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Report on the Impacts of Commercial Dredging on the Fishery of the Lower Kansas River

Kansas City District, Corps of Engineers
DACW 41-79-C-0075

1982

University of Kansas
Division of Biological Sciences

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1. INTRODUCTION

Commercial sand and gravel dredging operations on the lower Kansas River can be traced as far back as the early 1900s. The 22-mile reach of river located between Bonner Springs and the confluence of the Kansas and Missouri rivers has been heavily dredged since at least the 1950s. This study was initiated due to the paucity of information previously available regarding the cumulative impacts of commercial dredging and the isolated impacts of a single commercial dredge on fish population dynamics in this lower reach of the river. This report has been prepared for the Kansas City District, Corps of Engineers, and is intended for use by the District in its evaluation of permit applications for commercial dredging operations in the Kansas River, under authority of Section 10 of the River and Harbor Act of 1899 and Section 404 of the Clean Water Act.

The objective of this study is to relate the effects of the Kansas River commercial sand and gravel dredging industry to fish population dynamics in the lower Kansas River. The relationship of dredging to the fishery was determined by quantitative measurement of several physical, chemical, and biological parameters of the river during the period 30 May 1979 to 11 December 1981. Areas upstream of dredging activities were compared to a segment of river which is heavily impacted by dredging operations. The cumulative effect of dredging operations was determined by a comparison of data from three dredge sites located progressively farther downstream. The relationship of dredging to the Kansas River fishery is described in terms of present and possible future effects.

The study area extended from upstream of Bonner Springs to Turner, Kansas (river miles 25.0 to 9.3). The study area was subdivided into control study sites, dredge study sites, and a partial study site (Figs. 1,2).

Two control sites were located between river miles 23.0 and 25.0, in a reach of river not impacted by dredging. Each control site contained two transects located approximately 200 meters (m) apart. The uppermost transect in each control site was designated "A", and the lower designated "B" (Fig. 4a).

Three dredge study sites were located between river miles 12.5 and 22.3, in a river segment heavily impacted by commercial dredging. Each

dredge site contained five transects, designated "A" through "E" (Fig. 3). The "A" transects were located approximately 200 m upstream of the dredge pit. "B" transects were located just upstream from the dredges, within the dredge pit areas. "C" transects were located immediately downstream from the dredges, within the dredge pit areas. The lowermost transects, "D" and "E", were located approximately 200 m and 400 m downstream from the dredge pit, respectively. A schematic representation of each dredge study site is given in Figures 3, 4b-f.

Control and Dredge transects extended between the normal static banks, perpendicular to the flow of the river. Each transect was 50--100 m in length (longitudinal axis of the river), and comprised all aquatic habitats within this area.

The partial study site was located at Turner Bridge (river mile 9.3), to determine if the Missouri River backwater or dredging operations were a barrier to fish movement in the Kansas River. Fixed transect locations were not established at the partial site; rather sampling was conducted in a 400 m longitudinal distance with Turner Bridge as the midpoint.

Fish and water quality sampling was conducted at each study site in 8 months in 1979, 9 months in 1980, and 10 months in 1981. Water quality parameters included dissolved oxygen, pH, total dissolved solids, chlorophyll a, turbidity, total and phenolphthalein alkalinity, suspended particle size analysis, depth, and temperature.

Additionally, water samples were collected in conjunction with sediment core samples and delivered to the Environmental Protection Agency (EPA), Region VII laboratory, for analysis of specific chemical parameters. Analyses included trace metals, volatile solids, chemical oxygen demand, biochemical oxygen demand, immediate oxygen demand, non-filterable solids, total Kjeldall nitrogen, nitrate, total phosphorus, total organic carbon, phenols, oil-grease, sulfides, oxidation-reduction potential, cyanide, and pesticides. Sediment core samples were also analyzed for particle size composition.

Suspended solids and settleability were analyzed from water samples delivered to the Water Resources laboratory of the U.S. Geological Survey (USGS) in Lawrence, Kansas.

Data from fish samples included species composition, species diversity, relative biomass and density estimates, substrate affinities, condition,

growth, and stomach analysis. Relative species abundance for phytoplankton, zooplankton, and benthos were determined.

A schedule listing dates when field sampling occurred is given in Table 1. Mean biweekly discharge rates for the three-year period are given in Figure 5.

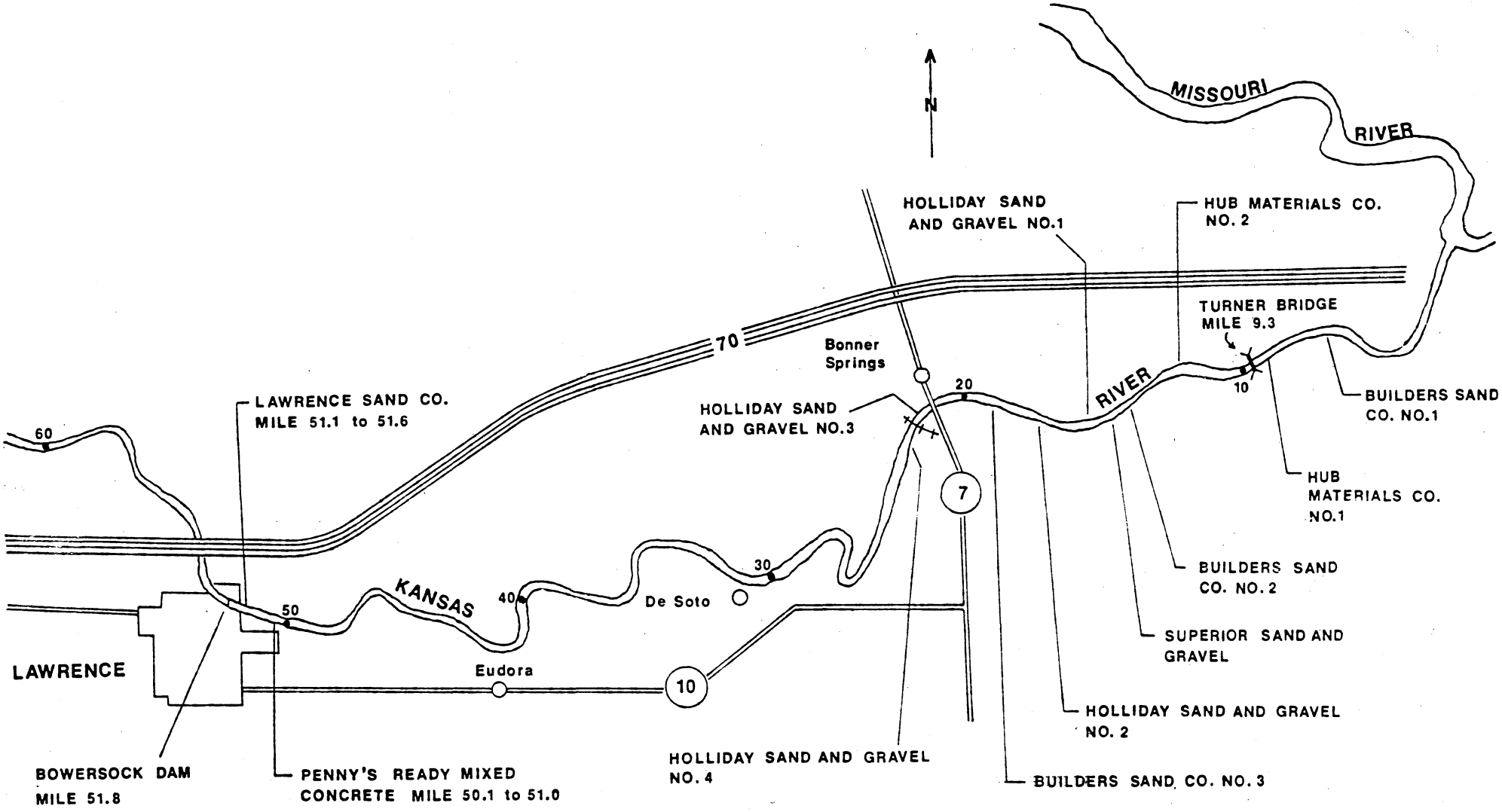

Fig. 1. Lower Kansas River, mile 60 to 0 (Lawrence to mouth).
Dredge sites and principal highways are shown.

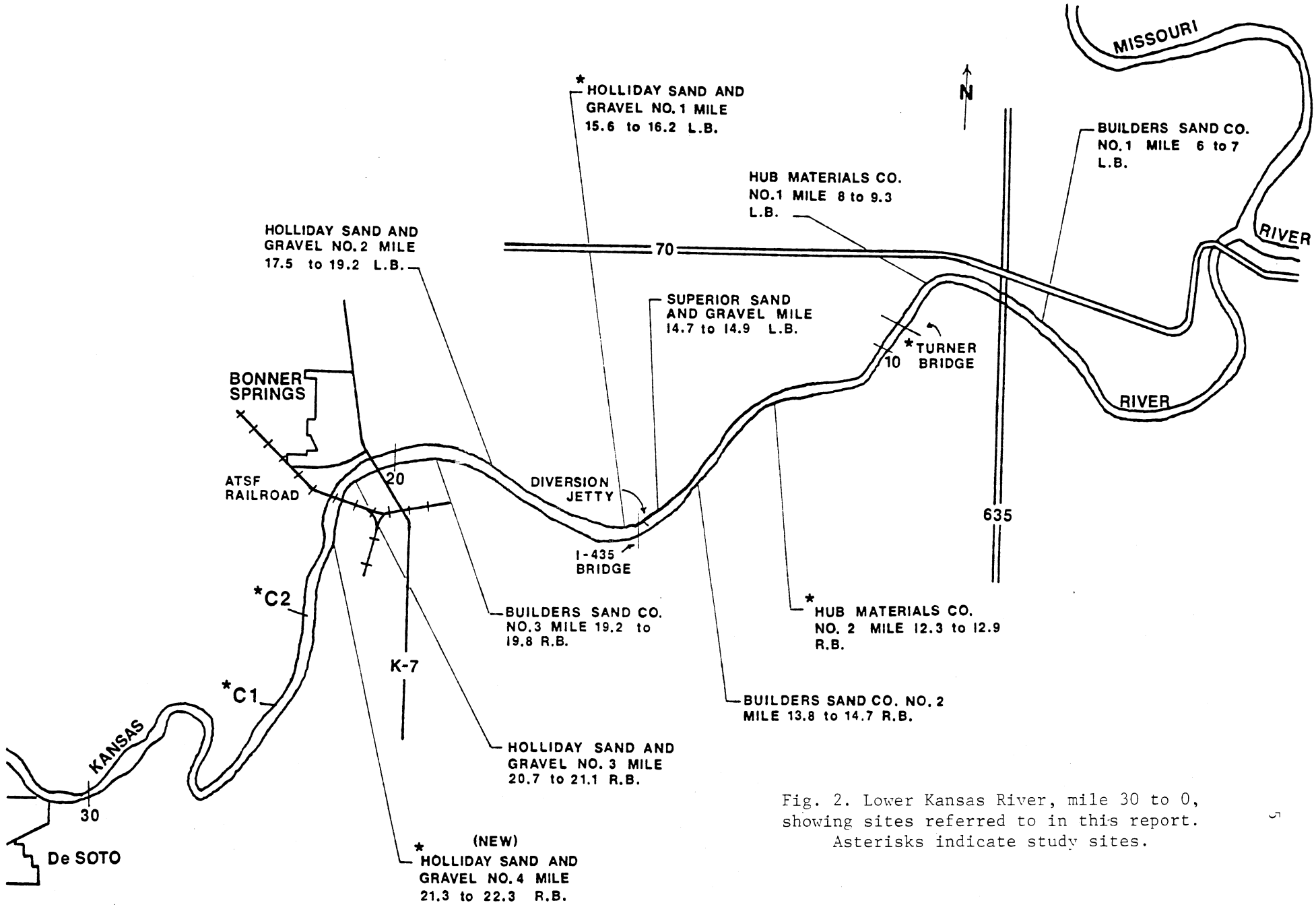

Fig. 2. Lower Kansas River, mile 30 to 0, showing sites referred to in this report. Asterisks indicate study sites.

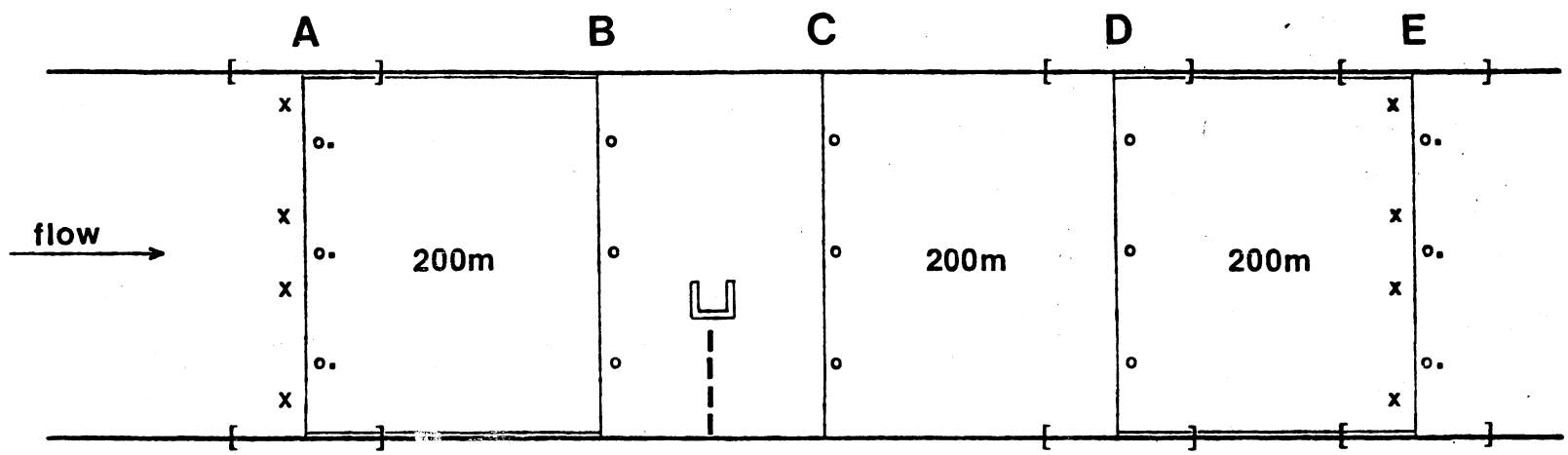

Fig. 3. Schematic diagram of a dredge study site, illustrating sampling points. A - E = transects at approximately 200 meter intervals; B and C are within the dredge pit. X = sediment cores and water samples analyzed by the Environmental Protection Agency. Small circles = measurements of depths, velocities, water quality parameters, and suspended solids samples analyzed by the U.S. Geological Survey. Small solid squares = benthos samples. Brackets = shoreline segments seined. Double lines joining A-B, D-E = segment of shoreline sampled by electrofishing.

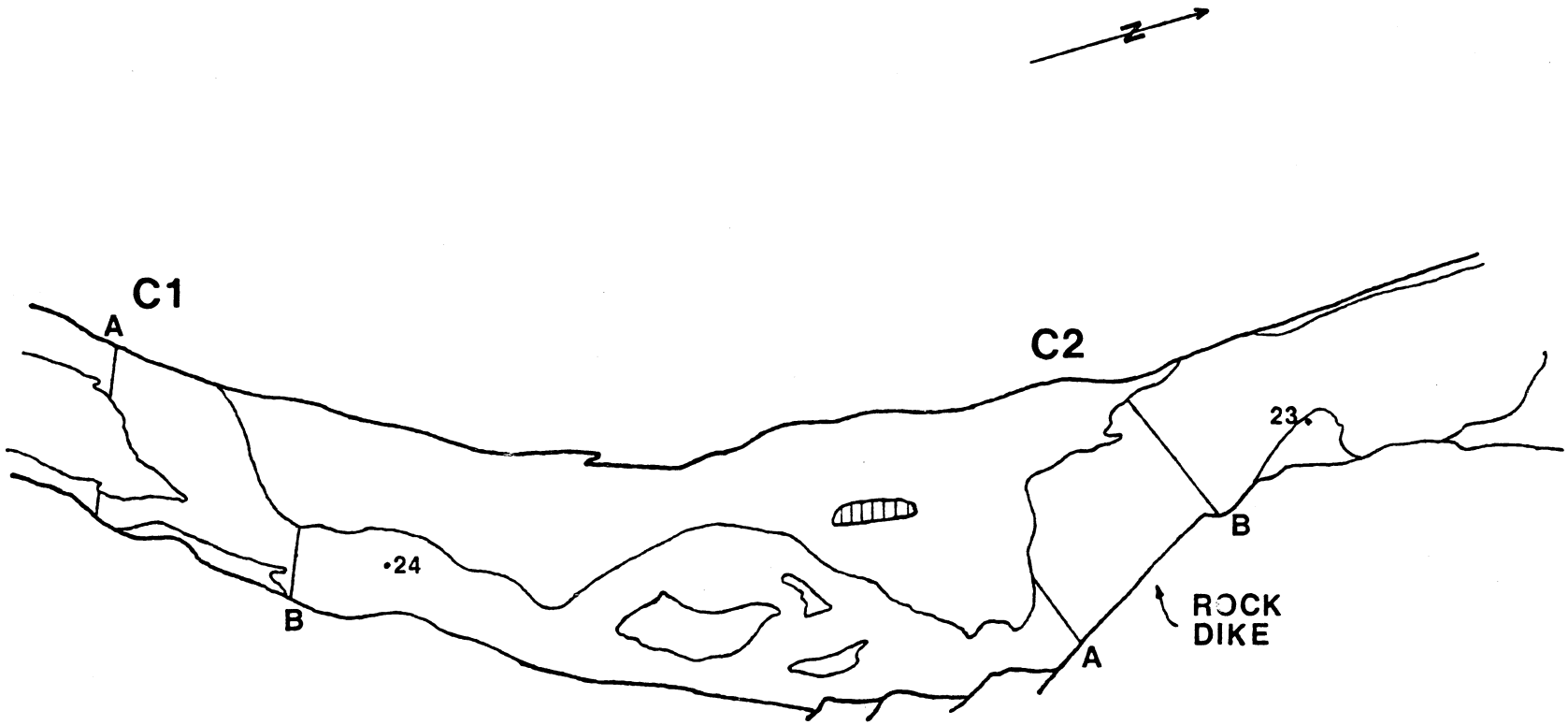

Fig. 4a. Location of Control sites 1 and 2, in river miles 23 and 24. Sandbars and islands in the channel are outlined. A and B = transect locations.

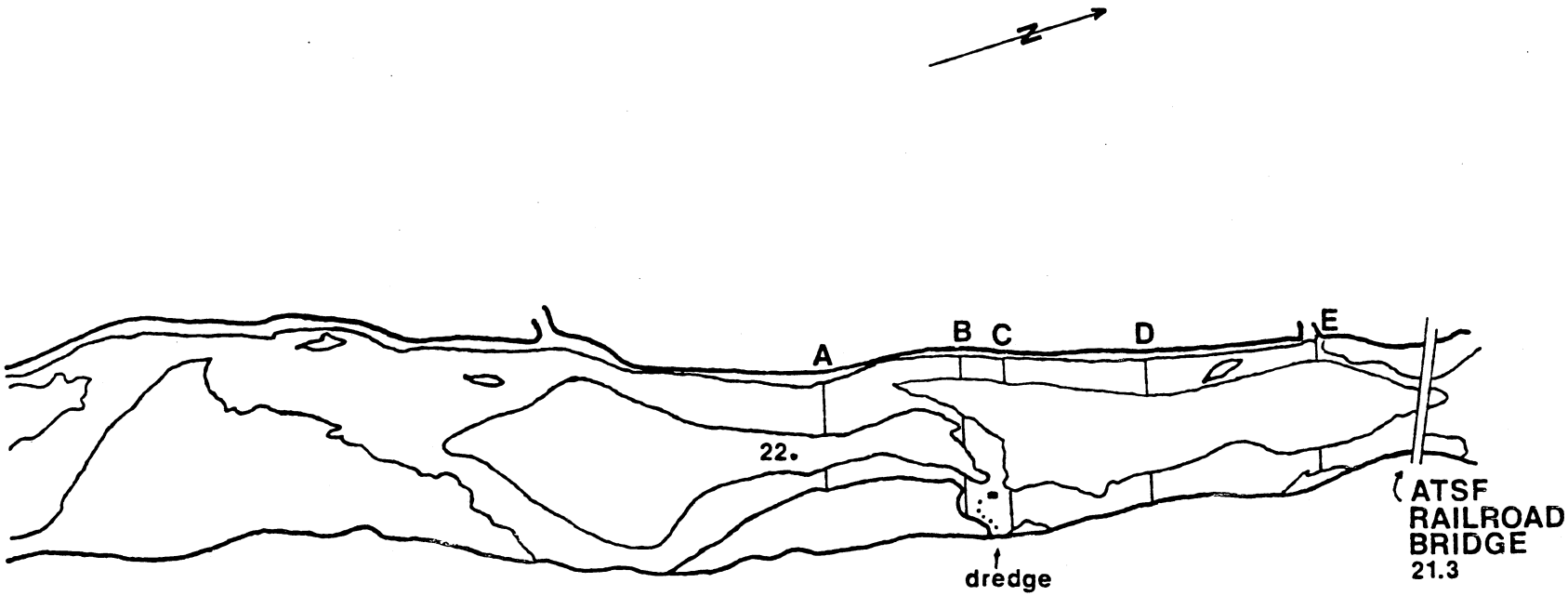

Fig. 4b. Dredge site 1, in river mile 21, as it appeared in 1979. Sandbars and islands in the channel are outlined. A, B, C, D, E = transect locations.

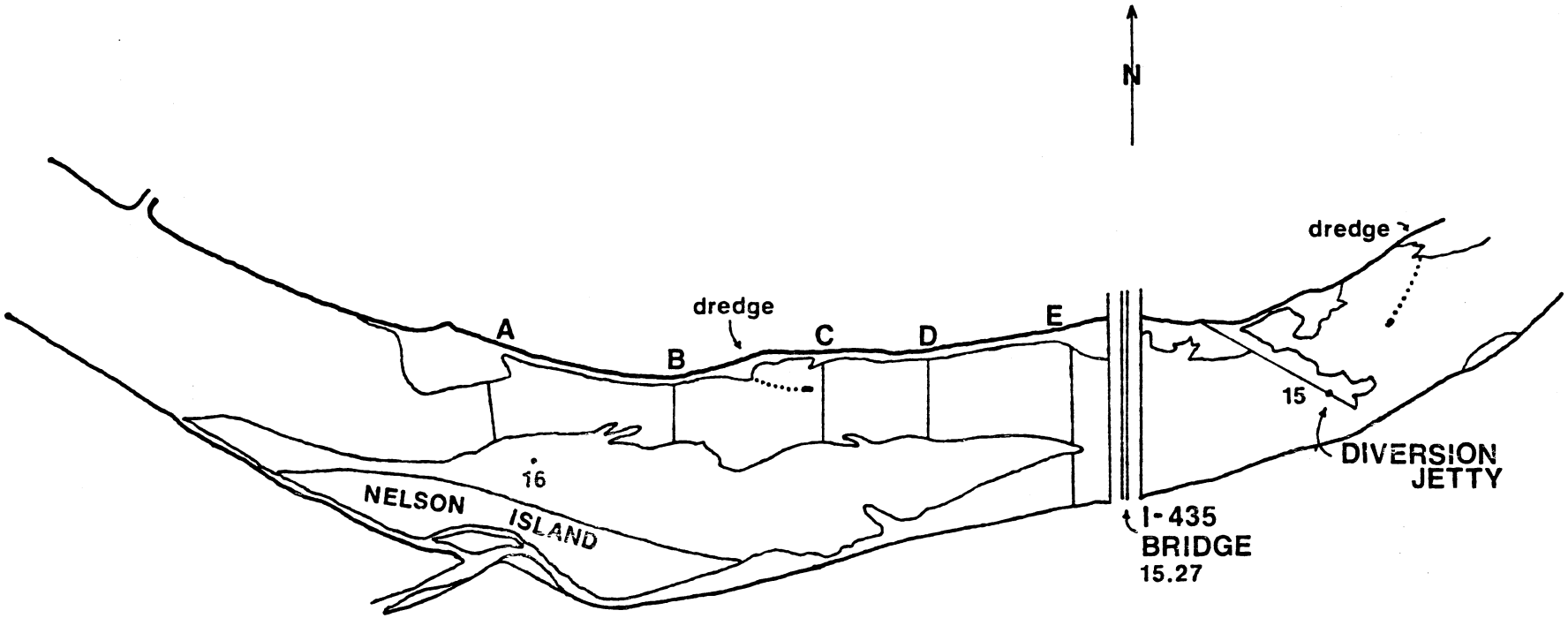

Fig. 4c. Dredge site 2, in river mile 15-16, as it appeared in 1979. Sandbars and islands in the channel are outlined. A, B, C, D, E = transect locations.

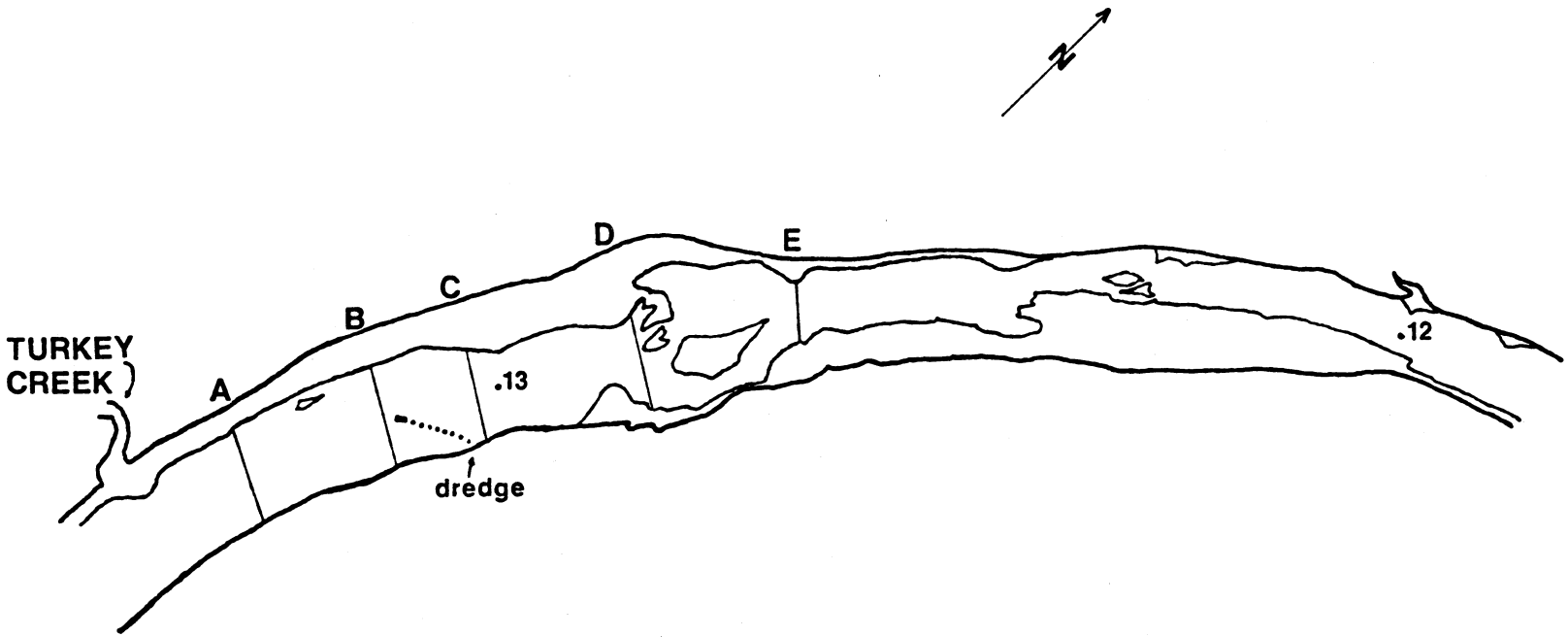

Fig. 4d. Dredge site 3, in river mile 12-13, as it appeared in 1979. Sandbars and islands in the channel are outlined. A, B, C, D, E = transect locations.

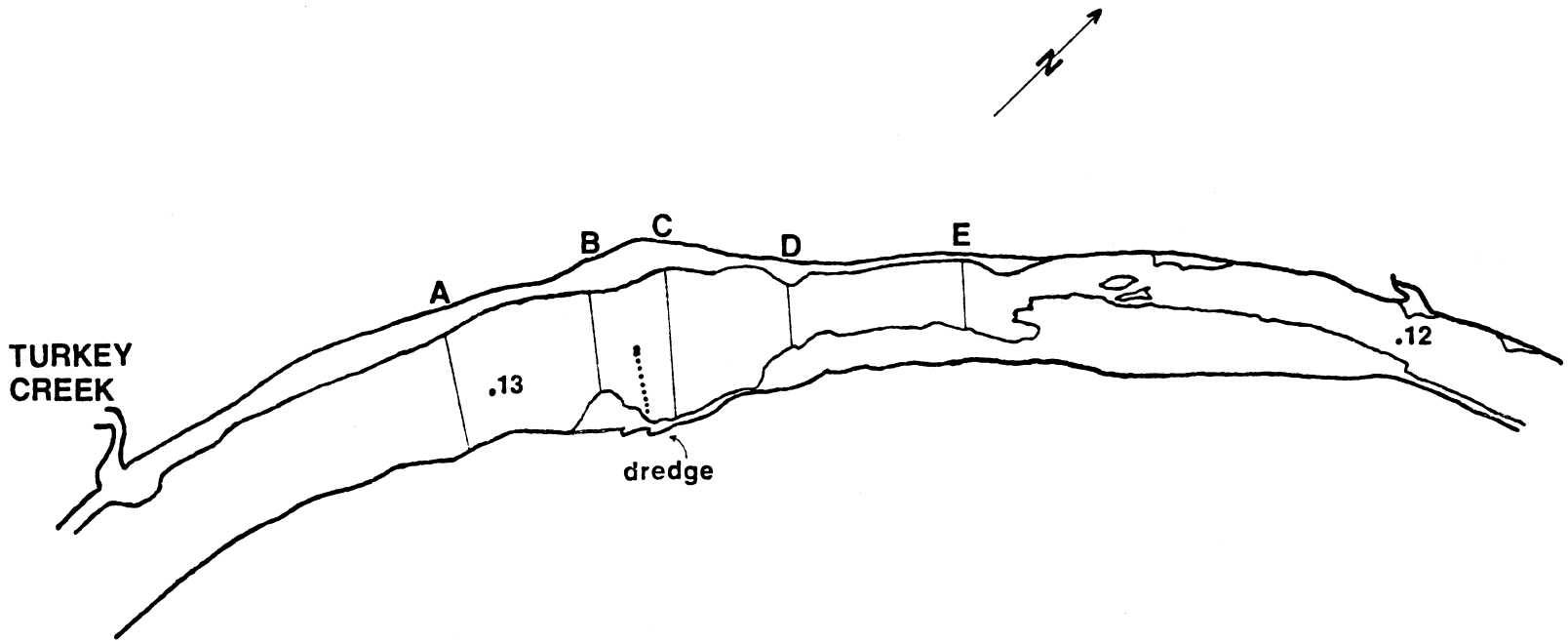

Fig. 4e. Dredge site 3, in river mile 12-13, as it appeared in August 1980. Bars in the channel are outlined. A, B, C, D, E = transect locations in summer and fall of 1980.

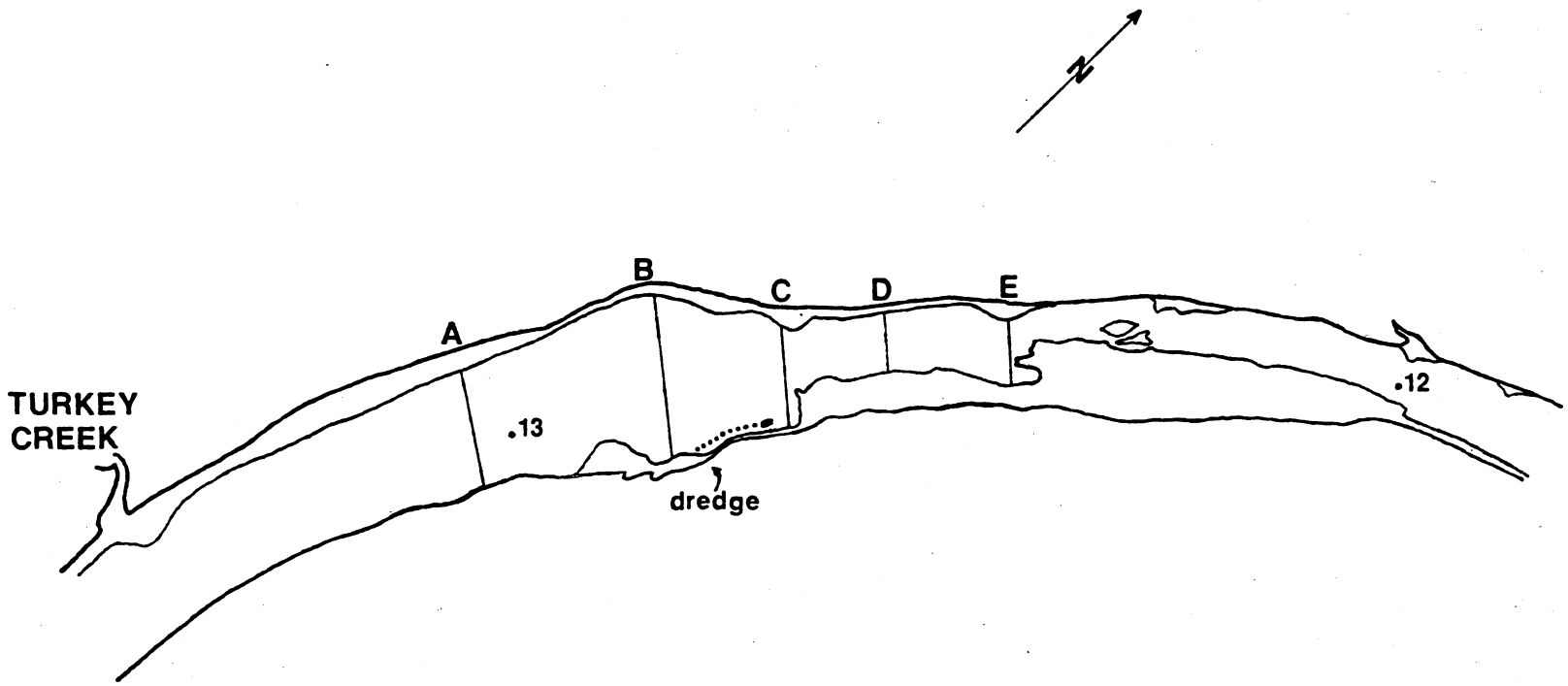

Fig. 4f. Dredge site 3, in river mile 12-13, as it appeared in 1981. Bars in the channel are outlined. A, B, C, D, E = transect locations in 1981.

Table 1. Sampling schedule for lower Kansas River, Fishery-Dredging Project, May 1979 through August 1980.

		Seining	Elec-fish	Water Quality	EPA-Trace Metals	EPA-Cores/Water	USGS-Susp. Solids	Aquatic Biology	Primary Productivity	24 Hour Pit Sample
1979										
	30-31 May, 4 June	X		X						
	12-15 June							X		
	20-21 June	X		X						
	12-13 July	X		X						
	19-20 July		X							
	6-7 Aug.						X			
	8-9 Aug.	X		X						
	20-21 Aug.				X			X		
	22-23 Aug.									
	31 Aug.	X	X							
	8-9 Sept						X			
	15-16 Sept	X		X	X					
	20-21 Sept					X				
	5 Oct.		X							
	11-12 Nov.							X		
	17-18 Nov.	X		X	X					
	8-9 Dec.		X				X			
1980	18-19 Jan.	X		X	X					
	7-8 Mar.		X				X			
	10-11 Mar.	X		X	X	X				
	22-23 Mar.							X		
	11-12 Apr.		X				X			
	2-3 May	X		X	X					
	19-20 May		X				X			
	21-22 May	X		X	X					
	19 June								X	
	23-24 June		X	X	X					
	26-27 June	X					X			
	17-18 July	X					X			
	31 July, 1 Aug.							X		
	5-6 Aug.		X	X	X					

Table 1. Sampling schedule, continued.

		Seining	Elec-fish	Water Quality	EPA-Trace Metals	EPA-Cores/Water	USGS-Susp. Solids	Aquatic Biology	Primary Productivity	24 Hour Pit Sample
1980, continued										
	11 Aug.		X							
	13-14 Aug.	X					X			
	19-20 Aug.		X			X				
	23 Aug.									X
	28 Aug.								X	
	6 Sept		X	X	X					
	13-14 Sept	X					X			
	1-2 Nov.	X					X			
	15 Nov.							X		
	22 Nov.		X	X	X					
1981	21 Feb.	X	X							X
	7-8 Mar.	X	X	X	X		X			X
	29 Mar.							X		
	25-26 Apr.	X	X	X	X		X			X
	6-7 May		X							X
	19-20 May	X					X			
	21-22 May		X							
	1 June					X				
	8 June							X		
	18-19 June		X				X			
	1 July			X	X					
	21 July	X								
	23-24 July	X	X	X	X					
	7 Aug.								X	
	29-30 Aug.	X								
	19 Sept							X		
	20 Sept	X								
	30 Sept					X				
	12 Nov.							X		
	25 Nov.					X				
	11 Dec.								X	

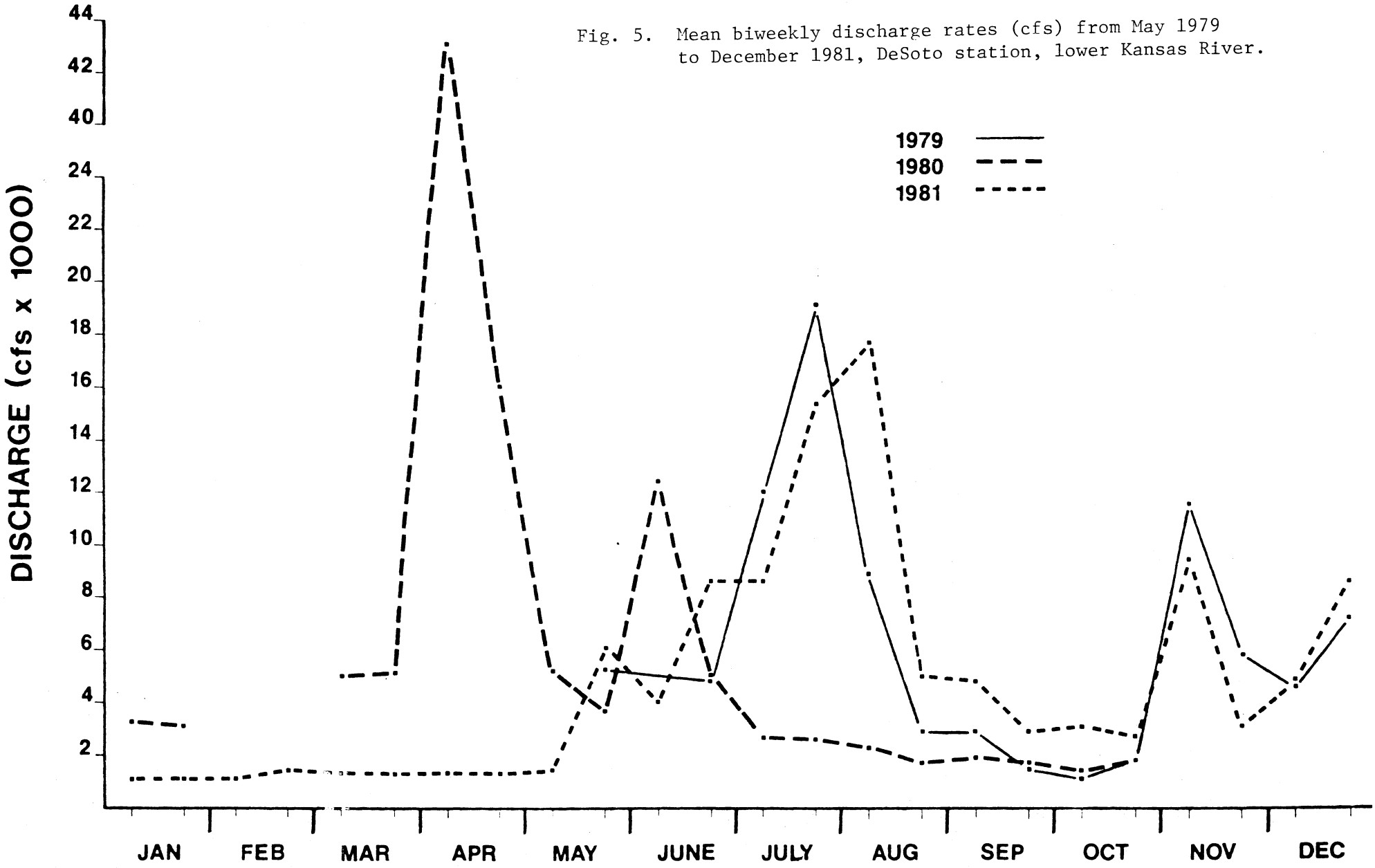

Fig. 5. Mean biweekly discharge rates (cfs) from May 1979 to December 1981, DeSoto station, lower Kansas River.

2. METHODS

a) Sediments, Water Quality and Plankton

Water - EPA

Water samples were composited from the upper one third of the water column across each of five transects. One transect at each control site and the "E" transect at each dredge study site were sampled. The water was composited in a 9.5 liter polypropylene carboy and then transferred to individual containers for each test requiring particular containers or preservatives. A list of these parameters can be found in Table A1-11. The immediate oxygen demand sample was obtained using a Van Dorn discrete depth sampler and was taken from the middepth point of the water column--in the center of the river channel. All samples were preserved according to EPA standards and delivered immediately to the Region VII laboratory. The samples were then analyzed using standard EPA methods.

Samples to be analyzed for trace metals were taken more frequently at each control, upstream and downstream from each dredge, and from the return water discharge pipe at each dredge site. These were obtained by submerging a polypropylene cubitainer in the middle of the river channel at the given transects, preserved with HNO_3 and submitted to the EPA laboratory for analysis.

Sediment Particle Size Analysis

Data on particle-size composition of the river bed were obtained in four independent operations: 1) core samples 5 cm in diameter and 60 cm long, analyzed using U.S. standard sieves in graded series from 2 mm through 0.075 mm mesh openings; 2) superficial samples 25 cm in diameter, analyzed using U.S. standard sieves in graded series from 25 mm through 1 mm mesh; 3) description of the bottom type over which each seine-haul was made for fishes as silt, silt-sand, sand, etc.; and 4) description of the bottom type on which each sample of benthic invertebrates was taken, in a manner similar to that for seine-hauls.

1) core samples - EPA --Four core tubes 60 centimeters (cm) long and 5 centimeters in diameter were driven into the sediments at each control site and at the "A" and "E" transects of each dredge site. The sediments were removed from the tubes at the EPA laboratory, fractioned into six parts and composited by fraction. As specified in this contract, the fraction delineations were the top one inch, the next two inches, the next three inches, the next six inches, the next six inches, and the bottom three inches. The individual fractions were weighed (dry) and a percentage composition of particulates was determined by size using standard sieves.

2) superficial samples, sieve analysis.--At two locations between DeSoto (river mile 31) and the uppermost Control site, and at each Control and Dredge site in this study, substrates were analyzed by the following means: A plastic cylinder 25 cm in diameter was pushed slightly into the riverbed, the purpose of the cylinder being to prevent loss of substrate material due to currents as well as to define the sample dimensions. Substrate was scraped from the soil-water interface to a depth of about 15 mm, or slightly deeper if necessary to include exposed cobbles. This material was graded using sieves of 25 mm, 16 mm, 8 mm, 4 mm, 1 mm, and in some cases 0.420 mm mesh openings. Three or more sets of these 25 mm samples were taken at most sites. The particle-size composition in each sample was expressed as percentage of the total volume in the sample, determined by water-displacement. Averages from the several samples were then taken as descriptive of the site.

3) Substrate in areas seined.--An analysis of substrate composition for areas seined was derived from point measurements taken at approximately one meter intervals perpendicular to the longitudinal axis of each haul. The number of measurements was standardized to two for 6-foot, three for 15-foot, and five for 30-foot seines. Series of point measurements were duplicated at five meter intervals in the longitudinal plane of the haul. The predominant substrate type for each haul was found by averaging coded values obtained in each dimension. Categories assigned for each seine haul were silt (< 0.420 mm), sand (0.420 - 4 mm), gravel (4 - 16 mm), rubble (> 16 mm), or combinations of these.

4) Substrate in areas of benthos sampling.--Substrates were characterized during benthos collections in the same manner as seining, with visual interpretations derived from the area within the portable invertebrate box sampler (PIBS).

