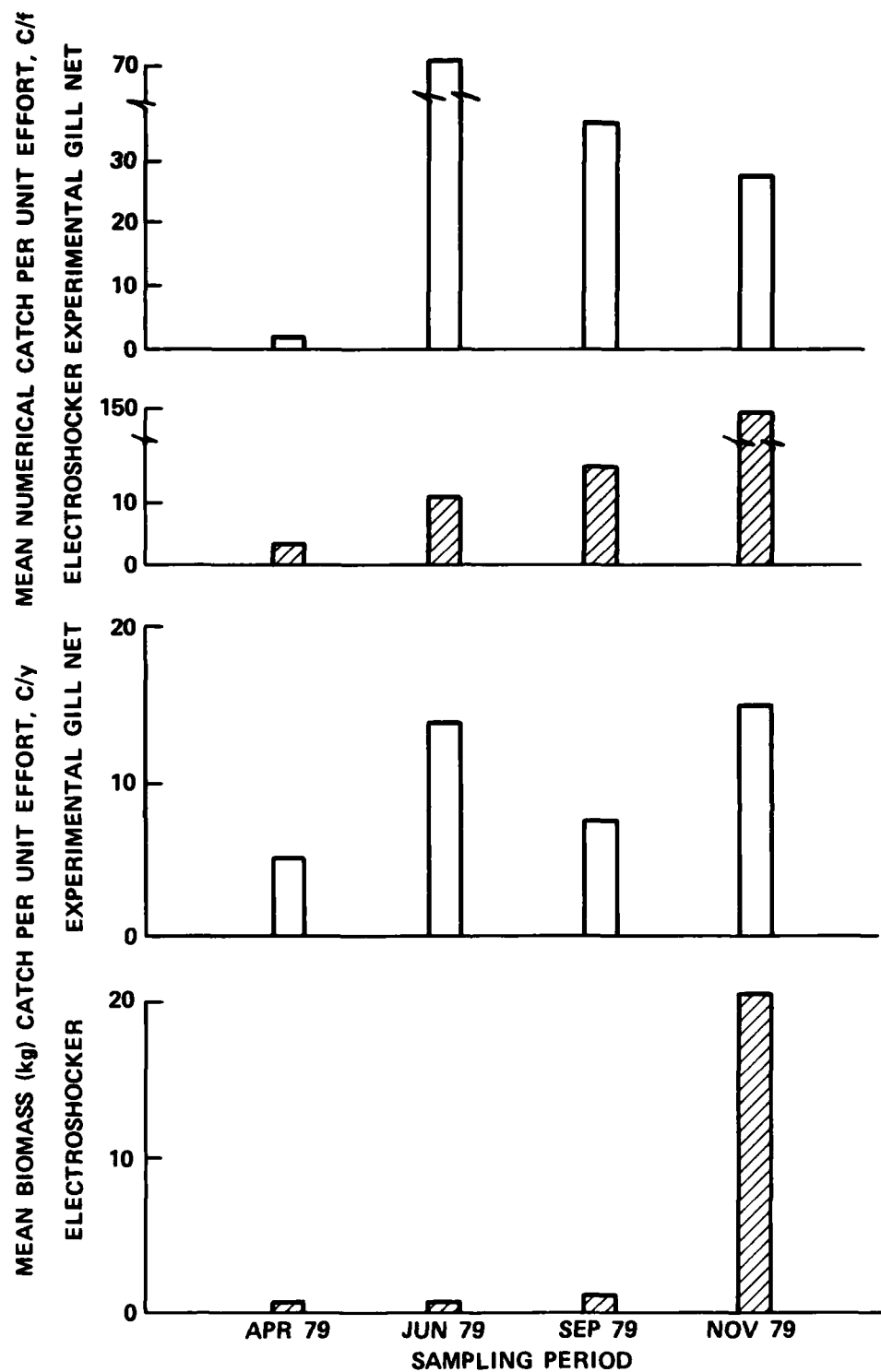


Figure 15. Mean C/f and C/y for the abandoned channel habitat in the Mississippi River

of any other month. The C/y was highest during November, however, indicating that fish collected at this time were relatively large. In contrast to gill net values, electroshocking C/f and C/y were significantly correlated ($r > 0.99$, $n = 4$). Values increased slowly from April through September, then rose dramatically in November (Figure 15).

92. Species diversity increased steadily at Matthews Bend during the study. April diversity was lowest (0.97) and November the highest (1.68). The increase in diversity from September (1.58) to November was relatively small despite a near doubling of the number of species collected (15 to 28). This suggests that the diversity during November may be near the yearly maximum for this habitat.

Length Frequencies

Gizzard shad

93. Length frequencies of gizzard shad were similar in all habitats during April (Figure 16). At least three age classes (I-III) were apparent in all habitats except Lakeport Revetment, where the catch for this species was almost always low. Ages I-III fish averaged approximately 140, 220, and 275 mm, respectively.

94. By June, the mean length of Age I fish had increased by about 30 to 40 mm. This age group dominated gizzard shad populations in all habitats except Leota Dike Field and, to a lesser extent, Matthews Bend. Older fish were nearly absent from bank habitats, but were common in the dike fields and the abandoned channel. During June, Age 0 fish (approximately 40 to 60 days old at this time) were collected only at Lower Craft Dike Field and Leota Dike Field. However, seining, an effective method of capturing juvenile fishes, was conducted only in these habitats, and this may have accounted for the failure to collect them in other habitats.

95. During September 1979, gizzard shad were virtually absent from bank habitats (Figure 16). Increasing numbers of Age 0 fish (approximately 50 to 100 mm total length (TL)) occurred in the three dike fields. Older fish continued to comprise the majority of this species in Matthews Bend.

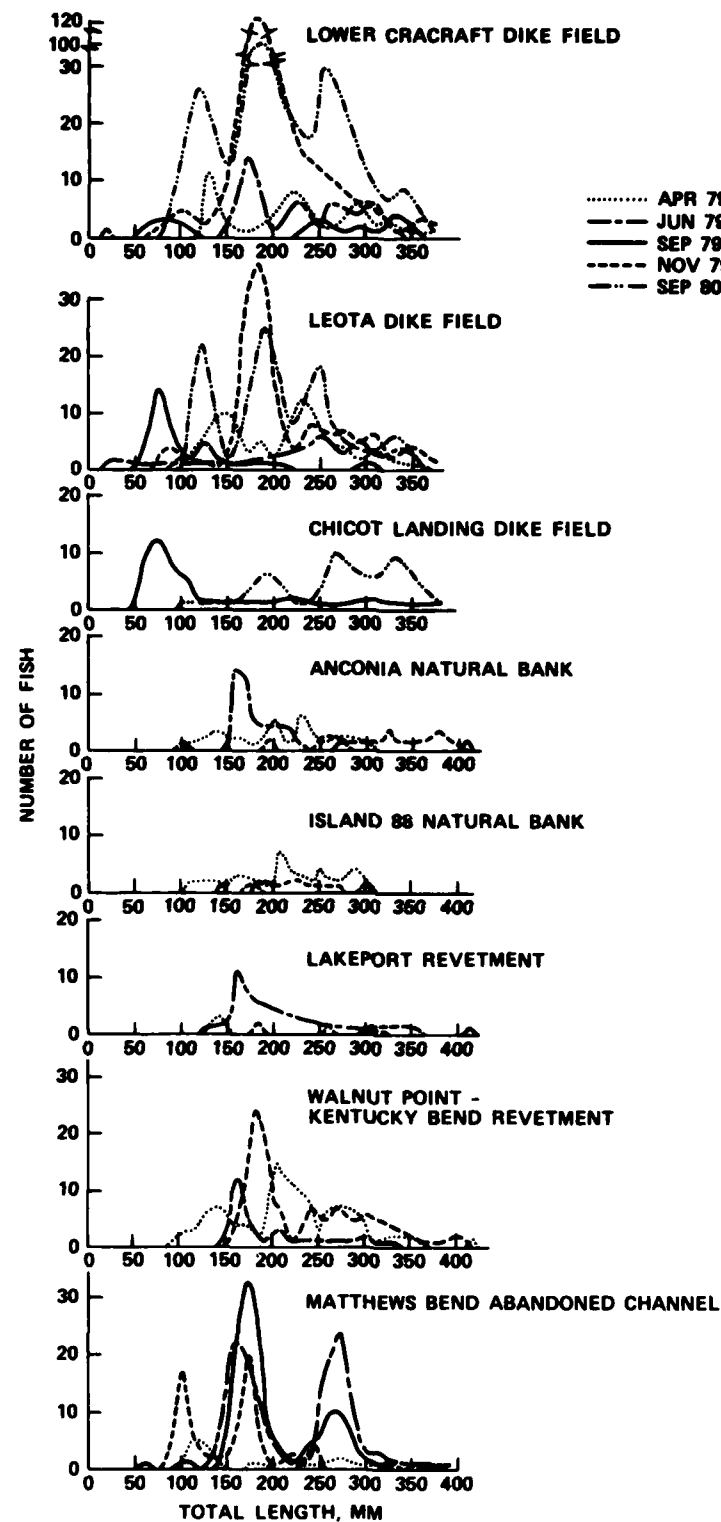


Figure 16. Length frequency of gizzard shad from the Mississippi River

96. The catch of gizzard shad during November was still low at three of the four bank habitats. At Walnut Point Revetment, at least three year classes (Ages I to III) were again apparent (Figure 16), with Age I fish predominating (ca. 150 to 200 mm TL). No Age 0 fish were collected here, and only a single individual was taken at the four bank habitats combined. A similar size distribution occurred at Cracraft and Leota Dike Fields, with the exception that some Age 0 fish were collected in these habitats. Age 0 gizzard shad were relatively abundant only in Matthews Bend.

97. Comparisons of gizzard shad length frequencies from the three dike fields during September 1979 and September 1980 (low-water samples) show some differences. Age 0 fish from 1980 collections at Cracraft and Leota averaged nearly 40 mm TL longer than the same age group in 1979 (Figure 16). This may have been caused by a relatively later spawn in 1979, or by relatively better conditions for growth during the summer of 1980. Also, four distinct size classes, corresponding to Ages 0 to III, were apparent during September 1980 but not during September 1979.

98. Length frequencies of gizzard shad at Chicot Landing Dike Field were generally similar to those at Cracraft and Leota. However, during September 1980, almost no Age 0 fish were collected at Chicot (Figure 16).

Freshwater drum

99. Numbers of freshwater drum were sufficient to make length frequency comparisons among habitats at only some sampling periods. During June, the distribution of sizes in dike field habitats was relatively uniform (Figure 17). Age 0 fish were missing from June collections at Walnut Point Revetment and Matthews Bend, however, and these habitats were dominated by fish of a single size class (225 to 325 mm TL).

100. During September 1979, Age 0 freshwater drum were collected only at Chicot Landing Dike Field (Figure 17); other habitats had predominantly Age I fish (150 to 250 mm TL). A similar size distribution occurred during November except that drum in the abandoned channel showed a smaller range of sizes.

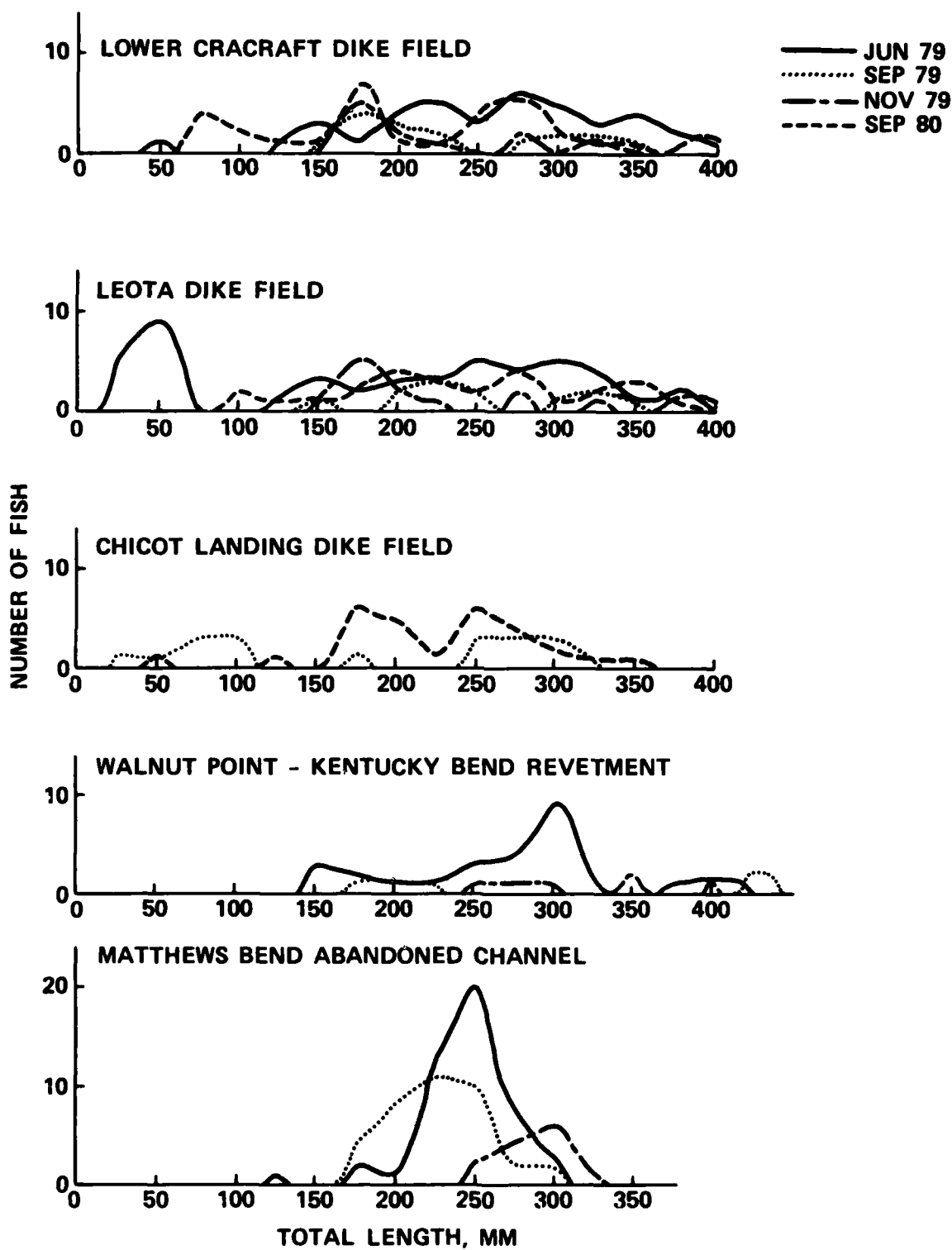


Figure 17. Length frequency of freshwater drum from the Mississippi River

101. Distribution of freshwater drum size classes in September 1980 indicated increased numbers of Age 0 fish at Lower Cracraft and Leota Dike Fields over those of the previous September. Numbers of Age 0 fish were reduced at Chicot Landing, however.

River shiner

102. This species was collected only from the three dike fields; in this habitat, however, they were one of the most abundant species. The inability to use seines may have accounted for their absence in collections made in other habitats as well as the April, high-water sampling period in the dike field habitats.

103. The size distribution of river shiners at Cracraft and Leota during June were somewhat different (Figure 18). In general, slightly larger fish occurred at Cracraft ($\bar{x} \approx 60$ mm TL) than at Leota ($\bar{x} \approx 48$ mm TL). Also, at Leota two size groups were abundant, possibly corresponding to early and late spawns during the summer of 1978.

104. During September 1979, two distinct sizes of river shiners occurred in all three dike fields (Figure 18). Fish of approximately 25 to 50 mm TL undoubtedly represented Age 0 individuals; fish from 60 to 85 mm TL were older, probably mostly Age I. Between June and September, these Age I fish were indicated to have grown by about 10 mm TL.

105. Both size classes of river shiners were still identifiable during November 1979. As would be expected, mean lengths of these classes had increased by about 10 to 15 mm since September.

106. Length frequencies of river shiners collected during September 1980, in contrast to September 1979, indicated a population consisting almost entirely of Age 0 fish (Figure 18). This suggested that a large postspawn or overwinter mortality of older shiners may have occurred.

Channel catfish

107. Channel catfish were collected in sizes ranging from approximately 25 to 650 mm. During April, June, and November 1979, all fish were Age I and older (TL > approximately 200 mm), and the range of sizes was similar in all habitats (Table 18). Fish from revetted banks averaged slightly longer than those from other habitats, however.

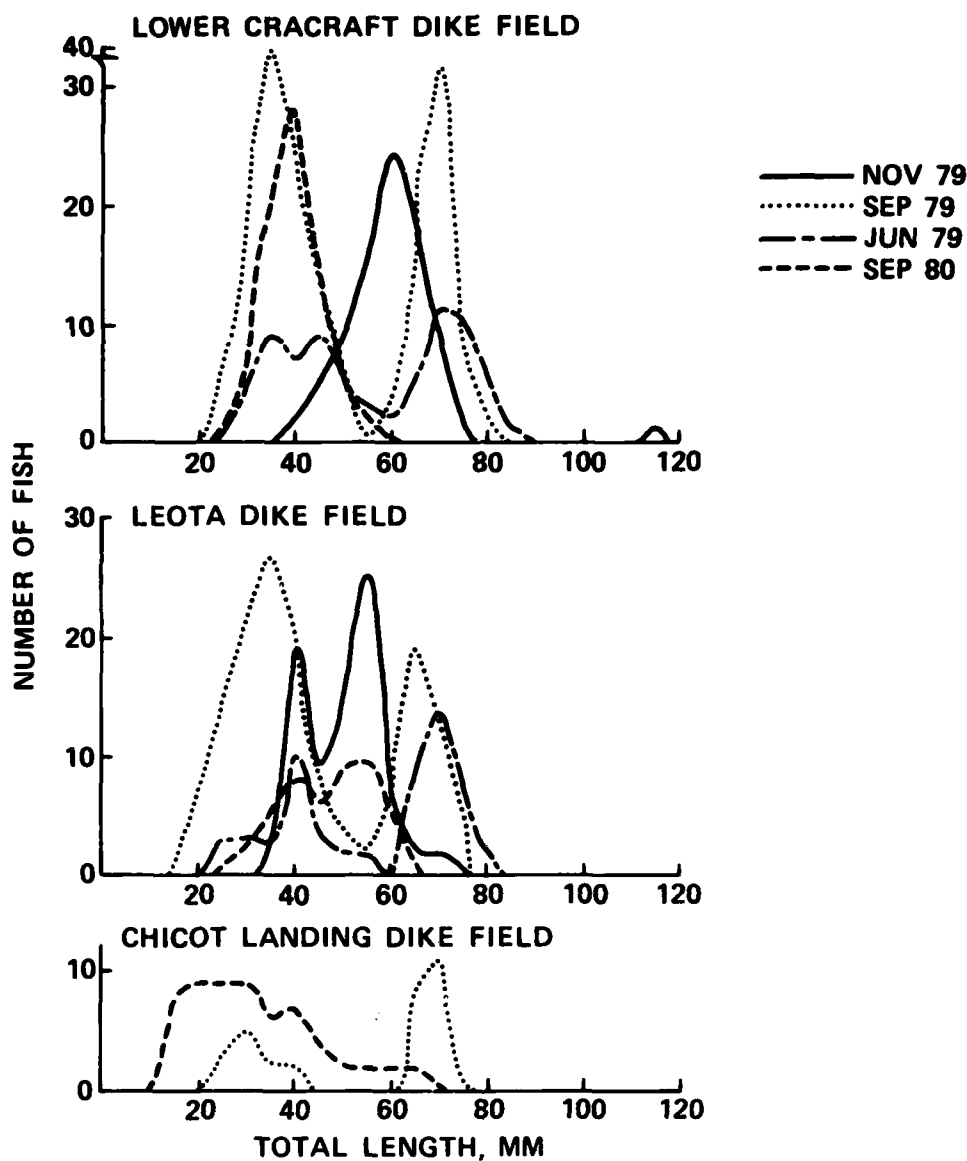


Figure 18. Length frequency of river shiner from three Mississippi River dike fields

108. Young-of-year fish (Age 0) were collected only during the two September samples. In 1979, Age 0 individuals comprised most of the channel catfish captured (Figure 19). Most of these fish were found at Lower Cracraft and Chicot Landing Dike Fields. In contrast, in 1980 few Age 0 channel catfish were collected.

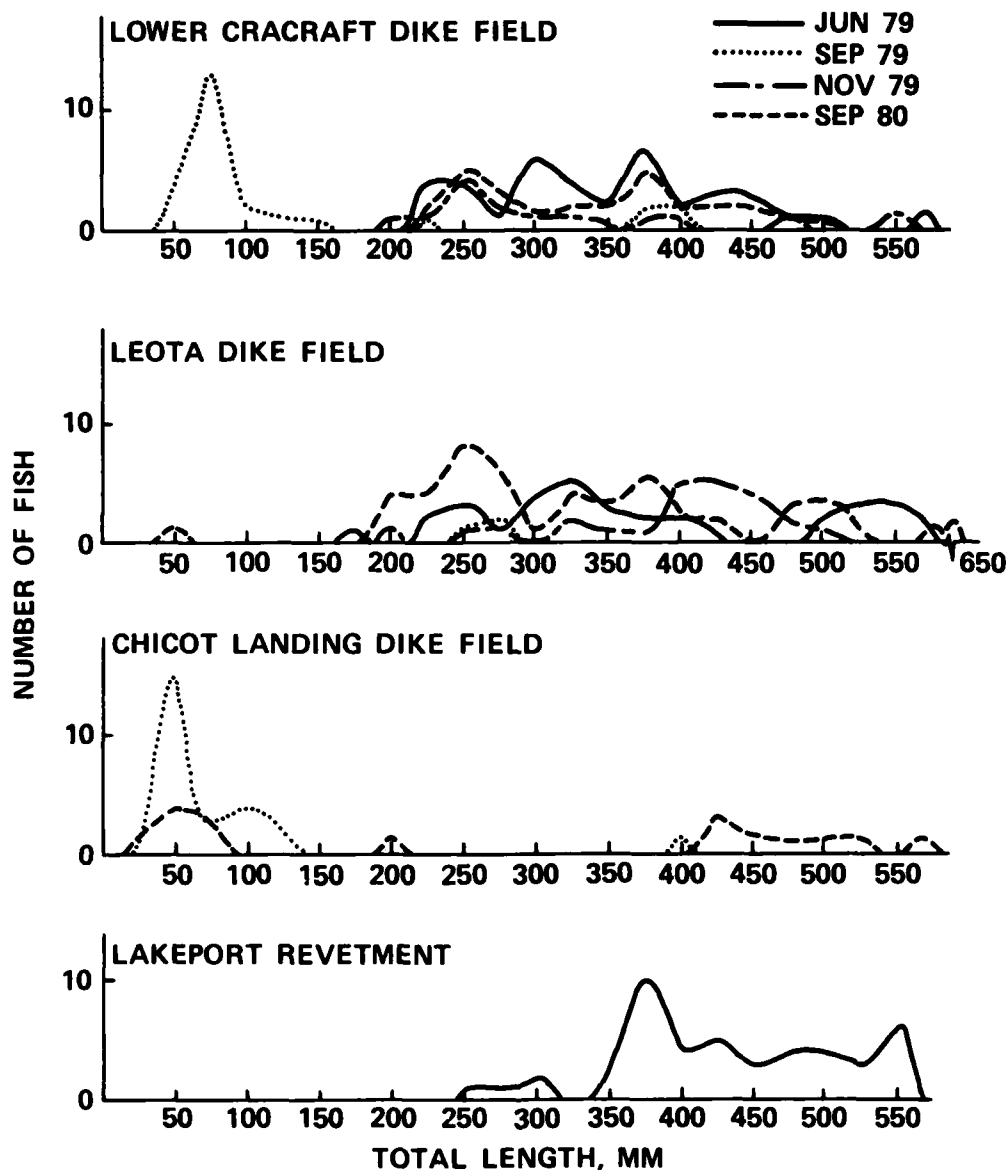


Figure 19. Length frequency of channel catfish from the Mississippi River

Blue catfish

109. Blue catfish ranged from approximately 50 to 725 mm TL (Table 18). Size ranges and mean sizes varied considerably across seasons and habitats. During June, all habitats had blue catfish of similar sizes. In September and November 1979, fish from Walnut Point Revetment averaged considerably larger than those from other habitats. Of the dike

field habitats, Chicot Landing had larger blue catfish than Lower Cracraft or Leota.

110. Large numbers of blue catfish, including many Age 0 fish, were collected at the three dike fields during September 1980 (Figure 20). This distribution did not occur in September 1979, when older fish predominated. If the obvious abundance peaks corresponded to year classes, then at least four, and probably more, ages were represented at this time. Age 0 fish ranged from approximately 50 to 150 mm TL; Age I, 175 to 275 mm TL; Age II, 300 to 375 mm TL; Age III and older, >400 mm.

Flathead catfish

111. Sizes of flathead catfish collected ranged from 50 to 875 mm TL; however, most individuals were relatively large. In general, Lower Cracraft Dike Field and the two revetted banks had the largest flathead catfish (Table 18). During September 1980, however, sizes of flathead catfish at all three dike fields were similar.