The four methods have differing utility. 1) Core samples analyzed by EPA provided the most precise particle-size determinations, and the only determinations in depth of the riverbed. Their disadvantages are that both the numbers of samples and the areas sampled are small, and core tubes could be driven into only the finer substrates; hence the results are biased with regard to variability in particle sizes of the riverbed at most sites.
2) Sieve analyses by KU personnel covered greater areas than the EPA core samples and allowed for inclusion of gravel and cobble substrates where present, but did not allow for grading below 1 mm (in field) or 0.420 mm (in lab) particle sizes due to logistic and equipment limitations.
3) Substrate determinations performed in areas seined are the most "representative" of study sites due to the large areal extent of the analyses. The disadvantage of this method is the lack of precise particle-size categories obtained in core samples and sieve analyses.
4) Substrate determinations made during benthos collections were merely descriptive as in seined areas, but adequately represent the composition of the top fraction inhabited by benthic organisms.

Most analyses and discussions of substrates which follow are based on the descriptive methods used in seining. Actual categories of substrates are less precisely defined but allow for extrapolation of cause-and-effect relationships to broad areas of the river bed.

Sediment Chemical Analysis - EPA

Two composite core tubes 60 centimeters long and 5 centimeters in diameter were driven into the sediments at each control site and at the "A" and "E" transects of each dredge site. The sediments were removed from the tubes at the EPA laboratory, fractioned into two fractions and composited by fraction. The top six inches and bottom fourteen inches

were then analyzed for each transect according to standard EPA methods for trace metals, pesticides and other parameters found in Table A1-10.

Suspended Solids and Settleability USGS

Water samples were collected at three points on each of seventeen transects (Fig. 3) following procedures prescribed by the USGS Water Resources Laboratory, which analyzed the samples. At each point a sampler was dropped slowly into the water, allowed to touch the substrate and then retrieved. Water entered the bottle during this time providing vertically composited samples of the entire water column. These samples were then analyzed according to standard USGS methods to provide data on the total suspended solids and a profile of the percent of the total solids with given full diameters.

Current velocity was obtained using a Gurley current meter at the same points as were used for sediment samples. When the river depth was at least 1 m at the sampling point, current velocities were obtained from several discrete depths and averaged to obtain the mean current velocity. If the water was less than 1 m in depth a single current velocity was obtained at 0.6 of the total depth. If this were the case, additional points were averaged to obtain the mean current velocity in feet per second.

Other Water Quality Parameters - KU

Dissolved oxygen

Dissolved oxygen samples were obtained at mid depth in the water column at three points (Fig. 3) on each of the nineteen transects. Additional samples were collected from the return water discharge pipe at each dredge site. The samples were collected using a Van Dorn discrete depth sampler, transferred to glass Biological Oxygen Demand (BOD) bottles with ground glass stoppers and fixed in the field. The modified Winkler with full bottle technique was employed for the analysis of dissolved oxygen concentration in milligrams/liter.

pH

pH samples were collected using the Van Dorn sampler at mid depth from three points (Fig. 3) on each of the nineteen transects and the discharge pipes at dredge sites. These samples were transferred to opaque polypropylene bottles and cooled for preservation. Analysis was done using a Horizon Ecology model 5996 pH meter.

Total Dissolved Solids

Samples for total dissolved solids (TDS) analyses were obtained and preserved in the same manner as the pH samples above. The ionic content of the water in milligrams/liter was determined using a Myron model 542T1 dissolved solids meter.

Chlorophyll a

Samples for chlorophyll a content determination were collected and preserved in the same manner as the pH samples. The concentration of chlorophyll a in milligrams/liter was determined using a Turner Designs model 10-000 fluorometer.

Turbidity

Samples for the measurement of turbidity were obtained and preserved in the same manner as the pH samples. The turbidity of the water was determined in Nelson Turbidity Units using a Hack model 16800 turbidimeter.

Total and Phenolphthalein Alkalinity

Samples for the measurement of alkalinity were collected and preserved in the same manner as the pH samples. The alkalinity values were determined in milligrams $CaCO_3$ per liter titrimetrically using phenolphthalein and bromcresolgreen-methyl red indicators.

Suspended Particle Size Analysis

Samples for the measurement and size classification of suspended particles were collected in the same manner as the pH samples. A Coulter particle size analyzer was utilized to count the number of particles in a 0.5 ml sample with diameters in the following eight size classes: 5-8 microns (μ), 8-13μ, 13-16μ, 16-25μ, 25-32μ, 32-40μ, 40-51μ, and 51-64μ. These size classes extend beyond the finest range of the USGS suspended solids analysis.

Depth

The river depth was measured at three points (Fig. 3) on each of the nineteen transects. A six meter long aluminum conduit was marked in ten centimeter graduations. For depths greater than six meters a weighted rope marked in 25cm graduations was utilized.

Temperature

The water temperature was taken at three points on each of the nineteen transects. The 30 cm depth was utilized where practical for the temperature readings. Air temperature was recorded at hourly intervals. A mercury thermometer was used to determine the temperature in degrees centigrade.

Plankton

Phytoplankton

Phytoplankton samples were collected at three points (Fig. 3) on each of seven transects. One control transect was sampled as were the "A" and "E" transects of each dredge site. The Van Dorn discrete depth sampler was utilized to collect the sample from the mid depth point. The sample was then transferred to a 125 milliliter (ml) glass bottle and preserved with Lugals preservative stain. Six milliliters of this was then allowed to settle onto a slide and phytoplankton were identified and counted using a Wild M40 microscope.

Carbon-14 primary productivity analyses were also conducted. Water samples were collected from the seven transects mentioned above by filling a dark polypropylene bottle near the surface of the water. These samples were cooled and analyzed immediately upon arrival at the lab. The samples were spiked with Carbon-14 and incubated in a growth chamber for four hours. The samples were then prepared as in Schindler (1972) ^{14}C and the radioactive carbon assimilated by the algae was counted using a Packard C2425 scintillation counter.

Zooplankton

Zooplankton samples were collected at the same points as the phytoplankton. A 70 micrometer (μm) mesh plankton net was attached to a six meter long aluminum conduit and passed vertically through the water column. The number of vertical net draws was dependent upon the water depth. Twenty meters of water were passed through the net at each point and concentrated into a 125ml sample. The samples were then preserved in 4% formalin and counted using a counting wheel and dissecting microscope. The entire 125ml sample was counted.

b) Benthos and Drift Samples

Between June 1979 and September 1981, invertebrates were collected from the benthos and drift at Control and Dredge sites on 10 occasions (Table 1). Whenever water depth and current velocity permitted, organisms in the benthos were collected using a standard portable invertebrate box sampler (PIBS) of area = $0.1m^2$. In deep water, a standard Ekman or a Peterson grab was used from an anchored boat. The benthic surface area sampled was standardized to that of the PIBS ($0.1m^2$). Of the 221 benthos sample sets, 11 used Ekman grab and 24 used Peterson grab. In Table 26 and throughout this section, all grab samples are expressed in PIBS-equivalents and in the text and other tables they are lumped with PIBS samples under the same heading. Incorporating this standardization, there was a total of 663 benthic samples taken over the course of this project. At the time that each benthic sample was taken, qualitative estimates of substrate composition, water velocity and depth were recorded. Aquatic invertebrates

in the drift were collected with 12" x 18", 54-mesh anchored drift nets. The mesh size (363 microns) precluded the capture of microinvertebrates generally considered zooplankton.

The sampling procedure involved a series of three PIBS sample sets, each consisting of three PIBS or PIBS-equivalent samples, along two transects at each of two Control sites, C1 and C2, and five transects (A through E) across each Dredge study site, D1, D2 and D3. Sample sets were taken from the left and right sides of the channel, as far offshore as the PIBS could be used effectively, up to one-fourth of the channel width. The third sample set was taken in midstream, most often with Ekman or Peterson grabs. After August 1979, the B, C and D transects were eliminated from the collection procedure and only one Control transect was sampled (Table 26). The drift was sampled by the placement of one anchored drift net along the river bank at each transect in water of mean depth 0.5m for 45 min to 1 hr. Beginning in June 1980, drift sampling effort was doubled by the placement of a second net on the opposite side of the river at each transect for the same duration. All organisms were hand picked from samplers in the field and preserved in 70% EtOH.

In the laboratory, all specimens were sorted and identified to genus when possible. A few taxonomically difficult groups, the annelids, gammarid amphipods, several diptera and pisidiid clams were identified to higher taxonomic levels, usually family. Identifications were made using invertebrate taxonomic keys in Merritt and Cummins (1978) and Pennak (1978). In addition, on several occasions, assistance was received from researchers at the Kansas Biological Survey (see acknowledgments) in the identification and verification of various specimens. Terrestrial invertebrates found in benthic and drift samples were ignored, though retained with the aquatic collections.

c) Fish samples

Three fish collecting techniques were employed in sampling. Each gear type is selective for certain kinds and sizes of fishes, and varies in effectiveness with depth, current velocity, turbidity, or other factors.

Fundamental differences between gear types, such as measurement of effort, habitat suitability, and efficiency and selectivity of capture require the treatment of these methods in separate sections of the analysis. Seining, electrofishing, and trammel netting were performed in accordance with the schedule summarized in Table 1.

c1) Seining.

Seines of various sizes (6' x 4' x 1/8", 15' x 5' x 1/4", 30' x 8' x 3/8") were used. The 15-foot seine was always used to provide standardized basic data from all sampling sites for the full term of the study. Additional hauls with other seines were made when possible. Seining was limited to the shoreline, islands, riffles, or backwaters where take-out was practicable. A minimum of four hauls (two on each side of river) were taken at each of these transects: C1A, C1B, C2A, C2B, D1A, D1D, D1E, D2A, D2D, D2E, D3A, D3D, D3E. Where transects disclosed several habitat types, more hauls were made. Supplemental seine hauls were taken occasionally near transects in addition to our standard effort. Haul lengths were measured in meters between fixed points parallel to the shoreline. Width of haul was determined by the distance between the seine operators. Haul areas used in computing density and biomass were calculated by multiplying the haul length by the haul width. All fish taken in seines were preserved in 10% formalin, and kept separately by haul.

An analysis of habitat structure for seining was modeled on Gorman and Karr (1978), utilizing three dimensions of habitat diversity. Point measurements of depth, current, and substrate were taken at approximately one meter intervals perpendicular to the longitudinal axis of each haul. The number of measurements was standardized to two for 6-foot, three for 15-foot, and five for 30-foot seines. Series of point measurements were duplicated at five meter intervals in the longitudinal plane of the haul. A gauge of habitat structure for each haul was found by averaging the values obtained in each dimension.

In the laboratory, metric lengths and weights for individual fish were measured for each species in each haul. Weights in 1979 were determined

using a triple-beam balance calibrated to 0.1 grams (gm). Acquisition of an electronic balance in late 1979 permitted subsequent weights to be measured to 0.01gm. Total and mean lengths, weights, and condition coefficients, densities (fish per m^2), and biomass (gms per m^2) were tabulated for each species from each transect using a Honeywell 66/60 computer. Length-frequency histograms were also tabulated by computer. Some specimens were examined for stomach contents, reproductive information, and parasites.

c2) Electrofishing

Electrofishing gear consisted of a 14' johnboat with a boom-mounted stainless steel rake anode and two trailing cathodes. The front-mounted anode was hung such that it extended about 6" - 18" below the surface. Power was provided by a 2750-watt Sears alternator, with current passing through a Coffelt variable voltage pulsator unit (model VVP-15) and pedal switch. One person dip-netted from the front of the boat, with netting assistance provided by the driver. Electrofishing effort was determined by length of shoreline sampled, usually 200 m along the longitudinal axis of the river on each side both upstream and downstream from each dredge pit. Electrofishing effort at dredge study sites was conducted between the established A and B, and D and E transects, hereafter referred to as A-B and D-E in electrofishing tables and discussion (Fig. 3). At the two control sites and the partial study site, 200 m sections along the longitudinal axis of the river on each side were electrofished upstream and downstream of a designated midpoint at each site. Characterization of upstream and downstream at these sites was undertaken merely to conform with dredge study site samples and the data were later combined by site only. Supplemental electrofishing was done in additional areas upstream and downstream of study sites. Because this effort was random, mostly to determine what additional fishes occupied the site, the data (total numbers only) were kept separate from standard samples. Effort units refer to the numbers of fish caught per 1000 m of electrofishing effort. Some or all parts of certain sites were at times impractical for electrofishing because of adverse water conditions. Catchability was negatively influenced by high turbidity and swift currents. Electrofishing effort in 1979 was measured by a timer rather than

by linear measurement. We encountered difficulties with this method, and discontinued its use after December 1979. As a consequence, composite tables based on effort include only data collected in 1980 and 1981. Attempts in 1979 to shock the dredge pits were unproductive and were dropped in 1980 and 1981.

Fish collected by the electrofisher were weighed, measured, and scales were taken in the field. Most fish were released, but some specimens of all species were kept for later examination. Internal organs of large preserved specimens were fixed by coelomic injection with 10% formalin. Data acquisition from preserved specimens was performed in the laboratory. Individual lengths, weights, and scales or spines were obtained. Gonads were extracted from mature fish and weighed. Egg counts and mean diameters were obtained from most mature females. Food items found in stomachs were enumerated to best attainable taxonomic category. Site-specific and composite tables based on frequency (presence or absence) of food items for several species are summarized in Tables A7-1 through A7-13.

c3) Trammel-netting

Trammel-nets of one size (60' x 6', with 1" inner and 9" outer panels, bar measure) were used in sampling. Effective use of trammel-nets was restricted to dredge pits at D2 and D3, where depth was sufficient and current minimal. The dimensions and location of the pit at study site D1 prevented trammel-netting at that site. Combinations of three to five trammel-nets were placed both parallel and perpendicular to current in dredge pits for variable lengths of time. Trammel-net sampling typically was performed in conjunction with electrofishing, at which times nets were set from two to four hours. Additional netting was conducted for 24-hour periods at D3 in August 1980, and once each month from February through May 1981. For this reason, and because access to study site D2 was limited in the spring of 1981, considerably more effort was expended at study site D3 than at D2. Effort units refer to numbers of fish caught per 100 hours of net time. Fish taken by trammel-nets were treated the same as described in electrofishing methods, except for a tagging-recapture study of sturgeon in March and April 1981.

3. DESCRIPTION OF THE LOWER KANSAS RIVER

The "lower Kansas River" extends from Bowersock Dam at river mile 51.8 in Lawrence downstream to the confluence with Missouri River at the Kansas-Missouri state line in Kansas City, but most observations in this report are concentrated in a primary study area that extended from river mile 9.3 to river mile 25.0.

The flow of the Kansas River has varied from 160 to 510,000 cubic feet per second (4.53 - 14,400 cubic meters per second) during the 65-year period of record at the lowermost gaging station, situated at Bonner springs (mile 20.3) prior to 1973 but transferred to DeSoto (mile 31.0) in 1973. The mean daily flow has been 6,935 c.f.s. (196 m^3/sec) at the Bonner Springs/DeSoto gage, yielding an average annual discharge of 5,024,000 acre-feet (6.19 cubic kilometers). The average gradient of the lower Kansas River is approximately 1.7 feet per mile.[1]

In river miles 9.3 - 31.0 the Kansas River has a bed width of 320 - 1760 feet (97.5 - 536 meters), averaging about 880 feet (268 meters). The river is shallow and turbid throughout its length and its substrate is principally sand, except where dredging or structures such as dams and bridges modify the channel locally. At low flow stages the stream either meanders over its bed exposing expansive bars that alternate between the left and right banks, or it divides into shallow braided channels. The exposed bars and islands are low, usually barren, with gently convex slopes. Their surfaces are generally sandy but some bars and islands have coarse sand and gravel at their upstream extremities and most are overlain by silt at their downstream extremities. When discharge is less than 1500 c.f.s, exposed bars and islands occupy approximately half the channel width, at least in the reach from mile 31 to mile 22.

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[1]Data cited are from U.S. Geological Survey reports, Water Resources Data for Kansas (various years) and from a report titled "Cumulative Impacts of Commercial Dredging on the Kansas River," prepared by Burns & McDonnell Engineering Co. for the Kansas City District of the Corps of Engineers, 1982. That report is cited subsequently as B&M 1982.

Geologic and historic record

Schoewe (1951:276-285) summarized evidence concerning the origin and physical character of the Kansas River. The westward extent of the ancestral basin has been a matter of dispute. Frye and Leonard (1952:194, Fig. 12) believed that the river's headwaters lay east of the Flint Hills prior to Kansan glacial advances and acquired the western tributaries following retreat of that glacier. Some other authors thought it probable that the western tributaries were "through-flowing" eastward from a much earlier time (e.g., Dreeszen and Burchett, 1971). In any case, the lower valley has been deeply incised and filled with alluvium at various times in its history. Present alluvial depths near Lawrence are 40 to 80 feet, and remnants of dissected terraces stand 100 feet above the existing floodplain (Schoewe, 1951:279). Pleistocene climatic variations account for most of the degradation and aggradation that determined the present form and course of the lower channel.

Although the river was and remains "navigable" for administrative purposes, "the government ... considered the river for purposes of practical navigation as a whole unworthy of improvement" (Schoewe, 1951:283). Steamboat traffic in the mid-19th century apparently was confined to periods of high flow. In August 1853, Tidball (as reported by Langsdorf, 1950) carefully described channel conditions from Junction City to the mouth. Tidball recorded bars forming shoals less than one foot in depth as far downstream as the mouth of "Rock Creek" (=Mill Creek, the location of site D2 in the present dredging study), Delaware Ferry (=Grinter's Ferry, 3 miles east of Edwardsville, near the D3 site), and three to five miles downstream from Delaware Ferry (probably near the present Turner Bridge location). Apart from such "bars of considerable magnitude," and "snags of more frequent occurrence," Tidball found the lowermost part of the channel to be narrower and deeper ("seldom less than five feet") than in its westward reaches.

Tidball's survey was made during a period of low flow. He observed that the general depth of water in the main channel was two to seven feet, but with numerous transverse bars that were much shallower (eight to 14

inches deep). He stated that "Except in a few places ... the bed of the river is easily yielding quicksand" and concluded that "No remedy suggests itself for the bars; they will always exist, if not where I found them, at other points; and during low water their presence must be an insuperable obstacle to navigation."

There is other evidence that the river was generally wide and shallow, both before and since the 19th-century period of westward exploration and settlement. The indigenous fish fauna is mainly indicative of shallow, turbid streams. Most early traffic across the prairies was overland, rather than by river as in eastern regions. Despite some successful ventures by steamboats (e.g. Charles Baker's excursion to Fort Riley in 1854) there seems little reason to doubt that the Kaw was sand-filled nearly to its mouth--as was the channel of the Missouri River which received its flow.

Degradation in the Lower Kansas River

Recent degradation of the bed of the lower Kansas River is described extensively in a report titled Cumulative Impacts of Commercial Dredging on the Kansas River, prepared by Burns and McDonnell Engineering Company of Kansas City, Mo., and submitted to the Kansas City District, U.S. Corps of Engineers, in 1982. Several kinds of information were used to document the location, degree, and rate of degradation: records associated with certain structures at fixed elevations in the river, such as the water-intake structure for Johnson County Water District #1 at river-mile 15.0 and the U.S. Geological Survey gage for discharge measurements at river mile 20.3; "equivalent water surface elevations" that were calculated for specific locations and years, using cumulative flow-duration curves at the 10% and 25% levels of frequency; and data from surveys of the river channel, made along the same transects in various years and showing changes in the elevation and configuration of the river bed through time. Some of the principal conclusions in that report are summarized below, and cited as "(B&M 1982)" plus the appropriate page-reference.

The river evidently was degrading its channel at the U.S.G.S. gaging station at Bonner Springs (mile 20.3) throughout the period in which that

station operated (1917-1973). The rate of downcutting varied within the 56-year term of records at that site. The water-surface elevation at that gage, calculated for the 25% flow-duration rate (9,500 cfs), declined 0.9 feet in the period 1917-1942, 4.6 feet in the period 1942-1962, and 5.1 feet in the period 1962-1973. The average annual rate of decline in water-surface elevation at the same rate of discharge (25% frequency or 9,500 cfs) was 0.15 feet per year in the period 1939-1961, but 0.46 feet per year in the period 1962-1973 (B&M 1982, pp. II-23,24).

At river mile 15.0, where the Johnson County Water District #1 installed an intake structure in 1964, the equivalent water surface elevation declined 3.7 feet in the period 1956-1967 (B&M 1982, p. II-30).

Changes in river surface elevations at equivalent rates of discharge were calculated for several other locations using discharge rating curves derived at the Bonner Springs/DeSoto U.S.G.S. gaging station, coupled with data from survey transects in files of the Kansas City District, Corps of Engineers. The following declines in elevation occurred in the period 1962-1977 at the sites indicated: 3 feet at Range N (mile 9.5); 6 feet at Range 9 (mile 14.10); 3.5 feet at Range 12 (mile 16.36); 6 feet at Range 21 (mile 21.00); and 4 feet at Range 26 (mile 23.70) (B&M 1982, p. II-28).

The reach in which degradation was occurring in 1977, though not precisely determinable, was "approximately defined by Range N at river mile 9.5 at its downstream and Range 26 at river mile 23.7 at its upstream terminus" (B&M 1982, p. II-30). The upstream limit and mode of upstream progression of the degrading zone was apparent in data on water surface slopes (gradients) between ranges in 1977. Calculated for a discharge of 1,000 cfs the slope in water surface elevation from DeSoto (mile 31.0) to Range 26 (mile 23.7) was 1.8 feet per mile; for Range 26 to Range 23 (mile 22.04) the slope was 3.0 feet per mile; from Range 23 to Range 9 (mile 14.1) the slope was 2.1 feet per mile; and from Range 9 to Range N (mile 9.5) the slope was 1.2 feet per mile (B&M 1982, p. II-31). The conclusion was that degradation will continue to be propagated upstream "until the moving zone of active erosion encounters some firm channel control." (B&M 1982, p. II-32).

The Burns and McDonnell report (1982) deals with transects surveyed in 1977 and prior years. In 1979 and 1981 personnel of the Kansas City District, Corps of Engineers, repeated surveys on some range lines that permit extension to 1981 of trends described in the Burns and McDonnell report. Cross-sectional representations of the river bed at six locations, in 1977-1981, are included here as Figure 6 a-f. These surveys indicate significant degradation between 1977 and 1981 at Range 22 (mile 21.6) and Range 23 (mile 22.0), but little change in elevation of the river bed is evident at Range 01 (mile 9.8), Range 4 (mile 11.5), Range 27 (mile 24.3) or Range 30 (mile 26.0). At Range 22, downcutting occurred mainly near the right bank in 1977-1981 (Fig. 6c). The lowest part of the channel - the part which carries water during low-flow periods - was adjacent to the left bank in 1977 but adjacent to the right bank in 1981 at Range 22. That shift in location of the mainstream agrees with observations made during the Fishery-Dredging Study. Flow shifted from the left to the right bank at this location, site D1 of the Fishery-Dredging study, in 1979, and the stream became progressively entrenched in its new configuration in 1980 and 1981 at this dredge-site (Holliday #4, which began dredging in autumn 1978).

Changes in channel characteristics associated with degradation as observed in aerial photographs of the lower Kansas River.--Changes in some characteristics of the lower Kansas River are apparent in series of aerial photographs in files of the Kansas City District, Corps of Engineers, for various years from 1954 through 1979. Figures 7a-f were traced from photographs of six river segments, including the sites used in the fishery-dredging study; photographic sets that show low-flow stages were selected for use. In these figures, boundaries of the riverbed were taken to be precipitous banks or the edge of riparian forest. Thus the figures include all areas having barren bars indicative of recent inundation, but exclude flood plain areas not inundated for many years. Sandbar areas shown for the years 1954 and 1976 were entirely exposed (above waterlevel) in the photographs. For the years 1970 and 1979, submerged bars as well as exposed bars are shown, to compensate for higher water levels (greater discharge rates) on dates of photography in 1970 and 1979. The locations of dredging operations are shown in these figures.

Fig. 6a-f. Cross-sectional representations of the riverbed, 1977-1981. These figures, provided by the Kansas City District Office of the Corps of Engineers, are based on survey data by Corps personnel on the dates recorded in each drawing.

6a = Range 01 - Mile 9.8. Little change is evident in form or elevation of the riverbed, 1977-1981.

6b = Range 4 - Mile 11.5. As in 6a, no degradation of the riverbed in the four-year period is evident.

6c = Range 22, Mile 21.6. This is the approximate location of Dredge 1 in the set of three dredge sites studied in this project. The dredge began operating in autumn 1978, on the right bank, accounting for lowering of the riverbed on that bank and transfer of the mainstream from the left to the right bank on this range line, 1977-1981.

6d = Range 23 - Mile 22.0. Degradation of the riverbed is evident, especially in the period 1979-1981. The location is near transect D1A of the Fishery-Dredging study, where rubble bars were increasingly exposed in the three years of study and the narrow left-bank channel afforded riffle habitat.

6e = Range 27 - Mile 24.3. No significant degradation is evident. The location is within Control site 1 of this study.

6f = Range 30 - Mile 26.0. Slight bed degradation is evident.

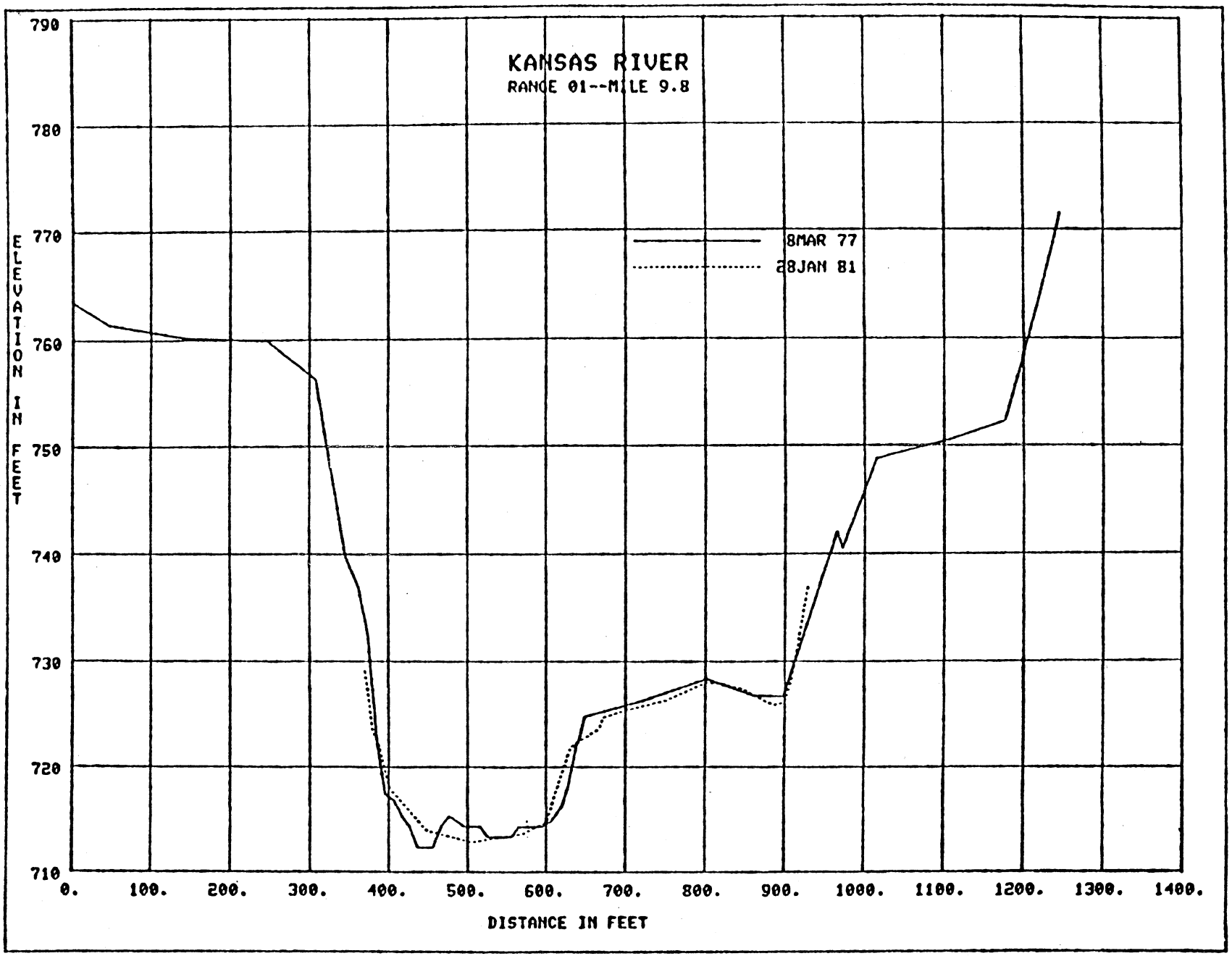

KANSAS RIVER
RANGE 01--MILE 9.8
8MAR 77
28JAN 81
ELEVATION IN FEET
790
780
770
760
750
740
730
720
710
0.
100.
200.
300.
400.
500.
600.
700.
800.
900.
1000.
1100.
1200.
1300.
1400.
DISTANCE IN FEET

Fig. 6a

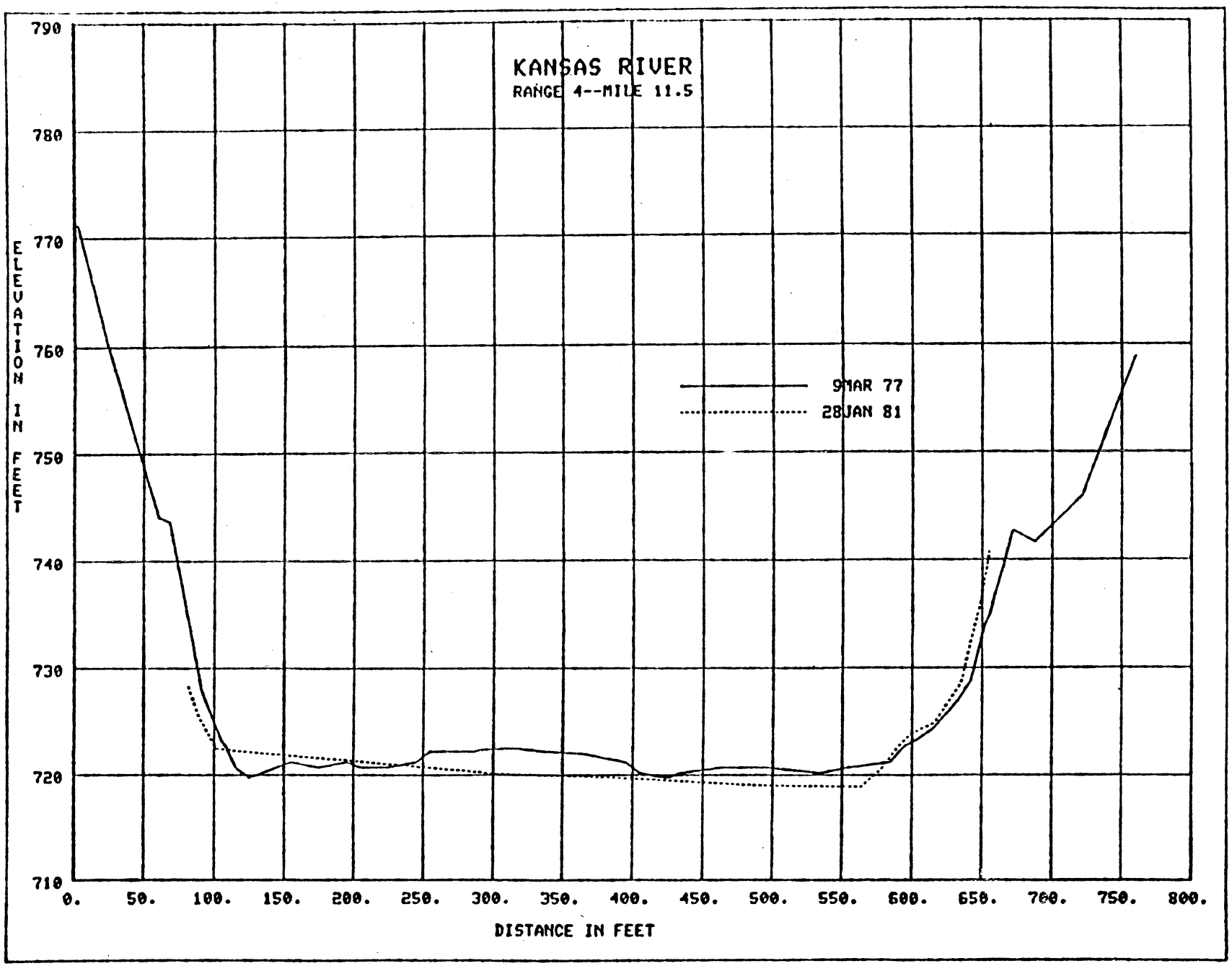

KANSAS RIVER
RANGE 4--MILE 11.5
9MAR 77
28JAN 81
ELEVATION IN FEET
790
780
770
760
750
740
730
720
710
0.
50.
100.
150.
200.
250.
300.
350.
400.
450.
500.
550.
600.
650.
700.
750.
800.
DISTANCE IN FEET

Fig. 6b

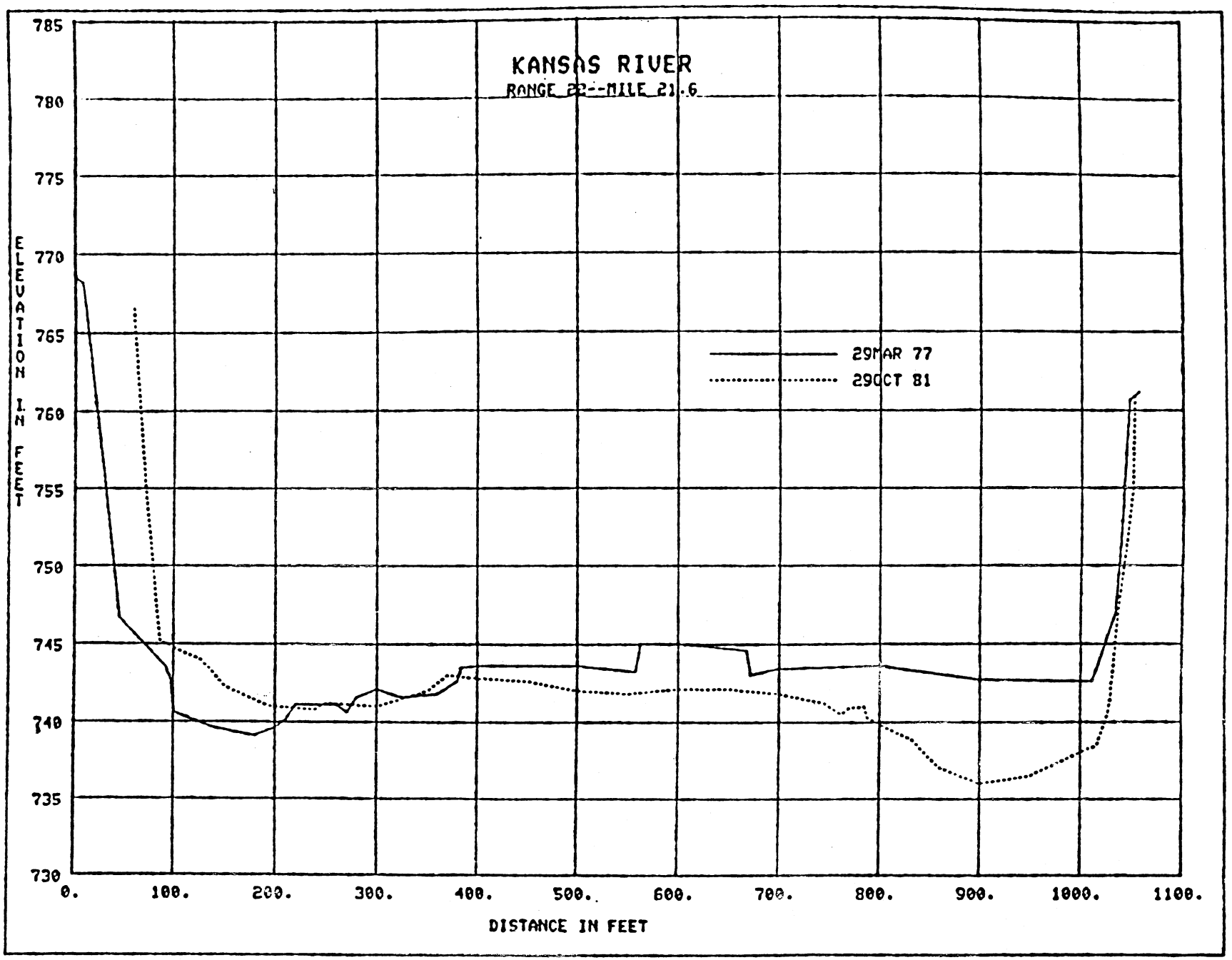

KANSAS RIVER
RANGE 22--MILE 21.6
29MAR 77
29OCT 81
ELEVATION IN FEET
785
780
775
770
765
760
755
750
745
740
735
730
0.
100.
200.
300.
400.
500.
600.
700.
800.
900.
1000.
1100.
DISTANCE IN FEET

Fig. 6c

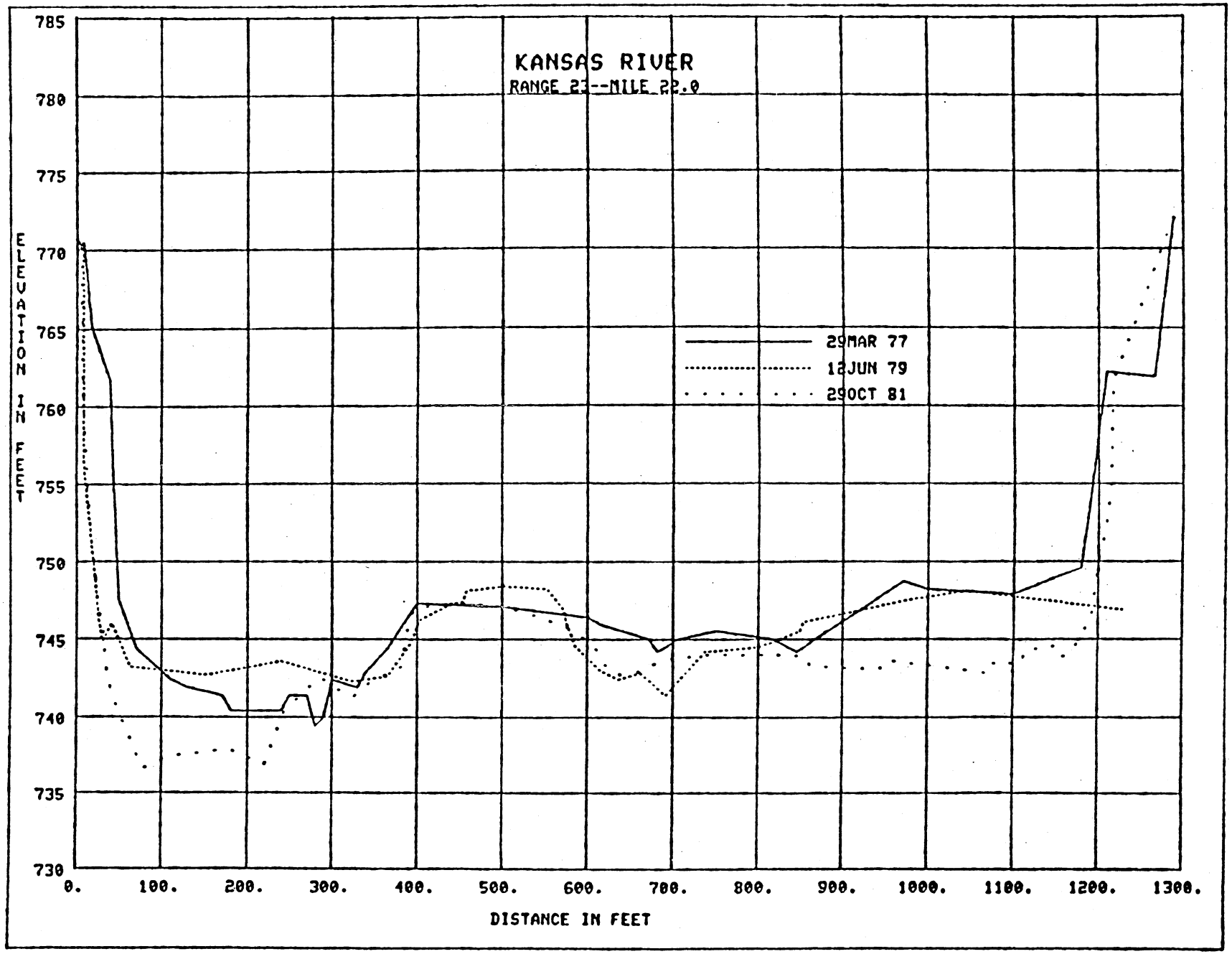

KANSAS RIVER
RANGE 23--MILE 22.0
29MAR 77
12JUN 79
29OCT 81
ELEVATION IN FEET
785
780
775
770
765
760
755
750
745
740
735
730
0.
100.
200.
300.
400.
500.
600.
700.
800.
900.
1000.
1100.
1200.
1300.
DISTANCE IN FEET

Fig. 6d

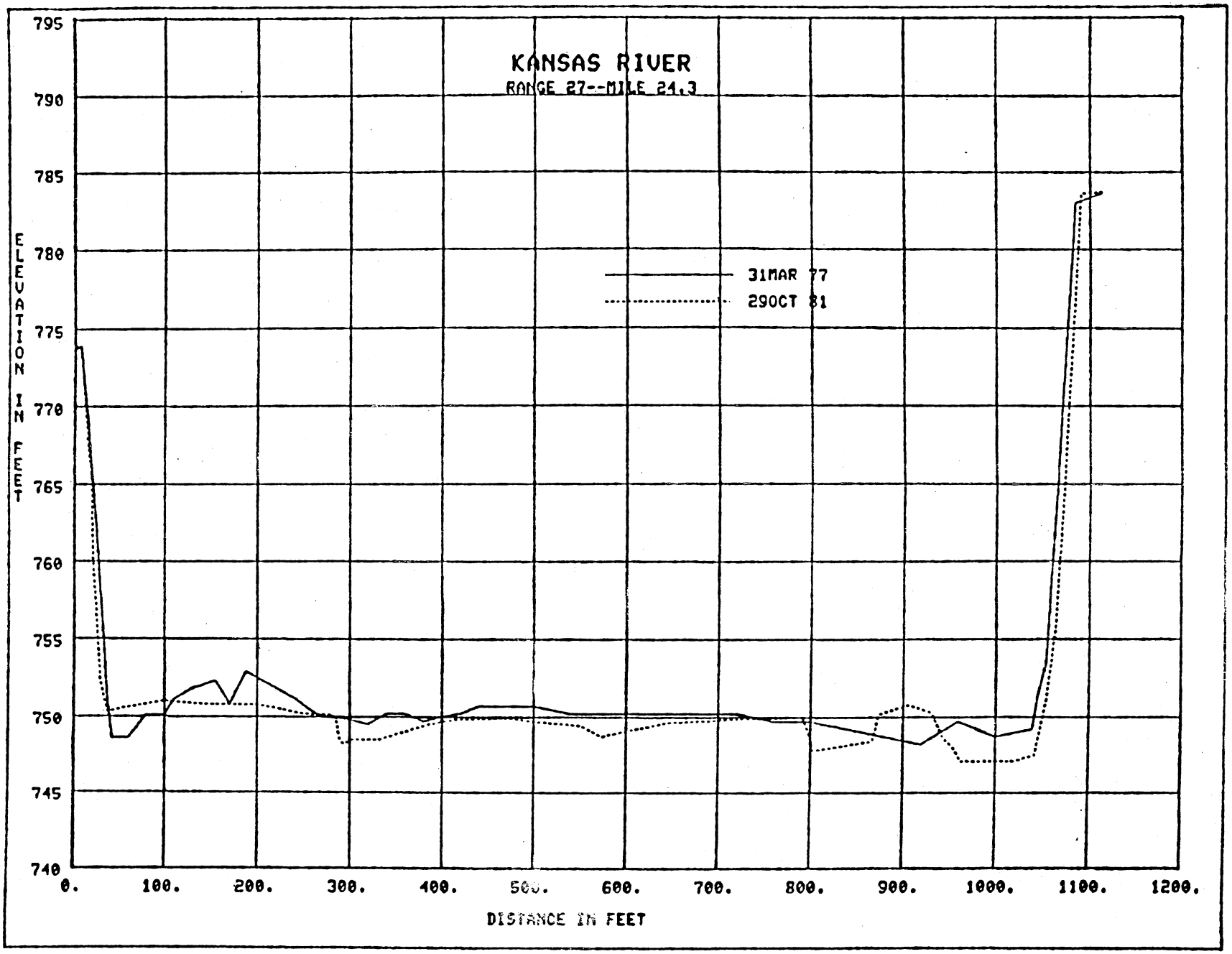

KANSAS RIVER
RANGE 27--MILE 24.3
31MAR 77
29OCT 81
ELEVATION IN FEET
795
790
785
780
775
770
765
760
755
750
745
740
0.
100.
200.
300.
400.
500.
600.
700.
800.
900.
1000.
1100.
1200.
DISTANCE IN FEET

Fig. 6e

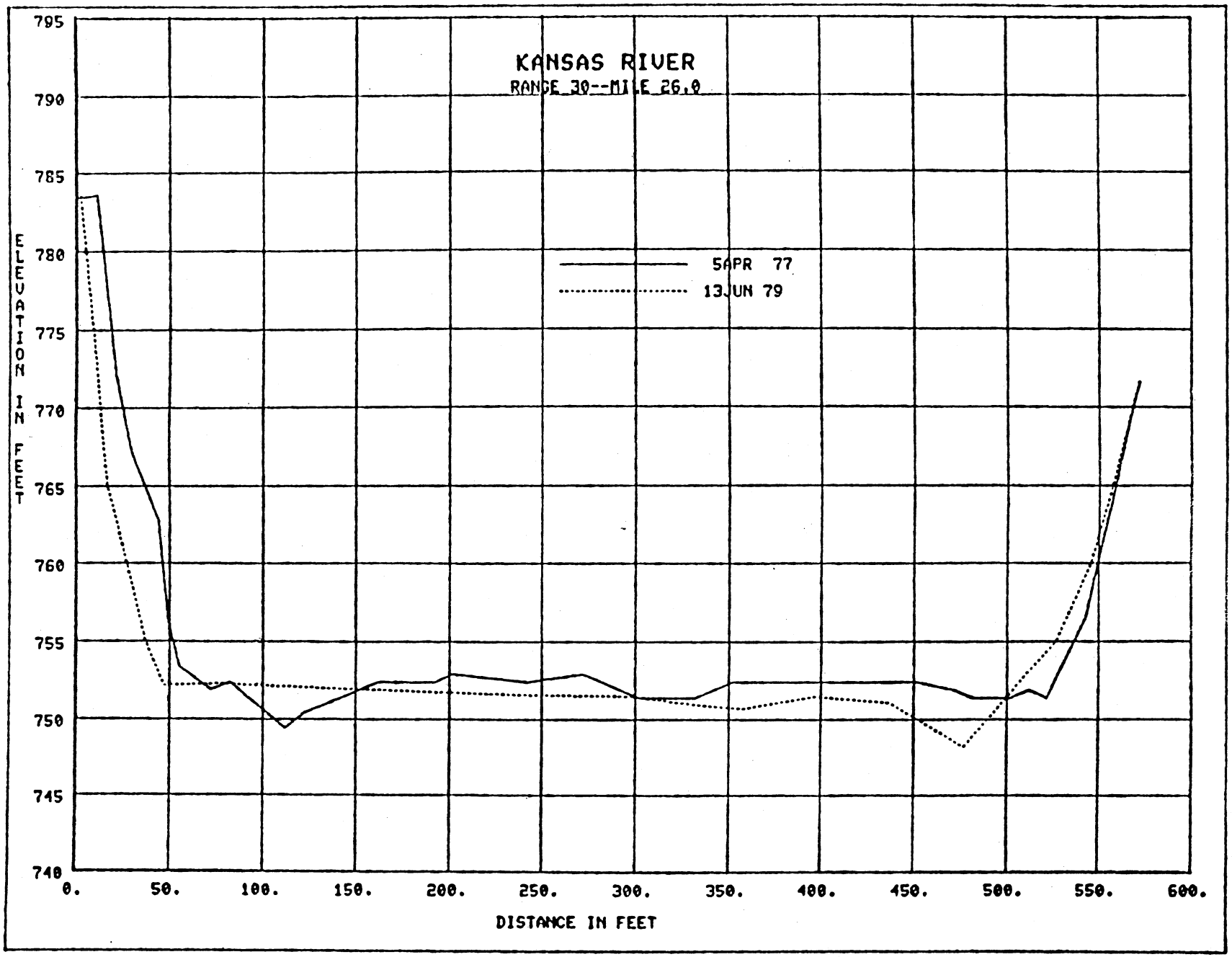

KANSAS RIVER
RANGE 30--MILE 26.0
5APR 77
13JUN 79
ELEVATION IN FEET
795
790
785
780
775
770
765
760
755
750
745
740
0.
50.
100.
150.
200.
250.
300.
350.
400.
450.
500.
550.
600.
DISTANCE IN FEET

Fig. 6f

The figures illustrate the degree of reduction in sandbar areas over time, especially downstream from mile 13.6, and reduction in the effective width of the channel as it became more deeply entrenched. A quantitative measure of these differences was made from the photograph sets for 1954 and 1979. Tracings of the riverbed were photocopied onto paper of uniform density, cut out and weighed on an analytical balance. Then sandbar areas were excised and weighed. The results are tabulated (Table 2) for four continuous segments of the river from mile 9.3 to mile 31.0. In 1954 the proportion of the riverbed consisting of exposed sandbars varied little from one segment to another (percentages in bars 45.82 to 50.87). In 1979 a much greater variation occurred, indicating progressive reduction in sandbar area downstream, from 43.06% in the segment near DeSoto to 24.66% in the segment near Turner Bridge (mile 9.3 - 15.0). The total bed area also differed in the two years, because of changes in bed width from 1954 to 1979. Bed-weights recorded for 1979 were taken as percentages of bed-weights for the same river-segments in 1954. The results indicate a 32% reduction in bed width from mile 9.3 to mile 15.0; a 26% reduction from mile 15.0 to 20.3; a 1% gain from mile 20.3 to 26.3; and a 20% reduction from mile 26.3 to 31.0. Although severe bank erosion at some points (e. g., range 25, mile 23.17) has caused lateral expansion of the bed, the more general tendency has been narrowing or constriction of the riverbed. It has become more deeply incised between relatively stable banks in its lower reach. In this process, much more riverbed material has been removed than is evident in Fig. 7a-b, because water surface elevations as well as riverbed elevations have receded.