River carpsucker

112. With the exception of the abandoned channel during November, river carpsuckers were abundant only in the dike field habitats (Table 18). Age 0 fish were present by June (Figure 21), at which time their mean length was approximately 50 mm. At this time, at least three, and probably four, age classes were present corresponding to the following: Age 0, 25 to 75 mm TL; Age I, 100 to 200 mm TL; Age II, 225 to 350 mm TL; Ages III and older, >375 mm TL.

113. By September 1979, few fish smaller than 100 mm were collected, and by November the mean length of apparent Age 0 fish had increased to 175 mm TL. In contrast, during September 1980, Age 0 river carpsuckers in the 25- to 125-mm length group were relatively abundant.

Condition Factors

Freshwater drum

114. Mean condition factors ranged from 0.99 (Anconia Natural Bank, September 1979) to 1.52 (Island 88 Natural Bank, June 1979). Overall, condition factor average was 1.22. Values were highest in

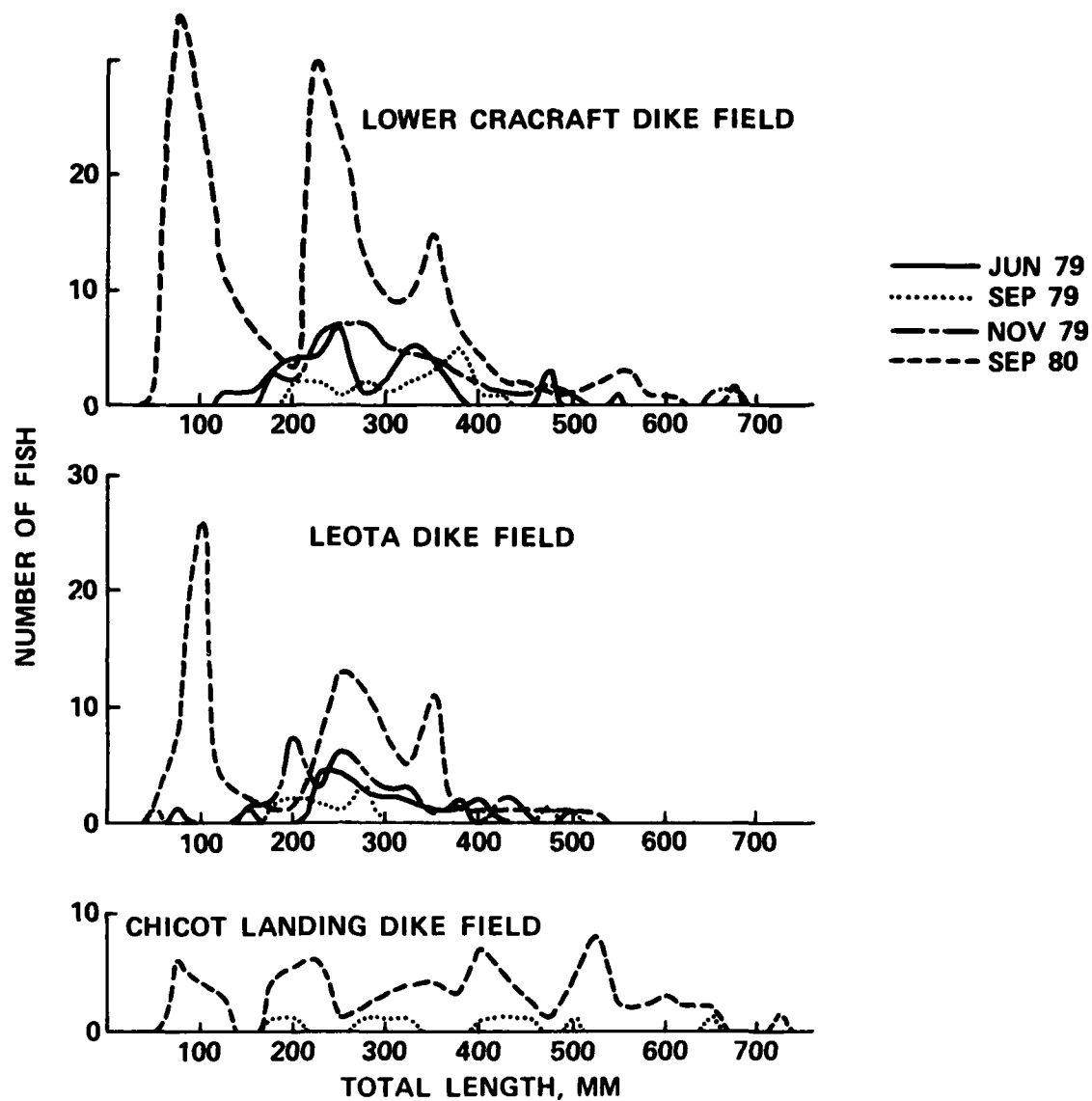


Figure 20. Length frequency of blue catfish from the Mississippi River

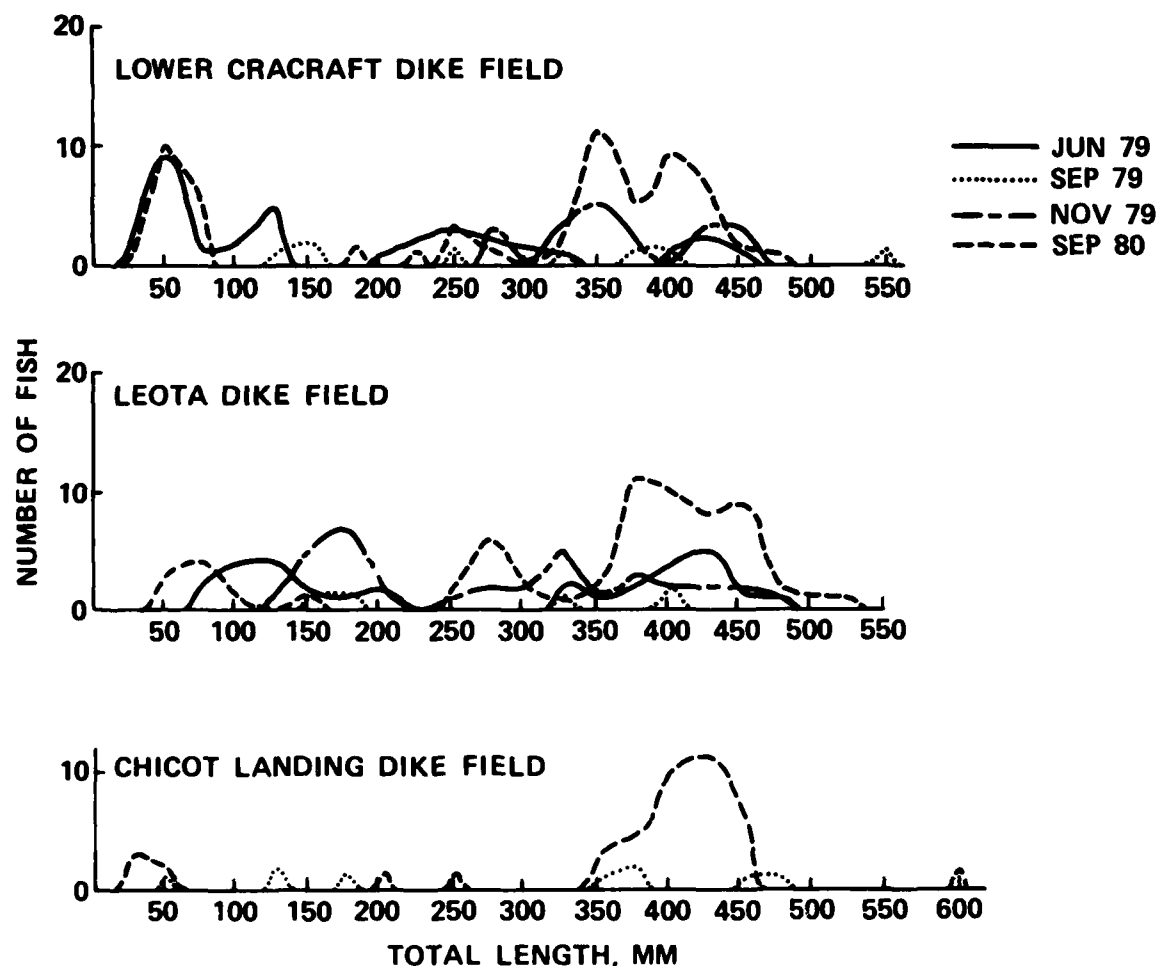


Figure 21. Length frequency of river carpsucker from the Mississippi River

June, and they decreased steadily through November, with one exception (Figure 22). The November 1979 value showed an increase over September at Island 88, but it was based on only a single specimen. Condition factors among habitats were not significantly different during any collecting period.

Gizzard shad

115. Mean condition factors of gizzard shad ranged from 0.83 to 1.10 (Figure 22), and showed no obvious differences among habitats or seasons. The June value for gizzard shad at Island 88 is obviously incorrect, as the condition factor for one of the two specimens was considerably above any other published value. The condition factor for

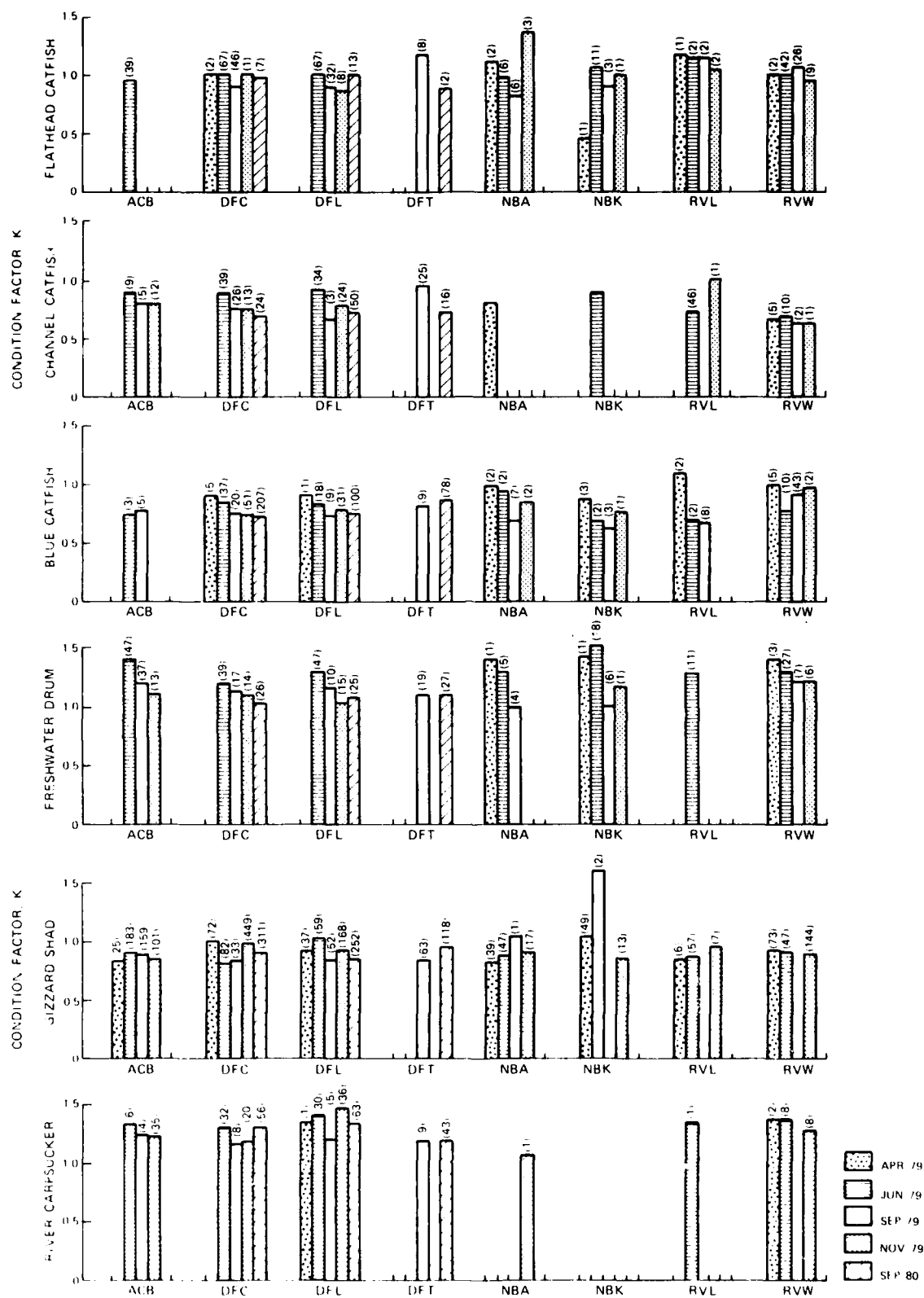


Figure 22. Condition factors for six species of fish from the Mississippi River

gizzard shad across all seasons and habitats averaged 0.91.