At present, downcutting seems to have slowed or ceased in the lowermost segment (miles 9-12, Fig. 6a-b). Downcutting in 1977-1981 has been extreme in miles 20-23 (Fig. 6c-d). Upstream from mile 24, bed elevations show little evidence of degradation (Fig. 6e-f). Observations during field work in the fishery-dredging study in 1979-1981 led to similar conclusions. Except where dredges were actively removing sand and gravel causing deep pits, the ongoing processes seemed to be as follows: depositional (progressive silt accumulation) downstream from mile 20; erosional (progressive expansion of "armored bars" surfaced by rocks rather than sand) in miles 20-23; and little change upstream from Control Site 1 during the

three years of this study. The full length of the river was inspected from mile 31 (DeSoto) downstream, mainly to verify that the sites we used as "Controls" were representative of the river where dredging has not occurred. The riverbed in miles 23-31 seemed relatively uniform with respect to size of substrate material, extent of bars, depth of flow, and other features. That segment was predominantly sandy, but with shallow silted backwaters. Downstream (miles 20-23) areas that were degrading actively had rubble as well as sandy substrates. Areas below mile 20 were blanketed by silt where currents slowed, but had coarse rubble substrate where currents were strong enough to prevent silt-deposition. Little sand remained in those areas.

The changes in substrate-composition are described more fully in other parts of this report, but it is useful to generalize here that 1) the proportion of coarse sand (as contrasted with silt and rubble) diminished progressively downstream from our Control sites; 2) the proportion of sandy substrates at each dredge site diminished from 1979 to 1981; and 3) little sand appeared to be transported downstream beyond the K-7 highway bridge at mile 21.3, even during long periods of high discharge (Fig. 8).

Degradational Evidence from fossil exposures.--The relative age of fossil vertebrates collected from the surface of the riverbed provides another line of evidence as to the prevailing rates of erosion. Numerous fossils found during the fishery-dredging study, by our field crew and other persons, were brought to the Museum of Natural History, University of Kansas, and identified by Dr. Larry Martin. Several of the fossils have been retained in the paleontological collections of this museum. Among fossils collected downstream from mile 20 are specimens of mammoth (*Mammuthus*), mastodon (*Mammut*), stag-moose (*Cervalces*), musk oxen (*Symbos*), giant beaver (*Castoroides*), and a peccary (*Mylohyus*). These animals became extinct at the close of the Pleistocene. On many of the specimens, bony surface details are so well preserved (uneroded) that it seems unlikely the specimens were transported great distances or long exposed to molar action at the surface of the streambed. If, as seems likely, the sands and gravels in which the specimens were embedded had the same age as the specimens themselves, then the bed-material recently exposed was deposited at least 10,000 years ago. Any depositional accumulations since that time have been

Fig. 7a-f. Channel of the lower Kansas River, traced from aerial photographs taken 20 November 1954, 24 December 1970 - 24 January 1971, 15 December 1976, and 22 September 1979. Discharge rates on dates of photography were 794 cfs (1954), 2030-2000 cfs (1970-71), 900 cfs (1976), and 1330 cfs (1979). The direction of flow is from left to right in each drawing. Light stippling indicates exposed bars in channel, heavy stippling submerged bars. Submerged bars were drawn in for the years 1970-71 and 1979 only, to compensate for higher discharge rates in those years. Tracings for 1970-71 were omitted from some sets because ice cover obscured boundaries of bars. Dredge locations are shown in each figure.

7a = Mile 9.3 (Turner Bridge) to mile 11.9. Four dredges operated in 1954, two in 1970, none thereafter. Sand bars disappeared and the channel narrowed.

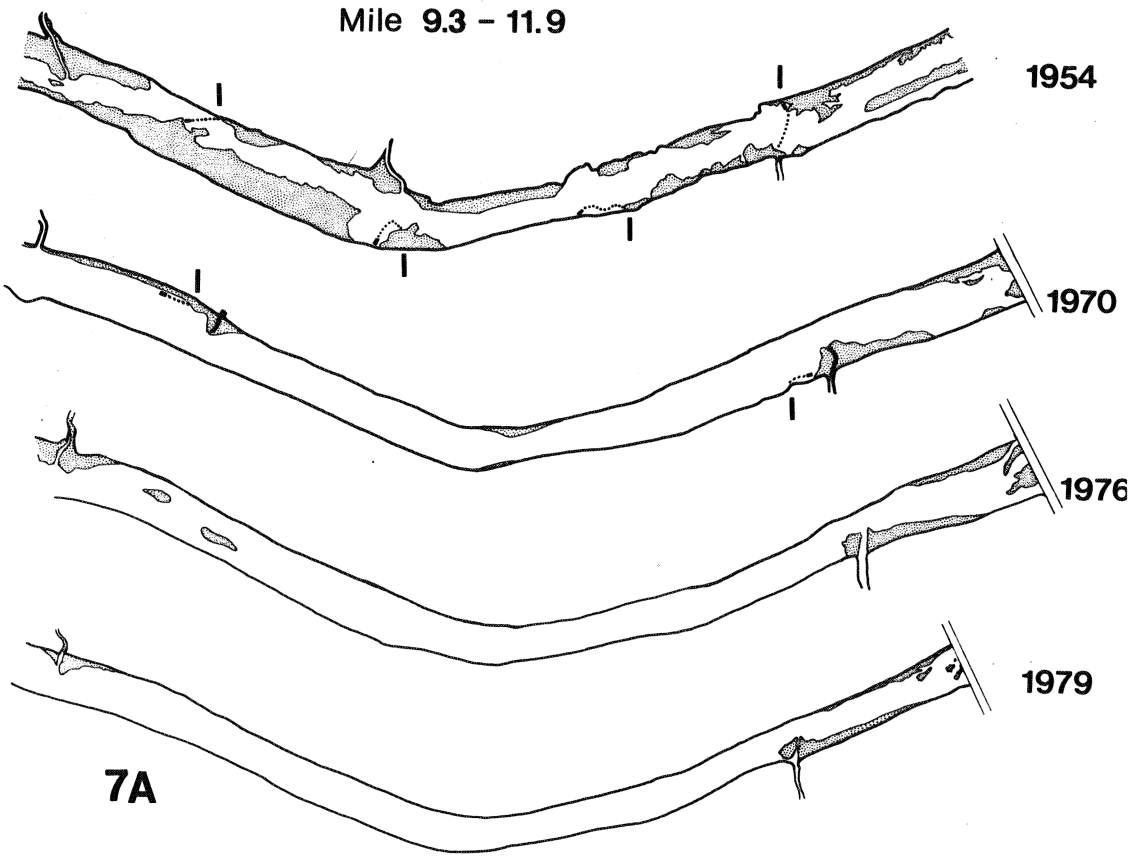
7b = Mile 11.8 - 13.6, slightly overlapping Fig. 7a. One dredge operated in 1954, three in 1970, one in 1976 and 1979. Dredge shown in 1979 is Study site D3 of this project. Channel width decreased over time.

7c = Mile 14.9 - 16.6. Two dredges began operation in this segment between 1970 and 1976. The area shown includes Study site D2, centering on the left bank dredge opposite Nelson Island (diagonally lined area). Near the right end of the figures the Johnson County Water District #1 diversion jetty is shown by a slanting line (1970-79), and I-435 bridge location (1979).

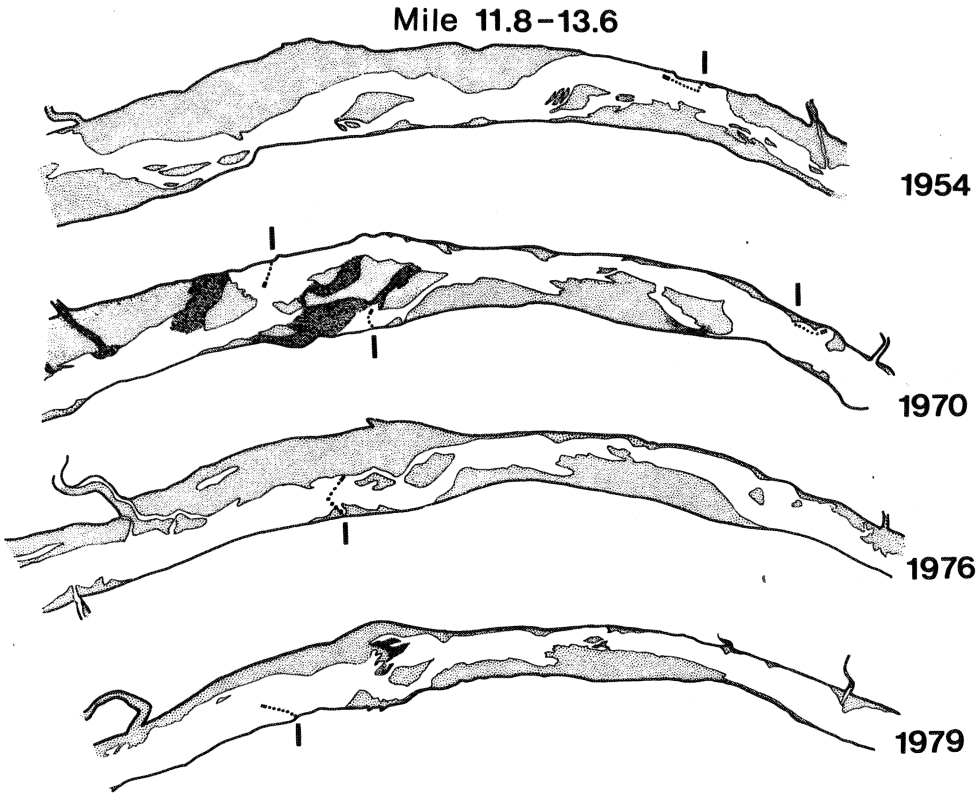
7d = Mile 21.3 - 22.8 (upstream from Highway K-7). The area includes Study site D1. The dredge began operating in autumn 1978. In 1979, the mainstream had begun to shift from its former location along the left bank to its subsequent right-bank location, from the dredge site downstream.

7e = Mile 22.8 - 24.5, slightly overlapping Fig. 7d. This area includes the two Control study sites, #1 at the extreme left edge of the figures, #2 opposite the bank stabilization dikes indicated by slanting lines on the right bank.

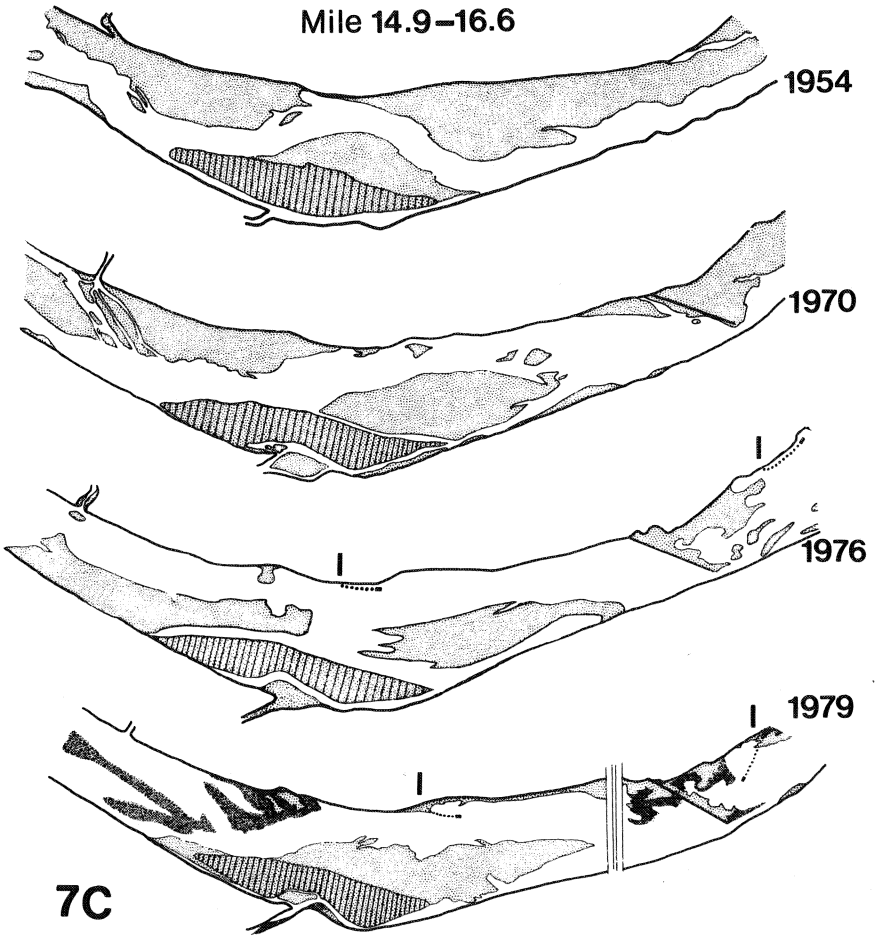
7f = Mile 28.2 - 31.0, downstream from bridge at DeSoto.


Mile 9.3 - 11.9
1954
1970
1976
1979

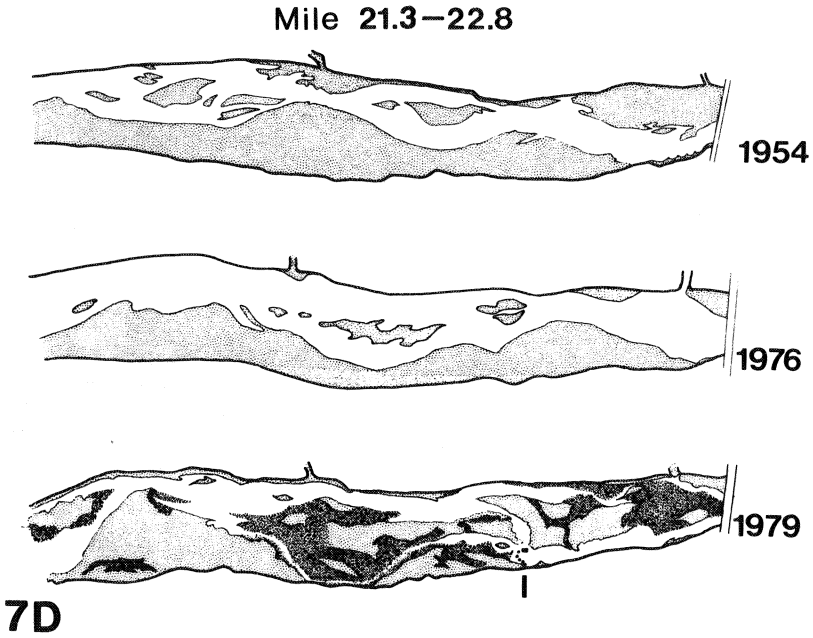
7A


Mile 11.8-13.6
1954
1970
1976
1979

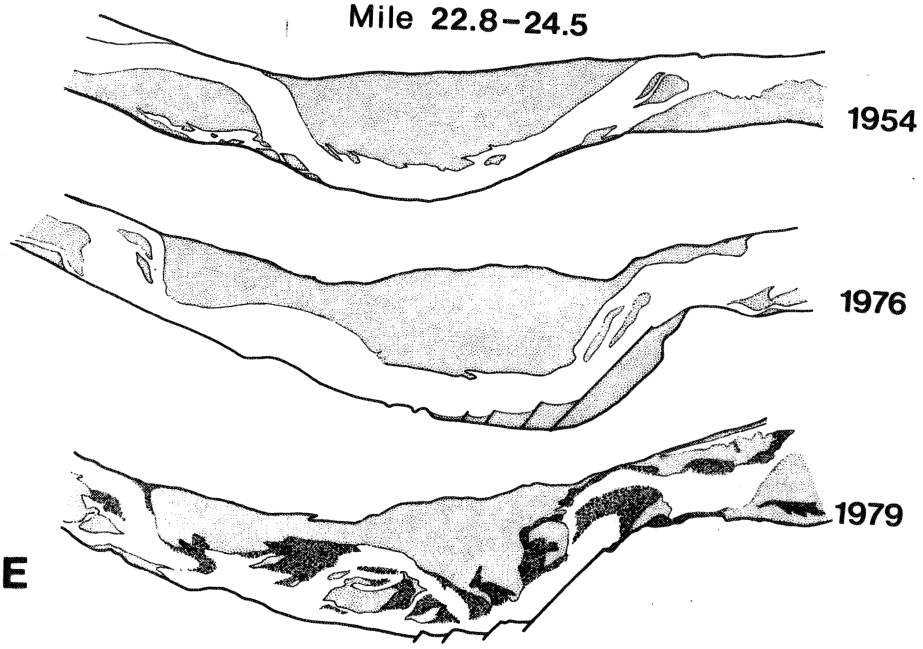
7B



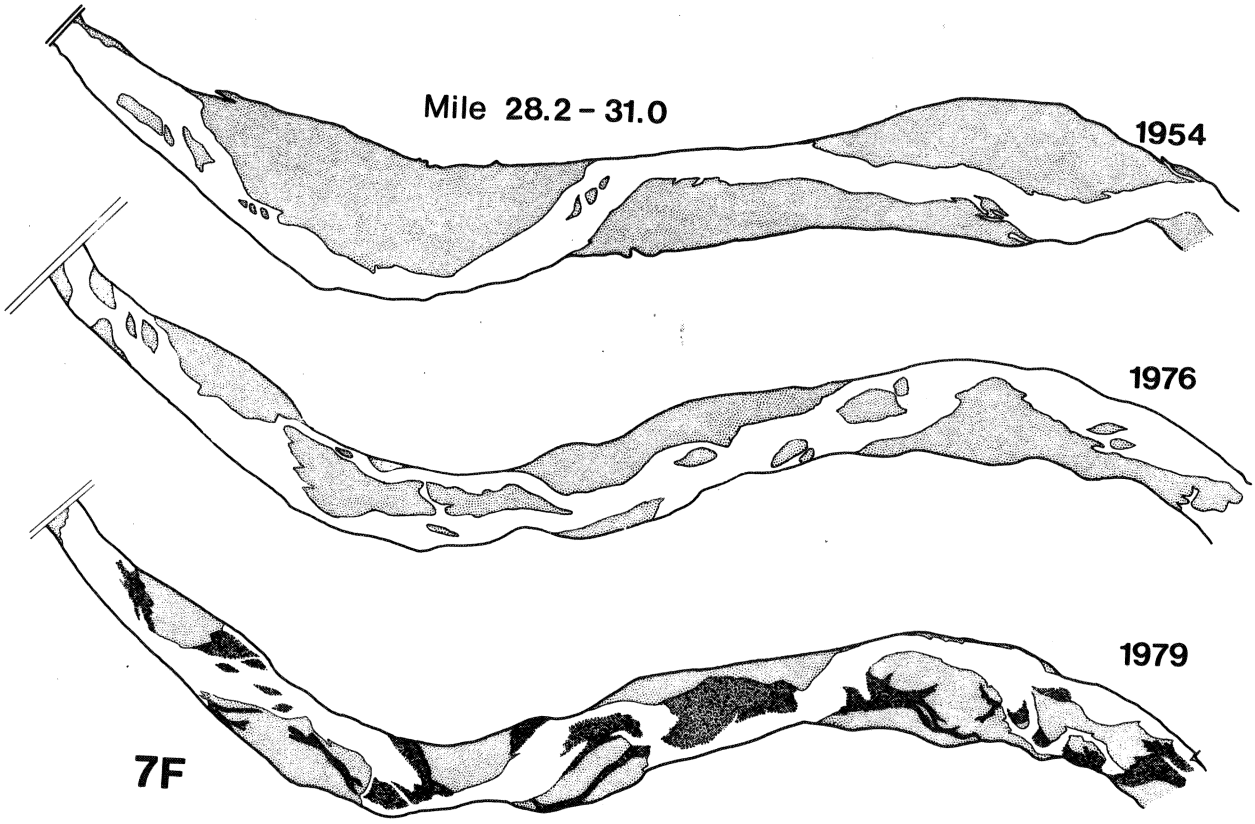
7C



7D



7E



7F

Table 2. Relative areas (expressed as weights) of the riverbed and that part of bed channel in exposed bars, mile 9.3 (Turner Bridge) to mile 31 (bridge at DeSoto), Kansas River, in 1954 and 1979. Discharge in 1954 was 794 c.f.s., in 1979 1330 c.f.s.

River Segment (miles above mouth)	Year 1954			1979		
	bed wt. (g)	bar wt.	% bar	bed wt. (g)	bar wt.	% bar
9.3 - 15.0	2.7860	1.2916	46.36	1.8965	0.4677	24.66
15.0 - 20.3	3.4080	1.7337	50.87	2.5190	0.6535	25.94
20.3 - 26.3	3.0681	1.4060	45.82	3.1140	1.0148	32.58
26.3 - 31.0	2.8356	1.4053	49.55	2.2615	0.9740	43.06

Fig. 8. Kansas River looking upstream from mile 18.7 toward the K-7 highway bridge at mile 20.3, on 29 August 1981 (discharge 3100 cfs). Little sand was transported into this area despite sustained high discharge (ave. 11,600 cfs) from 27 June -26 August 1981. The bar at left is silt-covered.

removed at the fossil locations. Thus it appears that recent rates of sediment removal exceed rates of past deposition or current replacement. Fossils found upstream from mile 20 since 1979 have been of younger age, mostly buffalo (Bison) or other Recent mammals. A few Pleistocene mammals have previously been reported at locations upstream from mile 20; however, some came from dredging operations (Martin et al. 1979).

Factors contributing to degradation.--Causes of the current cycle of degradation in the lower Kansas River probably are complex. Commercial dredging must be a contributory factor, because large amounts of sand and gravel have been removed in the degraded reach to meet the needs of the construction industry in the Kansas City metropolitan area. The amounts of sand and gravel extracted by dredges from Bonner Springs to Turner (miles 21 to 9) have exceeded the rate of sand and gravel deposited in this reach at least since 1962, according to evidence presented in the Burns and McDonnell report on Cumulative Impacts of Commercial Dredging on the Kansas River (B&M 1982, pp. II-50,51). Dredging cannot be the only factor involved, however (B&M 1982, II-32). The quantities of sand transported by the river and deposited in this reach have diminished from an average annual rate of 2.6 million tons per year for the period 1931-1961 (3.7 million tons/yr 1958-1961) to 1.5 million tons/yr in 1962-1969 and 1.1 million tons/yr in 1969-1975. The principal source of the sand transported appears to be upland terraces in Nebraska drained by the Republican and Blue rivers (B&M 1982, p. II-16, attributed to Schumm 1960). Those sources were intercepted by impoundment of the Blue River (Tuttle Creek Reservoir, where storage began in 1962) and the Republican River (Harlan County [Nebraska] Reservoir where storage began in 1952 and Milford Reservoir where storage began in 1967). Ten major impoundments, half of which were closed in the period 1962-1969, influence rates of sediment transport and deposition in the lower Kansas River (B&M 1982, p. II-43). The impoundments have eliminated floods, the extremely high flows having energetic capacity to move large amounts of sand into the lowermost part of the channel. Formerly, floods of varying magnitude were more or less annual events in the lower Kansas River Basin. Mr. Robert Pearse of the Sediment and Water Quality Unit, Water Control Section, Kansas City District of the Corps of Engineers, believes this change in the river's flow regime accounts mainly for reduced rates of sand

and gravel deposition in the lower basin. Land-management practices designed to reduce erosion in the watershed, as well as mainstream impoundments, may now reduce the volume of coarse sediment that enters the lower Kansas River. For whatever reason, there is now a severe imbalance between the rate of sand removal by dredging and the rate of its replacement.

A third factor probably contributes to degradation in the lowermost part of the Kansas River. The channel of the Missouri River has been modified - restricted and deepened - at and below its junction with Kansas River. Degradation in the Missouri River is indicated by a stage decline averaging 0.10 feet per year for the period 1943-1973, at the Kansas City gaging station (B&M 1982, II-32). A portion of the degradation in the lower Kansas River may be due to upstream propagation of Missouri River degradation (B&M 1982, II-32).

Whereas the Burns-McDonnell report and other studies have focused on the degree, causes, and economic implications of degradation in the lower Kansas River, the primary concern of the Fishery-Dredging project has been measurement of the effects of the degradation process on water quality and the biota, with specific reference to dredging activity.

4. COMMERCIAL DREDGING OF SAND AND GRAVEL

Sixteen dredges operated in the Kansas River in 1979-1981: one in mile 8, downstream from our study area; eight in miles 12-22, within our study area; one at mile 51 (Lawrence); four in miles 84-87 (Topeka); one in mile 126 (Wamego); and one in mile 152 (Manhattan).

The lower Kansas River has been dredged commercially for many years--since 1908 according to a representative of the industry. One dredge within the area studied (Holliday plant in mile 18) reportedly has operated at its present site since 1931. Writing in 1950, Schoewe (1951:285) stated that "the river furnishes vast quantities of sand annually to the 14 sand and gravel companies located between Kansas City and Junction City." In 1954, seven dredges operated in miles 9.4-18.5. Four of these dredges were in miles 9.4-12.0, whereas none occupy that part of the river now (Table 3, Fig. 7a). In 1979-1981, 8 dredges operated from mile 12.8 to 21.6, except that the lowermost discontinued operation in May 1981. This segment of the river (miles 9-22) has supported the greatest concentration of dredging activity. It is also the river segment where channel degradation has been most severe.

An historic record of sand and gravel production by commercial dredges in this river segment was tabulated in the report on Cumulative Impacts of Commercial Dredging on the Kansas River (B&M 1982, p. II-49) as follows:

Period (Dec. 31 - Dec. 31)	Average Sand Removed (million tons per year)
1940-1945	0.51
1945-1950	0.94
1950-1955	1.42
1955-1960	1.72
1960-1965	2.11
1965-1970	1.82
1970-1975	2.38

The dredges used are floating, hydraulic suction-type units. Each unit has either a chain-and-ladder device or a rotating head (Figs. 9,10,11) to loosen the sand and gravel bed before it enters the suction tube. A pipeline mounted on pontoons conveys the dredged material to a processing area on the riverbank, where it is cleaned, sorted by size, and stored in piles pending distribution to consumers. Excess water and fine materials are returned to the river (after passing through small settling pits in some cases). Turbidity and other attributes of water quality are affected most at the outfall site of this returning water, as described elsewhere in our report. Deltas of fine sand and silt develop alongshore at the outfall sites. The pontoon-floated sections of pipeline that link the dredge to shore can be extended and pivoted in a wide arc, so that each dredge is able to operate bank-to-bank along a rather extensive segment of the channel.

The dredging season extends from February or March through December, terminating when ice-cover precludes further operation at a site. The daily and weekly operating schedules vary greatly, depending on the amount of material in storage and sales anticipated at a site. One common schedule was 7 a.m. to 4 p.m., Monday through Friday, but dredges normally on that schedule would sometimes operate continuously (in three daily shifts) on six-day weeks. At the close of a day's operation the dredge is usually swung back against the riverbank. At the end of a season it is removed from the water for winter storage on shore. Individual dredges in the series of eight within our study-area were often "down" for repairs or other reasons.

Production-data provided by the producers for the years involved in this study are shown in Table 4. Not all dredges measure their daily production, so the data tabulated are estimated retrospectively, in some cases, using known sales tonnage and known daily operating schedules. Production declined from nearly three million tons in 1979 (May - December only) to approximately two million tons in 1980 and less than one million tons in 1981 (April through October).

Economic conditions probably account for the declining production, because construction activity in the region slowed from 1979 to 1981. We believe that the impact of decreased demand for sand affected producers differently, depending partly on their location. Two plants, the fourth and eighth in the series, were shut down for most of 1981.

Table 3. Locations of previous and present working dredges, by river mile, in the segment of the lower Kansas River covered by the Fishery-Dredging Study (Turner Bridge to Bonner Springs), 1954-1981. Data obtained from dredging equipment and/or storage sites evident on aerial photographs in the years indicated.

	1954	1970	1976	1979
	9.9			
	10.3			
	10.6			
	11.3	11.3		
	12.0	12.0		
		12.9	12.9	12.9[2]
		13.1		
	14.0[1]	14.0	14.0	14.0
	14.7[1]	14.7	14.7	14.7
			16.0	16.0
	18.4	18.4	18.4	18.4
			19.3	19.3
		21.0	21.0	21.0
				21.7[1]
Total dredges	8	8	7	8

[1] newly established sites
[2] ceased operation in 1981

Table 4. Sand and gravel production (tons) in the lower Kansas River, with reference to the three dredges used as study sites. Data provided by the producers. D1, D2, D3 = dredge sites identified in text.

Period		D1	All Dredges Upstream D2	D2	All Dredges Upstream D3	D3	All Dredges Total
1979:	4/27 - 6/1	7,295	150,824	66,195	281,548	22,831	304,379
	6/1 - 6/29	25,229	155,823	38,163	262,399	37,194	299,593
	6/29 - 7/27	19,399	236,884	22,099	317,716	23,218	340,934
	7/27 - 8/31	43,925	325,224	48,221	452,530	34,378	486,908
	8/31 - 9/28	50,461	286,771	32,995	388,834	26,398	415,232
	9/28 - 11/2	92,986	417,085	75,464	567,631	21,978	589,609
	11/2 - 11/30	52,907	225,539	30,909	307,678	16,056	323,734
	11/30 - 12/28	20,521	66,668	12,730	115,378	23,879	139,257
	Totals	312,723	1,864,818	326,776	2,693,714	205,932	2,899,646
1980:	3/2 - 3/28	2,040	41,540	22,600	64,140	23,000	87,140
	3/28 - 4/25	30,600	81,100	32,300	142,130	22,226	164,356
	4/25 - 5/30	51,200	139,300	77,600	263,452	38,223	301,675
	6/1 - 6/27	16,300	102,521	64,700	232,546	27,634	260,180
	6/28 - 7/25	26,600	130,378	37,200	231,902	37,269	269,171
	7/25 - 8/29	16,400	119,066	24,300	208,903	34,412	243,315
	8/29 - 9/26	41,975	118,002	12,960	193,953	27,627	221,580
	9/26 - 10/31	91,250	124,430	18,720	199,673	35,058	234,731
	10/31 - 11/28	29,200	99,808	18,000	164,624	28,962	193,586
	11/28 - 12/26	54,700	97,701	10,800	128,501	8,658	137,159
	Totals	350,265	1,053,846	319,180	1,829,824	283,069	2,112,893
1981:	4/6 - 5/9	35,800	60,646	26,218	123,409	10,400	133,809
	5/11 - 6/6	28,700	51,680	34,276	125,194	1,400	126,594
	6/8 - 7/4	36,000	54,657	28,963	127,983	0	127,983
	7/6 - 8/1	22,900	62,898	20,300	143,590	0	143,590
	8/3 - 8/29	0	48,702	36,800	143,960	0	143,960
	8/31 - 10/3	33,000	96,981	36,000	177,732*	0	177,732
	Totals	156,400	375,564	182,557	841,868	11,800	853,668
		(189,983)*		(223,846)*	(899,868)*		(911,668)*

*includes period before 4/6/81 for 3 dredges

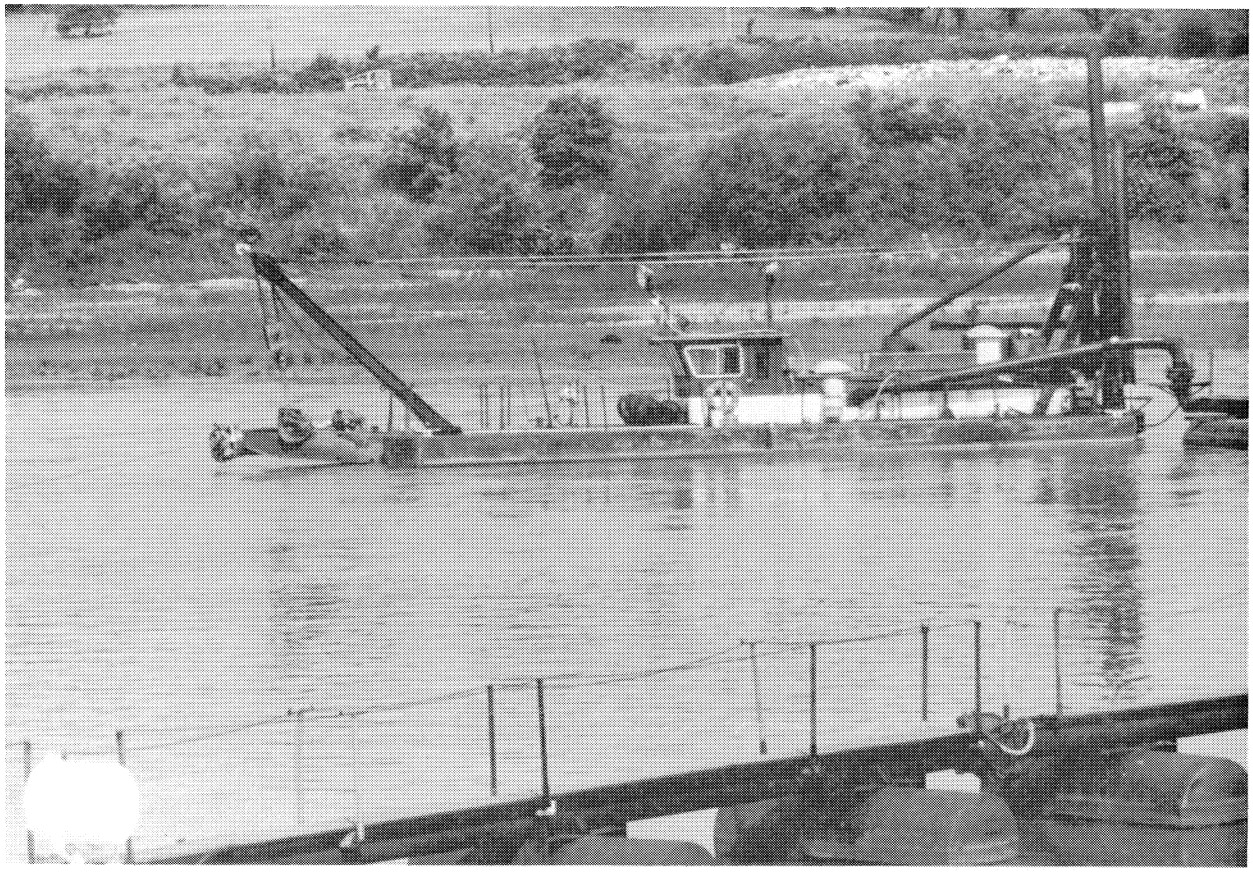


Fig. 9. Dredging unit operated by Holliday Sand and Gravel Co. at Dredge site 1 (mile 21.6). The dredging device shown is of the "rotating head" type. Sand is conveyed through the pontoon mounted pipeline in the foreground. Photograph June 1981.

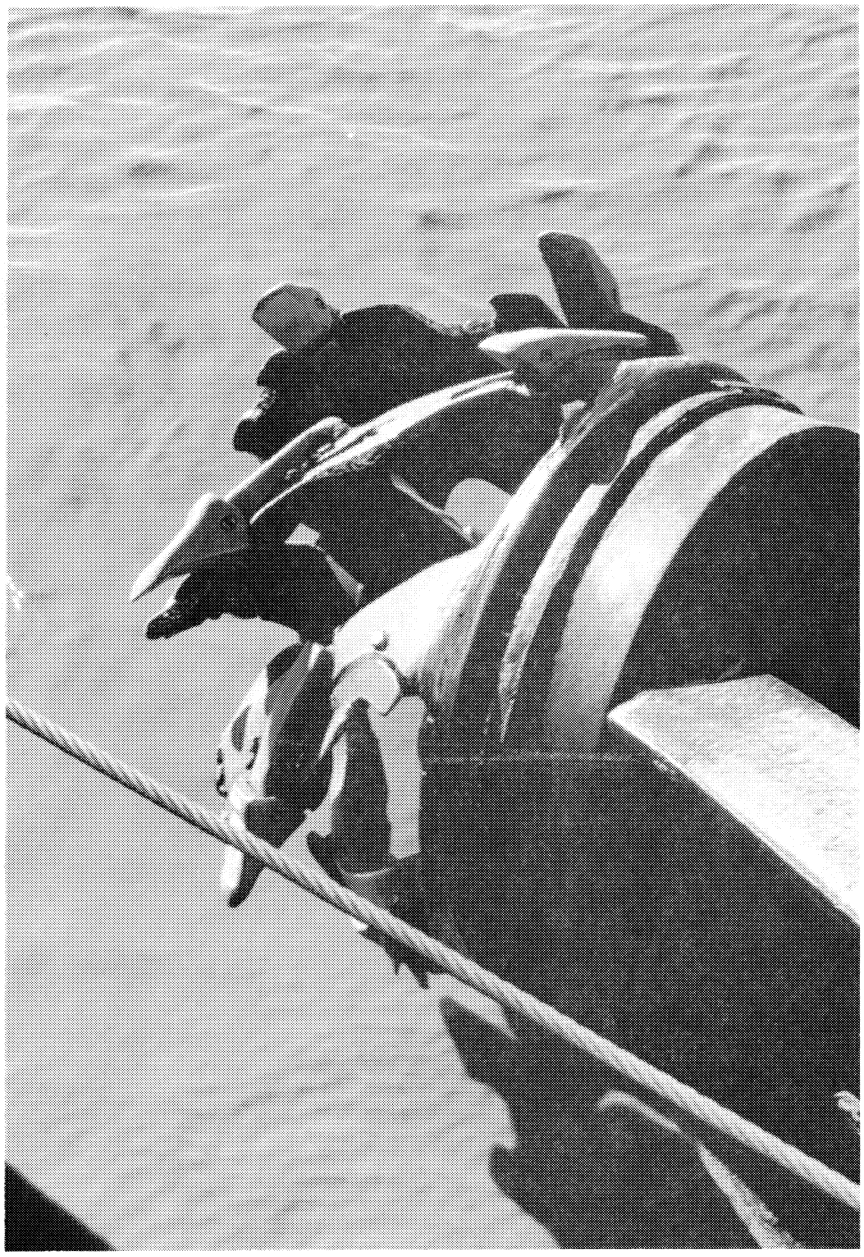


Fig. 10. Close-up of "rotating head" cutting device at Dredge 1 (site D1), Holliday Sand and Gravel Co., mile 21.6. Photograph 4 November 1979.

Fig. 11. "Chain-ladder" device that is lowered into the river and used to loosen substrate at Dredge 3 (site D3), Hub Materials Co., mile 12.8. Photograph January 1981.

5. GENERAL SITE DESCRIPTIONS

a) Individual sites

Control Sites

Two control study sites were located between river miles 23.0 and 25.0, in a river segment that has not been dredged. These sites were broad and shallow with moderate currents (0.40 - 0.45 m/sec) and predominantly sand substrate. At low discharge rates, the river bed had large exposed bars and braided channels (Figs. 12, 13). During periods of increased flow, the configuration of sand bars changed due to shifting and transport of sand.

The main channel, backwater areas below sand bars, small pools isolated from the main channel by the recession of high water, large snags and man-made debris, and shallow ribbon channels associated with sand bars were habitats frequently encountered. At moderate water levels, pools occasionally existed behind rock dikes used for bank stabilization.

Prolonged fluctuations in water level were primarily a function of reservoir discharge. Fluctuations in water level due to direct runoff were usually less extreme and of shorter duration. At low water levels turbidity was reduced, allowing light penetration to the stream bed, and increased primary productivity. Periphyton was common in backwaters, isolated pools, ribbon channels, and other areas characterized by shallow depth and reduced flow (Fig. 14). As discharge rates increased, the current velocity and shear stress on the bed increased. As a result, turbidity increased as sediments were contributed from upstream, backwaters and isolated pools were inundated, and periphyton was scoured and transported downstream (Fig. 15).