River carpsucker

116. River carpsucker condition factors showed no significant differences among habitats or seasons. June values tended to be highest at most habitats, however, and September 1979 values lowest (Figure 22). Overall average condition factor was 1.27.

Flathead catfish

117. Due to the low number of flathead catfish in some collections, mean condition factors varied considerably among seasons in many habitats (Figure 22). Habitats having somewhat larger sample sizes (Chicot Landing and Leota Dike Fields, and Walnut Point Revetment) showed no significant differences either among habitats or seasons (Figure 22). Excluding the unusually low value for the single April Island 88 individual (0.46), condition factors for flathead catfish ranged from 0.85 to 1.37, and they averaged 1.00 overall.

Channel catfish

118. Condition factors of channel catfish were higher during June than during other months, in most habitats. Values for Walnut Point Revetment channel catfish were consistently lower than those for other habitats (Figure 22), although the differences were not significant. Mean condition factors for individual collections ranged from 0.63 to 1.03; the average was 0.84 across all collections.

Blue catfish

119. Condition factors of blue catfish ranged from 0.63 to 1.10 and averaged 0.78. April mean values were highest in all habitats (Figure 22), while September 1979 and 1980 values were generally lowest. Among habitats, condition factors at Anconia Natural Bank always exceeded those at Island 88, and values at Walnut Point Revetment exceeded those at Lakeport except during April 1979 (Figure 22). Small sample sizes in these habitats prevented detection of any significant differences, however. Condition factors of blue catfish from Lower Cracraft Dike Field and Leota Dike Field were similar in all collections. Values at Chicot Landing were somewhat higher than at the other two dike fields during both September low-water samples.

Catch per Unit Effort

120. Since the units of effort for electroshocking and hoop netting were approximately equal in all four habitats, the relative catch per unit effort (C/f, C/y) can be used to compare them. One exception is that gill nets were used in Matthews Bend instead of hoop nets, and can be compared for this gear for only one sampling period.

121. Electroshocking C/f and C/y varied considerably from sampling period to sampling period in all habitats. Averaged across all collections, dike fields and revetted banks had higher C/f and C/y values than did natural banks and the abandoned channel. The difference was approximately 1.5 times greater for the C/f, and ranged from 2.5 to 4.0 times greater for the C/y. These averages do not include the exceptionally high November 1979 Matthews Bend catch, which may be atypical.

122. Hoop net C/f and C/y differed little among habitats. Gill net C/f was similar in the dike fields and the abandoned channel, but C/y was higher in the abandoned channel.

PART V: DISCUSSION

123. Since the early 1900's aquatic habitats on the Mississippi River have been altered by the construction of levees, dikes, and revetments, and by dredging. In the unimpounded Middle and Lower Mississippi River, side channels and other extra-channel habitats are being elevated relative to the main channel (Rasmussen 1979). In conjunction with high sedimentation rates, this is steadily reducing the river to predominantly main channel and main channel border habitats (Rasmussen 1979), which are less productive than extra-channel habitats (Barnickol and Starrett 1951; Pflieger 1971; Schramm and Lewis 1974).

124. Within the "reduced" river, aquatic habitats are also created by some modification activities. Some of these habitats, particularly dike fields, may at least partly replace lost habitats. Yet little information is available for comparing the relative merits of Lower Mississippi River habitats.

Comparisons Among Habitats

125. Comparisons among the four habitats investigated in this study are accurate only assuming that the gear types used in each habitat adequately sampled the species occurring there (Green 1979). This assumption was probably not strictly met (see Hocutt and Stauffer 1980) in this study. Nevertheless, it is evident that the habitats differ with respect to the ichthyofaunas they support. Dike fields, for example, harbored considerably more species than the other habitats. For many species, dike fields appeared to provide suitable habitat for many life history stages, from larvae (Schramm and Pennington 1980) to large adults. Age 0 fish were collected almost exclusively in the dike fields. Since most of these fish were collected in seines, the possibility that young fish also use the bank and the abandoned channel habitats cannot be dismissed. However, the occurrence of Age 0 fish of so many species indicates the importance of the dike fields as nursery areas. The progressive increase in the mean size of all age groups from June to

November 1979 also indicates that many species utilize this habitat continuously during much of their life.

126. The diversity of fishes collected from the dike fields was undoubtedly attributable to the variety of microhabitats available. In particular, dike fields offer a wide range of depths, currents, and substrates, which have been shown to be important habitat components affecting fish distributions (Baker and Ross 1981; Gorman and Karr 1978; Harrell 1978; and Sheldon 1980).

127. Revetted and natural banks supported similar fish species overall. These habitats differed considerably in the percentage comprised by the various species, however. Burress, Krieger, and Pennington (1982) and Kallemeyn and Novotny (1977) found this also to be true on the Missouri River. In this study, revetted bank habitats supported the highest percentage, by weight, of sport-commercial fish. Sport-commercial species are generally large, and they may better withstand the higher currents found on revetted banks. Biases of the gear in favor of capturing larger fishes in high current areas may also have been a factor.

128. The relative abundances of many species collected from the abandoned channel were markedly different from those of other habitats. The abundance and weight of sport-commercial species, in particular, was very low in this habitat. Much higher sport-commercial fish percentages were found in apparently similar habitats by Robinson (1972).

129. Despite the differences in number of species, C/f and C/y were not, on the average, greater in the dike fields than in other habitats. Dike fields and revetted banks had higher values overall for electroshocking than natural banks and the abandoned channel; however, values for all habitats were variable across river stages.

130. Fish populations were less distinct during relatively high-water periods (April, and to some extent June) than during low-water periods (September and November). This is probably attributable to a decrease in habitat distinctness, and to increased movement of fishes in response to increasing spring water temperature and flow rate. The inability to seine in the dike fields during April undoubtedly also

contributed to their relative lack of distinctness at this time.

Comparison with Previous Studies

Species composition

131. From a taxonomic standpoint, the ichthyofauna of the unpounded Middle and Lower Mississippi River is reasonably well established. Ecologically, however, information on its fish assemblages is limited (NUS Corporation 1974). Nearly all data that are available have been collected within the past 15 years.

132. The Federal Water Pollution Control Administration (1969) made fish collections at many Lower Mississippi River sites following endrin pollution. Most of these collections were made with coarse-mesh nets for the purpose of providing specific species for pesticide analysis. Thus, their comparative value is severely limited. Robinson (1972), Ragland (1974), and Emge et al. (1974) have reported on collections of fishes from the Middle and Lower Mississippi River bordering Missouri. In these studies, habitats including dike fields, sloughs, and main channel border were sampled but were not always reported separately. Ragland (1974) found that many of the most common species were more abundant in side channels than in main channel border areas. These latter areas often included dike fields. Minnows and juveniles of several species were especially abundant in side channels. Emge et al. (1974) reported a similar abundance distribution of juvenile fishes and minnows. Robinson's (1972) report did not separate the catch by habitat, although several different types were sampled with a wide variety of gears.

133. Few side channels occurred in the study area. One exception, however, was the side channel separating Choctaw Island from the west bank in the vicinity of river miles 558-564. The uppermost part of this side channel was sampled as part of the Chicot Landing Dike Field during September 1979 and 1980. At these times, its fish assemblages were quite similar to those of the other dike fields. In many respects, dike fields and side channels are quite similar. Both provide substantial areas of

variable depth, moderate to slack-water habitat during most river stages. In many instances, the nature of side channels is regulated by the presence of dikes (Ellis, Farabee, and Reynolds 1979). Although the relative abundance of some species in our study differed from the above studies, the species composition of our dike fields was very similar to their side channels. This suggests that, in our river reach, dike fields may replace side channels as habitat for many species.

134. Two recent studies have been accomplished in the general river reach of the present study, and are particularly pertinent for comparative purposes. NUS Corporation (1974) made fish collections in a number of river habitats in the vicinity of Grand Gulf, Miss. The James, Miss., area (vicinity of river mile 522), including some locations sampled in the present study, was sampled intensively by CDM/Limnetics (1976). Differences in the number and kinds of habitats sampled, and in gears employed, make comparisons with even these studies difficult, however. Comparisons of the relative abundances of the numerically dominant fish species in the above two studies (NUS Corporation 1974; CDM/Limnetics 1976) with those of the present study are presented in Table 19. Gizzard shad, freshwater drum, blue catfish, flathead catfish, and river carpsucker were among the 10 most abundant species in all three studies. Other relatively abundant species included bluegill, smallmouth buffalo, carp, skipjack herring, threadfin shad, and channel catfish.

135. The numerical importance of species common to backwater habitats (e.g., carp, smallmouth buffalo, shortnose gar, black and white crappie, and river carpsucker) were greater in the NUS Corporation (1974) and CDM/Limnetics (1976) studies than in the present study. In the former studies, these habitats were more extensively sampled. Our study placed a relatively greater amount of the total effort in the dike field habitats. Minnows and shiners, which inhabit sandbar habitats in many rivers (Shipp and Hemphill 1974; Morganweck 1971; Laser et al. 1969; Starrett 1950), were considerably more abundant in the present study. The relative numerical abundance of other species was thus reduced.

136. Gear use may also have contributed to some of the differences

shown in Table 19. Trammel nets, gill nets, and hoop nets were used most extensively by NUS Corporation (1974) and CDM/Limnetics (1976). We utilized primarily electroshocking, hoop nets, and seines. The effect of seining in the extensive sandbar areas characteristic of dike fields is evident in Table 19.

137. Species composition of hoop net samples in the above three studies was very similar, although we collected relatively fewer river carpsucker and more flathead catfish. Gill net catches were also similar, with the major differences being that we captured fewer goldeye and threadfin shad, and more skipjack herring. Seining results, although difficult to compare quantitatively, were similar in species composition.

138. Dike fields probably undergo a successional process from a more riverine to a more lentic habitat similar to that suggested for side channels (Ellis, Farabee, and Reynolds 1979; Simons et al. 1975). The eventual result is a complete filling in of most dike fields and side channels. Many dike fields on the Mississippi River have, in fact, reached this point in as few as 15 years. The rapidity and degree of depositional filling depends on many factors, including dike design. Studies to determine the effects of some dike design modifications have been completed or are under way (Pierce 1980; Kallemeyn and Novotny 1977). Even so, it is obvious that the loss of the dike field habitat on the Mississippi River would seriously affect the overall quality of fish habitat.

Length-frequency and condition factors

139. All specimens of each species in a collection were included in calculations of mean condition factors. Since condition factors often vary between sexes and among sizes within a species (Carlander 1969), and may also vary among gear types (Ricker 1975), only general comparisons with other studies are possible.

140. River carpsucker condition factors corresponded well with those presented by Carlander (1969). CDM/Limnetics (1976), however, reported considerably higher values (1.42 versus 1.27). This may reflect a tendency for trammel nets, used extensively by CDM, to capture heavier

fish at given lengths (Ricker 1971). Carlander (1969) reports spawning of river carpsucker from late April into July. Length-frequency analysis indicates that this species spawns relatively early during this period in our river reach. Although the number of intermediate-sized river carpsucker was rather low in our study, growth appeared to be somewhat faster than reported by Pflieger (1975), Robinson (1972), or Carlander (1969).

141. Condition factors of gizzard shad collected during this study averaged nearly 10 percent smaller than reported by both Carlander (1969) and CDM/Limnetics (1976). Our range of condition factors also included values lower than any given in either of the other sources. Gizzard shad spawn primarily from April to June (Carlander 1969), and in our study area they probably do so relatively early during this period (NUS Corporation 1974; CDM/Limnetics 1976). Therefore, fish collected during April are indicative of sizes attained at about 1-year intervals. Mean lengths of gizzard shad at these ages from our collections are similar to those reported by Carlander (1969), CDM/Limnetics (1976), and Pflieger (1975).

142. Mean condition factor values for flathead and channel catfish were nearly identical to those derived from Carlander (1969), while our values for blue catfish were smaller (0.87 versus 0.78). Condition factors for all three catfish species averaged smaller at the James, Miss., site in the CDM/Limnetics (1976) study. The size distribution of these species in our study was insufficient to accurately compare relative growth rates with other studies. However, growth of channel and flathead catfish appeared to be greater than for more northern areas (Carlander 1969). Growth of blue catfish was almost certainly intermediate between northern and Louisiana brackish-water populations reported by Carlander (1969).

143. Mean condition factors for freshwater drum were similar to those found by CDM/Limnetics (1976). Freshwater drum approximately 25 to 60 mm TL occurred in June 1979, slightly larger at that time than reported by Pierce (1980) for Upper Mississippi River fish. This is consistent with the general observation that fish spawn earlier in the

southern part of their range than in the northern part.

144. Mean lengths of the age groups of river shiners reported here were slightly larger than sizes listed by Carlander (1969) from more northern parts of their range. Except for a single 115-mm-TL specimen, however, the maximum size of river shiners collected (95 mm) was considerably smaller than that reported elsewhere (Carlander 1969).

145. Differences in the time of appearance and in mean size of Age 0 fish of some species indicated that spawning success and/or growth of juvenile fishes was quite different between 1979 and 1980. These differences were especially noticeable for channel and blue catfishes. Such year-to-year fluctuations were apparently common in riverine environments (Grossman, Moyle, and Whitaker 1981; Starrett 1951). These same dynamic changes in the populations of many river fishes may also account for much of the abundance variation between studies from the same place during different years (Grossman, Moyle, and Whitaker 1981).

PART VI: CONCLUSIONS AND RECOMMENDATIONS

Conclusions

146. The species collected during this study, and their relative abundances, were similar to those previously reported for the Lower Mississippi River.

147. Fish populations differed considerably among the four habitat types investigated. The greatest number of species was captured in the dike field habitat (53), followed in order by the abandoned channel (31), revetted banks (27), and natural banks (24).

148. The three dike fields were similar at most sampling periods in terms of species composition but were often different in the relative abundances of the constituent species. The two natural banks were generally similar in terms of both indices, while the revetted banks showed greater variability and overall lower similarity.

149. For comparable gears, numerical catch per unit effort (C/f) was seldom significantly different among habitats. Catches on revetted banks exceeded those on natural banks except during April 1979. The C/f in the abandoned channel was approximately seven times that of any other habitat during November 1979.

150. Biomass catch per unit effort (C/y) indicated a general ranking by habitat of revetted banks - dike fields - natural banks - abandoned channel, with two exceptions. During April 1979, the C/y of dike fields and natural banks exceeded that of revetted banks. During November 1979, C/y in the abandoned channel was greatest of all habitats.

151. Condition factors showed no significant differences among habitats or seasons. In most cases, condition factors reported in this study were similar to those reported in other studies.

152. Length frequency analysis showed differences in the size ranges of fish utilizing the four habitats. In particular, Age 0 fish of many species were abundant in dike fields, and to a lesser extent, the abandoned channel. Mostly adult fish were collected at natural and revetted bank habitats. The extent to which this was caused by gear

differences is not known. General theoretical considerations suggested, however, that the size distributions of fishes encountered in this study were realistic.

153. The differences in species, relative abundances, and length frequencies among habitats suggests that each habitat is valuable in maintaining the overall riverine ichthyofauna. Precise determination of their relative worth, however, cannot be made without further research concerning the actual use made of these habitats by the component species.

Recommendations

154. Because of the very nature and functional purpose of dikes, the aquatic habitat found in a dike field is short lived. Engineering features should be incorporated during design and maintenance stages to increase longevity of the aquatic habitat of a dike field.

155. The aquatic habitats found between the levees on the Lower Mississippi River are important to different life stages of many fish species. It is realized that navigation channel maintenance receives highest priority, but care should be exercised when dikes and revetments are placed so that side- and off-channel habitat integrity is not greatly altered.

156. Additional work is needed to determine the specific uses of dikes and revetments by fish. In particular, it should be determined whether fish are benefiting directly from these structures as residents, or whether these areas are utilized only by transient species.

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Table 1

Sampling Effort by Gear Type* Across Sampling Dates and Habitats

Habitat**	Apr 79						Jun 79						Sep 79						Nov 79						Sep 80						Totals							
	ES	HN	EG	SN	MT		ES	HN	EG	SN	MT		ES	HN	EG	SN	MT		ES	HN	EG	SN	MT		ES	HN	EG	SN	MT		ES	HN	EG	SN	MT			
	ES	HN	EG	SN	MT		ES	HN	EG	SN	MT		ES	HN	EG	SN	MT		ES	HN	EG	SN	MT		ES	HN	EG	SN	MT		ES	HN	EG	SN	MT			
DFC	11	18	--	--	--		10	62	--	7	16	17	68	--	11	12	22	56	12	8	14	23	--	17	12	--	83	204	29	38	42							
DFL	10	19	--	--	--		11	62	--	8	19	16	66	--	17	22	13	36	6	10	17	10	--	12	18	--	60	183	18	53	58							
DFT	--	--	--	--	--		--	--	--	--	--	10	26	6	6	11	--	--	--	--	--	--	13	--	12	20	--	23	26	18	26	11						
RVW	19	48	--	--	--		12	52	--	--	--	12	48	--	--	--	--	12	52	--	--	--	--	--	--	--	55	200	--	--	--							
RVL	3	16	--	--	--		3	15	--	--	--	2	12	--	--	--	--	3	15	--	--	--	--	--	--	--	11	58	--	--	--							
NBK	3	16	--	--	--		3	16	--	--	--	3	16	--	--	--	--	3	16	--	--	--	--	--	--	--	12	64	--	--	--							
NBA	3	16	--	--	--		3	16	--	--	--	3	16	--	--	--	--	3	15	--	--	--	--	--	--	--	12	63	--	--	--							
ACB	9	--	3	--	--		6	--	6	--	6	--	6	--	6	--	6	--	6	--	6	--	--	--	--	--	27	--	21	--	--							

* ES = electroshocker; HN = hoop net; EG = gill net; SN = seine; MT = minnow trap.

** DFC = Lower Cracraft Dike Field; DFL = Leota Dike Field; DFT = Chicot Landing Dike Field; RVW = Walnut Point-Kentucky Bend Revetment; RVL = Lakeport Revetment; NBK = Island 88 Natural Bank; NBA = Anconia Natural Bank; ACB = Matthews Bend Abandoned Channel. The three-letter abbreviation will be used in all the following tables to designate structures and habitats sampled.

Table 2
Families, Species, and Economic Classification of Fish Captured

Family and Species	Economic Classification*
Acipenseridae - sturgeons	
Shovelnose sturgeon (<i>Scaphirhynchus platyrhynchus</i>)	2,3
Polyodontidae - paddlefishes	
Paddlefish (<i>Polyodon spathula</i>)	3
Lepisosteidae - gars	6
Spotted gar (<i>Lepisosteus oculatus</i>)	6
Longnose gar (<i>Lepisosteus osseus</i>)	6
Shortnose gar (<i>Lepisosteus platostomus</i>)	6
Alligator gar (<i>Lepisosteus spatula</i>)	6
Amiidae - bowfins	
Bowfin (<i>Amia calva</i>)	4,6
Anguillidae - freshwater eels	
American eel (<i>Anguilla rostrata</i>)	2,3
Clupeidae - herrings	5
Skipjack herring (<i>Alosa chrysochloris</i>)	5
Gizzard shad (<i>Dorosoma cepedianum</i>)	5
Threadfin shad (<i>Dorosoma petenense</i>)	5
Hiodontidae - mooneyes	
Goldeye (<i>Hiodon alosoides</i>)	2,4
Mooneye (<i>Hiodon tergisus</i>)	5
Esocidae - pikes	
Pickerel (<i>Esox</i> sp.)	1,2,4
Cyprinidae - minnows and carps	2,4,5
Carp (<i>Cyprinus carpio</i>)	2,4
Mississippi silvery minnow (<i>Hybognathus nuchalis</i>)	5

(Continued)

* Economic Classification (from Lagler 1956): 1 = Sport, 2 = Commercial, 3 = Fine food, 4 = Coarse food, 5 = Forage, 6 = Other.

(Sheet 1 of 3)

Table 2 (Continued)

Family and Species	Economic Classification
Cyprinidae - minnows and carps (Continued)	
Speckled chub (<i>Hybopsis aestivalis</i>)	5
Silver chub (<i>Hybopsis storeriana</i>)	5
Emerald shiner (<i>Notropis atherinoides</i>)	5
River shiner (<i>Notropis blennius</i>)	5
Pugnose minnow (<i>Notropis emiliae</i>)	5
Spottail shiner (<i>Notropis hudsonius</i>)	5
Red shiner (<i>Notropis lutrensis</i>)	5
Taillight shiner (<i>Notropis maculatus</i>)	5
Silverband shiner (<i>Notropis shumardi</i>)	5
Weed shiner (<i>Notropis texanus</i>)	5
Blacktail shiner (<i>Notropis venustus</i>)	5
Mimic shiner (<i>Notropis volucellus</i>)	5
Bullhead minnow (<i>Pimephales vigilax</i>)	5
Catostomidae - suckers	
River carpsucker (<i>Carpiodes carpio</i>)	2,4
Quillback (<i>Carpiodes cyprinus</i>)	2,4
Highfin carpsucker (<i>Carpiodes velifer</i>)	2,4
Blue sucker (<i>Cycleptus elongatus</i>)	2,4
Smallmouth buffalo (<i>Ictiobus bubalus</i>)	2,4
Bigmouth buffalo (<i>Ictiobus cyprinellus</i>)	2,4
Spotted sucker (<i>Minytrema melanops</i>)	2,4
Ictaluridae - freshwater catfishes	
Blue catfish (<i>Ictalurus furcatus</i>)	3
Yellow bullhead (<i>Ictalurus natalis</i>)	1,3
Channel catfish (<i>Ictalurus punctatus</i>)	1,2,3
Flathead catfish (<i>Pylodictis olivaris</i>)	2,3
Cyprinodontidae - killifishes	
Blackspotted topminnow (<i>Fundulus olivaceus</i>)	5
Poeciliidae - livebearers	
Mosquitofish (<i>Gambusia affinis</i>)	5,6

(Continued)

(Sheet 2 of 3)

Table 2 (Concluded)

Family and Species	Economic Classification
Atherinidae - silversides	
Brook silverside (<i>Labidesthes sicculus</i>)	5
Inland silverside (<i>Menidia beryllina</i>)	5
Percichthyidae - temperate basses	
White bass (<i>Morone chrysops</i>)	1,2,3
Striped bass (<i>Morone saxatilis</i>)	1,3
Centrarchidae - sunfishes	
Warmouth (<i>Lepomis gulosus</i>)	1,3
Orangespotted sunfish (<i>Lepomis humulis</i>)	6
Bluegill (<i>Lepomis macrochirus</i>)	1,3
Longear sunfish (<i>Lepomis megalotis</i>)	6
Redear sunfish (<i>Lepomis microlophus</i>)	1,3
Largemouth bass (<i>Micropterus salmoides</i>)	1,3
White crappie (<i>Pomoxis annularis</i>)	1,3
Black crappie (<i>Pomoxis nigromaculatus</i>)	1,3
Percidae - perches	
Sauger (<i>Stizostedion canadense</i>)	1,2,3
Sciaenidae - drums	
Freshwater drum (<i>Aplodinotus grunniens</i>)	2,4
Mugilidae - mullets	
Striped mullet (<i>Mugil cephalus</i>)	2,5

Table 3
Relative Abundance of Fish Captures at Lower Cracraft Dike Field by Sampling Date and Gear*

Species	Apr 79				Jun 79				Sep 79				Nov 79				Sep 80				Total					
	HN	ES	TL	TL	HN	ES	MT	SN	TL	EG	HN	ES	MT	SN	TL	EG	ES	SN	TL							
Shovelnose sturgeon	6.7		0.4	0.5					0.1							0.5				0.2	0.3		0.1	0.1	0.1	0.1
Paddlefish		0.4	0.4																							0.1
Spotted gar						0.4																				0.1
Longnose gar						0.7																				0.1
Shortnose gar						0.4					1.5	1.7									1.6					0.4
Alligator gar						0.4																				0.4
American eel																										0.4
Skipjack herring	14.3	13.4				1.1	0.4				3.1	2.6						0.2		0.1						0.2
Gizzard shad	82.1	77.0	1.1	66.5		0.4	24.9					5.2				0.6	7.1	1.8		0.6	3.0	1.6	0.5	0.2	0.9	1.8
Threadfin shad	0.4	0.4		3.3		0.4	0.4	1.3				17.2		1.5	3.1	64.6	1.9	91.7	1.6	56.9	73.5	62.5	1.1	51.1	40.6	
Goldeye				0.4		0.4	3.2	1.3				0.9				0.1			0.9	0.2	0.3	10.8	0.4	3.4	1.2	
Mooneye							0.4	0.1				2.6				0.3	1.1			0.3	4.3	0.3		1.9	1.1	
Carp	60.0		3.8	0.5	2.9							0.9				0.1		0.2		0.1						0.1
Mississippi silvery minnow												12.1				1.3		0.6		0.2	0.2	0.2		0.1	0.7	
Speckled chub																4.8		0.8		0.3					2.3	
Silver chub				0.4		0.4	0.1							5.8	4.8					3.6					1.5	
Emerald shiner							0.7	0.4						0.2	0.2					0.9	0.2		0.2	0.0	0.2	
River shiner				0.4	22.2	26.6	10.3							8.9	7.3			0.4		7.2	2.0		30.3	8.0	5.0	
Spottail shiner													50.0	60.0	49.6			0.2		48.9	12.6		23.9	6.3	16.5	
Red shiner														0.1	0.1											0.1
Silverband shiner				0.7	22.2	5.8	2.7							5.0	4.1					1.3	0.3		1.4	0.4	0.2	0.2
Blacktail shiner				1.1	33.3	1.4	1.3							0.3	0.3					16.0	4.1		2.9	0.8	2.4	2.4
Mimic shiner						2.5	0.9							0.6	0.5					5.0	1.3		9.2	2.4	1.5	1.5
Bullhead minnow																									0.2	0.2
River carpsucker	0.4	0.4	0.5	6.9		4.3	4.3	3.1	5.2					0.5	0.4					0.9	0.2				0.2	0.2
Quillback	0.4	0.4		0.4			0.1								0.8			0.4		1.6	4.5	0.2	2.9	2.7	2.2	2.2
Highfin carpsucker				0.4			0.1													0.1		0.1		0.0	0.1	0.1
Blue sucker																		0.2		0.2					0.2	0.2
Smallmouth buffalo				3.8																						0.4
Bigmouth buffalo				0.5	1.8			2.2	1.6	3.1					0.2	0.2	0.2	0.5		0.2	0.2	0.2	0.2	0.2	0.4	0.1
Blue catfish	20.0	0.9	2.1	19.0	0.7							3.4			0.4											0.1
Channel catfish				19.0	1.5				5.0	7.7	12.9				1.9	13.1	5.7			4.1	5.5	24.2		9.8	6.0	6.0
Flathead catfish									6.2	3.1	3.4	33.3	2.1		2.5	1.6	13.2			1.0	2.6			1.1	1.8	
Mosquitofish	13.3		0.8	36.4					9.0	67.7	1.7				4.4					0.1	0.1	0.9		0.3	2.3	2.3
Brook silverside									0.4	0.1																0.1
														0.3	0.3					0.3	0.1		0.5	0.1	0.1	0.1

(Continued)

* Gear types are identified in column headings as follows: EG = experimental gill net; ES = electroshocker; HN = hoop net; MT = minnow trap; SN = seine; TL = total for all gear types.
** Values less than 0.05.