Transects at Control site 1 lay just upstream and downstream from Range 27, where little or no channel movement and bed degradation has been recorded. Transects at Control site 2 lay approximately on and below Range 25, where the channel has recently been active. Left-bank cutting of approximately 870 feet and bed degradation of about 4 feet occurred near these transects during the interval 1954-1977.

Fig. 12. View from right bank of Kansas River, looking downstream across transects C2A and C2B, located in mile 23. Transect C2A is located near the center-right of the photograph, near the leading edge of the large sandbar. Photograph January 1981.

Fig. 13. View of Kansas River from right bank, looking upstream from just below transect D1A (mile 21.9). Shallow bays and channels associated with sandbars are characteristic of unimpacted sections of the river. Photograph 2 July 1980.

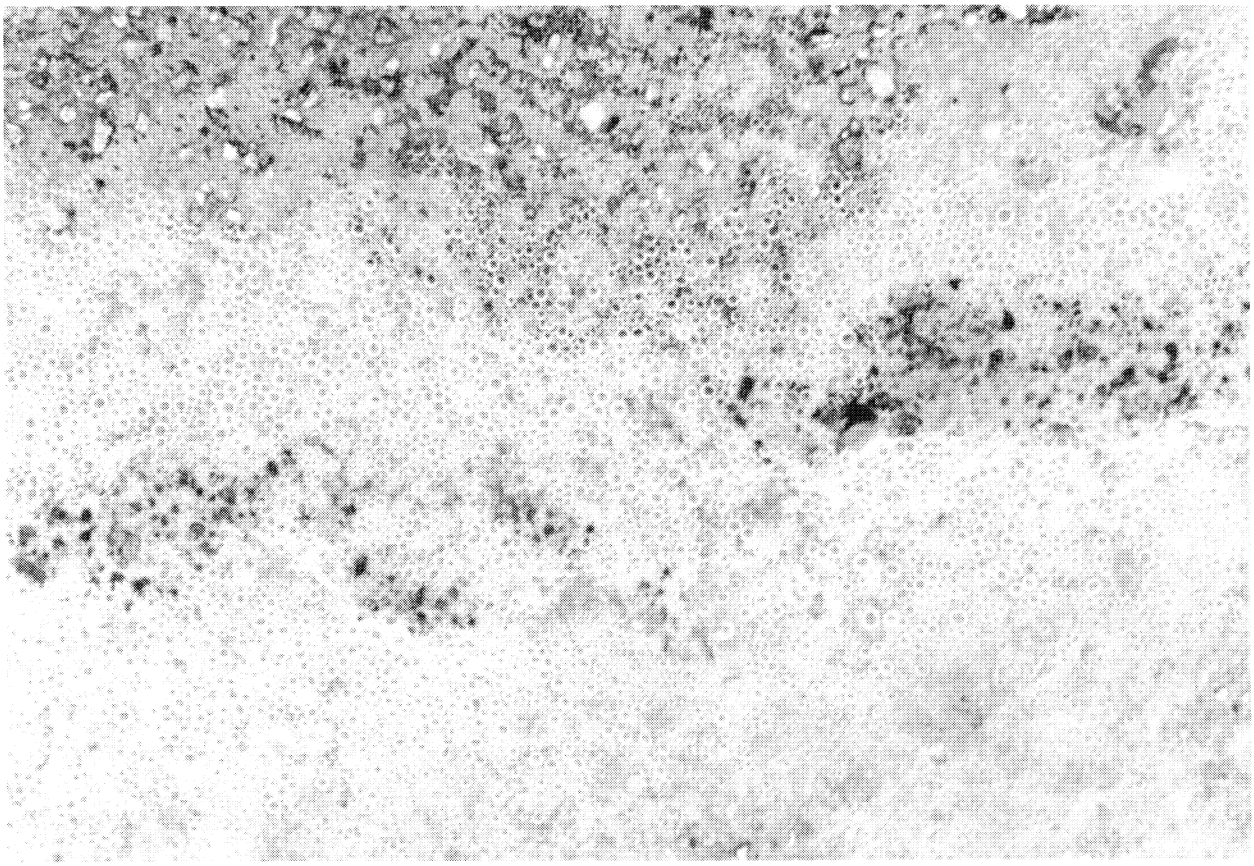


Fig. 14. Periphytic algae in shallow bays and channels provide primary production and an important food source for young of several fish species in the Kansas River. Bubbles result from photosynthesis. Photograph 2 July 1980.

Fig. 15. Periphyton in shallow sandy areas is subject to scouring and transport downstream as velocity increases in center of channel (upper right). Photograph 2 July 1980.

Study site D1

Dredge 1, located on the right bank between river miles 21.3 and 22.3, began operations in the fall of 1978, a few months prior to our initial investigations in May 1979. No other dredging operations occur in the river between this site and river mile 51, at Lawrence. In contrast to the control sites, this segment of river was characterized by reduced stream width, increased depth, steep banks, and increased current velocities (> 0.45 m/sec except in dredge pit). Sand was the predominant substrate, but rubble and silt increased during the years of study (Figs. 16,17,18).

Below the control sites, the stream swung in a long meander from the right to the left bank, due partly to its deflection by the rock dike at mile 23.2. Flow continued along the left bank, where active cutting and collapse occurred during and prior to the period of our studies. A broad, low sand bar extended outward from the right bank, spreading almost the full width of the river bed downstream to the railroad bridge at mile 21.3. Before dredging began, flow was shallow through this river segment, confined to the left bank at low stage but occupying the entire river bed at moderate to high rates of discharge. The river narrows downstream from the dredge, passing under the railroad bridge and K-7 highway bridge below this site.

Field observations in 1979 indicated the river had characteristically followed the left bank through this segment. During 1979, dredging activity caused the stream to migrate to the right bank. After cessation of dredging in November, the stream returned to its former position against the left bank. With the resumption of dredging in 1980, the stream repeated the left-to-right migration; it then became entrenched against the right bank and did not return to the former position after dredging ceased in 1980. Thus, flow patterns were influenced by dredging activity in this segment of river.

Shallow ribbon channels, irregularities in the shoreline, and riffle areas were the most common habitats encountered at transect D1A, above the dredge. Transects D1D and D1E, below the dredge, were similar to D1A but had reduced numbers of ribbon channels and riffle areas. A small tributary

Fig. 16. View of Kansas River, looking upstream toward Dredge site 1 from ATSF railroad bridge at mile 21.3. The dredge is located at center left. Photograph January 1981.

Fig. 17. Kansas River, looking downstream from transect D1A (mile 21.9), September 1981. Pleistocene fossils were exposed on the rubble bar alongside the channel following degradation of the river bed. ATSF railroad bridge at mile 21.3 in background.

Fig. 18. Rubble and silt substrate increased during the years of the study at transect D1A (mile 21.9). Photograph September 1981.

entered the river on the left bank at transect D1E. During periods of high flow, fishes congregated in the mouth of this stream to avoid swift currents. Below D1E, logs and other debris collected against the piers of a railroad bridge, forming habitats attractive to some fishes.

Movement of sand into this site was evident, because the dredge-pit refilled with sand soon after dredging ceased each year, and armored bars gained an overlay of sand during high flows. Nevertheless, other observations indicated that sand replacement rates were inadequate against active processes of sand removal. In the course of our study rubble-exposures became more extensive, both on bars and in the streambed at low-flow stages. The channel became more deeply incised, especially along the right bank downstream from the dredge. We conclude that dredging activity accelerated degradation of the river bed. However, active bank erosion and bed degradation occurred in this river segment before dredging began here, as is evident from cross-sectional data at ranges 21-25 (river miles 21.00-23.17) for the period 1954-1977.

Study site D2

Dredge 2 was located on the left bank between river miles 15.6 and 16.4. This segment of river was characterized by steep banks, increased depths, sluggish flow (< 0.25 m/sec), and a predominance of silt substrate. Sandy substrates were confined to a long bar (island) that was rarely inundated (Figs. 19,20,21).

The interaction of several factors was responsible for the physical characteristics of the Dredge 2 area. Long-term use of the site had created a dredge pit that was larger than the pit at Dredge 1, with greater depth, wider cross section, and a greater longitudinal axis. Below the dredge, a rock jetty (built to divert water into the Johnson County Water District #1 treatment facility) extended nearly across the width of the riverbed (Fig. 22). Also, a temporary construction platform existed immediately below the site in the latter part of 1979 and early in 1980, during construction of a bridge for Interstate Highway 435 at mile 15.3. The combination of these three factors caused a reduction in velocity, stabilized water level, increased silt deposition and homogeneity of habitats in the Dredge 2 area.

Fig. 19. View downstream from right bank at transect D2A. The right bank at this transect was steep, with silt substrate. The channel to the right of the island was opened by dredging in 1980-81. The person at right is using a PIBS invertebrate box sampler. Photograph September 1981.

Fig. 20. View upstream from left bank near transect D2C (mile 15.6). Dredging at this site in late 1980 was concentrated against a sandbar extending downstream from Nelson Island along the right bank. Photograph September 1981.

Fig. 21. Dredge site 2, looking upstream from I-435 bridge. By 1981, sandy substrates persisted only on the low island extending through the upper left part of this photograph. Mill Creek enters the river in the shallow backwater at the left of the brushy island. Photograph January 1981.

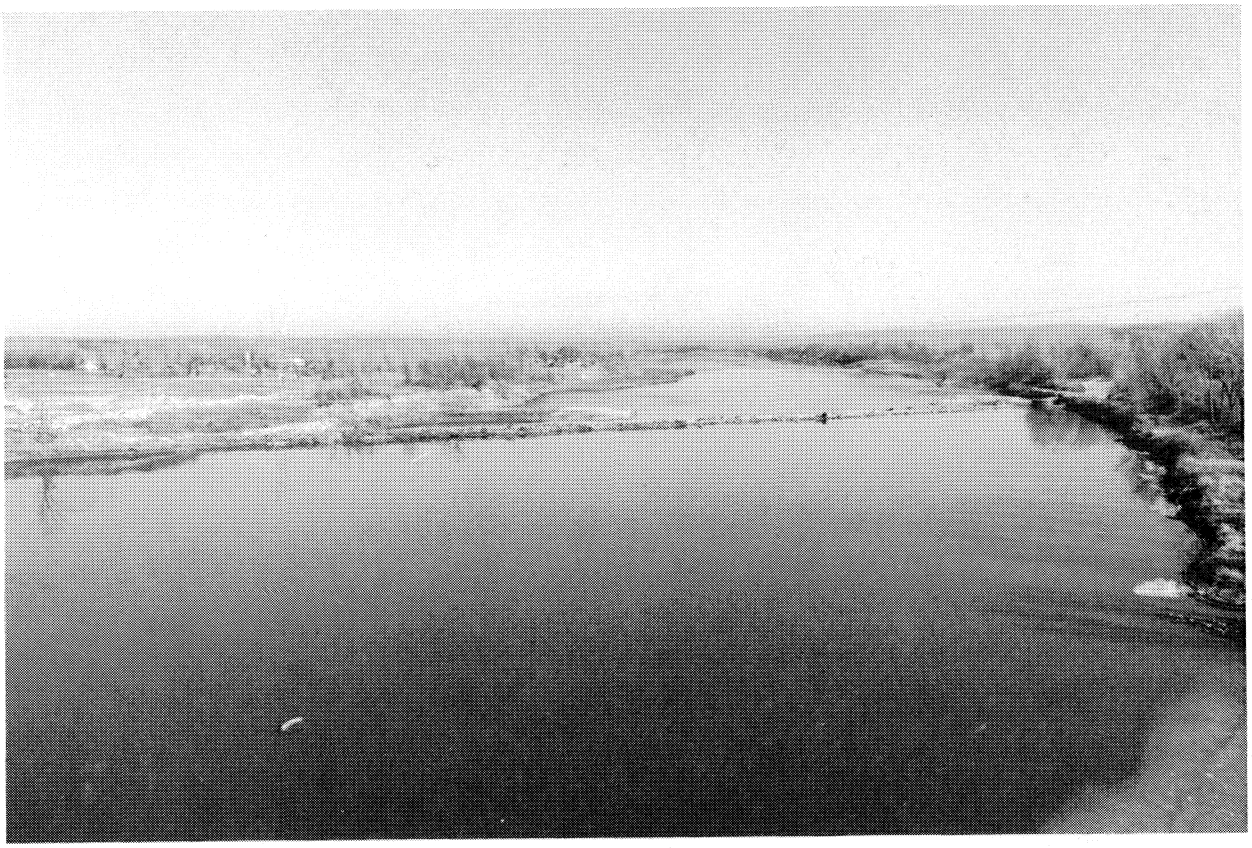


Fig. 22. View of Johnson County water district #1 diversion jetty (mile 15.0), looking downstream from I-435 bridge. This jetty acts to reduce flow, accelerating deposition of sediments upstream in Dredge site 2. Photograph January 1981.

An island several hundred meters in length separated the river from its confluence with a small tributary, Mill Creek, except during periods of very high discharge. The outlet from Mill creek, isolated from the river by the island, provided a large backwater area where riverine species congregated. An increase in lentic fishes reflected the impoundment-like characteristics of the Dredge 2 area.

Bed degradation has been offset by depositional processes at this site. The diversion jetty below the site negates the potential of the river to degrade and entrench--a process that has occurred downstream and is presently occurring at study site D1 upstream. We found little evidence that new sand is transported into this site to replace that being removed, under present conditions. Bars and channel areas upstream remained silty even after prolonged high flows in the summer of 1981 (Fig. 8).

Study site D3

Dredge 3, located on the right bank beteen river miles 12.3 and 12.9, was the lowermost site in the study area. This site was generally characterized as having a narrow bed width, steep banks, sluggish flow (< 0.25 m/sec except at D3E), and moderate depths. Silt as a discrete substrate was predominate at transect D3A, above the dredge. Below the dredge, at transects D3D and D3E, silt commonly occurred in association with rubble.

The main channel, shallow embayments over rubble bars, riffle areas, and irregularities in the shoreline provided the principal habitats within this site. No bars were present in the channel upstream from the dredge, so shallow water was confined to the banks at transect D3A. Downstream from the dredge, large rubble bars extended outward from the right bank.

A low replacement rate of sand in this segment of river resulted from its location as the lowermost site in the study area. The diminished accessibility of sand and gravel probably accounts for two shifts in the position of this dredge during the three-year period of this study. In 1980, a large bar that formed an island near the center of the channel was

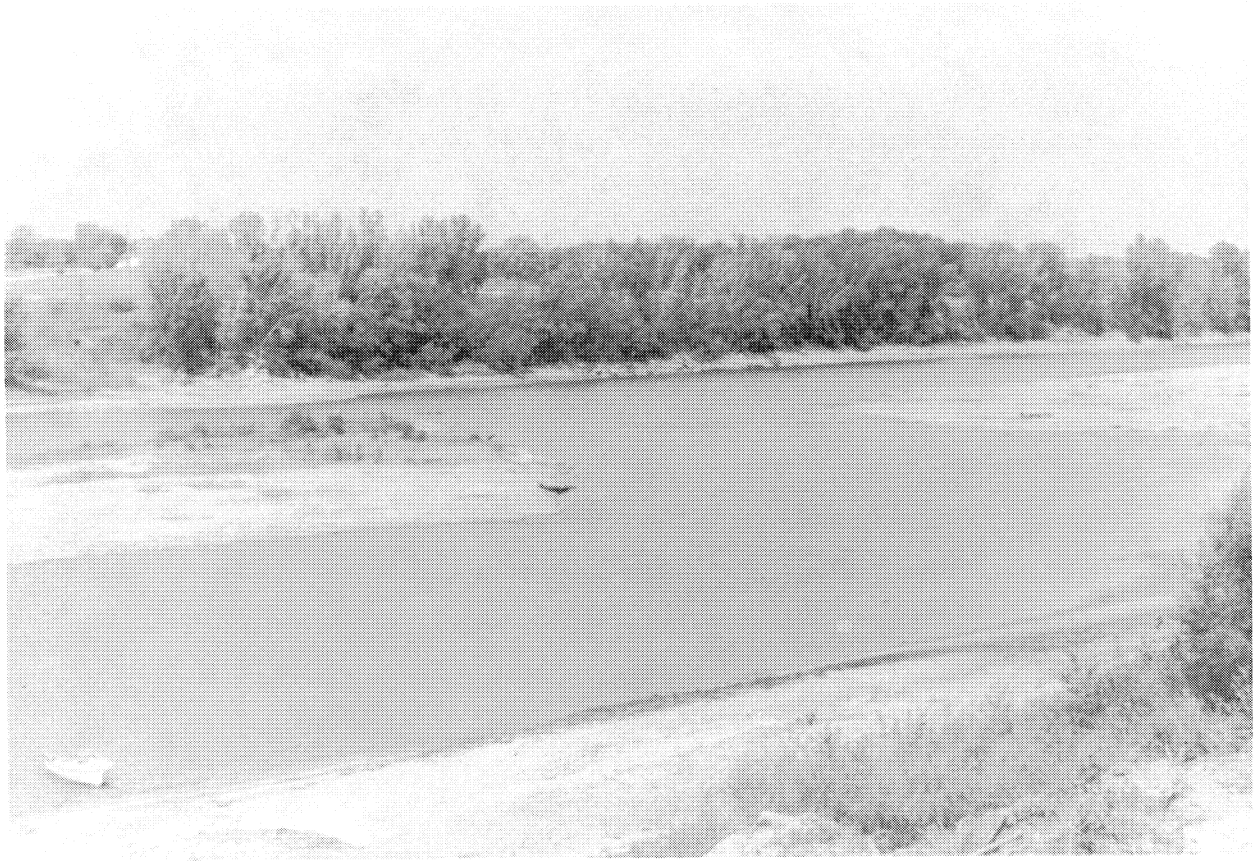


Fig. 23. View of transect D3D in 1979. Note island near center of channel. Transect D3E was located just upstream from the rubble bar extending out from the right bank at center right. Photograph May 1979.

Fig. 24. In early 1980, Dredge 3 relocated downstream and removed the island and associated shallow-water habitat shown in Fig. 23. Transects D3D and D3E were shifted downstream because of this change in the position of the dredge. Photograph 2 July 1980.

Fig. 25. View of Dredge 3 pit in 1981. Island and upper portion of the rubble bar downstream were dredged in 1980. Photograph September 1981.

Fig. 26. Rubble bar extending out from right bank in mile 12, downstream from Dredge 3. Photograph September 1981.

removed as a result of downstream relocation of the dredge (Figs. 23,24,25). Habitats previously associated with the island were rocky riffles and small pools, narrow stretches of unbroken flow (runs), and backwaters. After removal of the island depths increased, velocity was reduced, and silt was the predominant substrate. A second downstream relocation of the dredge in 1980 caused the upper portion of a large rubble bar to be removed, creating a pit offset from the flow of the mainstream (Fig. 7f). This rubble bar extended from the right bank to more than half the distance across the riverbed and represented the downstream edge of the pit.

Dredge 3 occupies a river segment subjected to degradational processes over an extended period of time. The armored bed below the dredge (Fig. 26) was highly resistant to scouring from increased discharge rates, and maintained a stable configuration through time.

Partial Study Site (Turner)

The Partial study site was located at Turner Bridge (river mile 9.3), in a river segment sometimes influenced by Missouri River backwater. This site was characterized by a narrow riverbed, steep banks, and moderate currents. Depths varied from 1-3m in the main channel. The predominant substrates were silt and rubble, which occurred as discrete substrates and in combination.

The main channel, irregularities in the shoreline, riffles, and shallow pools associated with rubble bars were habitats that characterized this site. Sand bars were absent in this river segment. At low discharge rates, the stream narrowed to a width less than 50m beneath the bridge. Currents were slow upstream of the bridge, but increased beneath and immediately downstream from the bridge. Rubble bars occurred near the right bank beneath the bridge and downstream from it. The configuration of the bars and associated riffles and pools did not change appreciably through time. Also, boulders originating from rip-rap used to stabilize the right bank littered the bottom of many pools.

This segment of the river has become deeply entrenched. The channel is narrower than in the past, and is devoid of sand bars. In 1954, four dredges operated in a 2.5-mile stretch of river upstream from this site, but none operate there today (Fig. 7a).

b) Depth Analysis of Lower Kansas River

The depth of the river was measured approximately each month from May 1979 to July 1981, at three points along each of nineteen transects. The values for the three points were averaged to obtain a single annual average value for each transect. Care was taken to return each month as closely as possible to the same points on each transect. The annual averages of mean depth are presented in Table 5 and Figs. 27-29.

The mean depth values for study sites C1 and C2 over the three years ranged from 60cm to 180cm. Unusually high water levels in 1981 increased the range substantially. These two sites were the most consistently shallow of the five sites studied. Their overall mean depth was 125 cm. Deep channels were rare and when found were constantly fluctuating in a lateral fashion as well as in depth. Increased flow usually resulted in a widening rather than deepening of the river at the Control sites.

The mean depth values for study site D1 over the three years ranged from 70cm to 490cm. The "A" transect was shallower in 1979 than the control areas, but gradually deepened and narrowed during the three year study period; its mean depth was 70 cm in 1979, 95 cm in 1980, and 160 cm in 1981. The "B" and "C" transects were much deeper than the Control transects or D1A, due to the dredge pit between and including transects D1B and D1C. The "D" and "E" transects had depths similar to or slightly greater than the "A" transect (95-165 cm).

The mean depth values for Study Site D2 over the three years ranged from 135cm to 500cm. The "A", "D", and "E" transects were similar to each other and represented an increase of 50% in average depth compared to the control area (overall mean depth 189 cm). The "B" and "C" transects on the upper and lower edges of the dredge pit were roughly twice as deep as the

Fig. 27. Mean depths on transects, Control and Dredge sites, 1979.

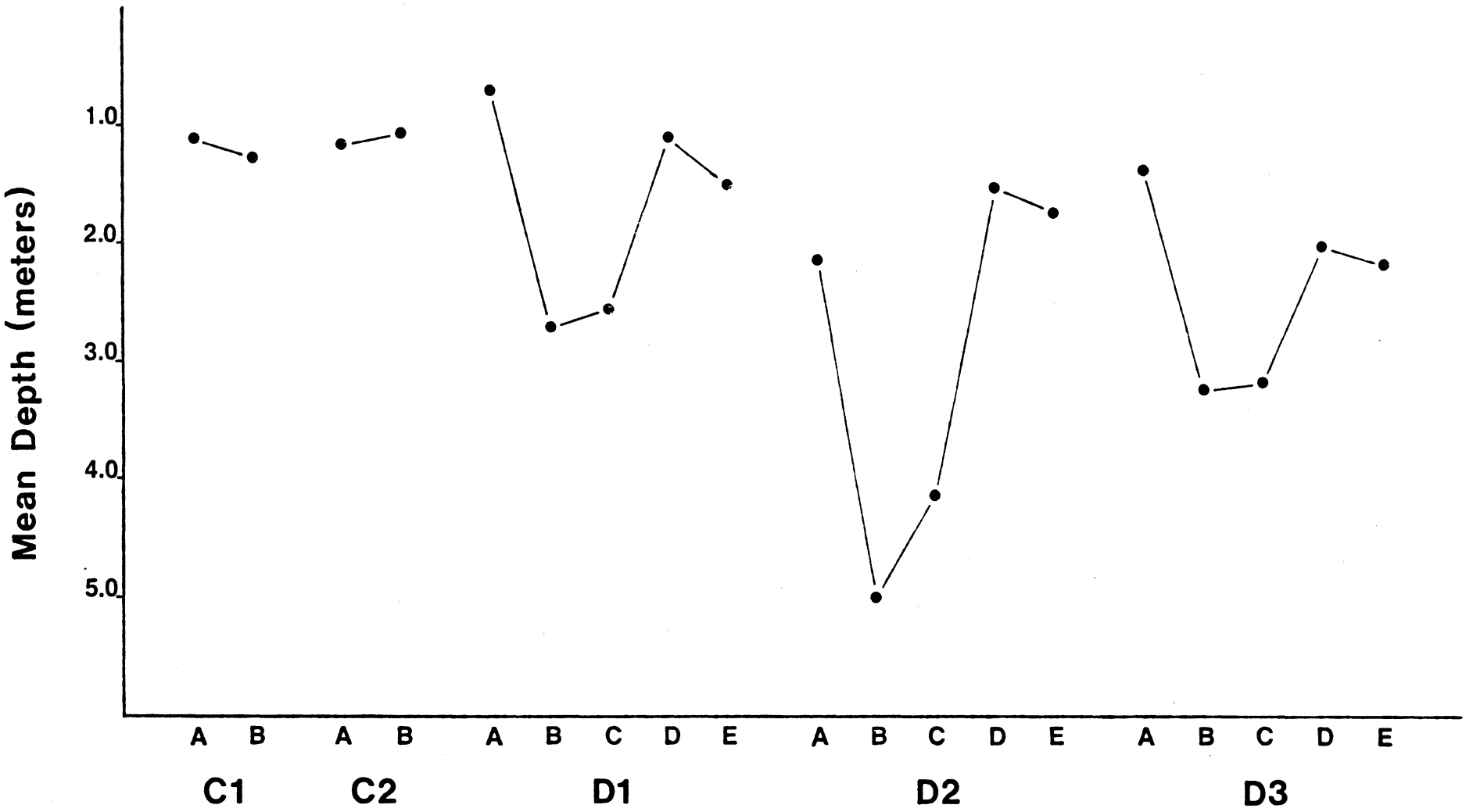


Fig. 28. Mean depths on transects, Control and Dredge sites, 1980.

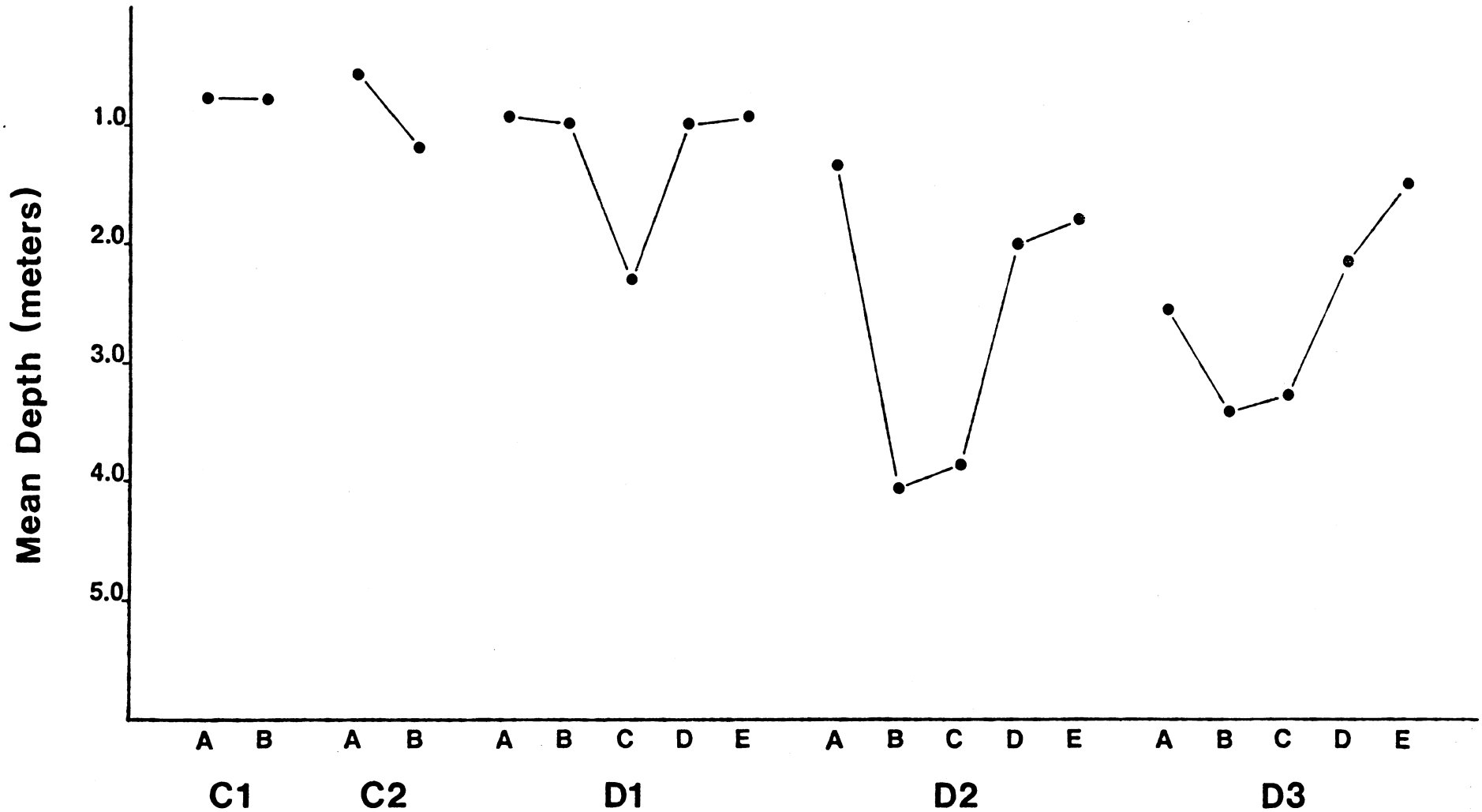


Fig. 29. Mean depths on transects, Control and Dredge sites, 1981.

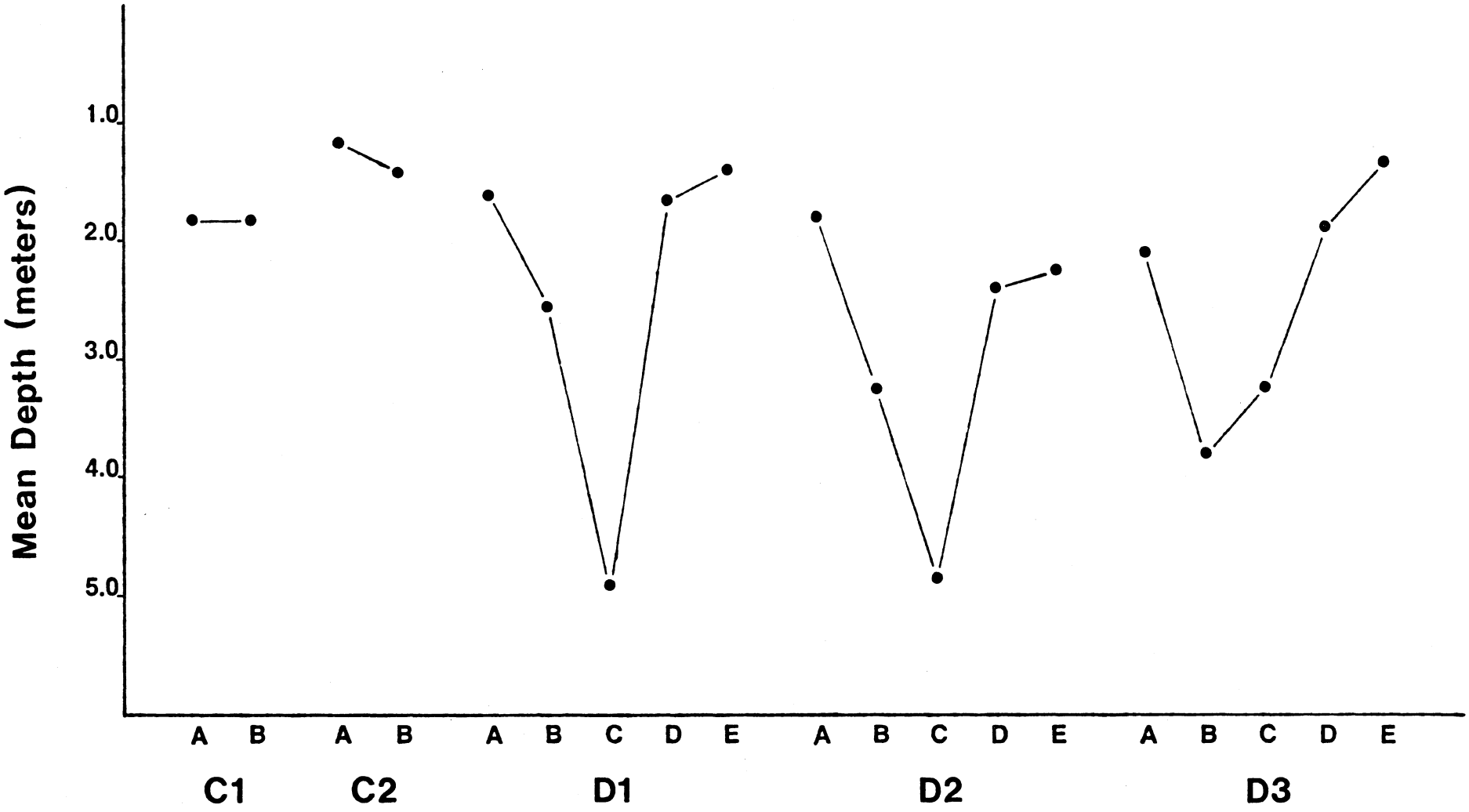


Table 5. Annual transect mean depths.

	1979	1980	1981
C1A	110 cm.	80 cm.	180 cm.
C1B	125	80	180
C2A	115	60	115
C2B	105	120	140
D1A	70	95	160
D1B	270	100	255
D1C	255	230	490
D1D	110	100	165
D1E	150	95	140
D2A	215	135	180
D2B	500	405	325
D2C	415	385	485
D2D	155	200	240
D2E	175	180	225
D3A	140	255	210
D3B	325	340	380
D3C	320	325	325
D3D	205	215	190
D3E	220	150	135

other three transects (mean 419 cm). The dredge pit at this site was larger than at D1 due to a longer period of dredging at D2 and lesser transport of sand to this site.

The mean depth values for study site D3 over the three years ranged from 135cm to 380cm. Again the "A", "D" and "E" transects were similar to each other in depth and represented an increase of 53% in average depth compared to the control area (mean 191 cm). The "E" transect was relatively shallow in 1980 and 1981 due to its relocation downstream, near armored bars forming shallow rapids. The pit area at D3 was not as deep as the dredge pit at D2 (mean 336 cm). This was due to the practice in 1980 and 1981 at this site of dredging sand and gravel from islands and bars rather than the bottom of the river channel at a fixed location. This was accomplished by dredging horizontally into an island as well as vertically following movement of the dredge.

The major change in river depth from the control sites to the lowermost dredge site is a 50% increase in mean depth, and a much greater increase in depth within the dredge pits themselves. The dredge pits are generally twice as deep as the river channel surrounding the pits. The result is the production of deep, calm water habitats in the dredged sites which are not present in the control sites.

c) Current Velocity in Lower Kansas River

The current velocity was measured approximately monthly from May 1979 to July 1981, at three points along each of seventeen transects. The velocity was measured at several discrete depths in the water column and then averaged for each point. These averages were then combined with the other points on the transect each month to obtain a single annual average value for each transect. The annual averages for mean current velocity are presented in graphic form in Figs. 30-33 and Table 6 in order to more easily compare the results.

The annual average current speeds ranged from .39 to .46 meters per second in the control sites, higher velocities than at Dredge 2 and

Fig. 30. Current velocity on transects, Control and Dredge sites, 1979.

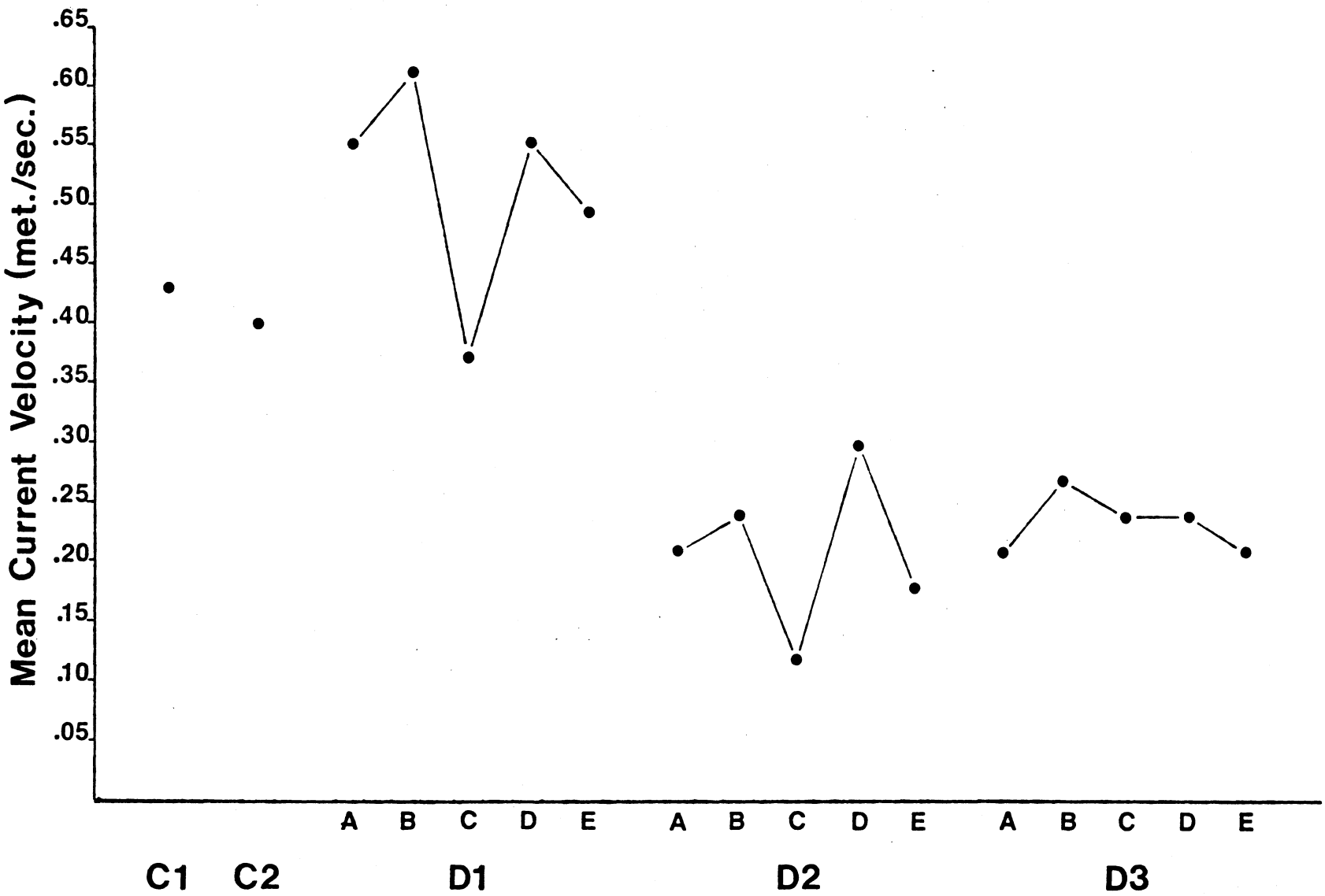


Fig. 31. Current velocity on transects, Control and Dredge sites, 1980.

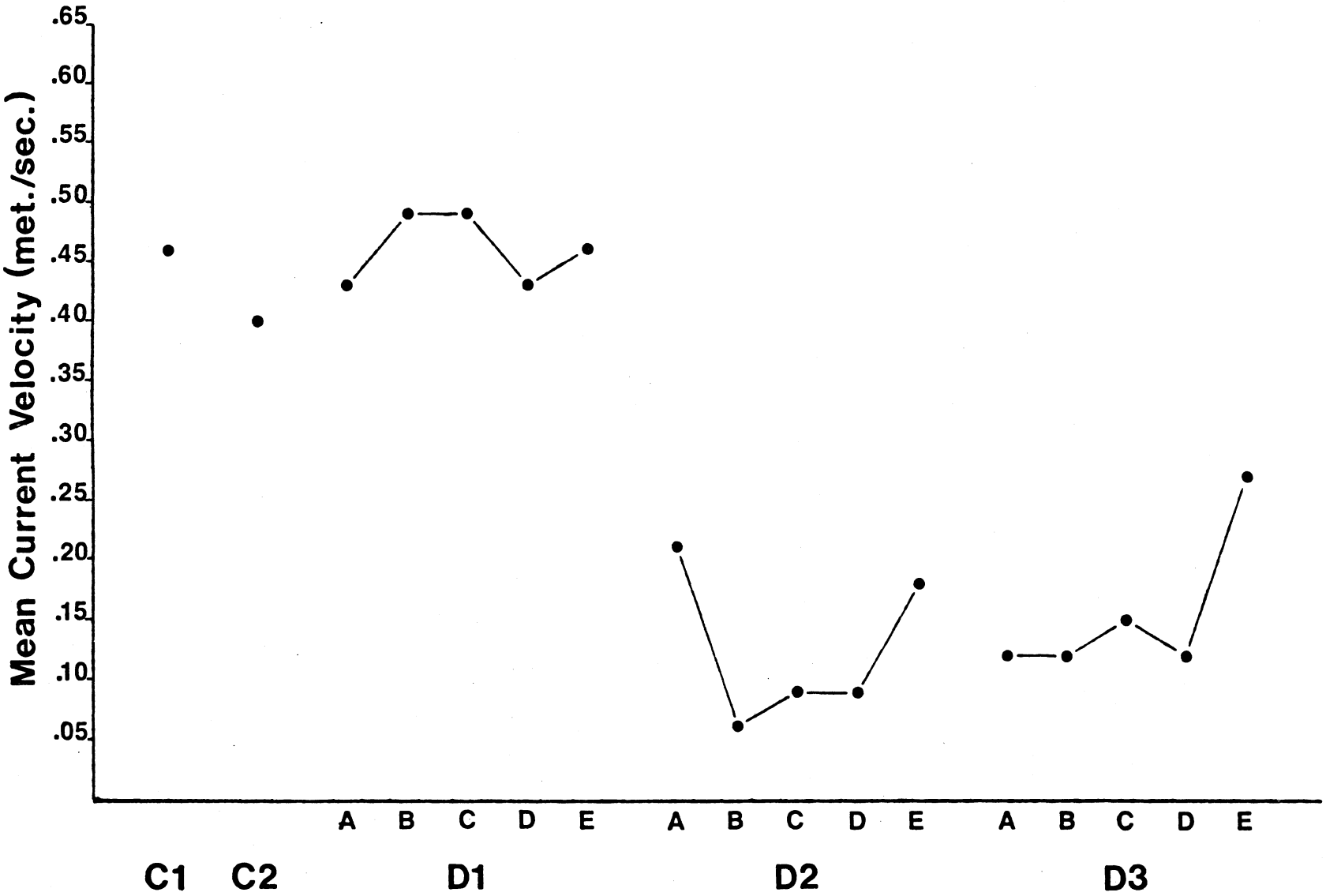


Fig. 32. Current velocity on transects, Control and Dredge sites, 1981.

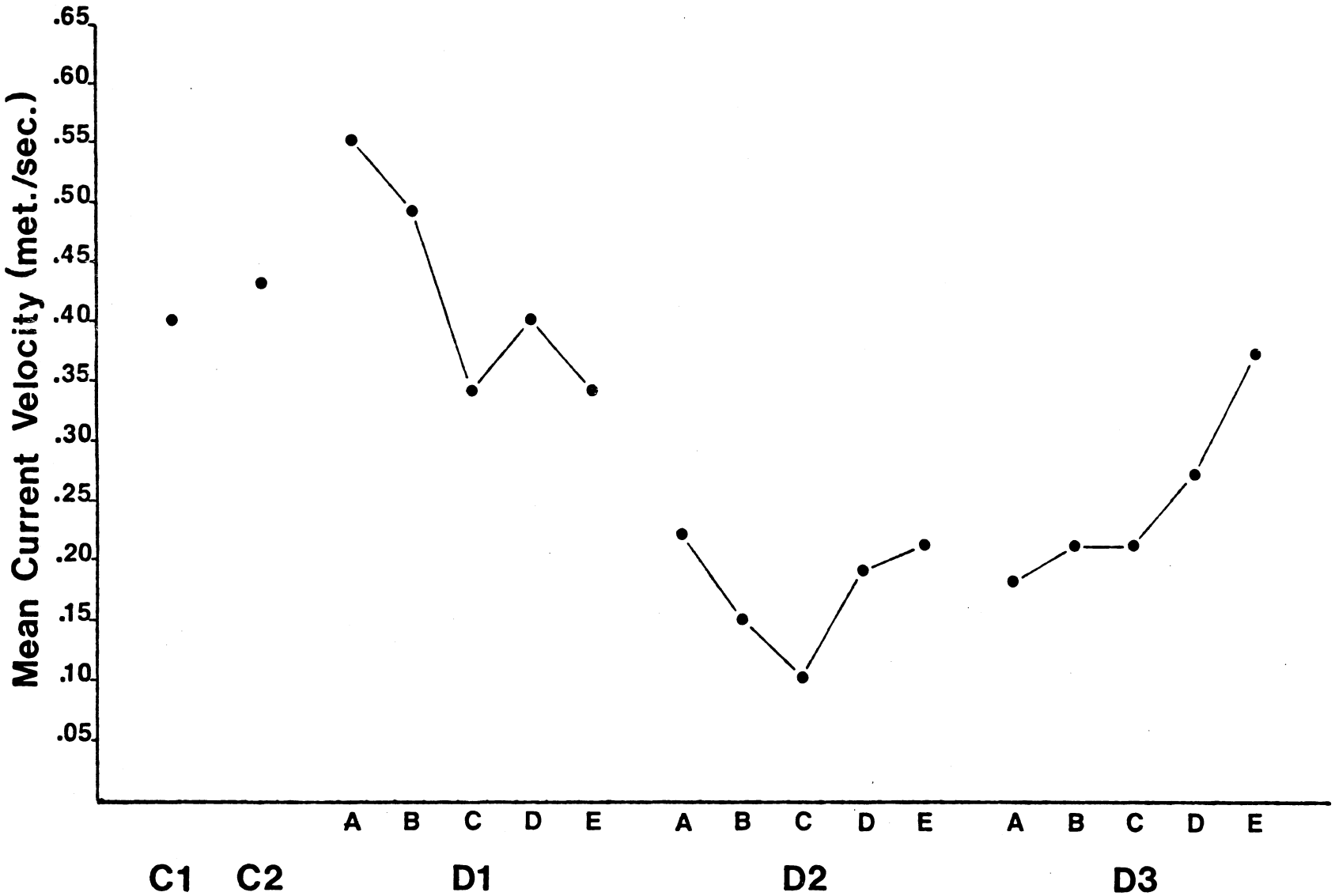


Fig. 33. Three-year average, current velocity on transects, Control and Dredge sites.