Table 3 (Concluded)

Species	Apr 79				Jun 79				Sep 79				Nov 79				Sep 80				Total			
	HN	ES	TL		HN	ES	TL		HN	ES	TL	SN	TL	EG	HN	ES	TL	SN	TL	EG		ES	SN	TL
Inland silverside																								
White bass		0.4	0.4			2.2	6.8	2.5	0.9			10.2	8.4									16.0	4.2	3.5
Striped bass					0.7		0.4	16.2	6.8		5.2	0.2	0.8			4.1	9.4	2.2		2.5	0.9		0.4	1.8
Bluegill					1.1		0.4	0.4	0.4		1.7	0.1	0.3			22.6			0.3	1.0	0.3		0.1	1.8
Largemouth bass																								0.1
White crappie					1.1	1.8			0.9		6.9		0.8			15.1				0.6	0.3	0.2	0.0	0.4
Black crappie								1.4	0.5		2.6		0.3			9.4				0.4			0.1	**
Sauger						1.8		2.5	1.6		4.3		0.5			1.1	1.9	0.4		0.6	0.8		0.3	0.5
Freshwater drum					16.3	2.9		0.4	5.2	10.8	8.6		1.6	0.8	13.2	0.8			1.1	3.1		1.3	0.6	
Striped mullet						0.4	0.1									0.2			0.1	0.1		0.0	1.8	
Fish not identified to species:																								
Lepomis spp.												16.7	0.1											**
Catostomidae								1.4	0.5			0.1	0.1										0.1	0.1
Motropis spp.																		0.3	0.1			11.1	2.9	1.2
Morone spp.								0.7	0.3															**

** Values less than 0.05.

Table 4
Relative Percent by Weight of the Ten Dominant Fish Species
Captured from the Lower Cracraft Dike Field

<u>Species</u>	<u>Apr 79</u>	<u>Jun 79</u>	<u>Sep 79</u>	<u>Nov 79</u>	<u>Sep 80</u>	<u>Total</u>
Gizzard shad	31.9	8.9	3.5	37.6	43.4	26.2
Flathead catfish	3.3	40.5	34.3	0.7	1.6	17.1
Blue catfish	6.7	6.5	4.5	13.0	17.1	10.8
Carp	27.2	7.7	25.3	5.4	2.6	10.3
River carpsucker	--	3.7	2.3	8.3	12.5	6.9
Channel catfish	--	10.6	1.4	3.3	3.9	4.8
Skipjack herring	18.7	*	0.1	8.0	1.7	2.2
White bass	0.1	1.5	3.7	7.0	1.9	3.0
Freshwater drum	--	6.2	3.1	2.1	1.6	3.0
Smallmouth buffalo	--	4.1	3.0	3.0	0.9	2.5
Total percent:	87.9	89.7	81.2	88.4	87.2	86.8

* = trace.

Table 5
Relative Abundance of Fish Captured at Leota Dike Field by Sampling Date and Gear*

Species	Apr 79				Jun 79				Sep 79				Nov 79				Sep 80			
	HN	ES	TL	TL	HN	ES	MT	SN	TL	HN	EG	ES	MT	SN	TL	TL	EG	ES	SN	TL
Shovelnose sturgeon					1.2				0.3								0.3			0.1
Paddlefish																				0.1
Spotted gar	1.3	1.2															0.2			0.1
Longnose gar						2.9				0.5	12.0	5.1			1.5		0.4	0.8		0.2
Shorthose gar	1.3	1.2	0.6			3.8				0.8	6.0				0.5		0.2	1.5		0.4
Alligator gar						1.0				0.2										0.5
American eel					0.6					0.2										0.5
Skipjack herring	11.1	15.8	15.5			1.9				0.3										0.5
Gizzard shad	44.4	77.0	75.2	0.6		49.5				1.8	9.5	20.3			7.9	8.4	4.0	66.1	50.2	0.3
Threadfin shad						10.5				3.4	3.6									0.3
Goideye												6.8			0.6		1.7	1.0		0.8
Mooneye						1.0				1.5	1.0									0.2
Carp	22.2	1.3	2.5	2.3	1.9					2.1	1.1									1.1
Mississippi silvery minnow																				0.9
Speckled chub										0.9	0.5									0.2
Silver chub										1.5	0.8									0.2
Emerald shiner										39.3	20.8									0.2
River shiner	0.7	0.6								2.1	1.1									0.2
Red shiner										2.1	1.1									0.2
Silverband shiner						53.8				3.4	2.9									0.2
Blacktail shiner										2.7	1.5									0.2
Mimic shiner										7.6	4.0									0.2
Bullhead minnow										46.2	3.0	2.6								0.2
River carp, cher	11.1	0.6	6.4	8.6						3.0	4.8									0.2
Quillback										0.3	0.2									0.2
Highfin carpsucker																				0.2
Blue sucker	11.1	0.6	0.6							4.9	4.0	2.0	5.1		0.6		2.2	1.0		0.1
Smallmouth buffalo	0.7	0.6	2.9	3.8																0.1
Bigmouth buffalo	0.7	0.6																		0.1
Blue catfish	0.7	0.6								3.1	10.0	3.4	20.0	0.2	1.5	20.0	11.1	0.5		7.3
Channel catfish										5.5	6.0				0.5	4.0	3.9	7.3		3.3
Flathead catfish										10.8	58.0	5.1			5.2	14.0	0.6			3.5
Blackspotted topminnow																				0.2
Mosquitofish																				0.4
Brook silverside																				0.4

(Continued)

* Gear types are identified in column headings as follows: EG = experimental gill net; ES = electroshocker; HN = hoop net; MT = minnow trap; SN = seine; TL = total for all gear types.
 ** Values less than 0.05.

Table 5 (Continued)

Species	Apr 79					Jun 79					Sep 79					Nov 79					Sep 80					Total	%									
	HN	ES	TL	HN	ES	TL	SN	MT	HN	ES	TL	SN	MT	HN	ES	TL	SN	MT	HN	ES	TL	SN	MT	HN	ES			TL	SN	MT	HN	ES	TL	SN	MT	
Island silverside							0.9	0.5				3.0	2.4																							
White bass							1.9	7.6	4.4			0.4	0.3																							
Striped bass																																				
Bluegill																																				
Longear sunfish							0.7	0.6				0.2	0.2																							
Longear sunfish												0.2																								
Longear sunfish							0.6																													
Largemouth bass																																				
White crappie							1.9					0.3	0.3																							
White crappie												0.3	0.2																							
Black crappie																																				
Black crappie							1.0					1.2	0.8																							
Sauger																																				
Sauger												0.8																								
Freshwater drum							17.9	1.0				4.6	7.6																							
Freshwater drum																																				
Striped mullet							2.9						0.5																							
Striped mullet																																				
Fish not identified to species:																																				
Morone spp.												5.5	2.9																							
Morone spp.												2.1	1.1																							
Notropis spp.																																				
Hybopsis spp.																																				
Hybopsis spp.																																				
Lepomis spp.																																				
Lepomis spp.																																				
Total number caught:																																				
Total number species:																																				

** Values less than 0.05.

Table 6
Relative Percent by Weight of the Ten Dominant Fish
Species Captured from the Leota Dike Field

<u>Species</u>	<u>Apr 79</u>	<u>Jun 79</u>	<u>Sep 79</u>	<u>Nov 79</u>	<u>Sep 80</u>	<u>Total</u>
Carp	28.7	6.1	5.0	38.9	18.1	19.0
Flathead catfish	--	31.7	32.4	3.1	6.0	14.9
River carpsucker	2.4	10.2	3.9	10.2	23.9	13.7
Gizzard shad	19.4	6.3	1.7	17.0	13.6	11.4
Channel catfish	--	16.1	0.6	9.6	12.9	11.0
Smallmouth buffalo	7.9	8.1	8.5	2.4	4.4	5.5
Blue catfish	1.5	3.0	2.7	5.3	8.3	5.2
Longnose gar	--	2.5	25.8	0.2	1.6	4.1
Freshwater drum	--	6.2	4.2	2.7	2.7	3.7
Shortnose gar	5.1	3.7	4.1	1.0	2.4	2.7
Total percent:	65.0	93.9	88.9	90.4	93.9	91.2

Table 7

Relative Abundance of Fish Captures at Chicot Landing Dike Field
by Sampling Date and Gear*

Species	Sep 79, %				Sep 80, %				% Total		
	HN	EG	ES	MT	SN	TL	EG	ES		SN	TL
Longnose gar		9.5				0.3	2.0			0.3	0.3
Shortnose gar		9.5	3.1		0.2	0.7	2.4	2.7		0.5	0.6
Skipjack herring			4.7		0.2	0.5	0.4		0.1	0.1	0.3
Gizzard shad	33.3		40.6		4.8	8.2	39.8	37.3		8.1	8.2
Threadfin shad					0.6	0.5		1.3	2.6	2.1	1.6
Goldeye			7.8			0.7					0.2
Mooneye			3.1			0.3					0.1
Carp		14.3	4.7			0.8	2.8	1.3		0.5	0.6
Mississippi silvery minnow			1.6		4.4	3.7			0.2	0.2	1.3
Speckled chub					6.0	4.8			1.4	1.1	2.3
Silver chub			1.6		5.3	4.4					1.5
Emerald shiner			12.5		6.0	5.9			3.8	3.0	3.9
River shiner				20.7	4.2	4.2			7.1	5.7	5.2
Pugnose minnow					0.2	0.1					**
Spottail shiner					0.2	0.1					**

(Continued)

* Gear types are identified in column headings as follows: EG = experimental gill net; ES = electro-shocker; HN = hoop net; MT = minnow trap; SN = seine; TL = total for all gear types.
 ** Values less than 0.05.