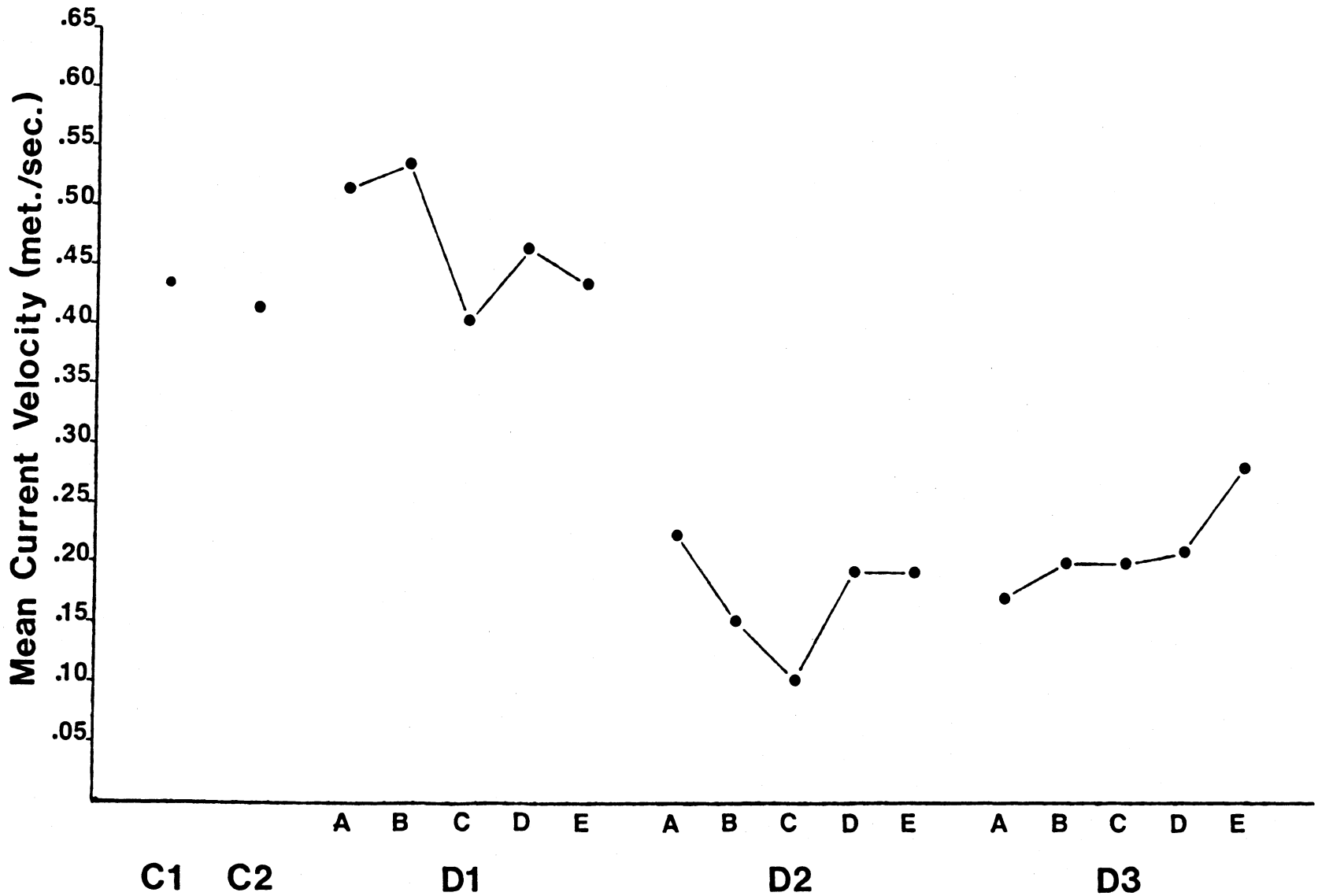


Table 6. Annual Average Current Speeds in Meters/Second.

	C1	C2	D1A	D1B	D1C	D1D	D1E	D2A	D2B	D2C	D2D	D2E	D3A	D3B	D3C	D3D	D3E
1979	.43	.40	.55	.61	.37	.55	.49	.21	.24	.12	.30	.18	.21	.27	.24	.24	.21
1980	.46	.40	.43	.49	.49	.43	.46	.21	.06	.09	.09	.18	.12	.12	.15	.12	.27
1981	.40	.43	.55	.49	.34	.40	.34	.24	.15	.09	.18	.21	.18	.21	.21	.27	.37
three year average	.43	.41	.51	.53	.40	.46	.43	.22	.15	.10	.19	.19	.17	.20	.20	.21	.28

Dredge 3. These values represent the relatively high, constant flow in the mainstream of the river. Side channels and backwater areas at the control sites differed from the mainstream in velocity and direction of flow. Backwater areas often had slow eddy currents while side channels frequently flowed perpendicular to the main channel and often slowed to intermittent flow resulting in isolated pools during periods of low flow.

The annual average current speeds at Dredge 1 ranged from .34 m/sec to .61 m/sec. Velocities were higher at this site than at any other sites. Transects upstream from the dredge (D1A and D1B) usually had higher velocities than transects below the dredge, but currents slackened only slightly in the pit area at D1. Both upstream and downstream from the relatively small dredge pit, the stream progressively entrenched itself in a narrow main channel. Velocities declined from 1979 to 1981 at transects D1D and D1E, as the stream became more narrowly confined against the right bank.

The average annual current speeds at Dredge 2 ranged from .06 m/sec to .30 m/sec. The "A", "D" and "E" transects showed a 57% reduction in current speed compared to the control sites. This can be attributed to the increase in depth and wider cross section. A temporary cofferdam used for bridge construction and a rock jetty utilized as the water diversion for Johnson County Water District #1 contributed to the slower current speed. The "B" and "C" transects had current speeds approximately 70% slower than those in the control area. The D2 pit attained depths greater than 7.5m, creating an area of very calm water which was not present in the control sites or Dredge 1.

The annual average current speeds at Dredge 3 ranged from .12 m/sec to .37 m/sec. Velocities at transects A through D were reduced by 57% relative to the control areas. The "E" transect had greater current speed than the other four transects in 1980 and 1981 due to rapids adjacent to armored bars downstream from the dredge. Velocities in the pit area, .20 m/sec at transects B and C, were not much lower than at the A and D transects, probably because of shifts in the position of the dredge during the study. The dredge was relocated downstream approximately 400 meters downstream from

its 1979 position at the beginning of the 1980 dredging season, and moved another 100 meters downstream in the latter part of 1980. Thus three dredge pits were formed, sequentially downstream, that deepened the channel and slowed the flow of the river. Because our sampling transects were adjusted to the new dredge position in each instance, movements of the dredge affected the current speeds we recorded.

The major trend in current velocity from the control sites to the lowermost dredge site was a reduction from approximately 0.47 m/sec to 0.20 m/sec. Dredge sites D2 and D3 had large areas of calm water that did not exist in the control area.

d) Substrate Analysis in the Lower Kansas River

"Substrate" as used here means the type or size of the material that forms the river bed at the soil-water interface. The substrate composition was measured in four ways, as described in Methods: 1) core samples taken by personnel of this survey and submitted to the EPA laboratory for particle size analysis using sieves with 0.075-2.00 mm mesh openings; 2) surface samples analyzed by survey personnel using sieves of 0.420 or 1.00 mm through 25 mm mesh openings; 3) classification of the predominant substrate over which each seine haul was made as silt, sand, gravel, rubble, or combinations of these; and 4) classification of substrates where benthos samples were taken, in a manner like that for seine hauls. The particle sizes represented by the categories used in the last two methods were, approximately: silt, less than 0.420 mm; sand, .420-4 mm; gravel, 4-16 mm; and rubble, greater than 16 mm.

Only the core samples reveal particle sizes in the river bed to any appreciable depth. The other samples were confined to the surface of the river bed. That surface is probably most important in determining usage by fishes, benthos, and other aquatic life.

Although all four of the procedures were employed at Control and Dredge sites, the data obtained vary in number of samples, areas represented in the samples, and frequency of collection.

The core samples have little value for describing variability of substrate types within or between sites, or changes in substrate composition over the term of the study. Few core samples were taken at each site, the area covered was small (16 cm^2 per sample), and bias resulted from inability to drive cores into coarse substrate; thus armored bars were not represented in these samples. Samples processed through sieves by survey personnel involved larger areas (including armored bars) than the core samples, but were confined to one year of study (1981).

The substrate descriptions recorded in connection with seining operations are most extensive. This data set includes approximately 960 separate records distributed uniformly over 10 transects at the five study sites (two control and three dredge sites). The records were obtained with equal frequency at each site through the 31-month term of the study. More than 58,000 m^2 of substrate is represented in the record, varying from 10,000 to 13,000 m^2 per site. Therefore this data set proved most useful for comparative purposes, within and between sites. Most subsequent discussion of substrates is based on the descriptions recorded while seining. Data from the core samples are recorded in Table 7, and data from samples sieved by KU personnel are listed in Table 8. Records of substrate composition associated with the benthos samples are analyzed in the section titled Benthos at Control and Dredge Sites.

Shannon diversity indices (Pielou, 1975) were employed to quantify substrate richness and equitability within sites, based on substrates on which seine hauls were made. Richness indicates the number of different types of substrate represented in a given area; equitability indicates the relative abundance of each type. The diversity index (H′) takes account of both factors.

Control Sites

Sand was the dominant substrate in the two control areas, comprising 62.22% of 21,000m^2 sampled for all years combined. The percentage occurrence of sand did not differ significantly from 1979 to 1981, remaining at 62±1% for each year (Table 9, Figs. 12,34).

Table 7. Particle size analysis for the first inch, inches 2-3, inches 4-6, inches 7-12, inches 13-18, and inches 19 and over, fraction of sediment cores taken from September 1979 through September 1981. The values in the table represent the percent of the total solids finer than the diameter given in the left hand column. n represents the number of core analyses.

inch 1	C1	C2	D1A	D1E	D2A	D2E	D3A	D3E
2.000	90.0	92.1	84.9	95.6	90.8	90.2	93.8	82.6
0.590	67.0	64.1	57.5	76.1	77.8	76.8	76.1	65.5
0.420	51.9	44.6	42.9	59.9	63.4	71.3	66.2	57.1
0.300	44.7	24.9	32.1	50.0	53.2	64.4	55.7	50.8
0.177	38.2	16.5	26.9	34.0	46.5	53.4	47.6	45.1
0.150	23.1	13.5	21.2	23.7	35.0	44.7	36.1	29.3
0.075	19.7	11.7	17.1	19.4	28.7	35.5	26.5	21.8
<0.075	0.0	0.0	0.0	0.0	0.0	1.22	0.0	1.1
	n=8	n=6	n=8	n=8	n=8	n=7	n=8	n=5
inch 2,3								
2.000	90.7	92.8	90.3	93.9	96.3	95.0	96.0	89.9
0.590	59.2	60.6	55.9	71.0	79.0	83.2	84.6	76.4
0.420	43.2	37.7	38.5	60.3	69.3	78.5	74.9	67.9
0.300	25.1	17.9	26.5	30.8	56.8	72.5	64.9	63.4
0.177	15.7	9.9	21.3	23.1	46.0	57.1	49.0	56.6
0.150	9.4	7.5	14.7	20.0	36.1	40.8	31.5	39.7
0.075	6.7	6.1	10.9	0.0	28.3	32.3	20.0	29.1
<0.075	0.0	0.0	0.0	0.0	0.0	0.12	0.48	6.9
	n=8	n=6	n=8	n=7	n=8	n=7	n=8	n=5
inch 4-6								
2.000	88.9	91.7	87.5	93.6	96.0	96.1	96.3	91.5
0.590	59.2	59.1	54.1	67.4	77.0	83.4	81.3	60.6
0.420	43.2	31.0	37.2	48.8	66.8	76.0	72.2	54.5
0.300	25.1	12.4	25.9	34.9	52.4	64.8	61.5	49.8
0.177	15.7	6.3	21.4	25.1	44.7	45.2	49.7	45.2
0.150	9.4	4.9	19.1	17.1	31.4	34.7	39.5	30.6
0.075	6.7	4.6	16.2	14.8	23.6	24.7	26.6	21.3
<0.075	0.0	0.0	0.0	0.0	0.0	0.7	0.28	5.16
	n=8	n=6	n=8	n=8	n=8	n=7	n=8	n=5
inch 7-12								
2.000	91.7	91.3	86.2	94.0	95.7	95.4	96.0	92.31
0.590	61.3	55.5	56.0	74.9	77.7	79.5	79.8	59.6
0.420	43.5	33.2	38.5	50.7	64.8	68.0	70.0	47.4
0.300	26.0	11.0	26.7	44.4	46.2	55.1	59.0	28.5
0.177	12.0	1.9	22.7	31.5	36.0	41.6	46.9	18.9
0.150	6.9	0.9	18.8	20.1	24.1	30.2	35.1	7.7
0.075	1.5	0.6	16.4	16.7	18.2	23.6	29.4	4.4
<0.075	0.0	0.0	0.1	0.0	1.4	0.0	0.0	4.0
	n=5	n=5	n=5	n=6	n=6	n=5	n=6	n=3

Table 7. continued.

Inch 13-18	C1	C2	D1A	D1E	D2A	D2E	D3A	D3E
2.000	93.1	92.6	86.5	97.7	97.7	92.3	95.6	85.0
0.590	66.2	63.8	51.6	82.5	85.6	78.0	78.2	38.6
0.420	50.3	41.3	39.1	63.9	75.6	73.2	69.7	28.1
0.300	32.7	18.5	29.1	45.8	63.4	68.1	61.1	15.7
0.177	18.8	3.8	24.8	30.7	52.3	60.5	54.9	13.2
0.150	15.3	2.2	18.7	19.7	32.6	49.0	42.0	1.4
0.075	14.0	1.7	16.3	15.6	22.1	39.3	33.7	.8
<0.075	0.0	1.1	0.0	0.0	0.03	0.0	0.13	0.0
	n=5	n=5	n=5	n=6	n=6	n=5	n=6	n=3
Inch 19+								
2.000	96.6				96.4		100.0	
0.590	58.3				79.0		99.3	
0.420	31.0				65.9		98.4	
0.300	8.0				48.8		97.1	
0.177	2.6				38.8		95.5	
0.150	0.8				18.8		72.1	
0.075	0.7				7.1		53.1	
<0.075	0.0				0.1		0.7	
	n=1				n=1		n=1	

Table 8. Particle-size analysis of Kansas River bed at locations from DeSoto to the lowermost dredge site, Fishery-Dredging Study. Numerals in each column are percent of total sample at that locality that consisted of particles in that size range, excluding organic matter (detritus). Values are averages of 2-4 samples taken on each transect. T = less than 1%. Data obtained in September 1981, using U.S. standard sieves.

Location	Particle size, mm. (as % of total)						
	0-1	1-2	2-4	4-8	8-16	16-25	>25
mile 30.0 below DeSoto	73	13	9	3	2	T	
mile 29.0 below DeSoto	74	17	8	1	T		
C2A	74	16	7	3	T		
C2B	90	6	1	2	1		
D1A	4	1	1	3	5	8	78
D1E	90	8	2	T	T		
D2A	100						
D2E	100						
D3A	100						
D3E	37	3	1	2	3	7	47

Silt comprised 11.60% of the substrates for the combined years, but silt as a discrete substrate declined to 2.73% of our samples in 1981. Silt-sand substrates increased each year, from approximately 5% in 1979 to 31% in 1981. These differences probably stem from two factors: a change in the location of one of our sampling points in 1981, and variations in discharge of the river between years. Silt substrates were confined to areas having little or no flow, primarily in backwaters below sand bars and behind rock dikes used for bank stabilization. A localized backwater area behind a long dike on the lowermost control transect (C2B) was sampled in 1979 and 1980. Sampling of that backwater was discontinued in 1981 due to the artificial nature of the habitat; very few such dikes now exist in the Kansas River. In 1981, sampling continued on transect C2B slightly downstream, below the end of the dike, in an area of increased flow having sand-silt substrate. Thus the relatively high values for silt substrate in 1979 and 1980 (Table 9), may be largely an artifact of sampling location on this transect. However, sustained high rates of discharge in 1981 probably mixed silt with sand in this generally shallow segment of the channel.

Coarse substrates (gravel, rubble) were not well represented in the control sites.

In general, the composition of the substrate in this segment of the river was relatively stable through time. Low substrate diversity values (Table 9) reflect the predominance of sand. Three of our substrate categories--silt, sand, and the silt-sand mixture--comprised more than 88% of the area sampled for all years combined. Sand, gravel, and sand-gravel comprised 71%; sand and gravel are the principal materials used by the dredging industry.

Study Site D1

Sand was the prevalent substrate within study site D1, comprising 29.53% of the area sampled for all years (Table 10); however, sand as a single-component substrate decreased from 46.38% in 1979 to 7.60% in 1981. Silt comprised 14.40% of sample areas for all years, decreasing from 1979 to 1980 and increasing again in 1981. Low rates of discharge, originating

Table 9. Composition of the substrate in Control sites. The area sampled (m^2) over each type of substrate is represented as a percentage of the total area sampled over all substrates for each year, 1979-1981. Areas for each substrate type are accumulated across all years for a site, and represented as percentages of the total area sampled at a given site for the full term of the study.

	1979		1980		1981		TOTAL	
	Total Area Sampled for Year (m^2)						All years (m^2)	
	6289		11456		3364		21109	
	Area	%	Area	%	Area	%	Area	%
SUBSTRATES:								
SILT	935	14.87	1422	12.41	92	2.73	2449	11.60
SILT-SAND	300	4.77	1672	14.59	1045	31.06	3017	14.29
SILT-RUBBLE	135	2.15	-	-	-	-	135	0.64
SAND	3869	61.52	7180	62.67	2085	61.98	13134	62.22
SAND-GRAVEL	580	9.22	801	6.99	142	4.22	1523	7.21
SAND-RUBBLE	-	-	-	-	-	-	-	-
GRAVEL	470	7.47	-	-	-	-	470	2.23
GRAVEL-RUBBLE	-	-	381	3.33	-	-	381	1.80
RUBBLE	-	-	-	-	-	-	-	-
MISC. SUBSTRATES:								
SILT-GRAVEL	-	-	-	-	-	-	-	-
SAND-GRAVEL-RUBBLE	-	-	-	-	-	-	-	-
SAND-CLAY	-	-	-	-	-	-	-	-
SHANNON DIVERSITY INDEX:								
H'		1.22		1.13		0.89		1.20
SUBSTRATE EQUIVALENCY		3.40		3.10		2.44		3.33

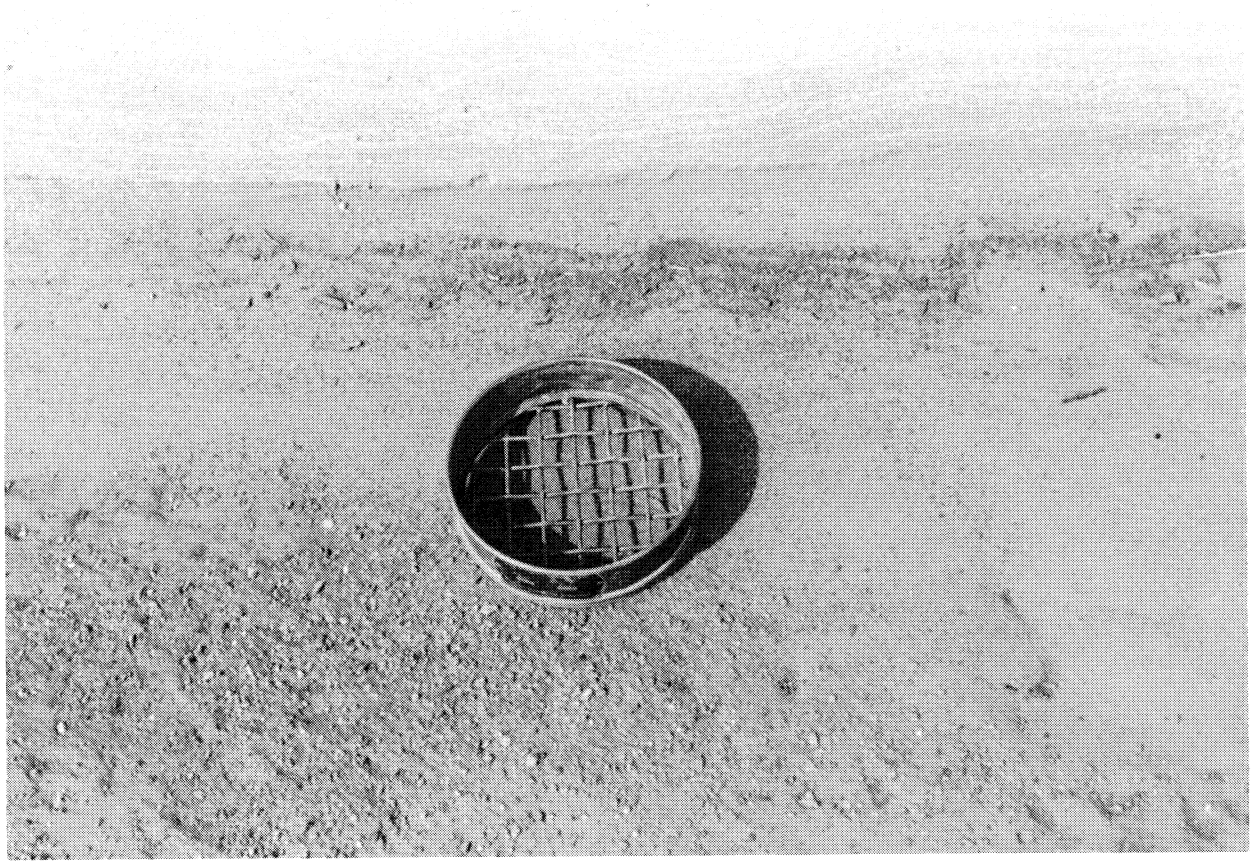


Fig. 34. Sand is the predominant substrate type in nondredged areas of the Kansas River, like that shown here at transect C2A (mile 23.35). Photograph September 1981.

mainly from reservoirs rather than direct runoff, may account for the low silt values in 1980; the relatively swift, shallow flow of clear water in 1980 may have removed most silt, or mixed it with sand, in the main channel. Rubble as a single-component substrate comprised 2.13% of the sampled area for all years. From 1979 to 1981, areas having rubble as one component of mixed substrates increased from 11.34% to 31.77%. Exposure of "armored bars" by reduction of sand account for most of this change (Fig. 17).

The primary substrate types at transect D1A, just upstream from the dredge, changed from sand (42.66%) in 1979 to sand-rubble (31.81%) and silt-sand (23.45%) in 1980, and to silt-sand (55.80%) and silt-rubble (31.40%) in 1981 (Table 11). The virtual disappearance of sand as a discrete substrate at D1A in 1981 applies only to that part of the channel where flow was continuous. A massive bar along the right bank remained largely sandy where it was seldom inundated.

At transects below the dredge (Table 12), sand decreased from nearly 48% in 1979 to about 20% in 1981. Silt-sand and silt-rubble increased in importance, and rubble occurred as a discrete substrate in 1981. Below the dredge the left bank remained generally sandy whereas the right bank became increasingly steep, composed of clay and rubble (Fig. 16).

Approximately 32% of all areas sampled at study site D1 were composed of sand, gravel, and sand-gravel substrates; but values for those three categories declined from 56% in 1979 to 8% in 1981.

Substrate diversity values (Table 10) were generally higher at this site than at the Control sites. The higher diversity reflects the occurrence of large substrate size categories (gravel and rubble). Both upstream and downstream from the dredge, two to five substrate categories occurred commonly at D1. The number of substrate categories varied with discharge rates. The lowest number of substrate types occurred in 1981, when flows were greatest; the high number of substrate types represented in 1980 reflects the low discharge rates in that year.

Table 10. Composition of the substrate in Dredge 1 site. The area sampled (m^2) over each type of substrate is represented as a percentage of the total area sampled over all substrates for each year, 1979-1981. Areas for each substrate type are accumulated across all years, and represented as percentages of the total area sampled at a given site for the full term of the study.

	1979		1980		1981		TOTAL	
	Total Area Sampled for Year (m^2)						All years (m^2)	
	3536		6430		658		10624	
	Area	%	Area	%	Area	%	Area	%
SUBSTRATES:								
SILT	1060	29.98	337	5.24	133	20.21	1530	14.40
SILT-SAND	90	2.55	2475	38.49	266	40.43	2831	26.65
SILT-RUBBLE	100	2.83	754	11.72	175	26.60	1029	9.69
SAND	1640	46.38	1447	22.50	50	7.60	3137	29.53
SAND-GRAVEL	345	9.76	-	-	-	-	345	3.25
SAND-RUBBLE	30	0.85	986	15.33	-	-	1016	9.56
GRAVEL	-	-	-	-	-	-	-	-
GRAVEL-RUBBLE	178	5.03	90	1.40	-	-	268	2.52
RUBBLE	93	2.63	99	1.54	34	5.17	226	2.13
MISC. SUBSTRATES:								
SILT-GRAVEL	-	-	45	0.70	-	-	45	0.42
SAND-GRAVEL-RUBBLE	-	-	-	-	-	-	-	-
SAND-CLAY	-	-	191	2.97	-	-	191	1.80
SHANNON DIVERSITY INDEX:								
H'		1.43		1.66		1.39		1.82
SUBSTRATE EQUIVALENCY		4.16		5.26		4.02		6.19

Table 11. Composition of the substrate upstream of Dredge 1. The area sampled (m^2) over each type of substrate is represented as a percentage of the total area sampled over all substrates for each year, 1979-1981. Areas for each substrate type are accumulated across all years, and represented as percentages of the total area sampled at a given site for the full term of the study.

	1979		1980		1981		TOTAL	
	Total Area Sampled for Year (m^2)						All years (m^2)	
	961		2968		414		4343	
	Area	%	Area	%	Area	%	Area	%
SUBSTRATES:								
SILT	90	9.37	123	4.14	50	12.08	263	6.06
SILT-SAND	-	-	696	23.45	231	55.80	927	21.34
SILT-RUBBLE	10	1.04	511	17.22	130	31.40	651	14.99
SAND	410	42.66	499	16.81	-	-	909	20.93
SAND-GRAVEL	150	15.61	-	-	-	-	150	3.45
SAND-RUBBLE	30	3.12	944	31.81	-	-	974	22.43
GRAVEL	-	-	-	-	-	-	-	-
GRAVEL-RUBBLE	178	18.52	90	3.03	-	-	268	6.17
RUBBLE	93	9.68	105	3.54	3	0.72	201	4.63
MISC. SUBSTRATES:								
SILT-GRAVEL	-	-	-	-	-	-	-	-
SAND-GRAVEL-RUBBLE	-	-	-	-	-	-	-	-
SAND-CLAY	-	-	-	-	-	-	-	-
SHANNON DIVERSITY INDEX:								
H'		1.57		1.66		0.98		1.88
SUBSTRATE EQUIVALENCY		4.80		5.28		2.66		6.53

Table 12. Composition of the substrate downstream of Dredge 1. The area sampled (m^2) over each type of substrate is represented as a percentage of the total area sampled over all substrates for each year, 1979-1981. Areas for each substrate type are accumulated across all years, and represented as percentages of the total area sampled at a given site for the full term of the study.

	1979		1980		1981		TOTAL	
	Total Area Sampled for Year (m^2)						All years (m^2)	
	2575		3462		244		6281	
	Area	%	Area	%	Area	%	Area	%
SUBSTRATES:								
SILT	970	37.64	214	6.18	83	34.02	1267	20.17
SILT-SAND	90	3.50	1779	51.39	35	14.34	1904	30.31
SILT-RUBBLE	90	3.50	243	7.02	45	18.44	378	6.02
SAND	1230	47.77	948	27.38	50	20.49	2228	35.47
SAND-GRAVEL	195	7.57	-	-	-	-	915	3.10
SAND-RUBBLE	-	-	42	1.21	-	-	42	0.67
GRAVEL	-	-	-	-	-	-	-	-
GRAVEL-RUBBLE	-	-	-	-	-	-	-	-
RUBBLE	-	-	-	-	31	12.70	31	0.49
MISC. SUBSTRATES:								
SILT-GRAVEL	-	-	45	1.30	-	-	45	0.72
SAND-GRAVEL-RUBBLE	-	-	-	-	-	-	-	-
SAND-CLAY	-	-	191	5.52	-	-	191	3.04
SHANNON DIVERSITY INDEX:								
H'		1.15		1.33		1.54		1.53
SUBSTRATE EQUIVALENCY		3.16		3.76		4.68		4.62

Study Site D2

Substrates at the study site D2 were primarily of three types--silt, sand, and the silt-sand complex. Silt was the predominant substrate, representing about 49% of sampled areas for all years (Table 13). Silt increased significantly from 1979 to 1980 and remained nearly constant in 1980 and 1981. The dominance of silt as a single component substrate and in complex with sand may be explained by the influence of dredging activity and two dams below this site. One dam, a low dike that diverts flow to an intake structure for the Johnson County Water District #1, was present throughout the study (Fig. 22). The second, a cofferdam installed during bridge-construction on I-435, affected flows during 1979 and part of 1980 but was then removed. The dams and dredge-pit just upstream interact to slow the flow of the river, increasing silt-deposition at this site.

Silt-sand increased steadily over the three-year period from 23.10% to 36.18%, representing approximately 26% of sampled areas across all years. At transect D2A, above the dredge, silt-sand increased significantly from about 36% of sampled areas in 1979 to approximately 63% in 1981 (Table 14). During 1981, samples were taken adjacent to a large silt-sand bar that was created along the left bank by the effluent from dredge 2 (Figs. 35,36). The significant increase in silt-sand at this transect is explained by expansion of this bar. Below the dredge, silt-sand increased from 1979 to 1980, but was replaced by silt in 1981 (Table 15, Figs. 20,37).

Sand comprised 23.75% of the sampled areas for all years, but decreased from about 43% in 1979 to 0% in 1981. At transect D2A, sand diminished from approximately 35% of sampled areas in 1979 to 0% in 1981. Below the dredge, sand decreased from 51% of sampled areas in 1979 to about 1% in 1980, and 0% in 1981. Sand was not entirely depleted within the D2 area, but silt covered those sampling areas that formerly had sand substrate.

Gravel substrate occurred in low percentage above the dredge, but not downstream. Sand, gravel, and sand-gravel substrates comprised approximately 24% of the areas sampled, decreasing from 43% to 1979 to 4.36% in 1981.

Table 13. Composition of the substrate in Dredge 2 site. The area sampled (m^2) over each type of substrate is represented as a percentage of the total area sampled over all substrates for each year, 1979-1981. Areas for each substrate type are accumulated across all years, and represented as percentages of the total area sampled at a given site for the full term of the study.

	1979		1980		1981		TOTAL	
	Total Area Sampled for Year (m^2)						All years (m^2)	
	5390		6392		688		12470	
	Area	%	Area	%	Area	%	Area	%
SUBSTRATES:								
SILT	1800	33.40	3943	61.69	409	59.45	6152	49.33
SILT-SAND	1245	23.10	1778	27.82	249	36.19	3272	26.24
SILT-RUBBLE	-	-	-	-	-	-	-	-
SAND	2345	43.51	617	9.65	-	-	2962	23.75
SAND-GRAVEL	-	-	-	-	-	-	-	-
SAND-RUBBLE	-	-	-	-	-	-	-	-
GRAVEL	-	-	-	-	30	4.36	30	0.24
GRAVEL-RUBBLE	-	-	-	-	-	-	-	-
RUBBLE	-	-	-	-	-	-	-	-
MISC. SUBSTRATES:								
SILT-GRAVEL	-	-	54	0.84	-	-	54	0.43
SAND-GRAVEL-RUBBLE	-	-	-	-	-	-	-	-
SAND-CLAY	-	-	-	-	-	-	-	-
SHANNON DIVERSITY INDEX:								
H'		1.07		0.92		0.81		1.08
SUBSTRATE EQUIVALENCY		2.91		2.51		2.26		2.94

Table 14. Composition of the substrate upstream of Dredge 2. The area sampled (m^2) over each type of substrate is represented as a percentage of the total area sampled over all substrates for each year, 1979-1981. Areas for each substrate type are accumulated across all years, and represented as percentages of the total area sampled at a given site for the full term of the study.

	1979		1980		1981		TOTAL	
	Total Area Sampled for Year (m^2)						All years (m^2)	
	2435		3646		394		6475	
	Area	%	Area	%	Area	%	Area	%
SUBSTRATES:								
SILT	725	29.77	1810	49.64	115	29.19	2650	40.93
SILT-SAND	870	35.73	1197	32.83	249	63.20	2316	35.77
SILT-RUBBLE	-	-	-	-	-	-	-	-
SAND	840	34.50	585	16.04	-	-	1425	22.01
SAND-GRAVEL	-	-	-	-	-	-	-	-
SAND-RUBBLE	-	-	-	-	-	-	-	-
GRAVEL	-		-		30	7.61	30	0.46
GRAVEL-RUBBLE	-	-	-	-	-	-	-	-
RUBBLE	-	-	-	-	-	-	-	-
MISC. SUBSTRATES:								
SILT-GRAVEL	-	-	54	1.48	-	-	54	0.83
SAND-GRAVEL-RUBBLE	-	-	-	-	-	-	-	-
SAND-CLAY	-	-	-	-	-	-	-	-
SHANNON DIVERSITY INDEX:								
H'		1.10		1.07		0.85		1.13
SUBSTRATE EQUIVALENCY		2.99		2.91		2.33		3.10

Table 15. Composition of the substrate downstream of Dredge 2. The area sampled (m^2) over each type of substrate is represented as a percentage of the total area sampled over all substrates for each year, 1979-1981. Areas for each substrate type are accumulated across all years, and represented as percentages of the total area sampled at a given site for the full term of the study.

	1979		1980		1981		TOTAL	
	Total Area Sampled for Year (m^2)						All years (m^2)	
	2955		2746		294		5995	
	Area	%	Area	%	Area	%	Area	%
SUBSTRATES:								
SILT	1075	36.38	2133	77.68	294	100.00	3502	58.42
SILT-SAND	375	12.69	581	21.16	-	-	956	15.95
SILT-RUBBLE	-	-	-	-	-	-	-	-
SAND	1505	50.93	32	1.17	-	-	1537	25.64
SAND-GRAVEL	-	-	-	-	-	-	-	-
SAND-RUBBLE	-	-	-	-	-	-	-	-
GRAVEL	-	-	-	-	-	-	-	-
GRAVEL-RUBBLE	-	-	-	-	-	-	-	-
RUBBLE	-	-	-	-	-	-	-	-
MISC. SUBSTRATES:								
SILT-GRAVEL	-	-	-	-	-	-	-	-
SAND-GRAVEL-RUBBLE	-	-	-	-	-	-	-	-
SAND-CLAY	-	-	-	-	-	-	-	-
SHANNON DIVERSITY INDEX:								
H'		0.97		0.58		0.00		0.96
SUBSTRATE EQUIVALENCY		2.65		1.78		1.00		2.60

Fig. 35. The dredge effluent, located on the left bank (at right in this figure, looking upstream) near transect D2A (mile 16.2), deposited a silt-sand bar in 1981. Photograph September 1981.

Fig. 36. Silt-sand substrate deposited below dredge effluent on left bank near transect D2A (see Fig. 35). Photograph September 1981.

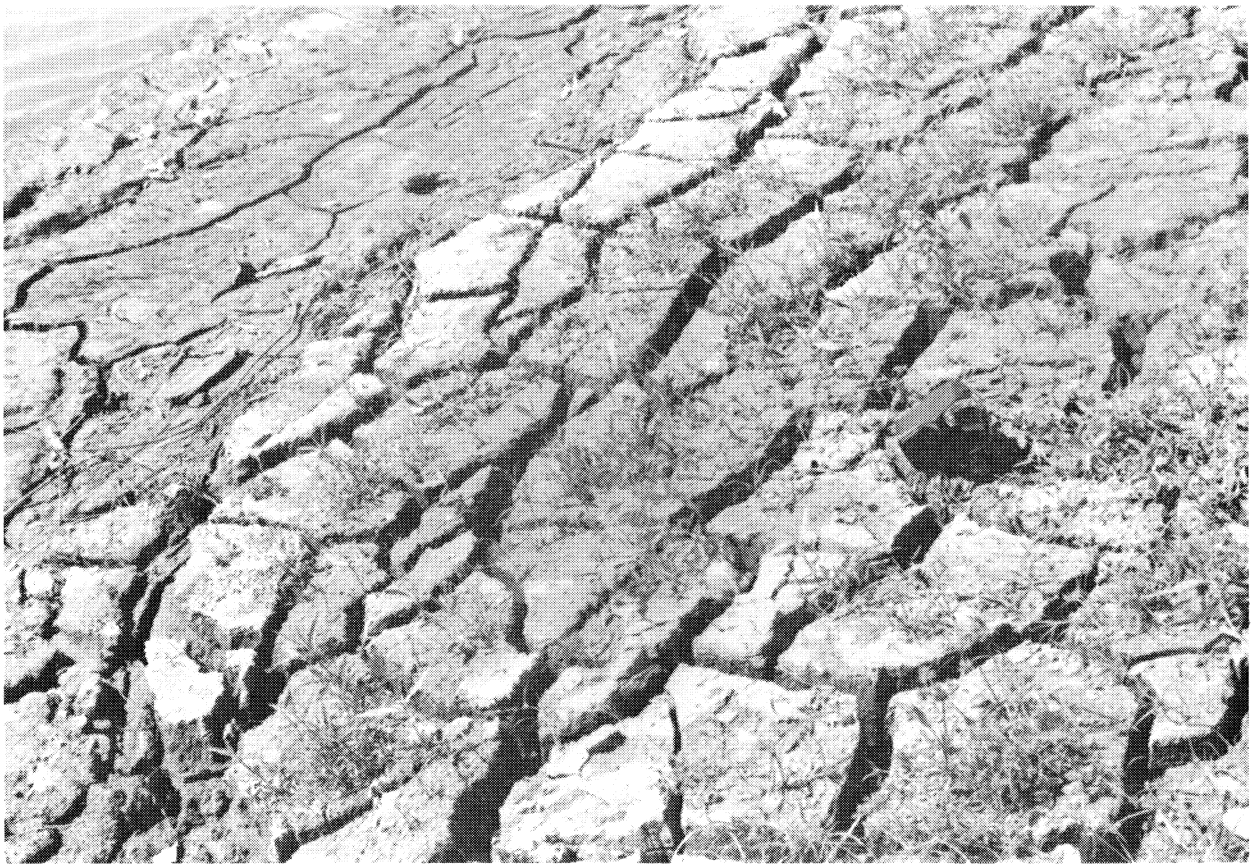


Fig. 37. Silt substrate on left bank, transect D2D (mile 15.6). Photograph September 1981.

Substrate diversity values for study site D2 were low (Table 13), due to the dominance of silt in this segment of the river. Transect D2A had higher values than below-dredge transects, due to the proportion of the substrates relative to each other (equivalency). The very low diversity values for 1981 are associated with the accumulation of silt in this segment of the river over the three-year term of the study.

Study Site D3

Dredge 3 worked at three locations within this site during the study, and did not operate after May 1981. The dredge was relocated approximately 400 meters downstream from its 1979 position at the beginning of the 1980 dredging season, and moved another 100 meters downstream in the latter part of 1980. Thus three dredge pits were formed, sequentially downstream, that deepened the channel, slowed the flow of the river, and increased silt deposition at this site (Figs. 38,39). Because our sampling transects were adjusted to the new dredge position in each instance, movements of the dredge affected the substrates we recorded.

Silt was the most common substrate, comprising 42% of samples from this site, although silt as a single-component substrate decreased from 51% in 1979 to 36.72% in 1981 (Table 16). Silt-sand increased from 15% in 1979 and 1980 to approximately 25% in 1981 (average 16.84%). Silt-rubble was not recorded in 1979, but represented nearly 42% of samples in 1980 and 30% in 1981. Thus, silt and silt-complex substrates comprised approximately 66% of our sample areas in 1979, 95% in 1980, and 91% in 1981.

Sand comprised 5.42% of all samples, decreasing from 12.66% in 1979 to 3.53% in 1981. Sand, gravel, and complexes of those two categories with rubble comprised approximately 24% of sample areas in 1979, but only 2.5 to 3.5% in 1980 and 1981.

Substrates differed markedly upstream and downstream from the dredge (Tables 17, 18; Figs. 40,41). Silt predominated upstream, at transect D3A, comprising 66% of the area. Silt and silt-sand comprised 88% of substrates in 1979, 97% in 1980, and 93% in 1981. Sand was the only other substrate

represented at D3A, comprising 11.7% of the area sampled in 1979, 2.8% in 1980, and 7% in 1981. Sand that was deposited at this site in 1981 apparently originated from Turkey Creek, a sandy tributary that enters the river just upstream from transect D3A.

The river bed downstream from dredge 3 consisted mainly of extensive armored bars. They formed shallow rapids, and much of their area was exposed during low-flow periods (Fig. 42). The sampling areas (transects D3D and D3E) were adjacent to these bars, accounting for the wide variety of substrates recorded (Table 18). In 1979, eight substrate categories occurred in the sample-areas below the dredge, four of them at frequencies of 13% or more. In 1980, the dredge-pit occupied that area, and transects D3D and D3E were relocated farther downstream.

Silt-rubble was the most common substrate below the dredge, representing 45% of samples for the three years combined. That complex was not recorded in 1979, but it was the dominant substrate type in 1980 (61%) and 1981 (52%). Silt comprised nearly 33% of substrates in 1979, diminishing to 4.48% in 1981. Silt and silt-complex categories together comprised 38% of the substrate in 1979, 94% in 1980, and 90% in 1981. Sand represented nearly 14% of samples in 1979, but was not recorded as a single-component substrate in 1981. Sand, gravel, and complexes of these with rubble comprised 40% of the substrates in 1979, but none of those categories was represented in 1981 (Table 18).

Rubble as a discrete category decreased below the dredge from about 16% in 1979 to 1% in 1980, increasing to 10% in 1981. Silt-rubble was always found in association with areas of little or no flow, whereas rubble substrate occurred in riffle areas only. The relative amounts of rubble and silt-rubble varied in response to shifts in the position of the dredge. In 1979, one transect was adjacent to an island that divided the channel into shallow, rocky riffles. In 1980, the island was removed by dredging, and our transects were in an area characterized by silt-rubble farther downstream.

Table 16. Composition of the substrate in Dredge 3 site. The area sampled (m^2) over each type of substrate is represented as a percentage of the total area sampled over all substrates for each year, 1979-1981. Areas for each substrate type are accumulated across all years, and represented as percentages of the total area sampled at a given site for the full term of the study.

	1979		1980		1981		TOTAL	
	Total Area Sampled for Year (m^2)						All years (m^2)	
	4580		7634		1615		13829	
	Area	%	Area	%	Area	%	Area	%
SUBSTRATES:								
SILT	2338	51.05	2881	37.74	593	36.72	5812	42.03
SILT-SAND	690	15.07	1202	15.75	396	24.52	2288	16.54
SILT-RUBBLE	-	-	3193	41.83	488	30.22	3681	26.62
SAND	580	12.66	113	1.48	57	3.53	750	5.42
SAND-GRAVEL	180	3.93	30	0.39	-	-	210	1.52
SAND-RUBBLE	80	1.75	-	-	-	-	80	0.58
GRAVEL	-	-	-	-	-	-	-	-
GRAVEL-RUBBLE	264	5.76	44	0.58	-	-	308	2.23
RUBBLE	333	7.27	66	0.86	81	5.02	480	3.47
MISC. SUBSTRATES:								
SILT-GRAVEL	115	2.51	-	-	-	-	115	0.83
SAND-GRAVEL-RUBBLE	-	-	105	1.38	-	-	105	0.76
SAND-CLAY	-	-	-	-	-	-	-	-
SHANNON DIVERSITY INDEX:								
H'		1.54		1.24		1.34		1.54
SUBSTRATE EQUIVALENCY		4.64		3.45		3.83		4.68

Table 17. Composition of the substrate upstream of Dredge 3. The area sampled (m^2) over each type of substrate is represented as a percentage of the total area sampled over all substrates for each year, 1979-1981. Areas for each substrate type are accumulated across all years, and represented as percentages of the total area sampled at a given site for the full term of the study.