(Sheet 1 of 3)

Table 7 (Continued)

Species	Sep 79, %				Sep 80, %				Total %		
	HN	EG	ES	MT	SN	TL	EG	ES		SN	TL
Red shiner					1.8	1.4			0.2	0.1	0.6
Taillight shiner				6.9		0.3					0.1
Silverband shiner				13.8	23.3	19.3			39.5	31.3	27.4
Weed shiner					0.3	0.3					0.1
Blacktail shiner					5.5	4.4			21.9	17.4	13.1
Mimic shiner					4.2	3.4			0.2	0.2	1.2
Bullhead minnow				13.8	21.6	18.0			3.9	3.1	8.0
River carpsucker	9.1		4.7		0.5	1.2	19.9		0.4	3.5	2.7
Quillback	3.0					0.1					**
Highfin carpsucker			3.1			0.3			0.1	0.1	0.1
Blue sucker								1.3		0.1	**
Smallmouth buffalo	3.0	4.8	1.6			0.4	1.2			0.2	0.3
Bigmouth buffalo							0.8		0.1	0.2	0.1
Blue catfish	12.1	19.0	1.6			1.2	13.9	54.7	0.2	5.0	3.8
Channel catfish			1.6	24.1	2.7	3.3	3.2		0.6	1.0	1.8
Flathead catfish	24.2					1.0	0.4	1.3		0.1	0.4
Mosquitofish									0.8	0.6	0.4
Brook silverside					1.8	1.4			0.1	0.1	0.5
Inland silverside					3.1	2.5			2.1	1.7	1.9

(Continued)

(Continued)

** Values less than 0.05.

(Sheet 2 of 3)

Table 7 (Concluded)

Species	HN	Sep 79, %			SN	TL	Sep 80, %			TL	% Total
		EG	ES	MT			EG	ES	SN		
White bass					0.3	0.3	1.6		0.2	0.4	0.3
Striped bass									0.1	0.1	**
Warmouth				3.4		0.1			0.1	0.1	0.1
Bluegill				17.2	1.1	1.6			5.2	4.1	3.3
White crappie			1.6			0.1	0.4			0.1	0.1
Black crappie	27.3					1.2	0.4			0.1	0.4
Sauger	3.0		3.1			0.4					0.1
Freshwater drum	18.2	9.5	3.1		1.5	2.5	10.8		0.1	1.8	2.0
Fish not identified to species:											
Carpiodes spp.					0.2	0.1					**
Lepomis spp.					0.2	0.1			7.0	5.5	3.8
Notropis spp.									1.4	1.1	0.7
Centrarchidae									0.3	0.3	0.2
Cyprinidae									0.2	0.2	0.1
Dorosoma spp.									0.2	0.1	0.1
Esox spp.									0.1	0.1	**
Total number caught:	33	21	64	29	619	766	251	75	1247	1573	2339
Total number species:	9	6	17	7	24	38	15	7	24	33	42

** Values less than 0.05.

(Sheet 3 of 3)

Table 8
Relative Percent by Weight of the Ten Dominant Fish Species
Captured from the Chicot Landing Dike Field

<u>Species</u>	<u>Sep 79</u>	<u>Sep 80</u>	<u>Total</u>
Blue catfish	14.2	36.0	30.9
River carpsucker	8.4	19.3	16.8
Gizzard shad	5.8	17.0	14.4
Carp	19.7	5.5	8.8
Longnose gar	5.8	7.9	7.4
Channel catfish	1.3	4.0	3.4
Freshwater drum	5.6	2.7	3.4
Flathead catfish	12.0	0.5	3.2
Smallmouth buffalo	6.6	1.5	2.7
Shortnose gar	3.9	1.8	2.3
Total percent:	83.3	96.2	93.3

Table 9
Similarity Comparisons of Three Dike Field Habitats
on the Lower Mississippi River

<u>Sampling Date</u>	<u>Location Pair</u>					
	<u>DFL-DFC*</u>		<u>DFT-DFC</u>		<u>DFT-DFL</u>	
	<u>CC</u>	<u>PS**</u>	<u>CC</u>	<u>PS</u>	<u>CC</u>	<u>PS</u>
Apr 79	0.41	0.77				
Jun 79	0.75	0.66				
Sep 79	0.74	0.62	0.77	0.40	0.74	0.48
Nov 79	0.69	0.52				
Sep 80	0.71	0.57	0.55	0.36	0.72	0.51
Mean:	0.66	0.63	0.66	0.38	0.73	0.50

* Habitat acronyms are explained in Table 1.

** CC = Coefficient of Community; PS = Percent Similarity.

Table 10

Relative Abundance of Fish Captured at Walnut Point-Kentucky Bend

Revetment by Sampling Date and Gear*

Species	Apr 79			Jun 79			Sep 79			Nov 79			Total %
	HN	ES	TL	HN	ES	TL	HN	ES	TL	HN	ES	TL	
Shovelnose sturgeon	5.4		1.0	1.2		0.4							0.4
Spotted gar		2.6	2.1										0.5
Longnose gar					4.1	2.6		1.3	0.8				0.8
Shortnose gar		0.6	0.5		6.1	3.9							1.2
Bowfin		0.6	0.5										0.1
American eel	2.7		0.5				3.8			16.7		1.3	0.8
Skipjack herring	2.7	3.2	3.1		6.1	3.9					0.4	0.3	1.9
Gizzard shad	10.8	80.6	67.2		31.8	20.3					92.5	85.2	50.7
Threadfin shad		8.4	6.8		4.7	3.0							2.3
Goldeye								1.3	0.8	4.2	1.8	2.0	0.8
Carp	24.3	1.3	5.7	2.4	11.5	8.2		13.9	8.4				4.8
River shiner		0.6	0.5										0.1
Silverband shiner					0.7	0.4							0.1
River carpsucker	5.4		1.0		5.4	3.4				16.7	1.4	2.6	2.1
Blue sucker	5.4		1.0	6.0	0.7	2.6	19.2	21.5	20.6				4.1

(Continued)

* Gear types are identified in column headings as follows: ES = electroshocker; HN = hoop net; TL = total for all gear types.

Table 10 (Concluded)

Species	Apr 79			Jun 79			Sep 79			Nov 79			% Total
	HN	ES	TL	HN	ES	TL	HN	ES	TL	HN	ES	TL	
Smallmouth buffalo				11.9	9.5	10.3	7.7	5.1	6.1	4.2	0.7	1.0	4.1
Bigmouth buffalo				0.7	0.4								0.1
Blue catfish	13.5		2.6	11.9		4.3	7.7	49.4	32.8	4.2	0.4	0.7	7.0
Channel catfish	13.5		2.6	11.9		4.3	3.8		1.5	4.2		0.3	1.5
Flathead catfish	5.4		1.0	36.9	7.4	18.1	46.2	2.5	19.8	37.5		3.0	9.1
White bass				2.0	1.3						0.7	0.7	0.6
Bluegill		0.6	0.5	0.7	0.4			1.3	0.8				0.4
Largemouth bass		0.6	0.5										0.1
Sauger	2.7	0.6	1.0							12.5		1.0	0.6
Freshwater drum	8.1		1.6	17.9	8.1	11.6	11.5	1.3	5.3		2.1	2.0	5.0
Striped mullet				0.7	0.4			2.5	1.5				0.4
Total number caught:	37	155	192	84	148	232	52	79	131	24	281	305	860
Number of species:	12	11	19	8	16	19	7	10	11	8	8	12	26

Table 11
Relative Percent by Weight of the Fifteen Dominant
Fish Species Captured from Bank Habitats

Species	Habitat			
	NBA	NBK	RVL	RVW
Flathead catfish	24.5	35.3	12.0	20.0
Gizzard shad	20.5	12.5	15.2	10.7
Blue catfish	7.7	2.9	4.5	11.5
Blue sucker	8.6		15.9	10.0
Freshwater drum	4.7	15.8	3.1	4.0
Carp	3.0	5.4		20.7
Bigmouth buffalo	14.8	4.4	2.1	
Channel catfish			39.9	3.5
Smallmouth buffalo		1.7	1.2	9.2
River carpsucker				2.5
American eel	2.3	4.1		
Shovelnose sturgeon	2.9		5.2	
Skipjack herring	4.1		0.9	
Shortnose gar		2.8		1.9
Longnose gar		5.5		
Total percent:	93.1	90.4	100.0	94.0

Table 12

Relative Abundance of Fish Captured at Lakeport Revetment
by Sampling Date and Gear*

Species	Apr 79			Jun 79			Sep 79			Nov 79			% Total
	%			%			%			%			
	HN	ES	TL	HN	ES	TL	HN	ES	TL	HN	ES	TL	
Shovelnose sturgeon	50.0		26.3				16.7		10.5				2.6
Longnose gar					0.6	0.5							0.4
Skipjack herring	10.0	33.3	21.1										1.5
Gizzard shad		66.7	31.6		93.1	67.4					77.8	43.8	58.9
Threadfin shad					1.9	1.4							1.1
Goldeye				1.6		0.5					22.2	12.5	1.1
River carpsucker					0.6	0.5							0.4
Blue sucker	10.0		5.3	3.3		0.9		85.7	31.8	28.6		12.5	4.0
Smallmouth buffalo					1.3	0.9							0.7
Bigmouth buffalo								14.3	5.3				0.4
Blue catfish	20.0		10.5	3.3		0.9	66.7		42.1				4.4
Channel catfish				75.4		20.8				14.3		6.3	17.1
Flathead catfish	10.0		5.3	3.3		0.9	16.7		10.5	28.6		12.5	2.6
White crappie					0.6	0.5							0.4
Sauger										28.6		12.5	0.7
Freshwater drum				13.1	1.9	5.0							4.0
Total number caught:	10	9	19	61	160	221	12	7	19	7	9	16	275
Number of species:	5	2	6	6	7	12	3	2	5	4	2	6	16

* Gear types are identified in column headings as follows: ES = electroshocker; HN = hoop net; TL = total for all gear types.

Table 13

Relative Abundance of Fish Captured at Anconia Natural Bank
by Sampling Date and Gear*

Species	Apr 79				Jun 79				Sep 79				Nov 79				Total %
	% ES		TL	HN	% ES		TL	HN	% ES		TL	HN	% ES		TL		
	HN	ES			HN	ES			HN	ES			HN	ES			
Shovelnose sturgeon	18.2		3.3													0.9	
Longnose gar					1.1		0.9									0.5	
Shortnose gar												11.1	77.3	3.2		0.5	
American eel				13.3			1.9									0.9	
Skipjack herring		20.0	16.4		1.1		0.9						9.1	6.5		5.9	
Gizzard shad		78.0	63.9		86.0		74.1		100.0	4.8				54.8		62.0	
Threadfin shad					8.6		7.4									3.6	
Goldeye													4.5	3.2		0.5	
Carp								5.0		4.8						0.5	
Mississippi silvery minnow													4.5	3.2		0.5	
Blacktail shiner					1.1		0.9									0.5	
River carpsucker												11.1		3.2		0.5	
Blue sucker								10.0		9.5						0.9	
Bigmouth buffalo		2.0	1.6	6.7			0.9									0.9	
Blue catfish	18.2		3.3	13.3			1.9	35.0		33.3	22.2	6.5				5.9	

(Continued)

(Continued)

* Gear types are identified in column headings as follows: ES = electroshocker; HN = hoop net; TL = total for all gear types.

Table 13 (Concluded)

Species	Apr 79			Jun 79			Sep 79			Nov 79			Total
	HN	ES	TL	HN	ES	TL	HN	ES	TL	HN	ES	TL	
Channel catfish	9.1		1.6										0.5
Flathead catfish	18.2		3.3	33.3	1.1	5.6	30.0		28.6	33.3		9.7	7.7
White bass										22.2		6.5	0.9
Warmouth	9.1		1.6										0.5
Bluegill	18.2		3.3										0.9
Freshwater drum	9.1		1.6	33.3		4.6	20.0		19.0				4.5
Striped mullet					1.1	0.9					4.5	3.2	0.9
Total number caught:	11	50	61	15	93	108	20	1	21	9	22	31	221
Number of species:	7	3	10	5	7	11	5	1	6	5	6	9	22

Table 14

Relative Abundance of Fish Captured at Island 88
Natural Bank by Sampling Date and Gear*

Species	Apr 79			Jun 79			Sep 79			Nov 79		
	%			%			%			%		
	HN	ES	TL	HN	ES	TL	HN	ES	TL	HN	ES	TL
Longnose gar					9.1	2.3		50.0	5.3			
Shortnose gar	8.0		3.0									
American eel	8.0		3.0				11.8		10.5			
Skipjack herring	4.0		1.5		18.2	4.5					5.9	5.0
Gizzard shad	28.0	100.0	73.1		18.2	4.5					76.5	65.0
Threadfin shad					18.2	4.5						
Goldeye											11.8	10.0
Carp							5.9		5.3			
Mississippi silvery minnow											5.9	5.0
Blue sucker							5.9		5.3			
Smallmouth buffalo				3.0	9.1	4.5						
Bigmouth buffalo	4.0		1.5									
Blue catfish	12.0		4.5	6.1	4.5	4.5	17.6		15.8	33.3		5.0
Channel catfish				3.0		2.3						
Flathead catfish	4.0		1.5	33.3	25.0	25.0	17.6		15.8	33.3		5.0
												10.7

(Continued)

* Gear types are identified in column headings as follows: ES = electroshocker; HN = hoop net; TL = total for all gear types.

Table 14 (Concluded)

Species	Apr 79			Jun 79			Sep 79			Nov 79		
	HN	ES	TL	HN	ES	TL	HN	ES	TL	HN	ES	TL
White bass	8.0		3.0									1.3
Bluegill	8.0		3.0		9.1	2.3	5.9		5.3			2.7
White crappie	12.0		4.5									2.0
Freshwater drum	4.0		1.5	54.5		40.9	35.3		31.6	33.3		5.0
Striped mullet				18.2		4.5		50.0	5.3			2.0
Total number caught:	25	42	67	33	11	44	17	2	19	3	17	20
Number of species:	11	1	11	5	7	11	7	2	9	3	4	7

Table 15

Similarity Comparisons of Revetted and Natural Bank
Habitats on the Lower Mississippi River

Sampling Date	Location Pair											
	RVL-RVW*		RVL-NBA		RVL-NBK		RVW-NBA		RVW-NBK		NBA-NBK	
	CC	PS**	CC	PS	CC	PS	CC	PS	CC	PS	CC	PS
Apr 79	0.32	0.15	0.45	0.37	0.31	0.23	0.38	0.43	0.36	0.45	0.50	0.73
Jun 79	0.48	0.36	0.35	0.56	0.53	0.17	0.43	0.42	0.58	0.31	0.57	0.26
Sep 79	0.21	0.21	0.38	0.55	0.28	0.32	0.39	0.26	0.75	0.25	0.50	0.60
Nov 79	0.39	0.09	0.23	0.43	0.30	0.56	0.47	0.16	0.46	0.12	0.55	0.71
Mean:	0.35	0.20	0.35	0.48	0.35	0.32	0.42	0.32	0.54	0.28	0.53	0.58

* Habitat acronyms are explained in Table 1.

** CC = Coefficient of Community; PS = Percent Similarity.

Table 16
Relative Abundance of Fish Captured at Matthews Bend
by Sampling Date and Gear*

Species	Apr 79			Jun 79			Sep 79			Nov 79			% Total
	HN	ES	TL	HN	ES	TL	HN	ES	TL	HN	ES	TL	
Paddlefish				0.5		0.4				0.6		0.1	0.2
Spotted gar		3.6	3.0	1.4	1.6	1.4	2.8		1.9	9.9	3.9	4.8	3.4
Longnose gar	20.0		3.0				1.9		1.3	1.9		0.3	0.4
Shortnose gar	20.0		3.0	1.6		1.4	5.6	3.2	4.9	5.6	0.1	0.9	1.8
Alligator gar				0.9		0.8							0.2
Bowfin										0.6		0.1	0.1
Skipjack herring	40.0		6.1	15.9		13.9	9.8	4.3	8.1	18.0		2.7	6.5
Gizzard shad		89.3	75.8	63.6	85.5	66.3	50.9	74.5	58.1	9.9	70.2	61.0	62.2
Threadfin shad								17.0	5.2		8.5	7.2	4.8
Goldeye							0.9	1.1	1.0	0.6		0	0.2
Carp	20.0	3.6	6.1	0.2		0.2				3.1	2.8	2.8	1.8
River carpsucker				1.4		1.2	1.9		1.3	18.6	0.6	3.3	2.4
Highfin carpsucker										0.6		0.1	0.1
Smallmouth buffalo				0.2		0.2	0.5		0.3	8.1	0.7	1.8	1.1
Bigmouth buffalo										3.1	0.1	0.6	0.4

(Continued)

* Gear types are identified in column headings as follows: ES = electroshocker; HN = hoop net; TL = total for all gear types.

Table 16 (Concluded)

Species	Apr 79			Jun 79			Sep 79			Nov 79			% Total
	HN	ES	TL	HN	ES	TL	HN	ES	TL	HN	ES	TL	
Spotted sucker										0.1	0.1	0.1	0.1
Blue catfish				0.7		0.6	2.3		1.6				0.4
Yellow bullhead										0.6		0.1	0.1
Channel catfish				2.1		1.8	2.3		1.6	5.6	0.3	1.1	1.4
Flathead catfish					1.6	0.2							0.1
White bass				0.2	1.6	0.4	2.8		1.9	6.2	0.3	1.2	1.1
Striped bass										1.2		0.2	0.1
Warmouth											0.1	0.1	0.1
Orangespotted sunfish													0.1
Bluegill					9.7	1.2				1.2	7.0	6.1	3.7
Redear sunfish										0.6		0.1	0.1
Largemouth bass			3.6							1.2	1.6	1.5	0.9
White crappie				0.2		0.2	0.5		0.3	0.6	1.4	1.3	0.8
Black crappie							0.5		0.3		0.9	0.8	0.5
Sauger											0.1	0.1	0.1
Freshwater drum				11.0		9.6	17.3		12.0	1.9	1.1	1.2	5.1
Total number caught:	5	28	33	428	62	490	214	94	308	161	891	1059	1890
Number of species:	4	4	7	14	5	16	14	5	15	22	19	28	31

Table 17
Relative Percent by Weight of the Ten Dominant
Fish Species Captured from Matthews Bend

<u>Species</u>	<u>Apr 79</u>	<u>Jun 79</u>	<u>Sep 79</u>	<u>Nov 79</u>	<u>Total</u>
Gizzard shad	10.4	45.3	27.7	8.7	20.1
Carp	12.8	3.2		26.1	16.3
Spotted gar	2.5	10.4	6.7	17.9	13.7
Skipjack herring	4.1	8.0	12.8	4.8	6.6
River carpsucker		3.2	4.2	9.0	6.5
Shortnose gar	3.1	4.6	19.6	3.3	5.7
Freshwater drum		11.2	10.7	1.7	5.0
Channel catfish		3.6	4.3	3.4	3.4
Smallmouth buffalo		1.7	0.9	4.2	2.9
White bass		0.3	4.7	2.8	2.3
Total percent:	32.9	91.5	91.6	81.9	82.5

Table 18
Mean Total Length ($\bar{x}$), Range of Lengths (R), and Number of Individuals (n) of
Four Species of Fish from Eight Mississippi River Habitat Locations
(Lengths in millimetres)

Date	Variable	Habitat Location							
		DFC	DFL	DFT	ACB	RVW	RVL	NBA	NBK
Blue Catfish									
Jun 79	$\bar{x}$	284	270		250	218	300	400	238
	R	125-550	75-400	--	225-275	150-425	150-450	300-500	225-250
	n	37	19		3	10	2	2	2
Sep 79	$\bar{x}$	318	242	378	290	440	222	207	225
	R	200-425	50-475	175-650	175-400	175-650	175-275	175-225	--
	n	20	9	9	5	43	8	7	3
Nov 79	$\bar{x}$	315	283			463		438	300
	R	175-675	150-500	--	*	225-700	*	425-450	--
	n	51	31			2		2	1
Sep 80	$\bar{x}$	207	220	357					
	R	50-675	50-525	75-725	--	--	--	--	--
	n	207	102	78					
Flathead Catfish									
Jun 79	$\bar{x}$	423	363		125	414	500	392	461
	R	225-750	125-675	--	--	125-725	225-775	150-550	275-800
	n	67	67		1	42	2	6	9
Sep 79	$\bar{x}$	435	361	366		411	625	342	383
	R	200-825	175-625	200-575		125-850	550-700	225-475	300-475
	n	46	32	8	*	26	2	6	3
Nov 79	$\bar{x}$	450	372			467	500	500	525
	R	--	175-475	--	*	225-875	375-625	450-575	--
	n	1	9			9	2	3	1
Sep 80	$\bar{x}$	364	390	363					
	R	275-425	50-575	350-375	--	--	--	--	--
	n	7	13	2					

(Continued)

* Sampling accomplished but no fish collected.

Table 18 (Concluded)

Date	Variable	Habitat Location							
		DFC	DFL	DFT	ACB	RVW	RVL	NBA	NBK
Channel Catfish									
Jun 79	$\bar{x}$	348	379		314	443	430		300
	R	225-575	175-575	--	200-450	325-600	250-550	*	--
	n	39	34		9	10	46		1
Sep 79	$\bar{x}$	132	267	81	365	500			
	R	50-400	250-275	50-400	300-475	--	*	*	*
	n	26	3	25	5	2			
Nov 79	$\bar{x}$	317	395		396	500	525		
	R	200-550	200-500	--	250-525	--	--	*	*
	n	13	24		12	1	1		
Sep 80	$\bar{x}$	346	338	250					
	R	225-525	50-650	25-575	--	--	--	--	--
	n	24	50	16					
River Carpsucker									
Jun 79	$\bar{x}$	177	273		321	331	300		
	R	25-450	75-475	--	225-350	300-375	--	*	*
	n	32	30		6	8	1		
Sep 79	$\bar{x}$	291	210	278	350				
	R	125-550	150-400	50-475	325-375	*	*	*	*
	n	8	5	9	4				
Nov 79	$\bar{x}$	358	278		346	356		450	
	R	225-450	125-475	--	200-450	275-450	*	--	*
	n	20	36		35	8		1	
Sep 80	$\bar{x}$	281	342	361					
	R	50-475	50-525	25-600	--	--	--	--	--
	n	57	63	43					

* Sampling accomplished but no fish collected.

Table 19

Relative Abundance of the Numerically Dominant Fish Species Collected
During Three Studies on the Lower Mississippi River

Species	Relative Numerical Abundance		
	NUS (1974)	CMD/Limnetics (1976)*	WES (1982)
Gizzard shad	37.4 (1)**	20.6 (1)	35.5 (1)
Freshwater drum	10.3 (2)**	4.6 (6)	3.0 (7)
Blue catfish	8.3 (3)	4.5 (7)	4.6 (4)
Flathead catfish	4.9 (4)	1.9 (9)	2.6 (9)
River carpsucker	4.8 (5)	14.7 (2)	2.6 (8)
Smallmouth buffalo	4.0 (6)	1.7 (11)	0.9 (20)
Shortnose gar	3.6 (7)	1.3 (15)	
White crappie	3.2 (8)**	1.5 (14)	
Shovelnose sturgeon	2.9 (9)	0.5 (22)	
Black crappie	2.7 (10)		
Carp	2.4 (11)	4.0 (8)	1.3 (15)
Silver chub	2.3 (12)	1.3 (16)	
Skipjack herring	1.8 (13)**	0.8 (19)	2.0 (12)
Bluegill	1.3 (14)**	1.3 (17)	1.4 (14)
Bowfin	1.2 (15)		
Threadfin shad	1.0 (16)**	6.4 (5)	2.4 (10)
Channel catfish	0.9 (17)**	7.2 (4)	2.4 (11)
Goldeye		1.9 (10)	
Speckled chub		1.6 (12)	1.0 (19)
River shiner		13.2 (3)	10.1 (2)
Sauger		1.6 (13)	
Emerald shiner	**	1.0 (18)	4.1 (6)
Bullhead minnow		0.8 (20)	1.6 (13)
Silverband shiner	**	0.8 (21)	5.9 (3)
Blacktail shiner			4.2 (5)
Mississippi silvery minnow	**		1.3 (16)
White bass	**		1.2 (17)
Inland silversides	**		1.1 (18)
Red shiner	**		
Mooneye	**		
Cypress minnow	**		
Silver chub	**		
Cumulative percentage:	93.0	93.2	89.2

Note: Rank abundance given in parentheses for each study.

* James, Miss., site only.

** Relatively abundant species collected during nearshore seining, but not included in relative numerical abundances presented.

APPENDIX A: GLOSSARY OF TERMS*

For the benefit of those who may not be familiar with the biological terms used in this report, the following glossary is presented for their convenience.

Age--The number of years of life completed, usually indicated by a roman numeral.

Biomass--The weight of a fish stock, or of some defined portion of it.

Catch per unit of effort--The catch of fish, in numbers or in weight, taken by a given unit of fishing effort.

Community--Any assemblage of populations living in a prescribed area or physical habitat.

Condition factor--An index obtained by computation of the length-weight relationship used to compare the well being of a fish based on the assumption that heavier fish of a given length are in better condition.

Dissimilarity--Numeric coefficient based on differences in number of individuals for any pairwise comparison.

Diversity--The number of species present and their numerical composition.

Length frequency--A method used to estimate fish age that is dependent upon the assumption that the lengths of fish of one age tend to form a normal distributional pattern.

Population--Groups of individuals of any one kind of organism occupying a particular space or habitat.

Similarity--Coefficient derived from the number of species in common between locations.

Total length--The greatest distance in a straight line between the most anteriorly projected part of the head and the farthest tip of the caudal fin.

Year class--The fish spawned or hatched in a given year.

* From Ricker (1975) and Green (1979).

In accordance with letter from DAEN-RDC, DAEN-ASI dated 22 July 1977, Subject: Facsimile Catalog Cards for Laboratory Technical Publications, a facsimile catalog card in Library of Congress MARC format is reproduced below.

Pennington, C.H.

Fishes of selected aquatic habitats on the Lower Mississippi River / by C.H. Pennington, John A. Baker, Carolyn L. Bond (Environmental Laboratory, U.S. Army Engineer Waterways Experiment Station). -- Vicksburg, Miss. : The Station ; Springfield, Va. : available from NTIS, 1983.

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III. United States. Army. Corps of Engineers. Office of the Chief of Engineers. IV. Environmental & Water Quality Operational Studies. V. U.S. Army Engineer Waterways Experiment Station. Environmental Laboratory. VI. Title VII. Series: Technical report (U.S. Army Engineer Waterways Experiment Station) ; E-83-2.