	1979		1980		1981		TOTAL	
	Total Area Sampled for Year (m^2)						All years (m^2)	
	2560		2432		812		5804	
	Area	%	Area	%	Area	%	Area	%
SUBSTRATES:								
SILT	1675	65.43	1612	66.28	557	68.60	3844	66.23
SILT-SAND	585	22.85	752	30.92	126	15.52	1463	25.21
SILT-RUBBLE	-	-	-	-	72	8.87	72	1.24
SAND	300	11.72	68	2.80	57	7.02	425	7.32
SAND-GRAVEL	-	-	-	-	-	-	-	-
SAND-RUBBLE	-	-	-	-	-	-	-	-
GRAVEL	-	-	-	-	-	-	-	-
GRAVEL-RUBBLE	-	-	-	-	-	-	-	-
RUBBLE	-	-	-	-	-	-	-	-
MISC. SUBSTRATES:								
SILT-GRAVEL	-	-	-	-	-	-	-	-
SAND-GRAVEL-RUBBLE	-	-	-	-	-	-	-	-
SAND-CLAY	-	-	-	-	-	-	-	-
SHANNON DIVERSITY INDEX:								
H'		0.87		0.74		0.95		0.87
SUBSTRATE EQUIVALENCY		2.38		2.09		2.58		2.38

Table 18. Composition of the substrate downstream of Dredge 3. The area sampled (m^2) over each type of substrate is represented as a percentage of the total area sampled over all substrates for each year, 1979-1981. Areas for each substrate type are accumulated across all years, and represented as percentages of the total area sampled at a given site for the full term of the study.

	1979		1980		1981		TOTAL	
	Total Area Sampled for Year (m^2)						All years (m^2)	
	2020		5202		803		8025	
	Area	%	Area	%	Area	%	Area	%
SUBSTRATES:								
SILT	663	32.82	1269	24.39	36	4.48	1968	24.52
SILT-SAND	105	5.20	450	8.65	270	33.62	825	10.28
SILT-RUBBLE	-	-	3193	61.38	416	51.81	3609	44.97
SAND	380	13.86	45	0.87	-	-	325	4.05
SAND-GRAVEL	180	8.91	30	0.58	-	-	210	2.62
SAND-RUBBLE	80	3.96	-	-	-	-	80	1.00
GRAVEL	-	-	-	-	-	-	-	-
GRAVEL-RUBBLE	264	13.07	44	0.85	-	-	308	3.84
RUBBLE	333	16.49	66	1.27	81	10.09	480	5.98
MISC. SUBSTRATES:								
SILT-GRAVEL	115	5.69	-	-	-	-	115	1.43
SAND-GRAVEL-RUBBLE	-	-	105	2.02	-	-	105	1.31
SAND-CLAY	-	-	-	-	-	-	-	-
SHANNON DIVERSITY INDEX:								
H'		1.86		1.10		1.08		1.62
SUBSTRATE EQUIVALENCY		6.44		3.01		2.94		5.06

Fig. 38. View upstream toward transect D3A from right bank in 1981. In 1979, dredge was located in center-left of picture. Absence of sand in this river segment is evident. Photograph January 1981.

Fig. 39. Silt deposited in former dredge pit at Dredge site 3. The area shown here was offshore, in the right foreground, of Fig. 24 in 1980. Photograph September 1981.

Fig. 40. Silt substrate and detritus at transect D3A in September 1981. Silt was the predominant substrate upstream from Dredge 3.

Fig. 41. Silt-rubble substrate at transect D3E in September 1981. This was the predominant substrate downstream from Dredge 3, following relocation of the dredge and transects D3D and D3E in 1980-81.

Fig. 42. View of Dredge site 3 looking upstream from transect D3E, in 1981. Riffle area in foreground is associated with the extensive rubble bar in mile 12 (left of photograph; Fig. 26). Photograph September 1981.

Substrate diversity indices were low for sample-areas upstream from this dredge, but high for areas below the dredge (Table 16). Values at D3A were lower than at any site excepting downstream from Dredge 2. Below dredge 3, diversity values in 1979 were the highest obtained at any site during the study; the indexes decreased in 1980 and 1981 to values less than those recorded at study site D1.

Summary of Trends in Substrate Composition

The major change in substrate from the Control sites to the lowermost Dredge study site is depletion of sand. At Control sites, 62% of the areas sampled in the main channel had sand substrate each year of the study. Sandy substrates decreased sequentially downstream to approximately 30%, 24%, and 5% of areas sampled at study sites D1, D2, and D3 respectively. Progressive reduction of sand substrate occurred during the three years of study; from 1979 through 1981, the proportion of sand substrate declined at site D1 from 46% to 8%, at site D2 from 44% to zero, at site D3 from 13% to 4%.

Substrates that replaced sand at the dredge sites were mainly silt and rubble. One common tendency as sand disappeared from the channel was exposure of "armored bars" having a veneer of coarse substrate (rubble). Armored bars existed especially at transects immediately above Dredge 1 and below Dredge 3. Such bars resisted erosion, but occurred only where flow was shallow and turbulent; where flow slackened, armored bars had silt-rubble admixtures (27% at site D1, 30% at site D3 in 1981). Where armored bars did not occur and the channel was relatively deep, silt and silt-sand became the predominant substrates. At study site D2, where a diversion dike compounded the effects of dredging to slow the flow of the river, substrates were almost entirely silt (59%) and silt-sand (36%) by the end of our study. At the study site D3, silt and silt-sand together comprised 91% of the substrate where dredging had occurred, but only 35% of substrates downstream where armored bars persisted.

The greatest variety of substrate types occurred at dredge sites having part of their area in the armored-bar stage of degradation (sites D1 and D3). Site D1 maintained high substrate diversity throughout the study, but substrate-diversity at D3 declined over the term of the project.

6. PHYSICAL AND CHEMICAL PARAMETERS

a) Physical and Chemical Parameters - Sediments

Water samples were collected in conjunction with sediment core samples six times in the study period. Both the water and sediment samples were analyzed by the Region VII EPA laboratories and are summarized here from the supplement of raw data separate from the report. In addition to the twenty trace metals and mercury, the samples were analyzed for volatile solids, chemical oxygen demand, biochemical oxygen demand, immediate oxygen demand, non-filterable solids, total Kjeldahl nitrogen, nitrate, total phosphorus, total organic carbon, phenols, oil-grease, sulfides, oxidation-reduction potential, cyanide, and pesticides (to include atrazine; mirex; PCB's; lindane; heptachlor; aldrin; heptachlor epoxide; beta chlordane; alpha chlordane; p,p-DDE; dieldrin; endrin; O,P-DDT; P,P-DDD; P,P-DDT).

The results of the trace metal analyses were similar to those taken on a monthly basis and will be discussed in another section. The pesticide analyses indicate that the river is not carrying a high pesticide load. There is no indication that dredging activity is resuspending pesticides which may have been bound up in the sediments. Except for rare appearances of random pesticides, all pesticide concentrations were less than the level of detection. This was also the case for many of the other parameters such as the immediate oxygen demand, ammonia, phenolics, sulfides and cyanides. The remainder of the parameters showed no reliable trend with regard to dredge versus non-dredged areas. It must be concluded therefore, that dredging is having little or no effect on the concentrations of the water quality constituents in the water column.

Chemical Analysis of the Sediment

The trace metal analysis of the sediments indicated differences in the concentration of some metals relative to those found in the water column. Magnesium, sodium and calcium were generally much higher in the sediments than in the water. Others such as aluminum and iron tended to be more concentrated in the sediments but only during periods of low flow.

Increased flow elevated the concentration of these metals in the water to higher levels than those found in the sediments. In addition, the top six inches of the river bed seem to have higher concentrations of the above mentioned metals than the underlying sediments. The major trend was an increase in the concentration of these metals in the sediments of the dredged areas relative to the control areas. This may be a function of the difference in substrate type as discussed in another section.

Biochemical oxygen demand, chemical oxygen demand, total Kjeldahl nitrogen, total phosphorus, ammonia and total organic carbon exhibited higher concentrations in the subtrate than in the water column. They also increased in concentration in the dredged areas relative to the controls. Oil and grease, sulfides and phenolics were generally found in lower concentrations in the sediments than in the water. These parameters exhibited no reliable trends relative to dredging activity. The remaining parameters, total volatile solids, immediate oxygen demands and redox potential either varied without pattern or showed no appreciable difference from the water.

No pesticides were detected in either the top six inch fraction of the river bed or the underlying, deeper sediments with the exception of the appearance of a PCB on one date at very low concentrations. No trend could be identified with regard to pesticide concentration in the sediments.

Sediment Particle Size Analysis

This discussion will focus mainly on the top one inch fraction of the river bed as this is the portion of the sediment in direct contact with the water column, plankton, fish fauna, and most benthic organisms (Table 7). The major trend noted was an increase in the percent of the total solid with a particle size diameter finer than 0.59 millimeters (mm) in the lower dredge sites relative to the control sites. In essence this indicates that a higher percentage of the top one inch fraction of the sediments is made up of silts rather than coarse sand in the dredge areas. Study site D1 did not differ significantly from the control study sites in particle size. (See Table 7).

A second tendency evident in Table 7 is that particle sizes increased slightly with increasing depth in cores from the control sites, but remained fine at all depths in the downstream dredge sites (D2 and D3).

b) Physical and Chemical Parameters - Water Quality

Turbidity

Turbidity is a measure of the total amount of suspended matter in the water column. Turbidity values from above and below the dredge did not differ such that dredging could be considered an influence on downstream turbidity (Table 19). The dredge effluents generally have a much higher turbidity than the river channel, however, there is no evidence that this influences downstream conditions. Examination of monthly data (Table A1-1) throughout the study shows occasional high values (12 May, June 1980) downstream enough to raise the annual downstream means (Table 19; 1980). Such measures, however, were the result of changing river conditions over the 48 hour sampling period due to rainfall and accompanying large increase in runoff to the river. The high flow conditions in 1981 due to heavy rainfall resulted in turbidity values which were considerably higher than the dredge effluent in previous years. These conditions persisted throughout most of the summer and fall. This indicates that natural conditions can, for extended periods of time, induce turbidity values which exceed those found in the localized region of the point of dredge effluent introduction.

Dissolved Oxygen

There seems to be no pattern to the dissolved oxygen concentrations related to the dredging operation (Table 19). Major differences in the data between the dredged and nondredged areas can be attributed to our inability to obtain samples from all stations in one 24 hour period as discussed for turbidity differences. The dredge effluent values tend to have lower oxygen concentration than the river channel, however, this does not seem to influence downstream conditions. In general the river maintains a high oxygen concentration throughout the year (Table A1-2). At no time did the

Table 19. Annual averages of water chemistry data from sampling sites in the lower Kansas River, Fishery-Dredging Project, May 1979 through July 1981.

	C1A	C1B	C2A	C2B	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3B	D3C	D3EFF	D3D	D3E
1979																						
Turbidity	77.3	77.7	77.7	78.0	78.1	73.7	73.6	120.0	82.5	73.8	95.0	166.8	81.3	80.2	81.5	80.3	85.0	82.9	86.7	141.2	84.4	85.1
Dissolved oxygen	9.5	9.4	9.6	9.7	9.3	9.3	9.4	7.0	9.1	9.4	9.3	4.9	9.3	9.5	9.5	9.5	8.7	8.7	8.7	7.9	8.7	8.6
Total Dissolved solids	218.0	218.0	218.0	218.0	217.0	215.0	215.0	165.0	217.0	215.0	224.0	267.0	223.0	225.0	224.0	224.0	221.0	222.0	222.0	239.0	221.0	222.0
pH	8.4	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.4	8.4	8.0	8.4	8.4	8.4	8.4	8.4	8.4	8.4	7.4	8.4	8.4
Alkalinity	167/4	168/6	165/5	156/4	166/5	165/5	163/7	159/5	165/5	614/6	167/7	161/1	167/7	165/7	167/7	164/8	164/6	166/6	164/7	291/2	165/6	164/6
Chl a	30.1	30.2	30.1	30.5	30.1	34.3	34.6	15.0	31.5	35.4	36.6	8.5	37.2	37.9	35.9	37.0	34.7	35.2	35.3	15.3	34.1	33.2
Total Suspended solids	183.0	-	151.0	-	267.0	204.0	193.0	-	145.0	324.0	351.0	-	196.0	203.0	204.0	322.0	327.0	219.0	216.0	594.0	205.0	382.0

	C1A	C1B	C2A	C2B	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3EFF	D3B	D3C	D3D	D3E
1980																						
Turbidity	57.3	55.4	56.1	60.5	52.3	55.3	54.7	253.3	56.4	63.4	217.1	1479.0	155.0	189.6	184.1	166.2	193.0	196.0	185.1	208.1	172.0	196.2
Dissolved oxygen	9.9	10.6	10.8	10.6	11.4	11.4	11.5	7.8	9.7	11.6	9.2	4.7	9.3	9.2	9.3	9.2	9.4	6.0	9.4	9.0	9.3	9.3
Total Dissolved solids	254.0	256.0	257.0	242.0	259.0	260.0	259.0	228.0	258.0	258.0	237.0	193.0	241.0	239.0	238.0	237.0	240.0	230.0	241.0	234.0	241.0	240.0
pH	8.2	8.2	8.2	8.3	8.3	8.4	8.4	8.2	8.4	8.4	8.1	7.8	8.1	8.1	8.0	8.1	8.0	7.8	8.0	8.0	8.0	8.0
Chl a	50.2	49.3	49.5	56.0	44.4	47.0	47.7	53.3	47.3	46.9	32.0	16.0	30.6	30.6	29.1	30.3	29.0	4.3	28.9	29.3	29.1	27.6
Total Suspended solids	218.0	-	199.0	-	203.0	118.0	124.0	-	112.0	230.0	214.0	8460.0	116.0	132.0	101.0	189.0	223.0	692.0	199.0	179.0	145.0	219.0

	C1A	C1B	C2A	C2B	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3EFF	D3B	D3C	D3D	D3E
May-June 1981																						
Turbidity	656.5	742.0	736.5	555.0	778.5	539.3	692.5	2600.0	345.0	1092.0	594.0	N.O.	617.5	791.5	854.5	803.5	582.5	N.O.	580.0	657.5	651.5	570.5
Dissolved oxygen	7.0	6.8	6.8	9.0	6.8	7.1	6.9	7.3	6.6	6.5	6.9	N.O.	7.1	7.0	7.0	6.9	7.2	N.O.	7.2	7.2	7.3	7.2
Total Dissolved solids	260.0	260.0	260.0	260.0	260.0	260.0	260.0	260.0	260.0	260.0	260.0	N.O.	260.0	260.00	260.0	260.0	260.0	N.O.	260.0	260.0	260.0	260.0
pH	7.4	7.4	7.4	7.5	7.4	7.3	7.4	7.4	7.3	7.2	7.5	N.O.	7.5	7.5	7.5	7.5	7.6	N.O.	7.6	7.6	7.5	7.5
Chl a	7.2	7.0	7.0	7.0	7.2	8.4	7.9	5.9	6.3	6.2	7.6	N.O.	7.7	7.2	7.5	7.4	8.0	N.O.	8.0	8.2	8.1	8.1
Total Suspended solids	1547.0	-	1771.0	-	1440.0	1704.0	1649.0	-	1689.0	1902.0	1830.0	-	1774.0	1580.0	1582.0	1551.0	1539.0	-	1500.0	1681.0	1484.0	1450.0

dissolved oxygen in the river drop below the 5 milligrams per liter (mg/l) State stream standard.

Total Dissolved Solids

TDS is a measure of the total ionic content of the water. The data indicate no major differences between dredged and nondredged areas, above or below a dredge or in the dredge effluent (Table 19, A1-3).

pH

The pH values vary without pattern along the entire stretch of river being studied. The annual averages indicate that there is little variation between stations (Table 19). The pH at the dredge effluent remained similar to those of the river. At no time did the pH of the dredge effluent differ from that of the river channel by more than one pH unit. All annual averages fell within the range of 6.5-8.5 which is the State stream standard. Most of the values fell in the upper end of the range (Table A1-4).

Alkalinity

The monthly values of both total and phenolphthalein alkalinity vary without pattern throughout the study area (Table A1-5). The annual averages indicate that there are no significant variations of alkalinity in the river channel (Table 19). The effluent from the dredge at study site D3 (D3Eff) tended to be higher in total alkalinity than the river water, however, this did not hold true for the other two dredge sites studied (Table A1-5). The increased alkalinity at study site D3 did not seem to influence downstream conditions.

Chlorophyll a

Chlorophyll a is a measure of algal biomass. The data shows no major difference between the samples taken above and those taken below each dredge (Table 19). Both the season and changing river conditions over the 48 hour

sampling period caused the major fluctuations in algal biomass (Table A1-5) as was noted also for turbidity and dissolved oxygen. The concentration both increased and decreased throughout the river with no major differences between the dredged and nondredged study areas.

Total Suspended Solids

Total suspended solids were collected upstream and downstream from each dredge and from the dredge effluent pipes. Although there existed less data when the dredges were operating, the data suggest that there is no effect attributable to the dredging operation (Table 20). An increase in suspended solids in the immediate vicinity of the dredge was not found (Table A1-7,8). No plume effect could be detected which originated at any dredge. The river channel itself seemed to be unaffected. This is contrary to what was expected due to the nature of the dredging operation. There appeared to be no cumulative effect of dredging on the total suspended solids (TSS) concentrations. One theory suggests that most of the water in contact with the dredge "bit" is being pumped onto shore with the sand. The water discharged from the system is generally very high in suspended solids. This usually resulted in a very localized increase in TSS which was not detectable 200 m downstream of the discharge pipe (Table A1-7,8). The suspended solids in the discharge settle out quickly. At study sites D2 and D3 a build-up of fine silt fanned out from the point of entry of the dredge effluent. This was not seen at study site D1 because of the relatively fast current which existed at the point of entry.

Particle Counts

The actual number of suspended particles in different size intervals in the water column was measured with an electronic particle counter. The range of particle sizes counted is contained within the smallest interval (<62μm) included in the USGS suspended solids data. Eight size classes were counted spanning 5 μm to 64 μm diameter particles. On some occasions all size classes show increases from upstream to downstream of each dredge (Table 21). There are also times while the dredge was operating that this did not occur. Again no alteration of suspended particles in the river water can be attributed to the dredging operation.

Trace Metals

Trace metal analyses were performed on the river water by the EPA. These samples were taken routinely from 200 m upstream and 400 m downstream from each dredge, from the dredge effluent discharge pipe, and at each control, and analyzed for twenty trace metals and mercury. The samples taken from the effluent pipes of the dredges tend to contain higher concentrations of aluminum, barium, chromium, copper, iron, manganese and zinc than the river channel, however, the discharge does not seem to influence the concentrations 400 m downstream of the dredge (Table A1-9). The annual averages for 1980 suggest that the concentrations of aluminum, barium, chromium, iron, manganese and zinc may increase downstream (Table 22). The 1979 and 1981 data are incomplete and as a result do not show the trend as well. High water conditions in 1981 increased the concentration of most of the metals throughout the study area. This may be due to the scouring effect of the high flow on the river bed or the properties of the storm runoff and subsequent reservoir discharge. The series of dredge operations may create a similar scouring effect although on a smaller scale. There may also be discharges of metals from industry or tributaries which would account for higher concentrations downstream.

Table 20. Monthly and Annual AVerages of USGS suspended solids concentration from sampling sites in lower Kansas River, Fishery-Dredging Project August 1979 through August 1981. Two days required for each monthly sampling series.

	C1	C2	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3EFF	D3B	D3C	D3D	D3E
Aug 1979	208	209	299	204	193	ONS	221	210	272	ONS	196	203	204	221	221	219	216	N.O.	205	243
Sept 1979	158	160	284			N.O.		438	692	N.O.				663	605			230		520
Dec 1979		85	218				69		90					81	155			958		107
Annual Average	183	151	267	204	193	-	145	324	351	-	196	203	204	322	327	219	216	594	205	382

	C1	C2	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3EFF	D3B	D3C	D3D	D3E
Mar 1980	138	134	205	-	-	N.O.	-	203	96	N.O.	-	-	-	98	88	N.O.	-	-	-	89
Apr 1980	902	781	741			N.O.		842	840	9480				826	830					839
May 1980	143	189	159	173	168	N.O.	161	198	106	7440	105	106	114	112	126	1380	125	132	127	123
June 1980	148	161	155	169	169	N.O.	163	167	281	N.O.	159	212	186	154	433		482	405	384	374
July 1980	151	78	73	79	96	N.O.	87	107	71	N.O.	120	139	73	59	74	589	84	81	96	85
Aug 1980	60	57	80	51	62	N.O.	72	124	122	N.O.	78	69	62	83	95	108	104	97	90	78
Sept 1980	104	111	1118			N.O.	116	115	111	N.O.			101	105	104	N.O.			100	97
Nov 1980	100	84	94			N.O.	75	87	87	N.O.			72	75	72	N.O.			71	67
Annual Average	218	199	203	118	124	-	112	230	214	8460	116	132	101	189	223	692	199	179	145	129

	C1	C2	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3EFF	D3B	D3C	D3D	D3E
Mar 1981	36	39													38				38	39
Apr 1981	92	123													122	N.O.	78	62	66	66
May 1981	1759	2169	1530	2108	1962		2113	2534	2654		2400	2450	2495	2239	2279		2170	2100	2144	2015
June 1981	1335	1373	1350	1299	1336		1264	1269	1005		1148	710	669	862	798		829	1262	824	885
July 1981	672	689							679		752	581	490	488						
Aug 1981	126	123	129	135	133		174	141	75		59	111	74	47						
May-June Average	1547	1771	1440	1704	1649		1689	1902	1830		1774	1580	1582	1551	1539		1500	1681	1484	1450

Table 21. Coulter Counter particle size analysis from selected stations in the lower Kansas River, Fishery-Dredging Project, May 1979 through August 1980. N.O.- dredge not operating

	C1A	C2A	D1A	D1EFF	D1E	D2A	D2EFF	D2E	D3A	D3EFF	D3E
May 1979											
5-8u	39182	37711	41749		37834	28842		30470	31152		28742
8-13u	41307	41653	40649		42333	42703		40067	42499		42853
13-16u	8152	9444	7513		9704	9537		9630	9847		11265
16-25u	1085	1164	1047		1404	2723		2400	2482		3047
25-32u	401	433	412		511	841		790	814		1023
32-40u	159	146	144		135	200		156	179		241
40-51u	40	43	43		38	58		56	67		72
51-64u	12	17	11		11	15		12	23		22
June 1979											
	18490	13524	17079	N.O.	16927	19789	7716	19169	21895	46024	20787
	17623	17240	17807		19368	16949	39333	16689	16356	12550	17105
	7833	8263	8361		9076	6887	37127	7095	6443	1911	5629
	4964	5372	5743		5815	3814	11960	4125	3450	542	2504
	2088	2438	2690		2770	1686	3089	1893	1485	302	1198
	457	540	644		658	427	565	495	485	133	875
	97	135	169		161	114	92	135	119	55	93
	26	38	46		46	27	12	44	35	9	24
July 1979											
	14601	17897	17398	4564	6349	11718	6369	17715	14348	7695	21334
	28515	32959	29856	12764	17315	26456	27977	40346	33600	25064	40472
	13512	16303	14320	13512	13540	16714	27885	18269	18788	5274	19477
	3963	3051	3891	4532	5057	4624	12652	6142	5244	1294	4642
	1772	1175	1770	1473	1788	1829	4180	2677	2231	567	1722
	733	469	737	525	707	703	896	1151	905	241	651
	213	141	236	140	209	253	127	362	332	93	183
	34	62	42	32	35	61	15	69	80	31	41
August 1979											
	41047	38952	36130	36760	40502	32464	24861	34925	37835	30884	33337
	24887	22041	23913	29627	27480	29272	43992	30115	27345	37515	25867
	4313	3852	3473	5469	3909	5070	35320	5223	3996	8862	4101
	870	821	861	1418	806	1130	10968	999	809	1743	908
	341	313	376	644	336	443	4509	387	322	659	332
	125	108	157	268	133	162	1357	134	106	204	128
	42	50	57	94	42	51	313	41	27	57	40
	9	7	10	24	9	11	62	10	5	15	8
June 1980											
	30892	33167	29537	N.O.	27022	12569		28143	16060	N.O.	21548
	36112	35503	36934		37216	40403		44275	36333		46895
	9693	8602	10975		10540	30132		18969	25200		26480
	1987	1778	2350		2374	5192		2919	4089		4135
	827	736	954		960	1302		684	962		1079
	309	278	374		350	295		248	255		280
	102	116	136		115	111		65	76		65
	37	46	37		38	23		6	24		17

Table 21. continued.

	C1A	C2A	D1A	D1EFF	D1E	D2A	D2EFF	D2E	D3A	D3EFF	D3E
August 1980											
5-8u	31918	34769	37545	22904	34548	9157	too	15843	20681	N.O.	20440
8-13u	30450	33309	33165	41347	33966	33924	turbid	37904	42237		41091
13-16u	7675	7478	7208	23161	7727	24277		24343	21524		20709
16-25u	1809	1517	1286	6165	1479	8025		6323	19267		4480
25-32u	679	491	476	2413	554	3769		2253	1390		1517
32-40u	309	191	172	978	221	1043		732	416		437
40-51u	145	70	72	409	80	311		175	93		119
51-64u	50	16	24	122	32	80		36	21		31
September 1980											
	22864	23696	23209	N.O.	23689	26466	N.O.	33693	31524	N.O.	27015
	23224	28091	27747		28137	29449		33788	31441		28203
	8727	9982	9887		9873	9230		8907	8696		8439
	2360	2424	2222		2272	1811		1425	1604		1652
	842	798	750		635	499		423	504		507
	299	315	270		245	129		106	146		158
	137	117	121		79	45		36	45		64
	44	47	44		28	10		9	17		16
March 1981											
		16704							19295	N.O.	15416
		14012							21143		21747
		4701							8726		8167
		459							742		617
		164							213		202
		56							53		43
		18							16		12
		5							6		1
April 1981											
		31651							25184	N.O.	28049
		33150							27990		29495
		13097							10620		9699
		2374							2435		1596
		980							784		477
		343							230		140
		107							61		42
		28							19		12
July 1981											
		25829				23766	Too	30209			
		33630				32850	Turb	31544			
		10907				6035		10117			
		1673				1088		1524			
		547				341		399			
		180				97		101			
		50				16		23			
		8				3		3			

Table 22. Annual averages of trace metals from sampling sites on the lower Kansas River, Fishery-Dredging Project, May 1979 through July 1981.

1979

	C1B	C2B	D1A	D1EFF	D1E	D2A	D2EFF	D2E	D3A	D3EFF	D3E
Silver ug/l	*	*	*	*	*	*	*	*	*	*	*
Aluminum ug/l	2347	2313	2880	3570	2657	3013	5640	2600	3283	9290	3183
Arsenic ug/l	*	*	*	*	*	*	*	*	*	*	*
Barium ug/l	144	151	157	189	155	151	482	148	157	604	155
Beryllium ug/l	*	*	*	*	*	*	*	*	*	*	*
Cadmium ug/l	4	3	*	*	7	*	3	4	*	6	*
Chromium ug/l	6	8	10	*	6	9	9	11	26	15	10
Copper ug/l	19	29	22	48	12	18	32	28	931	21	15
Iron ug/l	1984	1980	2340	5220	2137	2647	5465	2000	2185	22033	2843
Manganese ug/l	147	111	177	277	164	168	132	167	150	2107	175
Nickel ug/l	*	18	*	*	*	*	*	18	*	27	*
Lead ug/l	33	*	33	*	*	*	*	*	*	*	*
Antimony ug/l	*	*	*	*	*	*	*	*	*	*	*
Selenium ug/l	*	*	*	*	*	*	*	*	*	*	*
Thallium ug/l	*	*	*	*	*	*	*	*	48	*	*
Zinc ug/l	42	43	29	46	56	31	48	37	39	80	35
Calcium mg/l	56	60	60	59	60	57	105	58	44	111	58
Magnesium mg/l	14	15	15	16	16	15	13	15	34	18	15
Sodium mg/l	66	67	68	74	70	60	61	64	51	33	61
Mercury ug/l	0.6	0.4	1.7	*	0.7	0.5	0.3	0.8	0.6	0.9	0.5

Table 22. Continued.

1980

	C1B	C2B	D1A	D1EFF	D1E	D2A	D2EFF	D2E	D3A	D3EFF	D3E
Silver ug/l	*	*	*	*	*	*	*	*	*	*	*
Aluminum ug/l	2742	2724	2715	14056	3175	7991	132933	8474	9112	2060	10920
Arsenic ug/l	*	*	*	*	*	*	*	*	*	*	*
Barium ug/l	147	292	149	297	152	185	2401	183	189	516	195
Beryllium ug/l	*	*	*	*	*	*	7	*	*	*	*
Cadmium ug/l	*	*	*	6	*	7	77	9	9	3	11
Chromium ug/l	3	3	4	15	4	9	127	11	11	3	13
Copper ug/l	13	10	13	20	7	13	203	15	14	5	14
Iron ug/l	2028	2021	2060	17260	2317	7131	198333	8023	8117	12800	9525
Manganese ug/l	129	129	137	580	130	206	3028	200	214	1738	228
Nickel ug/l	*	7	9	20	*	15	156	16	20	*	17
Lead ug/l	18	8	15	21	16	12	133	13	9	26	11
Antimony ug/l	*	*	*	*	*	*	*	*	*	*	*
Selenium ug/l	*	*	*	*	*	*	33	*	*	*	*
Thallium ug/l	*	*	*	*	*	*	*	*	*	*	*
Zinc ug/l	11	10	10	50	11	29	569	49	30	10	38
Calcium mg/l	67	69	69	83	69	66	241	65	70	103	70
Magnesium mg/l	17	18	18	19	18	17	43	17	17	16	17
Sodium mg/l	78	79	80	69	80	73	55	73	73	36	74
Mercury ug/l	0.8	0.8	0.7	1.0	0.8	1.2	0.9	1.1	0.9	*	1.5

Table 22. Continued.

1981

	C1B	C2B	D1A	D1EFF	D1E	D2A	D2EFF	D2E	D3A	D3EFF	D3E
Silver ug/l	2	*	*	*	*	*		*	*		*
Aluminum ug/l	27109	22316	47700	241900	68000	26347		32060	20103		18594
Arsenic ug/l	*	*	*	*	*	*		*	*		*
Barium ug/l	271	264	457	2602	677	312		329	247		326
Beryllium ug/l	*	2	2	12	3	2		*	*		*
Cadmium ug/l	*	*	*	*	*	*		*	*		*
Chromium ug/l	30	23	48	230	67	27		31	20		24
Copper ug/l	32	35	30	218	42	18		20	17		18
Iron ug/l	15783	18055	39000	251700	57900	22140		24093	15268		14539
Manganese ug/l	522	499	895	8482	1320	557		526	421		415
Nickel ug/l	34	25	40	226	57	23		26	28		29
Lead ug/l	12	6	*	*	*	*		*	9		11
Antimony ug/l	*	*	*	*	*	*		*	*		*
Selenium ug/l	*	*	*	*	*	*		*	*		*
Thallium ug/l	*	*	*	*	*	*		*	*		*
Zinc ug/l	101	76	82	813	159	65		68	62		56
Calcium mg/l	65	69	65	365	74	55		60	73		71
Magnesium mg/l	17	16	16	54	18	12		14	17		17
Sodium mg/l	57	64	19	23	12	22		25	65		63
Mercury ug/l	1.6	1.6	0.8	0.9	0.9	0.6		0.6	1.1		1.1

7. PLANKTON PARAMETERS

Phytoplankton

The structure of the phytoplankton (suspended algae) community remained generally unchanged downstream from Control stations through the Dredge stations (Table 23). The most obvious changes occurred seasonally, or in periods of high discharge from lakes, which added a new contingent of organisms to the community. Usually, plankton was most abundant under low-flow conditions.

Measurement of the growth rate of these organisms in non-dredged and dredged areas revealed no consistent trends which can be associated with Control or Dredge sites (Table 24).

Benthic algae which form thin mats were present in shallow areas where light penetrated to stable substrate under low flow conditions. Organisms dominating these areas were generally filamentous, Chlorophyta and Cyanophyta. Shallow areas were most extensive in the Control sites, but dredged areas were not devoid of periphyton.

Zooplankton

The zooplankton community (microscopic crustaceans) appeared to be unaffected by the dredging operations. The distribution of these organisms varied more with season and lake discharge than with site (Table 25). Cyclopoid copepods were the major constituent of the zooplankton, but calanoid copepods were generally present in low numbers as were several genera of Cladocerans. Ostracods occurred rarely.

Table 23. Enumeration of dominant phytoplankton species by station and month, lower Kansas River, Fishery-Dredging Project, June 1979-August 1980. Organisms as numbers/ml.

	C2A	D1A	D1E	D2A	D2E	D3A	D3E
June 1979							
Actinastrum	118	451	494	794	372	137	265
Ankistrodesmus	353	666	480	637	372	78	255
Coelastrum	431	627	1215	745	902	745	941
Crucigenia	784	804	568	392	284	118	274
Cyolotella	2244	1156	2087	1617	1372	1480	1333
Scenedesmus	372	784	804	1215	468	216	823
August 1979							
Actinastrum	1362	1695	1499	980	2342	382	2646
Ankistrodesmus	892	333	715	461	598	294	500
Coelastrum	1323	1568	1392	1784	921	1509	902
Cyclotella	549	480	784	568	647	461	539
Dictyosphaerium	1392	1980	1009	1058	1617	216	764
Scenedesmus	1182	2509	2430	2646	1705	2009	2234
November 1979	all species in very low numbers						
March 1980							
Chlamydomonas	1813	1294	1960	2166	1470	1823	1852
Melosira	7938	6252	4351	4586	3499	3930	3900
June 1980							
Coelastrum	-	353	78	157	314	274	862
Cyclotella	608	559	696	774	784	764	1126
Scenedesmus	98	118	196	392	39	461	598
August 1980							
Coelastrum	1254	980	235	1313	578	823	333
Cyclotella	862	892	980	1068	921	1147	1068
Dictyosphaerium	941	1274	137	666	235	745	39
Gymnodinium	49	49	89	10	29	39	20
Pediastrum	470	157	627	539	-	-	157
Scenedesmus	2038	1921	725	1000	1078	1098	784

Table 23. Continued.

	C2B	D1A	D1E	D2A	D2E	D3A	D3E
November 1980							
Anabaena	-	-	140	60	-	-	40
Ankistrodesmus	160	80	-	80	240	320	520
Aphanizomenon	-	160	-	180	160	-	100
Chlamydomonas	1180	1450	2420	1420	940	1540	1100
Coelastrum	-	-	-	320	-	-	-
Cruciginia	-	-	-	-	160	-	-
Cryptomonas (a)	260	280	180	80	80	280	220
Cryptomonas (b)	320	40	180	400	340	20	120
Cyclotella (a)	440	340	260	220	300	240	440
Cyclotella (b)	53700	33200	49600	48700	47700	4100	50500
Dinobryon	-	-	60	-	-	-	-
Euglena	120	20	40	60	40	80	80
Kirchneriella	40	20	-	160	60	-	20
Melosira	-	-	60	20	-	-	-
Navicula	80	60	20	20	40	80	
Oocystis	260	160	220	480	240	160	160
Pinnularia	100	20	-	-	60	-	40
Scenedesmus	240	400	160	160	520	320	240
Sphaerocystis	160	-	-	160	-	400	240
Stichococcus	36800	20800	22700	29500	25800	30800	35200
Synedra	600	320	500	500	200	620	260
March 1981							
Asterionella	240	-	-	-	-	-	240
Cryptomonas (a)	360	-	-	-	-	360	960
Cryptomonas (b)	1380	-	-	-	-	4200	960
Cyclotella (a)	13260	-	-	-	-	27840	35280
Cyclotella (b)	22260	-	-	-	-	49560	45480
Euglena	480	-	-	-	-	1200	1080
Gymnodinium	480	-	-	-	-	360	-
Kirchneriella	1200	-	-	-	-	720	480
Navivula	960	-	-	-	-	600	840
Oocystis	900	-	-	-	-	480	960
Pinnularia	60	-	-	-	-	-	-
Scenedesmus	240	-	-	-	-	960	-
Sphaerocystis	-	-	-	-	-	-	480
Synedra	3720	-	-	-	-	5160	5640
June 1981							
Ankistrodesmus	-	60	60	-	-	-	-
Cosmarium	-	-	120	-	-	-	-
Cryptomonas (a)	780	480	300	300	240	240	420
Cryptomonas (b)	540	420	240	840	300	300	240

Table 23. Continued.

	C2B	D1A	D1E	D2A	D2E	D3A	D3E
Cyclotella (a)	60	120	60	300	180	240	180
Cyclotella (b)	120	180	120	180	60	120	60
Euglena	60	-	60	-	60	-	60
Gymnodinium	-	240	-	240	-	-	-
Navicula	-	60	-	60	60	120	-
Oocystis	-	180	-	360	-	-	480
Pandorina	-	-	480	-	-	-	-
Phacus	60	-	-	240	-	60	-
Pinnularia	60	-	-	60	-	-	-
Sphaerocystis	-	-	-		1440	-	-
Synedra	-	-	-	-	60	60	-
September 1981							
Actinastrum	2400	3120	2340	1500	4380	1080	2280
Anabaena	-	-	-	900	-	-	-
Ankistrodesmus	60	180	120	-	600	180	60
Aphanizomenon	120	-	420	-	120	-	-
Chlamydomonas	840	-	-	-	-	840	-
Cosmarium	-	-	60	-	-	-	60
Cryptomonas (a)	240	420	360	300	240	240	480
Cryptomonas (b)	180	1560	1260	1020	1140	1080	1020
Cyclotella (a)	2460	4560	4860	5640	6900	6360	6780
Cyclotella (b)	6220	70440	53880	42660	59520	63180	44460
Euglena	-	-	120	60	-	60	180
Melosira	-	120	-	-	-	-	-
Navicula	120	-	-	120	60	60	120
Oocystis	1260	1320	1680	3120	2760	2280	2820
Phacus	-	-	60	-	-	-	-
Pinnuclaria	-	-	60	-	60	-	-
Scenedesmus	480	480	240	-	2400	480	2280
Sphaerocystis	960	720	240	480	-	1200	720
Synedra	-	-	-	-	-	-	-
November 1981							
Aphanizomenon	-	-	-	-	-	-	120
Chlamydomonas	30	30	90	30	30	120	-
Chroococcus	-	-	-	60	-	-	-
Cryptomonas (a)	120	60	-	90	-	60	90
Cryptomonas (b)	300	120	240	330	360	210	330
Cyclotella (a)	150	90	90	150	240	120	360
Cyclotella (b)	30	30	150	60	60	270	60
Euglena	-	-	-	30	-	-	-
Gelnodinium	60	-	-	30	-	-	-
Kirchneriella	-	-	-	-	-	-	30

Table 23. Continued.

	C2B	D1A	D1E	D2A	D2E	D3A	D3E
Navicula	-	-	-	-	30	-	30
Oocystis	-	-	-	30	30	-	30
Stichococcus	120	-	-	60	-	120	60
Synedra	-	-	60	-	30	-	-

Table 24. Estimation of rate of photosynthesis of the river phytoplankton as counts per minute of ^{14}C uptake for a 4h incubation.

Date	C2A	C2B	D1A	D1B	D2A	D2B	D3A	D3B
6-19-80	9308.1	9263.6	9878.4	9508.3	7114.4	6234.2	6468.2	6297.0
8-29-80	5631.7	4595.6	4546.4	3811.2	3765.5	4397.1	4293.9	3338.2
7-24-81	---	2754.5	2570.0	2926.5	5011.6	12289.3	2909.0	1901.1
8- 7-81	---	293.1	281.5	279.9	238.8	334.8	316.0	325.6
12-11-81	---	268.9	304.3	297.2	413.7	340.6	423.5	465.1

Table 25. Enumeration of the zooplankton by station and by month, lower Kansas River, Fishery-Dredging Project, June 1979 through August 1980.

	C2A	D1A	D1E	D2A	D2E	D3A	D3E
June 1979							
Cyclopoid copepod	64	64	74	56	71	63	74
Calanoid copepod	2	3	0	4	4	5	2
Nauplii	38	35	28	4	3	27	55
Simocephalus	0	0	0	0	1	1	1
Bosmina	0	3	0	0	0	0	1
Diaphanosoma	0	0	1	0	0	0	0
Daphnia	1	0	0	0	0	0	0
Ostracoda	1	6	1	1	0	0	4
August 1979							
Cyclopoid copepod	16	26	14	17	6	13	4
Calanoid copepod	1	2	3	0	0	0	0
Nauplii	7	3	2	6	0	0	5
Simocephalus	0	0	0	0	0	1	0
Diaphanosoma	0	0	0	0	1	0	0
Ceriodaphnia	0	1	0	0	0	0	0
Ostracoda	0	0	0	0	0	1	0
November 1979							
Cyclopoid copepod	169	71	34	126	77	58	44
Calanoid copepod	28	46	3	28	21	10	18
Nauplii	20	9	2	10	8	8	4
Simocephalus	1	1	0	1	0	0	0
Bosmina	7	7	1	5	3	1	3
Daphnia	38	26	11	28	20	11	11
Ceriodaphnia	1	1	2	0	3	1	2
Ostracoda	0	4	0	0	1	0	0
March 1980							
Cyclopoid copepod	327	322	131	206	198	223	255
Calanoid copepod	22	23	5	19	32	22	11
Nauplii	6520	246	124	246	326	572	855
Simocephalus	0	1	0	0	0	0	0
Bosmina	26	20	8	16	17	34	28
Diaphanosoma	0	0	0	0	0	1	0
Daphnia	5	4	0	0	0	1	2

Table 25. continued.

	C2A	D1A	D1E	D2A	D2E	D3A	D3E
June 1980							
Cyclopoid copepod	158	186	*	215	242	97	93
Calanoid copepod	55	72	*	112	111	59	69
Nauplii	31	204	*	244	337	163	142
Simocephalus	5	1	*	3	1	0	1
Bosmina	11	4	*	6	12	3	3
Daphnia	94	65	*	145	123	32	38
Ceriodaphnia	2	2	*	0	1	0	0
Chydorus	0	0	*	1	0	0	0
Ostracoda	1	1	*	0	0	0	0
August 1980							
Cyclopoid copepod	9	5	0	8	21	7	8
Nauplii	3	0	0	0	2	0	0
Diaphanosoma	3	1	0	6	52	16	24
Ostracoda	1	0	0	1	0	0	0
November 1980							
Cyclopoid copepod	3	1	2	2	8	6	1
Calanoid copepod	4	1	3	0	1	0	0
Nauplii	3	1	0	2	0	1	2
Daphnia	0	0	1	0	1	1	0
Simocephalus	0	0	5	0	0	1	0
March 1981							
Cyclopoid copepod	350	*	*	*	*	695	731
Calanoid copepod	8	*	*	*	*	20	19
Nauplii	>1000	*	*	*	*	>1000	>1000
Simocephalus	3	*	*	*	*	0	2
Bosmina	13	*	*	*	*	0	5
Daphnia	29	*	*	*	*	5	6
Ceriodaphnia	3	*	*	*	*	1	4
Chydorus	2	*	*	*	*	1	2
Diaphanasoma	1	*	*	*	*	0	1
June 1981							
Cyclopoid copepod	125	69	97	62	86	44	40
Calanoid copepod	6	4	2	5	5	7	8
Daphnia	2	4	6	3	14	7	5
Bosmina	0	5	0	0	0	0	0
Diaphanosoma	0	0	1	0	0	1	0
Ostracoda	0	0	0	0	2	0	2
November 1981							
Cyclopoid copepod	25	15	33	15	10	10	7
Calanoid copepod	1	1	3	2	3	4	3
Nauplii	1	0	0	1	0	0	0
Daphnia	0	0	2	6	0	0	0

* this transect not sampled.

8. BENTHOS AT CONTROL AND DREDGE SITES

A total of 56 aquatic invertebrate taxa, collected from June 1979 through September 1981 by methods previously described, were identified and are summarized in Table A2-1. The reader is advised to refer to this summary for the classification of organisms discussed throughout this section.

Because of the large number of taxa, Common Taxa (Table 26), those organisms of which more than five were collected in PIBS samples from 1979-1981, and Rare Taxa (Table 27), those organisms of which five or less were collected, are often treated separately. The cutoff for the two groups is arbitrary; however there is a real necessity to treat rare organisms with care in data analysis because their sparse and possibly patchy natural distributions may require that a great many more samples be taken to reveal ecological trends than required for common species. Needham and Usinger (1956), using a Surber sampler, demonstrated that a much greater sampling effort is necessary to reveal true numeric proportions of invertebrate taxa including rare species than is necessary to produce an accurate species composition list. For these reasons, treatment of rare taxa is confined to general qualitative discussion in this report, while more common taxa are subject to finer scrutiny and quantitative analysis.

In the discussions to follow, the habitat affinities of the aquatic invertebrates collected are referred to whenever they are known. Merritt and Cummins (1978) provide detailed summaries of ecological characteristics of most North American insect genera, which includes habitat types to which they are associated. The habitat categories used in Merritt and Cummins (1978) are adopted in this report and include lotic erosional (e) and lotic depositional (d) (Tables 28,29). Lotic erosional conditions are characterized by coarse sediments, rubble and gravel, usually associated with fast currents, while lotic depositional conditions are characterized by fine sediments, clay, silt and sand, deposited by slow currents typical of stream pools and margins (Merritt and Cummins, 1978). Tables 28 and 29 summarize the substrate associations of Kansas River invertebrate taxa and are referred to often. The same information for invertebrates other than

Table 26. Actual numbers of "Common" invertebrate taxa collected in PIBS samples (P) and drift samples (D) at Control and Dredge sites, lower Kansas River, 1979-1981.

	Control		D1-upstream		D1-downstream		D2-upstream		D2-downstream		D3-upstream		D3-downstream	
	P	D	P	D	P	D	P	D	P	D	P	D	P	D
Oligochaeta	29	16	12	1	24	-	308	4	671	17	344	26	275	1
Stenelmis	1	5	6	-	4	-	2	1	1	-	1	-	22	-
Ceratopogonidae	18	-	10	1	10	2	15	-	30	-	5	1	21	0
Chironomidae	256	145	278	30	151	62	235	39	444	21	369	408	308	26
Simulium	3	1	2	1	4	-	-	-	-	-	13	4	6	3
Baetis	9	18	41	34	69	28	3	9	5	7	4	-	260	3
Centroptilum	2	-	2	-	1	-	-	-	1	1	2	-	-	-
Caenis	22	9	24	2	58	14	18	8	45	5	25	2	98	4
Hexagenia	4	4	-	-	-	-	22	2	44	-	16	75	-	-
Heptagenia	-	-	1	-	1	-	-	-	-	-	-	-	4	-
Stenacron	1	-	7	-	-	-	-	-	-	-	-	-	3	-
Stenonema	8	16	12	2	29	1	2	-	1	1	4	1	218	1
Isonychia	-	-	14	-	17	1	-	-	-	-	-	-	14	-
Pentagenia	4	-	-	-	3	-	8	-	13	8	9	-	71	-
Ephoron	19	-	3	-	9	-	-	-	1	-	-	-	8	-
Tricorythodes	-	3	3	1	2	3	-	3	-	-	1	-	9	2
Trichocorixa	15	23	218	22	14	9	544	99	473	78	155	37	150	16
Argia	-	1	1	-	-	1	-	-	1	-	1	4	7	1
Gomphus	7	-	2	-	4	-	5	-	30	-	6	-	10	-
Neoperla	-	-	6	-	6	-	-	-	3	-	-	-	8	1
Perlesta	-	-	5	-	3	-	-	1	-	-	-	-	5	-
Isoperla	-	1	4	-	6	-	-	-	3	-	3	1	15	-
Cheumatopsyche	-	2	27	-	10	-	-	-	6	4	-	-	18	-
Hydropsyche	4	36	70	16	746	21	1	26	108	25	12	1	538	9
Potamyia	21	131	486	66	761	70	4	7	119	40	25	31	486	22
Nectopsyche	-	18	4	1	2	8	1	4	6	18	5	7	5	4
Physa	-	1	-	-	-	1	-	-	5	15	1	-	-	-
Sphaeridae	-	-	-	-	-	-	5	-	5	-	-	-	-	-
Totals:	422		1238		1934		1173		2016		1001		2559	
item 153:	132	19	84	14	93	14	84	13	90	14	87	15	93	13

Table 27. Actual numbers of "Rare" invertebrate taxa collected in PIBS samples (P) and drift samples (D) at Control and Dredge sites, lower Kansas River, 1979-1981.

TAXON	Control		D1-upstream		D1-downstream		D2-upstream		D2-downstream		D3-upstream		D3-downstream	
	P	D	P	D	P	D	P	D	P	D	P	D	P	D
Hirudinia	-	-	-	1	-	-	-	-	1	1	-	-	-	-
Hyallela	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Orconectes	-	-	1	-	-	-	-	-	-	-	-	-	1	-
Dubiraphia	-	-	-	-	1	-	1	-	2	-	-	-	1	-
Macronychus	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Helodidae	-	-	-	-	-	1	-	-	-	-	-	-	-	-
Collembola	-	-	-	-	1	-	-	-	-	-	-	1	-	-
Chaoborus	4	66	-	-	1	3	-	1	-	-	-	3	-	1
Hemerodromia	-	-	1	-	-	-	-	2	-	-	-	-	1	-
Ephydridae	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Tipulidae	2	-	-	-	-	1	2	-	-	-	1	3	1	-
Apobaetis	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Brachycercus	-	1	-	-	-	-	2	-	1	-	2	-	-	-
Choroterpes	-	-	2	-	-	-	-	-	-	-	-	1	2	-
Homoeoneuria	4	-	-	-	1	-	-	-	-	-	-	-	-	-
Tortopus	-	-	-	-	-	-	1	-	-	-	-	-	4	-
Potamanthus	-	-	-	-	1	-	-	-	-	-	-	-	-	-
Notonecta	-	-	1	-	-	-	-	-	-	-	-	1	-	1
Neoplea	-	-	-	-	-	-	1	-	-	1	-	-	1	-
Rhagovelia	-	1	-	3	-	-	-	-	-	-	-	-	-	-
Corydalus	-	-	-	-	-	1	-	-	-	1	-	-	-	1
Sialis	-	-	1	-	-	-	-	-	-	-	-	-	-	-
Neurocordulia	-	-	-	-	-	-	-	-	-	-	-	-	2	-
Progomphus	-	-	-	-	-	-	1	-	-	-	-	-	1	-
Neureclipsis	-	-	1	-	-	-	-	1	-	-	-	-	-	-
Cyrnellus	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Lymnaeae	-	-	-	-	-	-	-	-	1	-	-	-	-	-
Corbicula	-	-	-	-	-	-	-	-	-	-	2	-	-	-
Totals:	11	68	7	4	5	6	8	4	6	4	5	10	14	4
item 153:	132	19	84	14	93	14	84	13	90	14	87	15	93	13

Table 28. Habitat associations (ecotypes) of the "Common" Invertebrate Taxa of the Kansas River. The letter "d" denotes associates of depositional substrates, "e", erosional substrates and "d & e" those taxa whose specific association cannot be determined at this taxonomic level (after Merrit and Cummins, 1978).

Taxon	Ecotype	Taxon	Ecotype	Taxon	Ecotype
Oligochaeta	d	Stenacron	e	Neoperla	e
Stenelmis	e	Stenonema	e	Perlesta	d & e
Ceratopogonidae	d	Isonychia	e	Isoperla	d & e
Simulium	e	Pentagenia	d	Cheumatopsyche	e
Baetis	d & e	Ephoron	d & e	Hydropsyche	e
Centroptilum	d & e	Tricorythodes	d	Potamyia	e
Caenis	d	Trichocorixa*	d	Nectopsyche	d & e
Hexagenia	d	Argia	d & e	Physa	d & e
Heptagenia	e	Gomphus	d	Spaeriidae	d & e

*Trichocorixa is not a true benthic organism, spending much of its life in the limnetic zone, however, in lotic situations it cues in on and lives in depositional conditions.

Table 29. Habitat associations (ecotypes) of "Rare" Invertebrate Taxa of the Kansas River. The letter "m" denotes associates of river margin habitat. The letter "d" denotes associates of depositional substrates, "e" erosional substrates and "d & e", those taxa whose specific association cannot be determined at this taxonomic level (after Merrit and Cummins, 1978).

Taxon	Ecotype	Taxon	Ecotype	Taxon	Ecotype
Hirudinia	d	Tipulidae	d & e	Rhagovelia	e
Hyallela	m	Apobaetis	d	Corydalus	e
Orconectes	d & e	Brachycercus	d	Sialis	d
Dubiraphia	e	Choroterpes	e	Neurocordulia	d
Macronychus	d & e	Homoeoneuria	d	Progomphus	d & e
Helodidae	d	Tortopus	d	Neureclipsis	e
Collembola	m	Potamanthus	d	Cyrnellus	d & e
Chaoborus*	d	Notonecta*	d	Lymnaeae	d & e
Hemerodromia	d & e	Neoplea	d	Corbicula	d & e
Ephydridiae	d				

*These taxa are not true benthic, spending much of their lives in the limnetic zone, however, in lotic situations they cue in on and live in depositional conditions.

insects was obtained through Pennak (1978) and Huggins, Liechti and Ferrington (1981).

In analysis of data, within site results are presented and discussed first, followed by between site comparisons. Dredge sites are often discussed upstream and downstream from the dredge pit locations, on transects A and E, respectively. The analysis deals primarily with benthos collection results. Drift sample data are used in qualitative comparisons with benthic sample data in within-site data analysis only, because of the limitations inherent to the qualitative nature of drift sampling methods used: current velocities at drift sample sites were only grossly estimated, therefore the volume of water processed by each drift net could not be determined and thus the true relative importances of taxa in the drift at different sites and at different times could not be determined.

Control Sites

Twenty taxa were collected with PIBS from the Control sites over the full term of the project (Tables 26 and 27). Of these taxa, chironomid (Diptera) larvae are by far the most abundant, with greater than 8.5 times more individuals than oligochaetes, the second most abundant taxon collected (Table 26). The Chironomidae represent better than half the total abundance of all organisms collected at Control sites. However, as with the Dredge site discussions to follow, the interpretation of the importance of this group is limited due to the tremendous potential variation in ecological requirements between its member species. For this reason, in this section and those to follow, we must look beyond the often abundant group, Chironomidae, to other taxa for ecological interpretation of sample results.

Second to chironomid larvae, six taxa, Oligochaeta, Ceratopogonidae, *Caenis*, *Ephoron*, *Trichocorixa* and *Potamyia* share almost equal abundance, though none have very great densities (1 - 2.5 org/m^2) (Tables 26 and 30). The remaining 13 taxa are comparatively rare (Tables 26 and 27), with densities less than one organism per m^2 in all cases (Table 30).

Table 30. Densities of Common Taxa (no./m^2) as determined by PIBS samples at Control and Dredge sites, lower Kansas River, 1979-1981. Dredge site densities are calculated for upstream of the dredge pit (A), downstream of the dredge pit (B) and total for all transects combined (T).

Taxon	Control	Dredge 1			Dredge 2			Dredge 3		
		A	B	T	A	B	T	A	B	T
Oligochaeta	2.20	1.43	2.58	2.03	36.67	74.56	56.26	39.54	29.57	34.39
Stenelmis	0.08	0.95	0.43	0.68	0.24	0.11	0.17	0.11	2.36	1.28
Ceratopogonidae	1.36	1.19	1.08	1.13	1.79	3.33	2.59	0.57	2.26	1.44
Chironomidae	19.39	33.10	16.24	24.24	27.98	49.33	39.02	42.41	33.12	37.61
Simulium	0.23	0.24	0.43	0.34	-	-	-	1.49	0.64	1.06
Baetis	0.68	4.88	7.42	6.21	0.36	0.56	0.46	0.46	27.96	14.67
Centroptilum	0.15	0.24	0.11	0.17	-	0.11	0.06	0.23	-	0.11
Caenis	1.67	2.86	6.24	4.63	2.14	5.00	3.60	2.87	10.54	6.83
Hexagenia	0.30	-	-	-	2.62	4.89	3.79	1.84	-	0.89
Heptagenia	-	0.12	0.11	0.11	-	-	-	-	0.43	0.22
Stenacron	-	0.83	-	0.40	-	-	-	-	0.32	0.17
Stenonema	0.61	1.43	3.12	2.32	0.24	0.11	0.17	0.46	23.44	12.33
Isonychia	-	1.67	1.83	1.75	-	-	-	-	1.51	0.78
Pentagenia	0.30	-	0.32	0.17	0.95	1.44	1.26	1.03	7.63	4.44
Ephoron	1.44	0.36	0.97	0.68	-	0.11	0.06	-	0.86	0.44
Tricorythodes	-	0.36	0.22	0.28	-	-	-	0.11	0.97	0.56
Trichocorixa	1.14	25.95	1.50	13.11	64.76	52.67	58.45	17.82	16.13	16.94
Argia	-	0.12	-	0.06	-	-	-	0.11	0.75	0.44
Gomphus	0.53	0.24	0.43	0.34	0.60	3.33	2.01	0.68	1.08	0.83
Neoperla	-	0.71	0.64	0.68	-	0.33	0.17	-	0.86	0.44
Perlesta	-	0.60	0.32	0.45	-	-	-	-	0.54	0.28
Isoplera	-	0.48	0.64	0.56	-	0.33	0.17	0.34	1.61	1.00
Cheumatopsyche	-	3.21	1.08	2.09	-	0.67	0.34	-	1.94	1.00
Hydropsyche	0.30	8.33	80.22	46.10	0.12	12.00	6.26	1.38	57.85	30.50
Potamyia	1.59	57.86	81.94	70.51	0.48	13.22	7.07	2.87	52.26	28.39
Nectopsyche	-	0.48	0.22	0.34	0.12	0.67	0.40	0.57	0.54	0.56
Physa	-	-	-	-	-	0.56	0.29	0.11	-	0.06
Sphaeridae	-	-	-	-	0.60	0.56	0.58	-	-	-
Total densities	31.97	147.38	207.96	179.21	139.6	224.00	183.28	115.06	275.16	197.78
Total sampling effort (PIBS):	132	84	93	177	84	90	174	87	93	180

Of the six important taxa other than Chironomidae, four are depositional habitat associates (Table 28), one is an erosional habitat associate and one cannot be determined at the taxonomic level to which it was identified (Table 28). These ecotypes represent 20%, 5% and 4% of the total abundance of organisms at Control sites, respectively. The relative importances of these taxa suggests that depositional habitat is most important at Control sites, while erosional habitat is available, but to a much lesser degree. In fact, sand and some silt constitute 86.3% of the Control area sampled by PIBS (Table A2-3) and 88.1% of the total area sampled by minnow seine, while gravel and rubble are constituents of 2.3% of the area sampled by PIBS and 4.0% of the Control area sampled by minnow seine (Table 9).

Only Oligochaeta and Trichocorixa were collected every year, while all other taxa have at least one year in which they were not found (Table A2-2). Oligochaeta and Trichocorixa exhibit unstable densities within samples between years. Probably none of the taxa at Control sites are abundant enough to allow conclusive interpretation between years with the given sample size; however, totals over the three years will be useful for later comparisons between sites.

Of the 20 taxa collected by PIBS at the Control sites, nine are depositional in their habitat association, five are erosional and 10 cannot be determined at the taxonomic level to which they were identified (Tables 28, 29), representing 25%, 7% and 68% of the total abundance, respectively.

Drift samples include eight taxa not collected with PIBS (Tables 26, 27). It is difficult to explain why these taxa are not represented in the PIBS collection; probably they have low abundances and patchy spatial distributions.

Dredge Site 1

Thirty taxa were collected with PIBS from the benthos above the dredge pit at Dredge site 1 in 1979-1981, and 28 taxa from below the pit (Tables 26, 27). Of all taxa, 14 are not shared between above and below pit

locations, while 22 are shared. Of the 14 unshared taxa, 11 were very rarely encountered anywhere on the Kansas River (Table 27).

At D1A, the trichopteran genus Potamyia, an erosional habitat associate (Table 27), is the most important taxon with nearly twice the abundance of Chironomidae and over twice the abundance of Trichocorixa, the second and third most abundant taxa, respectively (Table 26). These three taxa represent nearly 80% of the total organisms collected from D1A, and each occurs in densities greater than 25 org/m^2 (Table 30). The importance of Potamyia implies that erosional habitat is important in the D1A location, and indeed, rubble as a substrate constituent was present in 53.3% of the total area sampled by PIBS (Tables A2-3, A2-4) and 48.2% of the total area sampled by minnow-seine above the pit at Dredge 1 (Tables 11 and A2-4). The relative importance of Trichocorixa, a depositional habitat associate (Table 28) implies that depositional habitat is also well represented in the D1A site. Clay, silt and sand substrates constituted 42.8% of the area sampled by PIBS (Tables A2-3, A2-4) and 48.3% of the area above Dredge 1 sampled by minnow-seine (Tables 10, A2-4).

Of the 30 taxa collected from D1A, seven are depositional habitat associates, 12 are erosional habitat associates and 11 cannot be determined at these taxonomic levels (Tables 26, 27, 28, 29). The relative importances in percent total abundance of these ecotypes are 22%, 51% and 27%, respectively.

At the D1E location, the trichopteran genera, Hydropsyche and Potamyia, both erosional habitat associates, share equal dominance (Chi Square, α=.05) in abundance among the 28 taxa collected. Each is five times greater in abundance than Chironomidae, the second important taxon. Together, Hydropsyche and Potamyia comprise 78% of the total abundance of organisms from D1E. The great numeric importance of these two genera implies the importance of erosional habitat at this location. Rubble is a constituent of the substrate of 45% of the area sampled by PIBS (Tables A2-3, A2-4), but only 9.7% of the area sampled by minnow seine (Tables 12, A2-4). This means that the relative abundances of organisms rightly indicates the importance of erosional substrates in the samples from which they were actually taken

(PIBS), but the area sampled by PIBS does not present an accurate portrayal of the relative substrate importances over the majority of the D1E site (Table A2-4). The non-random PIBS sampling procedure revealed here is a result of a peculiarity in the river channel morphology at the D1-E transect. Because of the very steep banks, deep channel and swift currents on the right side of the river at D1-E, PIBS samples could only be made effectively here from rock jetties that extended into the channel. The discrepancies encountered here between substrates sampled by PIBS and those sampled by seine cause some difficulties in making specific comparisons between sites; however, summary comparisons between sites in terms of taxonomic diversities are not affected.

Of the 28 taxa collected at D1E, 10 are depositional habitat associates, 10 erosional associates and seven undetermined with percent of total abundance values of 7%, 81% and 12%, respectively.

Dredge Site 2

Twenty-one taxa were collected by PIBS from the Dredge 2 site above the dredge pit and 27 taxa from Dredge 2 below the pit. Of the total taxa at this site, 17 are shared at the D2A and D2E locations. The four taxa unique to D2A were all rarely captured in the Kansas River (Table 27) over the three year study. Of the six taxa unique to the D2E location, none are very important in terms of abundance ($\leqq 6$) and densities ($\leqq 1$ org/m^2) (Tables 26, 27, 30).

The hemipteran genus Trichocorixa was the most abundant taxon at the D2A site, approximately 1.8 times greater in number than the Oligochaeta, which were second in importance (Table 26). The Chironomidae ranked third in numerical importance. Other than these three dominant taxa, the remaining 18 taxa contain less than 23 individuals each (Tables 26, 27) and have densities less than 3 org./m^2, and often less than 1 org./m^2 (Table 30). The clear dominance of Trichocorixa and Oligochaeta, both depositional habitat associates (Table 30) comprising 73% of the total number of organisms collected from D2A in three years and having densities of 64.8 and 36.7 org/m^2, respectively (Table 30), predicts that depositional substrates

are prevalent at the D2A location. In fact, clay, silt and sand comprise 82.1% of the area at D2A sampled by PIBS and 98.7% of the substrate area sampled by minnow-seine. Of the remaining taxa collected at this site, no erosional habitat associates occur in large abundance or density, the greatest being Potamyia, with abundance of four and density of 0.48 org/m^2. As might be expected, coarse substrates characteristic of erosional habitats have minor importance at D2A, comprising 7.2% of the area sampled by PIBS (Tables A2-3, A2-4) and 0.5% of the area sampled by minnow-seine (Table 14, A2-4). Depositional associated taxa dominate the total diversity and abundance of organisms collected at D2A also, with 10 of the 21 taxa depositional habitat associates, five erosional habitat associates and six undetermined, comprising 79%, 1% and 21% of the total abundance, respectively.

Five aquatic insect genera are represented in the drift samples but not in PIBS samples (Tables 26, 27). Of these, Trichorythodes and Chaoborus are associated with depositional habitats, Neureclipsis with erosional habitats and Perlesta and Hemerodromia are undetermined.

A similar dominance pattern among its 27 taxa occurs in the Dredge 2 site below the dredge pit as above, except that Oligochaeta and Trichocorixa are reversed in order of dominance, Oligochaeta being most dominant in abundance and density (Tables 26, 30). In addition, two erosional habitat associates, Hydropsyche and Potamyia share equal (Chi square, α=.05) moderately high abundances (Table 26) and densities (Table 30) at the D2E location. Together, these trichopteran genera represent 11.3% of the total abundance of organisms at D2E.

The importance of Oligochaeta and Trichocorixa, which together embody 57% of the total abundance, again implies, as in D2A, the importance of depositional habitat at D2E. Clay, silt and sand are substrate constituents of 96.7% of the area sampled by PIBS and 100% of the area sampled by minnow-seine (Table A2-4). Although the moderate combined importance of Hydropsyche and Potamyia suggest that erosional substrate types are likewise of some importance at D2E, coarse materials are found in the substrate of only 3.3% of the area sampled by PIBS (Tables A2-3, A2-4) and are absent

from substrate sampled by seine. Assuming sample error is minimal, this would imply that Hydropsyche and Potamyia were very densely congregated in the 3.3% PIBS area of coarse subtrate ($0.3m^2$), with a combined real density of 757 org/m^2. This is not an unreasonably high density for these organisms as the data from individual PIBS samples ($0.3m^2$) on several occasions indicate. A PIBS sample from August 1980 at D1-A transect estimated the density of Potamyia to be 447 org/m^2. Another PIBS sample from the same month at D3-E transect indicated a combined density of Potamyia and Hydropsyche of 787 org/m^2, and still another PIBS sample of the same month at D1-E estimated a combined density for these two trichopteran genera at 2767 $org./m^2$ (Table A2-8). As discussed below, the small erosional substrate patches sampled by PIBS, along with their associated taxa, were encountered primarily in 1979 and with decreasing frequency through 1980 and 1981.

Of the remaining taxa at D2-E, four depositional habitat associates, Ceratopogonidae, Caenis, Hexagenia and Gomphus form another importance level, with abundances ranging from 30 to 45 individuals and densities ranging from 3.3 to 5.0 org/m^2. Among all taxa collected at D2-E, 10 are depositional habitat associates, seven are erosional habitat associates and 10 cannot be determined at these taxonomic levels (Tables 28, 29). Respectively, these ecotypes represent 65%, 12% and 23% of the total abundance of organisms at D2E.

Three genera are present in the drift samples that are not in the PIBS samples at D2-E. All of them represent rarely captured taxa by any sampling method (Table 27). Of these taxa, two, Hyallela and Neoplea, are associates of aquatic marginal habitat with slow currents, detrital sediments and submerged vegetation (Huggins, Liecti and Ferrington, 1981). The remaining organism, Corydalus, is associated with lotic erosional habitat (Table 29).

When the between-year densities of the four dominant taxa (other than Chironomidae) are considered at the Dredge 2 site, an interesting pattern emerges (Table A2-2). Both Oligochaeta and Trichocorixa occur in 1979 in relatively low densities, 16.8 org/m^2 and 6.2 org/m^2, respectively, exceeded by or nearly equal to the densities of Hydropsyche (14.7 org/m^2) and

Potamyia (17.3 org/m^2). Substrate importances of that same year (Table A2-5) show coarse substrates to be a constituent of 13.5% of the area sampled by PIBS and fine sediments to comprise 50% of the area sampled by PIBS. Through 1980 and 1981 there is a great increase in the densities of oligochaetes and Trichocorixa and a decrease to zero in the densities of Hydropsyche and Potamyia. This trend is reflected in the decrease over time to zero of coarse sediments found in the PIBS-sampled substrates at Dredge 2 and an increase to 100% of silt (Table A2-5). Changes in substrate quality over time in Dredge 2 area sampled by minnow-seine does not reflect this trend (Table 13); fine substrates dominate at least 95% of the area in any given year. At the "microscopic" level of PIBS samples, however, the tendency is revealed at Dredge 2 to become more lentic in character over time.

Dredge Site 3

Twenty-three taxa were collected by PIBS from the Dredge 3 site above the dredge pit and 33 taxa from below the pit. Of these, 20 taxa are not shared between the two locations, while 17 are shared. Of the shared common taxa (Table 26), there is no significant difference between the number that are erosional and those that are depositional in habitat association (Chi-square, α=.05). Among unshared taxa, the distribution of depositional and erosional common taxa between above- and below-pit locations is significantly different (α=.05), with more erosional taxa present in the D3E location. While D3A and D3E have both erosional and depositional habitats, the erosional habitat is more important in D3E over the combined three year study period.

The Oligochaeta and Chironomidae share dominance in abundance (Chi square, α=.05) at the D3A location (Table 26). The second important taxon, with a little less than half the abundance of the dominant taxa, is Trichocorixa. The remaining taxa at D3A occur in relatively low abundances ($\leq$25) with densities less than 3 org/m^2 in all cases. Of the dominant taxa, Oligochaeta and Trichocorixa, both depositional habitat associates, represent 50% of the total abundance of organisms at D3A. This implies that depositional habitat is important at D3A and in fact, silt and sand are substrate constituents of 75.7% of the area sampled by PIBS and 98.8% of the

area sampled by minnow-seine (Tables A2-3, 17). Coarse erosional substrates are present at this location, but in low importance in terms of percent of total area sampled (7.0% by PIBS, 1.3% by seine).

Of all taxa collected by PIBS at D3A, nine are depositional habitat associates, four are erosional and 10 are undetermined, with percent of total abundance 56%, 5% and 39% respectively.

It is important to note that in September of 1981 two individuals of the Asian pelicypod, Corbicula manilensis, were collected from the D3A site (Tables A2-8, 27). This is the second of only two localities in Kansas at which this species has been found. Introduced into North America from Asia around 1938, C. manilensis has spread rapidly from the Gulf and southeast coastal regions of the United States throughout the southeastern United States (Huggins, Liechti and Ferrington, 1981). Kansas represents a northwestern front of the range extension of this invader species. In older and more established locations, C. manilensis can sometimes reach such great abundances that it clogs water intake valves of irrigation systems, sand and gravel production plants and pumping plants (Pennak, 1978). It also threatens the native fauna by direct competition (Huggins, Liechti and Ferrington, 1981). Shifting sand is unsuitable habitat for bivalves (Pennak, 1978), therefore it is plausible that Corbicula manilensis may be able to establish populations more readily in the Kansas River at dredge operation sites in response to the creation of large areas of suitable habitat.

Four taxa additional to those collected by PIBS at D3A were collected from the drift. All representatives of rarely encountered taxa, one, Collembola, is a marginal habitat associate, two, Chaoborus and Notonecta, are midwater predators of lentic habitats and one, Choroterpes, is an erosional habitat associate (Tables 27 and 29).

In the D3E location, the erosional substrate associates Hydropsyche and Potamyia (Table 28) share dominance (Chi-square, α=.05) being nearly two times more abundant than each of Oligochaeta, Chironomidae and Baetis, the second most abundant taxa (α=.05) (Table 26). Stenonema, an erosional

habitat associate, and Trichocorixa, a depositional habitat associate, are third and fourth in abundance, representing 8% and 6% of total abundance, respectively. The remaining taxa at D3E have abundances less than 100 each, and percent total abundance less than 4%.

The importance of Hydropsyche and Potamyia suggests that erosional habitat is important at D3E. Coarse substrates constitute 67.8% of the area sampled by PIBS and 57.1% of the area sampled by seine. The presence of Oligochaeta and Trichocorixa in moderate numerical importance implies that depositional habitat is of some importance also at D3E. Silt and sand are substrate constituents of 22.5% of the area sampled by PIBS (Tables A2-3, A2-4) and 34.8% of the area at D3E sampled by minnow-seine (Tables 18 and A2-4).

Of the 33 taxa collected by PIBS at D3E, 10 are depositional habitat associates, 12 are erosional and 11 are undetermined with percent total abundance 25%, 52% and 23%, respectively. Combined data from 1979-1981 indicate a notable shift in habitat importance relationships and associated benthic faunas between D3A and D3E, from generally depositional in nature at D3A to generally erosional at D3E (Tables A2-3, 26). However, as discussed below, the patterns in substrate composition and associated invertebrate taxa at the above-pit and below-pit locations change over time and indicate a general trend toward depositional habitat at the consolidated Dredge 3 site.

Four taxa, all representative "rare" organisms, are found in the drift of D3E and not in PIBS samples (Table 27). Chaoborus, Ephydridae and Notonecta are depositional associates, while Corydalus is erosional.

In 1979, Oligochaeta and Trichocorixa have very low abundances and densities and, combined with the six other common depositional taxa, represent 20% of the total abundance of organisms at Dredge 3 in that year. Hydropsyche and Potamyia, however, have relatively high abundances and densities, and with five other erosional taxa comprise 70% of the total abundance for 1979 (Table A2-2). Silt and sand are constituents of substrate in 36.4% of the area at Dredge 3 sampled by PIBS, while coarse materials constitute the substrate of 40.8% in 1979 (Table A2-5).

In 1980, the effects of the relocation of Dredge 3 and the subsequent relocation of Dredge 3 sampling transects (see General Site description), in which transect A crossed the 1979 dredge pit, are expressed. Oligochaeta and Trichocorixa became more important and along with six other common depositional taxa, comprise 39% of the total abundance at Dredge 3 in 1980. Erosional habitat associates became less important in 1980. Hydropsyche, Potamyia and five other erosional taxa constitute 50% of the total abundance (Table A2-2). Similarly, silt and sand as constitutents of substrate reflect an increase in importance in 1980 over 1979 with percent total area sampled by PIBS of 54.3% (Table A2-5). Coarse materials are substrate constituents of 36.2% total area sampled by PIBS at Dredge 3 in 1980.

By 1981 the trend is clear, as demonstrated by benthic invertebrate organisms and substrate composition, that depositional habitats with fine sediments are most important while coarse substrates are of lesser importance, and are generally mixed with silt except under erosional conditions. Oligochaeta and Trichocorixa, with six other depositional taxa, comprise 72% of the total abundance of common organisms collected at Dredge 3 in 1981, while Hydropsyche and Potamyia and six other erosional habitat associates comprise 17% of the total abundance.

Comparisons Between Sites: Benthos

The most striking difference between the total benthic faunas of the Control sites and the Dredge sites is taxonomic richness and abundance. Looking at all years combined, the Control sites have only 16 of the 27 Common taxa, while Dredge 1, Dredge 2 and Dredge 3 have 25, 22 and 27 of the total number of Common taxa collected over the three year study, respectively (Table A2-6). The Shannon diversity index for each site, H', which expresses taxonomic richness as well as evenness of abundance supports the initial impression that the benthic fauna at Control sites is less diverse than any of the Dredge sites (Table A2-6). However, except for Chironomidae, abundances are distributed fairly evenly at the Control sites. When the broad and uninformative group, Chironomidae, is omitted from the faunal list at all sites, the Control sites have a higher index of taxonomic diversity and evenness, H', for all years combined (Table A2-6,

H'-modified). This reflects the fact that even though fewer taxa are represented at the Control sites, importance in terms of relative abundances are evenly distributed among the different taxa. The low substrate diversity index (Table A2-7) at Control sites for three years combined does not seem to logically support the even abundance of organisms (sand, as a single-component substrate is very important). However, the associated faunal data probably reflect benthic invertebrate community response to the unstable and harsh environment created by shifting sands. No benthic organism appears to be particularly well adapted to sand substrate, but rather several taxa are probably able to survive in low numbers on the slight diversity of sand-silt mixtures and gravel and rubble patches.

The exposure of rubble substrates, the depletion of sand, and the retention of silt and its subsequent settlement in slow currents, all associated with the dredging operations on the Kansas River, are expressed in Dredge site composition of substrates sampled by PIBS (Table A2-5) and high substrate diversity (H') relative to Control sites. These greater substrate diversities at Dredge sites result in greater taxonomic richness of benthic invertebrates. As a group, the Dredge sites exhibit increased importance of silt and rubble along with their associated invertebrates, and a decreased importance of sand. In contrast to sand substrate, several organisms are highly adapted to silt or rubble substrates. This results in great abundances of certain organisms at Dredge sites. Each Dredge site, however, has conditions peculiar to it which affect the relative importance of silt or rubble in the substrate, and consequently the relative abundances of associated organisms.

At Dredge 1, the most recent of the dredging operations, sand remained a fairly important single-component substrate, for all transects combined, over the three year study (Tables A2-5, 10). The importance of silt as a single-component substrate sampled by PIBS, decreased over time, while rubble mixtures became more important. As a result, Dredge 1 has nine taxa not found at the Control sites, and, more of these are erosional habitat associates (5) than depositional habitat associates (1) (Table A2-6). In abundance also, erosional habitat associates exceed depositional taxa at Dredge 1.

At Dredge 2, retention of silt, due to return of fine materials from dredging and their subsequent settling in the slow currents of the dredge pit, is compounded by the presence of a rock jetty downstream from the site. Over time silt became predominant at this site, and substrate diversity sampled by PIBS dropped to zero by 1981 (Table A2-5). As a result, species richness declined over time while several erosional substrate associates disappeared (Table A2-2), and the diversity-evenness index (H') for Dredge 2 dropped much lower than the Control index in 1980 and 1981. The construction platform for the I-435 bridge probably contributed to siltation at the D-2 site in 1979, but siltation continued after removal of that structure in 1980. Therefore control of the river level by the Water District #1 jetty (ponding effect), coupled with dredging, best explains the extreme accumulation of silt in the D2 site.

At the Dredge 3 site, substrates became progressively more silty. However, rubble bars remained at points of erosional stream flow downstream (Table A2-5, Table 18). The resultant substrate "landscape" at Dredge 3 remained consistently more diverse than at Control sites (Table A2-5) and that diversity is reflected in taxonomic benthic invertebrate richness and abundance, as well (Table A2-2). Nevertheless, the impact on the benthic fauna of siltation at Dredge 3 is greater than that of rubble, which only occurs in patches at riffle areas. This is indicated by the increased importance of depositional habitat associates such as Oligochaeta and the decreased importance of erosional habitat associates, such as Hydropsyche and Potamyia, over time (Table A2-2). Species richness and abundances, however, will probably not drop below that of the Control sites simply because the predominant substrate at Dredge 3 is more amenable to benthic invertebrate life than the abrasive shifting sand which predominates at Control sites.

Summary Concerning Benthos

Dredge sites generally exhibit greater substrate diversity and greater benthic invertebrate taxonomic richness as compared with Control sites. These two phenomena are apparently causally related. The increased importance of silt and rubble at Dredge sites, as sand is depleted, support

depositional and erosional habitat associated invertebrates not found at the Control sites. Dredge 1 and Dredge 3 have greater substrate diversity and therefore greater taxonomic diversity than Dredge 2 which is entirely silty in substrate character. Dredge 2 represents a possible ultimate effect of long-term dredging: increased importance of silt in the channel substrates due to sand removal, stirring of the sediments and general slowing of current velocity, though these effects are exaggerated at this site by an obstruction downstream. Silt, as a single component substrate increased in importance at Dredge 2 until it monopolized the area by 1981 (Table A2-5). Concurrently, six taxa disappeared and three decreased appreciably. By 1981, Dredge 2 was lower in taxonomic diversity and evenness (H') than the Controls (Table A2-2). At the other two Dredge sites, silt increased in importance as a single component substrate and mixed with coarser materials also. At Dredge 3 the two most important erosional associates were replaced in importance by two depositional associates over time.

In general, the removal of sand by dredge operations and the exposure of rubble and subsequent settlement of silt in slow currents greatly alter the habitats available to benthic invertebrates. This results in great changes in benthic invertebrate community composition and structure at Dredge sites versus Control sites, usually involving the addition of depositional and erosional habitat associates.

9. FISHES OF THE LOWER KANSAS RIVER: REVIEW OF THE HISTORIC RECORD

Information about the fish fauna of the lower Kansas River originates with a list of species "observed at Lawrence," published in 1875 by F. H. Snow. Snow's brief note resulted from proposals for introductions of fishes, and "the propriety of enumerating the native species with which the river is already stocked." The list consists entirely of species that attain relatively large size, omitting smaller kinds that must have been present. A few of the names used by Snow are synonyms of other names in his list, and some probably represent misidentifications (based on Snow's descriptive comments and other data). Nevertheless, that brief publication establishes the indigenous occurrence of the following fishes in the lower Kansas River, as far upstream as Lawrence: lake sturgeon, shovelnose sturgeon, paddlefish, longnose gar, shortnose gar, American eel, goldeye, blue sucker, buffalofish (species indeterminable, probably three represented, the smallmouth buffalo named), carpsucker (species indeterminable, but presumably river carpsucker), shorthead redhorse, blue catfish, channel catfish, bullhead (species indeterminable, probably black bullhead), flathead catfish, sauger, several sunfishes (probably white crappie, bluegill, green sunfish, and orangespotted sunfish), and possibly white bass.

Remarks associated with various species indicate that these kinds were "common" to "very abundant": shovelnose sturgeon, goldeye, buffalo, blue catfish, channel catfish, and flathead catfish. The utility Snow ascribed to channel catfish was, interestingly, "as bait for the larger species [of catfish]." Weights of 100 to 188 pounds were reported for the flathead catfish, and 175 to 250 pounds for the blue catfish. Such large individual fish were depleted gradually in years subsequent to Snow's account. We have found no records of catfish larger than 100 pounds that were caught in the Kansas River later than 1920. The lake sturgeon was extirpated, as were a few other species recorded at or before the turn of the century by persons other than Snow; noteworthy examples are the burbot, highfin carpsucker, and silverband shiner (see Metcalf, 1966:118,142,153).

Metcalf (1966) and Cross (1967) published comprehensive accounts of fishes in the Kansas River Basin. They recorded 64 species from the lower mainstream, 59 of which are thought to be native. In 1978, a report entitled Assessment of the Aquatic Environment in Kansas, prepared by the Kansas Department of Health and Environment and the Kansas Fish and Game Commission, listed 77 species from the Kansas River Basin, including its lakes and tributaries from the junction of the Republican and Smoky Hill rivers to the mouth. Six of these species were recorded as introduced (actually 10 are). That report also estimated the average standing crop of fish in the river as 258 pounds per acre, based on samples obtained in 1976-77. Reasonably good records of the fauna exist since 1950, based on frequent collections and on observations of sport-fishing catches. Commercial netting of food-fishes ceased to provide information on the fauna when it was made illegal in the 1920's.

Presently, and for several decades past, the hook-and-line catch consists principally of carp, channel catfish, freshwater drum, and flathead catfish. Species caught in lesser numbers include white crappie, black bullhead, white bass, sauger, bluegill and green sunfish, largemouth bass, buffalo, and shovelnose sturgeon. The carp, introduced in 1880, provides the greatest poundage harvested.

Records of collections made by seining in the lower Kansas River indicate that the ten species most abundant during the 1950's were: sand shiner, red shiner, river carpsucker, carp, plains minnow, speckled chub, emerald shiner, flathead chub, fathead minnow, and channel catfish. During the 1970's, the species represented most often in collections were: red shiner, sand shiner, river carpsucker, gizzard shad, silver chub, channel catfish, emerald shiner, drum, speckled chub, and plains minnow. Changes in relative abundance of several species during the past three decades are apparent in the two ranked sets, warranting further discussion of recent faunal trends. The same three species lead both lists, and their predominance has increased. Gizzard shad are much more abundant now than formerly. The silver chub, channel catfish, and drum have advanced in rank; those species were well represented in the older collections, though not among the first ten in frequency of occurrence. The carp, plains minnow,

speckled chub, flathead chub, and fathead minnow have declined in rank. Although carp remain abundant, they were represented less consistently in seine-samples (principally as young-of-year) in the 1970's than in the 1950's. The plains minnow was far more abundant in the 1950's than subsequently, the speckled chub only slightly more so. The flathead chub, recorded in 60% of the earlier collections, has not been taken since 1959. The fathead minnow remained present in low numbers.

Recent changes in the abundance of several additional species seem apparent from the accumulated seining data, angling catches, and other evidence. Species captured in the 1950's that later decreased or disappeared are pallid sturgeon, sicklefin chub, sturgeon chub, black bullhead, and plains killifish. Species that increased during the same period (in addition to ones already cited) are skipjack herring, river shiner, bullhead minnow, quillback, white bass, largemouth bass, bluegill, white crappie, and black crappie.

As a group, the fishes that decreased share characteristics adaptive to similar habitats, as do the species comprising the group that increased. Nearly all species that decreased are small-eyed but profusely endowed with tactile and chemosensory systems. Their native ranges centered in shallow, sandy, highly turbid plains streams, where visual perception is limited. Species that have increased are relatively large-eyed but lack elaboration of tactile and chemosensory systems. They occurred more abundantly in the Ohio, Tennessee, and upper Mississippi drainages than in the Missouri basin. The five native chubs of the genus Hybopsis exemplify this relationship. The three species that are least dependent on visual perception (sicklefin chub, sturgeon chub, and flathead chub) have virtually disappeared from the lower Kansas River; none occurs eastward of the Mississippi mainstream. The silver chub (large-eyed) and speckled chub (eyes moderately large) have maintained reasonably large populations in the Kansas River; they occur widely in less turbid rivers east of the Mississippi. Other species that have increased have done so by introduction or by natural dispersal westward from their original ranges.

These changes in composition of the fauna coincide in time with 1) major variations in discharge such as flood and drought in the 1950's; 2) development of a system of impoundments that modify rates of discharge and sediment load; and 3) introductions of game and forage fishes into the new impoundments in the basin.

10. FISHES AT CONTROL AND DREDGE SITES, 1979-1981.

a) Changes in the Fish Fauna Within Sites

Control Sites

Thirty-nine species were taken (at least once) from the Control sites. Thirty-seven species were collected by seining from May 1979 to September 1981 representing 54,532 fishes (Table 31). Fifteeen species were collected by electrofishing from 1980 and 1981 combined representing 770 fishes (Table 35). Two species, the blue sucker and flathead catfish, were collected by electrofishing only.

Three species were predominant based on percentage of total numbers of fishes collected by seining. Red shiners were the most common species, comprising approximately 69% of all fishes collected during the three-year period of this study (Table 32). The sand shiner comprised about 19% and the river carpsucker about 9% of the total number of fishes collected. Mean densities (fish per 100 square meters) of the 15 most common species taken by seining from 1979 to 1980 ranged from 12.46 at transect C1A to 17.27 at C1B, 27.04 at C2A, and 15.89 at C2B (Table A3-1). The highest total densities for red shiners, sand shiners, and river carpsuckers occurred within the control sites.

Other species commonly collected by seining were the bullhead minnow, bluntnose minnow, white crappie, and white bass. These species comprised approximately 10% of the total number of fishes collected exclusive of red shiners and sand shiners from 1979 to 1981 (Table 33). Species less common included the silver chub, speckled chub, emerald shiner, fathead minnow, and bluegill sunfish.

The red shiner was the predominant species each year in seining samples, increasing from approximately 53% of the total number of fishes collected in 1979 to 71% in 1980, and 73% in 1981 (Table 32). Sand shiners decreased from approximately 34% in 1979 to about 11% in 1980, and increased to approximately 34% in 1981. River carpsuckers increased from about 10% of

Table 31. Composite tabulation of all fishes captured by seining, at all standard sampling sites (excluding "supplemental samples") for the full term of the study (1979-1981, lower Kansas River).

SITE:	C1A	C1B	C2A	C2B	D1A	D1D	D1E	D2A	D2D	D2E	D3A	D3D	D3E	Turner	Total
SPECIES:															
Shovelnose Sturgeon	1														1
Shortnose Gar		1	1	1			5	2	1		4	3	1		19
Longnose Gar				4	1	1	1	2		1		5	1		16
Skipjack Herring												2			2
Gizzard Shad		17	20	90	25	80	3	593	127	111	214	111	106	4	1501
Goldeye			1					5	3			1	4		14
Carp	1	1	1	8	1		2	1			1	4	2		22
Golden Shiner		2		1			2				1	1	1		8
Creek Chub	1		2	3	4	3	1	6	2		3	5			30
Silver Chub	3		4	13	6	8	16	15	21	194	18	2	11		311
Speckled Chub	11	1	5	4	16	12	14	1		2	6		44	4	120
Sturgeon Chub												1	2		3
Suckermouth Minnow	5	1	3	2	11		2	2		3			3		32
Emerald Shiner	1	17	30	14	12	8	37	19	45	19	805	270	583	301	2161
Redfin Shiner		1	1	1	5	1	46	1		1	1	1			59
River Shiner		1									3	1	15	9	29
Red Shiner	4037	8137	15313	10284	5203	3464	5715	3800	1205	1983	4452	2948	3600	380	70521
Sand Shiner	1751	1097	5440	2210	1731	1107	1351	968	840	1362	1517	562	601	41	20578
Plains Minnow											2	1	35	1	39
W. Silvery Minnow							1				1	3	7	9	21
Fathead Minnow		4	10	11	5	4	2	19	1	161	6	20	6		249
Bullhead Minnow	43	74	181	104	39	28	17	222	40	116	237	56	18	11	1186
Bluntnose Minnow	3	12	54	24	15	10	13	23	30	89	5	9	9		296
Central Stoneroller	1	1	4		22		3		2			8		1	42
Bigmouth Buffalo											1		2		3
Smallmouth Buffalo		1		1						1			1		4
Carpsucker*	1209	646	2101	1125	588	597	159	364	176	309	270	120	217	21	7902
Shorthead Redhorse		4	1	3		1	2				1				12
White Sucker	2														2
Black Bullhead			1			2							2		5
Channel Catfish	55	29	20	33	90	23	26	41	137	99	45	39	127	39	803
Flathead Catfish								4		1		2	1		8
Stonecat	1				12		2					20	5		40
Slender Madtom					1										1
White Bass	5	8	25	14	10	4	1	26	5	54	24	9	11		196
Largemouth Bass	1	7		1	6	1	4	7	2		10	4	2	1	46
Green Sunfish		2	2	5	2	2	1	5	4	7	6	3	11		50
Bluegill Sunfish		1	6	15	8	2	22	35	17	26	54	29	83	2	300
Longear Sunfish							1								1
Orange-spotted Sunfish		11	1	4	2			16	30	31	24	9	7		135
White Crappie	2	15	32	44	6	5	10	11	15	11	19	24	49	2	245
Black Crappie							2								2
Sauger		2	3						1			1			7
Walleye		1													1
Logperch											1				1
Orange-throated Darter					1			1					7		9
Freshwater Drum		12	7	12	1	11	18	42	5	81	67	10	22	9	297
TOTAL:	7133	10106	23269	14031	7823	5374	7479	6231	2709	4662	7798	4284	5596	835	107330
EFFORT (m^2):	5198	4166	5731	5871	4343	3511	2122	6475	2960	2855	5804	3993	3610	540**	

* River Carpsucker and Quillback, not all of which were distinguished in the field.
** Estimate of sampled area.

Table 32. Fishes captured by seining at Control sites, Kansas River. The fifteen species listed represented 99% of the total catch using seines.

	1979		1980		1981		TOTAL ALL YEARS	
Total No. Fish For Year	6923		26912		20697		54532	
SPECIES:	No.	% of total	No.	% of total	No.	% of total	No.	% of total
Gizzard Shad	7	0.10	101	0.38	19	0.09	127	0.23
Silver Chub	1	0.01	14	0.05	13	0.04	28	0.05
Speckled Chub	10	0.14	10	0.04	2	0.01	22	0.04
Emerald Shiner	4	0.06	54	0.20	4	0.02	62	0.11
Red Shiner	3689	53.29	19069	70.86	15014	72.54	37772	69.27
Sand Shiner	2322	33.54	2969	11.03	5206	25.15	10497	19.25
Fathead Minnow	7	0.10	17	0.06	1	0.01	25	0.05
Bullhead Minnow	3	0.04	277	1.03	122	0.59	402	0.74
Bluntnose Minnow	32	0.46	61	0.23	2	0.01	95	0.17
River Carpsucker	670	9.68	4168	15.49	243	1.17	5081	9.32
Channel Catfish	74	1.07	34	0.13	29	0.14	137	0.25
White Bass	20	0.29	28	0.10	5	0.02	53	0.10
Bluegill Sunfish	5	0.07	10	0.04	7	0.03	22	0.04
White Crappie	22	0.32	47	0.17	24	0.12	93	0.17
Freshwater Drum	17	0.25	12	0.04	2	0.01	31	0.06
SHANNON DIVERSITY INDEX:								
H'		1.09		0.91		0.70		0.91
SPECIES EQUIVALENCY		2.97		2.50		2.01		2.50

Table 33. Species most common in seine samples from Control sites, lower Kansas River (exclusive of Red Shiners and Sand Shiners).

	1979		1980		1981		TOTAL ALL YEARS	
Total No. Fish For Year	912		4874		477		6263	
SPECIES:	No.	% of total	No.	% of total	No.	% of total	No.	% of total
Gizzard Shad	7	0.77	101	2.07	19	3.98	127	2.03
Silver Chub	1	0.11	14	0.29	13	2.73	28	0.45
Speckled Chub	10	1.10	10	0.21	2	0.42	22	0.35
Emerald Shiner	4	0.44	54	1.11	4	0.84	62	0.99
Fathead Minnow	7	0.77	17	0.35	1	0.21	25	0.40
Bullhead Minnow	3	0.33	277	5.68	122	25.58	402	6.42
Bluntnose Minnow	32	3.51	61	1.25	2	0.42	95	1.52
River Carpsucker	670	73.46	4168	85.51	243	50.94	5081	81.13
Channel Catfish	74	8.11	34	0.70	29	6.08	137	2.19
White Bass	20	2.19	28	0.57	5	1.05	53	0.85
Bluegill Sunfish	5	0.55	10	0.21	7	1.47	22	0.35
White Crappie	22	2.41	47	0.96	24	5.03	93	1.48
Freshwater Drum	17	1.86	12	0.25	2	0.42	31	0.49

Table 34. Electrofishing summary for 1979 through 1981. Numerals indicate numbers of fish caught using this method. A-B and D-E indicate sampling locations, along shore on both sides of the channel between these transects.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	1.0	-	4.0	3.0	2.0	1.0	-	-	11.0
Shortnose Gar	2.0	4.0	-	1.0	1.0	1.0	1.0	7.0	1.0	18.0
Gizzard Shad	18.0	58.0	10.0	22.0	279.0	73.0	85.0	58.0	99.0	702.0
Skipjack Herring	-	-	-	-	-	-	-	1.0	1.0	2.0
Goldeye	2.0	-	-	1.0	2.0	1.0	4.0	3.0	11.0	24.0
Common Carp	30.0	20.0	7.0	15.0	7.0	13.0	10.0	40.0	34.0	176.0
Blue Sucker	1.0	1.0	-	-	-	-	-	-	-	2.0
Bigmouth Buffalo	-	-	-	-	1.0	-	1.0	-	1.0	3.0
Smallmouth Buffalo	-	-	-	-	-	-	-	1.0	1.0	2.0
Shorthead Redhorse	-	-	1.0	2.0	1.0	1.0	6.0	5.0	15.0	31.0
River Carpsucker	299.0	77.0	33.0	52.0	52.0	31.0	41.0	70.0	70.0	725.0
Black Bullhead	1.0	2.0	-	-	-	-	1.0	-	-	4.0
Channel Catfish	101.0	69.0	12.0	12.0	11.0	5.0	3.0	9.0	31.0	253.0
Flathead Catfish	5.0	8.0	6.0	12.0	-	2.0	3.0	9.0	26.0	71.0
White Bass	4.0	6.0	-	2.0	7.0	6.0	14.0	9.0	14.0	62.0
Green Sunfish	-	1.0	-	2.0	-	1.0	1.0	-	7.0	12.0
Bluegill Sunfish	2.0	1.0	-	10.0	2.0	5.0	-	1.0	10.0	31.0
O.-spotted Sunfish	-	-	-	-	-	2.0	-	-	-	2.0
Longear Sunfish	-	-	-	-	-	-	-	1.0	-	1.0
Largemouth Bass	-	-	-	2.0	-	-	-	-	3.0	5.0
White Crappie	2.0	-	1.0	5.0	17.0	2.0	15.0	3.0	12.0	57.0
Black Crappie	-	-	-	-	-	1.0	2.0	2.0	7.0	12.0
Sauger	-	-	-	-	-	-	-	6.0	5.0	11.0
Freshwater Drum	29.0	26.0	18.0	22.0	26.0	8.0	62.0	105.0	57.0	353.0
Total Fish	496.0	274.0	88.0	164.0	409.0	154.0	250.0	329.0	405.0	2569.0

Table 35. Electrofishing summary for 1980 through 1981. Numerals indicate numbers of fish caught using this method. A-B and D-E indicate sampling locations, along shore on both sides of the channel between these transects.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E	Site	
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	1.0	-	3.0	3.0	2.0	-	-	-	9.0
Shortnose Gar	2.0	4.0	-	-	1.0	1.0	-	2.0	1.0	11.0
Gizzard Shad	18.0	58.0	10.0	22.0	279.0	56.0	85.0	39.0	99.0	666.0
Skipjack Herring	-	-	-	-	-	-	-	-	1.0	1.0
Goldeye	2.0	-	-	1.0	2.0	-	4.0	2.0	11.0	22.0
Common Carp	30.0	20.0	7.0	13.0	7.0	12.0	10.0	26.0	32.0	157.0
Blue Sucker	1.0	1.0	-	-	-	-	-	-	-	2.0
Bigmouth Buffalo	-	-	-	-	1.0	-	1.0	-	1.0	3.0
Smallmouth Buffalo	-	-	-	-	-	-	-	1.0	1.0	2.0
Shorthead Redhorse	-	-	1.0	2.0	1.0	1.0	6.0	5.0	15.0	31.0
River Carpsucker	299.0	77.0	33.0	48.0	50.0	29.0	41.0	59.0	63.0	699.0
Black Bullhead	1.0	2.0	-	-	-	-	1.0	-	-	4.0
Channel Catfish	101.0	69.0	12.0	12.0	9.0	5.0	2.0	9.0	31.0	250.0
Flathead Catfish	5.0	8.0	6.0	12.0	-	2.0	3.0	8.0	26.0	70.0
White Bass	4.0	6.0	-	2.0	7.0	6.0	14.0	9.0	12.0	60.0
Green Sunfish	-	1.0	-	2.0	-	1.0	1.0	-	7.0	12.0
Bluegill Sunfish	2.0	1.0	-	10.0	2.0	5.0	-	1.0	10.0	31.0
O.-spotted Sunfish	-	-	-	-	-	2.0	-	-	-	2.0
Longear Sunfish	-	-	-	-	-	-	-	1.0	-	1.0
Largemouth Bass	-	-	-	2.0	-	-	-	-	3.0	5.0
White Crappie	2.0	-	1.0	5.0	17.0	1.0	15.0	3.0	12.0	56.0
Black Crappie	-	-	-	-	-	1.0	2.0	2.0	7.0	12.0
Sauger	-	-	-	-	-	-	-	4.0	5.0	9.0
Freshwater Drum	29.0	26.0	18.0	18.0	24.0	8.0	56.0	98.0	55.0	332.0
Total Fish	496.0	274.0	88.0	152.0	403.0	132.0	241.0	269.0	392.0	2447.0
Fish/1000 m	157.5	79.4	63.5	89.4	123.1	35.9	68.9	97.1	176.6	97.4
Elec. Eft. (meters)	3150.0	3450.0	1385.0	1700.0	3275.0	3675.0	3500.0	2770.0	2220.0	25125.0

all fishes collected in 1979 to approximately 15% in 1980, and decreased to about 1% in 1981. The bullhead minnow, a recent introduction in the lower Kansas River, increased in abundance each year. In 1979, this species comprised less than 1% of all fishes collected exclusive of red shiners and sand shiners (Table 33). Approximately 26% of the fishes collected within the control sites in 1981 were bullhead minnows.

Several less common species which increased in relative abundance over the three-year period were gizzard shad, silver chub, and white crappie. The speckled chub, fathead minnow, bluntnose minnow, and freshwater drum decreased relative to other species from 1979 to 1981.

River carpsuckers, channel catfish, gizzard shad, carp, and frshwater drum were the most common species taken by electrofishing in 1980 and 1981 combined (Table 35). The density of river carpsuckers was about 57 fish per 1000 meters, channel catfish about 26, gizzard shad about 12, carp about eight and freshwater drum approximately eight.

In 1980, river carpsuckers accounted for approximately 24% of all fishes collected per 1000 meters electrofishing at Control 1, and about 27% at Control 2 (Table A4-5). In 1981, this species accounted for about 70% of all fishes at Control 1, and approximately 30% at Control 2 (Table A4-9). Channel catfish comprised about 7% of all fishes collected per 1000 meters electrofishing at Control 1 in 1980, and approximately 2% at Control 2 (Table A4-5). In 1981, this species comprised about 24% of all fishes at Control 1, and about 47% at Control 2 (Table A4-9). Gizzard shad accounted for approximately 14% of all fishes collected per 1000 meters electrofishing at Control 1 in 1980, and about 42% at Control 2 (Table A4-5). In 1981, this species comprised approximately 1% of all fishes at Control 1, and nearly 3% at Control 2 (Table A4-9).

Young-of-year of 14 species were collected by seining in June, July and August of 1979. These included creek chub, silver chub, suckermouth minnow, red shiner, sand shiner, fathead minnow, bluntnose minnow, central stoneroller, river carpsucker, white sucker, channel catfish, largemouth bass, white crappie, and freshwater drum. Five species were collected in

June, seven species in July, and three species in August. Young of three species were collected at transect C1A, six species at C1B, ten species at C2A, and three species at C2B. In 1980, young-of-year representing 15 species were collected by seining in May, June, July, and August. These included longnose gar, carp, creek shub, silver chub, speckled chub, suckermouth minnow, red shiner, sand shiner, fathead minnow, bullhead minnow, bluntnose minnow, river carpsucker, white bass, bluegill sunfish, and white crappie. One species was collected in May, 12 species in June, six species in July, and one species in August. Young of three species were collected from transect C1A, five species from C1B, four species from C2A, and 12 species from C2B. In 1981, young-of-year representing seven species were collected by seining in July. These included silver chub, suckermouth minnow, red shiner, channel catfish, green sunfish, bluegill sunfish, and white crappie. Five species were collected at transect C2A, and three species at C2B.

Dredge Site 1

Thirty-six species were taken (at least once) in Dredge site 1. Thirty-four species were collected by seining from May 1979 to September 1981 representing 21,563 fishes (Table 31). Fourteen species were collected by electrofishing from 1980 and 1981, comprising 240 fishes (Table 35). Two species, goldeye and flathead catfish, were collected by electrofishing only.

Three species were predominant based on percentage of total numbers of fishes collected by seining. Red shiners were the most common species, comprising 67% of all fishes collected during the three-year period of this study (Table 36). The sand shiner comprised about 20% and the river carpsucker about 6% of the total number of fishes collected. Mean densities (fish per 100 square meters) of the 15 most common species taken by seining from 1979 to 1981 ranged from 11.91 at transect D1A to 10.18 at D1D, and 23.26 at D1E (Table A3-1). The mean density value for transect D1E reflects the high total densities of red shiners and sand shiners at this transect.

Table 36. Fishes captured by seining at Dredge 1 site, Kansas River. The fifteen species listed represented 96 ± 3% of the total catch using seines.

	1979		1980		1981		TOTAL ALL YEARS	
Total No. Fish For Year	3417		10317		7829		21563	
SPECIES:	No.	% of total	No.	% of total	No.	% of total	No.	% of total
Gizzard Shad	3	0.09	139	1.35	---	---	142	0.66
Silver Chub	14	0.41	16	0.16	---	---	30	0.14
Speckled Chub	5	0.15	37	0.36	---	---	42	0.19
Emerald Shiner	2	0.06	40	0.39	15	0.19	57	0.26
Red Shiner	2520	73.75	6355	61.60	5570	71.15	14445	66.99
Sand Shiner	436	12.76	1887	18.29	1883	24.05	4206	19.51
Fathead Minnow	6	0.18	4	0.04	1	0.01	11	0.05
Bullhead Minnow	1	0.03	62	0.60	20	0.26	83	0.38
Bluntnose Minnow	16	0.47	29	0.28	1	0.01	46	0.21
River Carpsucker	87	2.55	1087	10.54	205	2.62	1379	6.40
Channel Catfish	51	1.49	89	0.86	64	0.82	204	0.95
White Bass	2	0.06	31	0.30	1	0.01	34	0.16
Bluegill Sunfish	18	0.53	32	0.31	7	0.09	57	0.26
White Crappie	5	0.15	450	4.36	7	0.09	462	2.14
Freshwater Drum	27	0.79	10	0.10	2	0.03	39	0.18
SHANNON DIVERSITY INDEX:								
H'		0.81		1.23		0.76		1.03
SPECIES EQUIVALENCY		2.24		3.41		2.15		2.81

Table 37. Species most common in seine samples from Dredge 1 site, lower Kansas River (exclusive of Red Shiners and Sand Shiners).

	1979		1980		1981		TOTAL ALL YEARS	
Total No. Fish For Year	461		2075		376		2912	
SPECIES:	No.	% of total	No.	% of total	No.	% of total	No.	% of total
Gizzard Shad	3	0.65	139	6.70	-	-	142	4.88
Silver Chub	14	3.04	16	0.77	-	-	30	1.03
Speckled Chub	5	1.08	37	1.78	-	-	42	1.44
Emerald Shiner	2	0.43	40	1.93	15	3.99	57	1.96
Fathead Minnow	6	1.30	4	0.19	1	0.27	11	0.38
Bullhead Minnow	1	0.22	62	2.99	20	5.32	83	2.85
Bluntnose Minnow	16	3.47	29	1.40	1	0.27	46	1.58
River Carpsucker	87	18.87	1087	52.39	205	54.52	1379	47.36
Channel Catfish	51	11.06	89	4.29	64	17.02	204	7.01
White Bass	2	0.43	31	1.49	1	0.27	34	1.17
Bluegill Sunfish	18	3.90	32	1.54	7	1.86	57	1.96
White Crappie	5	1.08	450	21.69	7	1.86	462	15.87
Freshwater Drum	27	5.86	10	0.48	2	0.53	39	1.34

Other species commonly taken by seining within Dredge 1 site were the white crappie, channel catfish, gizzard shad, and bullhead minnow. These species comprised approximately 31% of all fishes collected exclusive of red shiners and sand shiners during the three-year term (Table 37).

The red shiner was the predominant species each year in seining samples, decreasing from about 74% of all fishes collected in 1979 to approximately 62% in 1980, increasing to about 71% in 1981 (Table 36). Sand shiners increased each year, from nearly 13% in 1979 to 24% in 1981. River carpsuckers increased from 3% of all fishes collected by seining in 1979 to approximately 11% in 1980, and decreased to about 3% in 1981. White crappie increased from about 1% of all fishes collected seining exclusive of red shiners and sand shiners in 1979 to nearly 22% in 1980, and decreased to about 2% in 1981 (Table 37). The significant increase noted for 1980 is attributable to one collection made in April near the mouth of a small tributary entering the river at transect D1E, in which 442 crappie were taken.

The bullhead minnow increased each year, from less than 1% of all fishes collected by seining in 1979 exclusive of red shiners and sand shiners to about 3% in 1980, and approximately 5% in 1981 (Table 37). Emerald shiners increased each year, from less than 1% of all fishes collected seining in 1979 to 4% in 1981. The percentage composition of freshwater drum and fathead minnows diminished each year. Three species, gizzard shad, silver chub, and speckled chub, were not collected during 1981 at Dredge 1.

River carpsuckers, freshwater drum, channel catfish, and gizzard shad were the most common species taken by electrofishing in 1980 and 1981 combined (Table 35). The density of river carpsuckers was about 26 fish per 1000 meters, freshwater drum about 12, channel catfish about eight, and gizzard shad approximately 10. The highest densities of flathead catfish and bluegill sunfish for primary sites occurred in Dredge site 1 (Table 38).

In 1980, river carpsuckers accounted for 33% of all fishes collected per 1000 meters electrofishing upstream from Dredge 1, and about 29%

Table 38. Electrofishing summary for 1980 through 1981. Numerals indicate numbers of fish caught per 1000 meters of electrofishing effort. A-B and D-E indicate sampling locations, along shore on both sides of the channel between these transects.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E	Site	
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	0.3	-	1.8	0.9	0.5	-	-	-	0.4
Shortnose Gar	0.6	1.2	-	-	0.3	0.3	-	0.7	0.5	0.4
Gizzard Shad	5.7	16.8	7.2	12.9	85.2	15.2	24.3	14.1	44.6	26.5
Skipjack Herring	-	-	-	-	-	-	-	-	0.5	<0.1
Goldeye	0.6	-	-	0.6	0.6	-	1.1	0.7	5.0	0.9
Common Carp	9.5	5.8	5.1	7.6	2.1	3.3	2.9	9.4	14.4	6.2
Blue Sucker	0.3	0.3	-	-	-	-	-	-	-	0.1
Bigmouth Buffalo	-	-	-	-	0.3	-	0.3	-	0.5	0.1
Smallmouth Buffalo	-	-	-	-	-	-	-	0.4	0.5	0.1
Shorthead Redhorse	-	-	0.7	1.2	0.3	0.3	1.7	1.8	6.8	1.2
River Carpsucker	94.9	22.3	23.8	28.2	15.3	7.9	11.7	21.3	28.4	27.8
Black Bullhead	0.3	0.6	-	-	-	-	0.3	-	-	0.2
Channel Catfish	32.1	20.0	8.7	7.1	2.7	1.4	0.6	3.2	14.0	10.0
Flathead Catfish	1.6	2.3	4.3	7.1	-	0.5	0.9	2.9	11.7	2.8
White Bass	1.3	1.7	-	1.2	2.1	1.6	4.0	3.2	5.4	2.4
Green Sunfish	-	0.3	-	1.2	-	0.3	0.3	-	3.2	0.5
Bluegill Sunfish	0.6	0.3	-	5.9	0.6	1.4	-	0.4	4.5	1.2
O.-spotted Sunfish	-	-	-	-	-	0.5	-	-	-	0.1
Longear Sunfish	-	-	-	-	-	-	-	0.4	-	<0.1
Largemouth Bass	-	-	-	1.2	-	-	-	-	1.4	0.2
White Crappie	0.6	-	0.7	2.9	5.2	0.3	4.3	1.1	5.4	2.2
Black Crappie	-	-	-	-	-	0.3	0.6	0.7	3.2	0.5
Sauger	-	-	-	-	-	-	-	1.4	2.3	0.4
Freshwater Drum	9.2	7.5	13.0	10.6	7.3	2.2	16.0	35.4	24.8	13.2
Total Fish	496.0	274.0	88.0	152.0	403.0	132.0	241.0	269.0	392.0	2447.0
Fish/1000 m	157.5	79.4	63.5	89.4	123.1	35.9	68.9	97.1	176.6	97.4
Elec. Eft. (meters)	3150.0	3450.0	1385.0	1700.0	3275.0	3675.0	3500.0	2770.0	2220.0	25125.0

Table 39. Electrofishing summary for 1980 through 1981. The distribution of each species across sites is shown as a percentage of the total number of that species caught (per 1000 meters). A-B and D-E indicate sampling locations, along shore on both sides of the channel between these transects.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E	Site	(%)
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	8.6	-	51.4	25.7	14.3	-	-	-	100.0
Shortnose Gar	16.7	33.3	-	-	8.3	8.3	-	19.4	13.9	100.0
Gizzard Shad	2.5	7.4	3.2	5.7	37.7	6.7	10.8	6.2	19.7	100.0
Skipjack Herring	-	-	-	-	-	-	-	-	100.0	100.0
Goldeye	7.0	-	-	7.0	7.0	-	12.8	8.1	58.1	100.0
Common Carp	15.8	9.7	8.5	12.6	3.5	5.5	4.8	15.6	24.0	100.0
Blue Sucker	50.0	50.0	-	-	-	-	-	-	-	100.0
Bigmouth Buffalo	-	-	-	-	27.3	-	27.3	-	45.4	100.0
Smallmouth Buffalo	-	-	-	-	-	-	-	44.4	55.5	100.0
Shorthead Redhorse	-	-	5.5	9.4	2.3	2.3	13.3	14.1	53.1	100.0
River Carpsucker	37.4	8.8	9.4	11.1	6.0	3.1	4.6	8.4	11.2	100.0
Black Bullhead	25.0	50.0	-	-	-	-	25.0	-	-	100.0
Channel Catfish	35.7	22.3	9.7	7.9	3.0	1.6	0.7	3.6	15.6	100.0
Flathead Catfish	5.1	7.3	13.7	22.7	-	1.6	2.9	9.3	37.4	100.0
White Bass	6.7	8.7	-	6.2	10.8	8.2	20.5	16.4	27.7	100.0
Green Sunfish	-	5.7	-	22.6	-	5.7	5.7	-	60.4	100.0
Bluegill Sunfish	4.4	2.2	-	43.1	4.4	10.2	-	2.9	32.8	100.0
O.-spotted Sunfish	-	-	-	-	-	100.0	-	-	-	100.0
Longear Sunfish	-	-	-	-	-	-	-	100.0	-	100.0
Largemouth Bass	-	-	-	46.2	-	-	-	-	53.8	100.0
White Crappie	2.9	-	3.4	14.1	25.4	1.5	21.0	5.4	26.3	100.0
Black Crappie	-	-	-	-	-	6.3	12.5	14.6	66.7	100.0
Sauger	-	-	-	-	-	-	-	37.8	62.2	100.0
Freshwater Drum	7.3	6.0	10.3	8.4	5.8	1.7	12.7	28.1	19.7	100.0
Total Fish	496.0	274.0	88.0	152.0	403.0	132.0	241.0	269.0	392.0	2447.0
Fish/1000 m	17.7	8.9	7.1	10.0	13.8	4.0	7.7	10.9	19.8	100.0
Elec. Eft. (meters)	3150.0	3450.0	1385.0	1700.0	3275.0	3675.0	3500.0	2770.0	2220.0	25125.0

Table 40. Electrofishing summary for 1980 through 1981. Relative species composition at each site is shown as a percentage of all fish caught (per 1000 meters) at that site. A-B and D-E indicate sampling locations, along shore on both sides of the channel between these transects.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E	Site	
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	0.4	-	2.0	0.7	1.4	-	-	-	0.4
Shortnose Gar	0.4	1.5	-	-	0.2	0.8	-	0.7	0.3	0.4
Gizzard Shad	3.6	21.2	11.3	14.4	69.2	42.3	35.3	14.5	25.3	27.2
Skipjack Herring	-	-	-	-	-	-	-	-	0.3	0.1
Goldeye	0.4	-	-	0.7	0.5	-	1.6	0.7	2.8	0.9
Common Carp	6.0	7.3	8.0	8.5	1.7	9.2	4.2	9.7	8.2	6.4
Blue Sucker	0.2	0.4	-	-	-	-	-	-	-	0.1
Bigmouth Buffalo	-	-	-	-	0.2	-	0.4	-	0.3	0.1
Smallmouth Buffalo	-	-	-	-	-	-	-	0.4	0.3	0.1
Shorthead Redhorse	-	-	1.1	1.3	0.2	0.8	2.5	1.9	3.9	1.2
River Carpsucker	60.3	28.1	37.5	31.5	12.4	22.0	17.0	21.9	16.1	28.5
Black Bullhead	0.2	0.8	-	-	-	-	0.4	-	-	0.2
Channel Catfish	20.4	25.2	13.7	7.9	2.2	3.9	0.9	3.3	7.9	10.3
Flathead Catfish	1.0	2.9	6.8	7.9	-	1.4	1.3	3.0	6.6	2.9
White Bass	0.8	2.1	-	1.3	1.7	4.5	5.8	3.3	3.1	2.5
Green Sunfish	-	0.4	-	1.3	-	0.8	0.4	-	1.8	0.5
Bluegill Sunfish	0.4	0.4	-	6.6	0.5	3.9	-	0.4	2.5	1.2
O.-spotted Sunfish	-	-	-	-	-	1.4	-	-	-	0.1
Longear Sunfish	-	-	-	-	-	-	-	0.4	-	0.1
Largemouth Bass	-	-	-	1.3	-	-	-	-	0.8	0.2
White Crappie	0.4	-	1.1	3.2	4.2	0.8	6.2	1.1	3.1	2.3
Black Crappie	-	-	-	-	-	0.8	0.9	0.7	1.8	0.5
Sauger	-	-	-	-	-	-	-	1.4	1.3	0.4
Freshwater Drum	5.8	9.4	20.5	11.9	5.9	6.1	23.2	36.5	14.0	13.6
Total Fish	496.0	274.0	88.0	152.0	403.0	132.0	241.0	269.0	392.0	2447.0
Fish/1000 m (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Elec. Eft. (meters)	3150.0	3450.0	1385.0	1700.0	3275.0	3675.0	3500.0	2770.0	2220.0	25125.0

downstream (Table A4-5). In 1981, this species accounted for about 41% of all fishes above the dredge, and approximately 33% below (Table A4-9). Freshwater drum comprised about 19% of all fishes collected per 1000 meters electrofishing above the dredge in 1980, and about 12% below (Table A4-5). In 1981, this species comprised approximately 22% of all fishes above the dredge, and about 12% below (Table A4-9). Gizzard shad accounted for about 12% of all fishes collected electrofishing above the dredge in 1980, and approximately 12% below (Table A4-5). In 1981, this species comprised nearly 10% of all fishes above the dredge, and about 21% below (Table A4-9). Channel catfish comprised about 2% of all fishes collected per 1000 meters electrofishing above the dredge in 1980, and were not seined below (Table A4-5). In 1981, this species comprised nearly 24% of all fishes above the dredge, and about 14% below (Table A4-9).

Carp were common in electrofishing samples in 1980, representing nearly 17% of all fishes collected per 1000 meters upstream from the dredge, and about 20% downstream (Table A4-5). No carp were taken by electrofishing in 1981 (Table A4-9). In 1980, white crappie accounted for about 2% and 3% of all fishes collected per 1000 meters electrofishing above and below Dredge 1, respectively (Table A4-5). No white crappie were taken by electrofishing above the dredge in 1981, but comprised approximately 3% of all fishes below (Table A4-9).

Young-of-year of 11 species were collected by seining in May, July, and August of 1979. These included carp, speckled chub, red shiner, bluntnose minnow, river carpsucker, shorthead redhorse, channel catfish, largemouth bass, bluegill sunfish, and freshwater drum. One species was collected in May, nine species in July, and one species in August. Young of five species were collected from transect D1A, one species from D1D, and six species from D1E. In 1980, young-of-year representing ten species were collected by seining in May, June, July, and August. These included gizzard shad, speckled chub, suckermouth minnow, stoneroller, river carpsucker, and green sunfish. One species was collected in May, eight species in June, 15 species in July, and one species in August. Young of five species were collected at transect D1A, three species at D1D, and six species at D1E.

Dredge Site 2

Thirty-two species were taken (at least once) in Dredge site 2. Twenty-nine species were collected by seining from May 1979 to September 1981, representing 16,205 fishes (Table 31). Seventeen species were collected by electrofishing in 1980 and 1981, comprising 535 fishes (Table 35). Thirteen species were taken by trammel netting in 1980 and 1981, representing 81 fishes (Table 43). Two species, bigmouth buffalo and shorthead redhorse, were collected by electrofishing and trammel netting only. Black crappie were taken by electrofishing only. One shovelnose sturgeon was collected by trammel netting.

Four species were predominant based on percentage of total numbers of fishes collected by seining. Red shiners were the most common species, comprising nearly 53% of all fishes collected during the three-year period of this study (Table 41). The sand shiner comprised about 24%, the river carpsucker about 6%, and the gizzard shad approximately 5% of the total number of fishes collected. Mean densities (fish per 100 square meters) of the 15 most common species taken by seining from 1979 to 1981 ranged from 6.36 at transect D2A to 6.43 at D2D, and 10.78 at D2E (Table A3-1).

Other species commonly taken by seining within Dredge site 2 were channel catfish, bullhead minnow, fathead minnow, bluntnose minnow, silver chub, and freshwater drum. These species comprised approximately 36% of all fishes collected exclusive of red shiners and sand shiners during the three-year term (Table 42). The highest total densities (fish per 100 square meters) of these species occurred within Dredge 2 site (Table A3-1).

The red shiner was the predominant species each year in seining samples, decreasing from about 56% of all fishes collected in 1979 to approximately 49% in 1980, increasing to about 79% in 1981 (Table 41). Sand shiners increased from about 15% of all fishes collected in 1979 to nearly 27% in 1980, and decreased to approximately 8% in 1981. River carpsuckers decreased each year, from about 7% in 1979 to approximately 4% in 1981. Gizzard shad increased from less than 1% of all fishes in 1979 to about 7% in 1980. No gizzard shad were seined in 1981.

Channel catfish decreased from nearly 42% of the fishes collected by seining, exclusive of red shiners and sand shiners, in 1979 to less than 1% in 1980, and increased to about 5% in 1981 (Table 42). Bullhead minnows increased each year, from less than 1% of fishes seined in 1979 to about 33% in 1981. Fathead minnows and bluntnose minnows increased from 1979 to 1980, but were not collected in 1981. Silver chubs decreased each year, from approximately 8% of all fishes collected exclusive of red shiners and sand shiners to about 3% in 1981. White bass and freshwater drum decreased from 1979 to 1980, and were absent from seine samples.

Gizzard shad, river carpsuckers, freshwater drum, carp, and white crappie were the most common species taken by electrofishing in 1980 and 1981 combined (Table 35). The density of gizzard shad was about 48 fish per 1000 meters, river carpsuckers about 11, freshwater drum about five, carp about three, and white crappie approximately three. The highest density of gizzard shad for primary sites occurred in Dredge site 2 (Table 38).

In 1980, river carpsuckers accounted for approximately 8% of all fishes collected per 1000 meters electrofishing upstream from Dredge 2, and about 9% downstream (Table A4-5). In 1981, this species accounted for about 33% of all fishes above the dredge, and approximately 34% below (Table A4-9). Gizzard shad comprised about 81% of all fishes collected per 1000 meters electrofishing above the dredge in 1980, and about 66% below (Table A4-5). In 1981, this species accounted for approximately 23% of all fishes above the dredge, and about 21% below (Table A4-9).

White bass were common in electrofishing samples in 1980, representing about 2% of all fishes collected per 1000 meters upstream from the dredge, and approximately 6% downstream (Table A4-5). In 1981, white bass were not collected above the dredge, but comprised 3% of all fishes collected per 1000 meters below (Table A4-9). Channel catfish represented about 1% of all fishes collected per 1000 meters above the dredge in 1980, and 3% below (Table A4-5). In 1981, channel catfish comprised nearly 9% of all fishes per 1000 meters above the dredge, and about 5% below (Table A4-9).

Table 41. Fishes captured by seining at Dredge 2 site, Kansas River. The fifteen species listed represented 99 ± 1% of the total catch using seines.

	1979		1980		1981		TOTAL ALL YEARS	
Total No. Fish For Year	2179		12554		1472		16205	
SPECIES:	No.	% of total	No.	% of total	No.	% of total	No.	% of total
Gizzard Shad	19	0.87	827	6.59	---	---	846	5.22
Silver Chub	48	2.20	176	1.40	7	0.48	231	1.43
Speckled Chub	1	0.05	2	0.02	---	---	3	0.02
Emerald Shiner	4	0.18	78	0.62	7	0.48	89	0.55
Red Shiner	1218	55.90	6188	49.29	1156	78.53	8562	52.84
Sand Shiner	336	15.42	3393	27.03	111	7.54	3840	23.70
Fathead Minnow	20	0.92	161	1.28	---	---	181	1.12
Bullhead Minnow	3	0.14	321	2.56	68	4.62	392	2.42
Bluntnose Minnow	13	0.60	130	1.04	---	---	143	0.88
River Carpsucker	163	7.48	778	6.20	63	4.28	1004	6.20
Channel Catfish	260	11.93	11	0.09	11	0.75	282	1.74
White Bass	45	2.07	68	0.54	---	---	113	0.70
Bluegill Sunfish	5	0.23	62	0.49	13	0.88	80	0.49
White Crappie	12	0.55	33	0.26	7	0.48	52	0.32
Freshwater Drum	25	1.15	110	0.88	---	---	135	0.83
SHANNON DIVERSITY INDEX:								
H'		1.46		1.46		0.82		1.46
SPECIES EQUIVALENCY		4.30		4.31		2.26		4.34

Table 42. Species most common in seine samples from Dredge 2 site, lower Kansas River (exclusive of Red Shiners and Sand Shiners).

	1979		1980		1981		TOTAL ALL YEARS	
Total No. Fish For Year	625		2973		205		3803	
SPECIES:	No.	% of total	No.	% of total	No.	% of total	No.	% of total
Gizzard Shad	19	3.04	827	27.82	-	-	846	22.25
Silver Chub	48	7.68	176	5.92	7	3.41	231	6.07
Speckled Chub	1	0.16	2	0.07	-	-	3	0.08
Emerald Shiner	4	0.64	78	2.62	7	3.41	89	2.34
Fathead Minnow	20	3.20	161	5.42	-	-	181	4.76
Bullhead Minnow	3	0.48	321	10.80	68	33.17	392	10.31
Bluntnose Minnow	13	2.08	130	4.37	-	-	143	3.76
River Carpsucker	163	26.08	778	26.17	63	30.73	1004	26.40
Channel Catfish	260	41.60	11	0.37	11	5.37	282	7.42
White Bass	45	7.20	68	2.29	-	-	113	2.97
Bluegill Sunfish	5	0.80	62	2.09	13	6.34	80	2.10
White Crappie	12	1.92	33	1.11	7	3.41	52	1.37
Freshwater Drum	25	4.00	110	3.70	-	-	135	3.55

Table 43. Trammel net summary for 1980 through 1981. Numerals indicate numbers of fish caught at each site, followed by frequency values based on the ratio of fish caught per 100 hours of net time. (Each net 60' by 6').

Species	Dredge 2 Pit		Dredge 3 Pit		Total Fish	
	No. Fish	/100 hr.	No. Fish	/100 hr.	No. Fish	/100 hr.
Shovelnose Sturgeon	1.0	2.3	539.0	77.7	540.0	73.6
Longnose Gar	1.0	2.3	1.0	0.1	2.0	0.3
Shortnose Gar	1.0	2.3	12.0	1.7	13.0	1.8
Gizzard Shad	4.0	9.2	16.0	2.3	20.0	2.7
Skipjack Herring	-	-	-	-	-	-
Goldeye	-	-	5.0	0.7	5.0	0.7
Common Carp	7.0	16.2	17.0	2.5	24.0	3.3
Blue Sucker	-	-	1.0	0.1	1.0	0.1
Bigmouth Buffalo	2.0	4.6	3.0	0.4	5.0	0.7
Smallmouth Buffalo	-	-	-	-	-	-
Shorthead Redhorse	1.0	2.3	-	-	1.0	0.1
River Carpsucker	26.0	60.0	56.0	8.1	82.0	11.2
Black Bullhead	-	-	-	-	-	-
Channel Catfish	28.0	64.7	7.0	1.0	35.0	4.8
Flathead Catfish	1.0	2.3	2.0	0.3	3.0	0.4
White Bass	3.0	6.9	4.0	0.6	7.0	1.0
Green Sunfish	-	-	-	-	-	-
Bluegill Sunfish	-	-	1.0	0.1	1.0	0.1
O.-spotted Sunfish	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-
White Crappie	2.0	4.6	7.0	1.0	9.0	1.2
Black Crappie	-	-	-	-	-	-
Sauger	-	-	-	-	-	-
Freshwater Drum	4.0	9.2	4.0	0.6	8.0	1.1
Total Fish	81.0	81.0	675.0	675.0	756.0	756.0
Fish/100 hrs.	186.9	186.9	97.4	97.4	103.1	103.1
Net Eft. (hours)	40'20"	40'20"	693'15"	693'15"	733'35"	733'35"

River carpsuckers and channel catfish were the predominant species collected by trammel netting in 1980 and 1981. Twenty-six river carpsuckers were collected representing a frequency of 60 per 100 hours of net time. Twenty-eight channel catfish were collected representing approximately 65 per 100 hours of net time. Gizzard shad, carp, white bass, and freshwater drum were commonly collected, representing approximately nine, 16, seven, and nine fishes per 100 hours of net time, respectively (Table 43).

Young-of-year of 12 species were collected by seining in June and July of 1979. These included longnose gar, goldeye, silver chub, sand shiner, bluntnose minnow, river carpsucker, channel catfish, flathead catfish, white bass, green sunfish, sauger, and freshwater drum. Young of four species were collected at transect D2A, four species at D2D, and eight species at D2E. In 1980, young-of-year representing 18 species were collected by seining in May, June, July and August. Species included longnose gar, gizzard shad, silver chub, speckled chub, suckermouth minnow, emerald shiner, redfin shiner, red shiner, sand shiner, bullhead minnow, bluntnose minnow, smallmouth buffalo, river carpsucker, white bass, green sunfish, bluegill sunfish, orangethroat darter, and freshwater drum. One species was collected in May, ten species in June, 11 species in July, and four species in August. Young of 13 species were collected at transect D2A, four species at D2D, and 11 species at D2E. In 1981, young-of-year representing four species were collected by seining in June and July. Species included shortnose gar, silver chub, channel catfish, and white crappie. Young of one species were collected in June and three species in July. Two species were collected from transect D2A, one species from D2D, and one species from D3A.

Dredge Site 3

Forty-three species were taken (at least once) in Dredge site 3. Forty-one species were collected by seining from May 1979 to September 1981, representing 18,066 fishes (Table 31). Nineteen species were collected by electrofishing from 1980 and 1981, comprising 510 fishes (Table 35). Fifteen species were taken by trammel netting in 1980 and 1981, representing 675 fishes (Table 43). Black crappie were collected by electrofishing only. Shovelnose sturgeon were collected by trammel netting only.

Three species were predominant based on percentage of total numbers of fishes collected by seining. Red shiners were the most common species, comprising nearly 61% of all fishes collected during the three-year period of this study (Table 44). The sand shiner comprised about 15% and the emerald shiner approximately 9% of the total number of fishes collected. Mean densities (fish per 100 square meters) of the 15 most common species taken by seining from 1979 to 1981 ranged from 8.89 at transect D3A to 7.53 at D3D, and 10.13 at D3E (Table A3-1).

Other species commonly taken by seining within Dredge 3 site were the river carpsucker, gizzard shad, bullhead minnow, and channel catfish. These species comprised approximately 40% of all fishes collected exclusive of red shiners and sand shiners during the three-year term (Table 45).

The red shiner was the predominant species each year in seining samples, increasing from about 56% of all fishes collected in 1979 to about 65% in 1980, decreasing to approximately 61% in 1981 (Table 44). Sand shiners decreased from about 12% of all fishes in 1979 to approximately 11% in 1980, and increased to about 23% in 1981. Emerald shiners increased each year from about 6% in 1979 to approximately 14% in 1981. River carpsuckers decreased each year, from about 6% in 1979 to less than 1% in 1981. Gizzard shad increased from nearly 9% of all fishes collected exclusive of red shiners and sand shiners in 1979 to about 17% in 1980. Gizzard shad were not collected by seining in 1981 (Table 45). Bullhead minnows increased from about 3% of all fishes collected in 1979 (exclusive of red shiners and sand shiners) to approximately 10% in 1980 and decreased to about 9% in 1981.

Skipjack herring, sturgeon chub, bigmouth buffalo, and logperch were collected by seining only at Dredge 3. The plains minnow was collected predominantly from this site, with one specimen taken from the partial study site.

Gizzard shad, river carpsuckers, and freshwater drum were the most common species taken by electrofishing in 1980 and 1981 combined (Table 35). The density of gizzard shad was about 20 fish per 1000 meters, river

Table 44. Fishes captured by seining at Dredge 3 site, Kansas River. The fifteen species listed represented 98 ± 2% of the total catch using seines.

	1979		1980		1981		TOTAL ALL YEARS	
Total No. Fish For Year	2714		8700		6652		18066	
SPECIES:	No.	% of total	No.	% of total	No.	% of total	No.	% of total
Gizzard Shad	76	2.80	356	4.09	---	---	432	2.39
Silver Chub	17	0.63	13	0.15	1	0.02	31	0.17
Speckled Chub	48	1.77	4	0.05	1	0.02	53	0.29
Emerald Shiner	163	6.01	603	6.93	934	14.04	1700	9.41
Red Shiner	1528	56.30	5635	64.77	4053	60.93	11216	62.08
Sand Shiner	337	12.42	922	10.60	1498	22.52	2757	15.26
Fathead Minnow	19	0.70	8	0.10	7	0.11	34	0.19
Bullhead Minnow	22	0.81	208	2.39	99	1.49	329	1.82
Bluntnose Minnow	2	0.07	21	0.24	---	---	23	0.13
River Carpsucker	165	6.08	426	4.90	22	0.33	613	3.39
Channel Catfish	184	6.78	57	0.66	2	0.03	243	1.35
White Bass	20	0.74	23	0.26	1	0.02	44	0.24
Bluegill Sunfish	11	0.41	153	1.76	2	0.03	166	0.92
White Crappie	15	0.55	77	0.89	---	---	92	0.51
Freshwater Drum	46	1.69	54	0.62	---	---	100	0.55
SHANNON DIVERSITY INDEX:								
H'		1.54		1.30		1.01		1.30
SPECIES EQUIVALENCY		4.68		3.67		2.75		3.68

Table 45. Species most common in seine samples from Dredge 3 site, lower Kansas River (exclusive of Red Shiners and Sand Shiners).

	1979		1980		1981		TOTAL ALL YEARS	
Total No. Fish For Year	849		2143		1101		4093	
SPECIES:	No.	% of total	No.	% of total	No.	% of total	No.	% of total
Gizzard Shad	76	8.95	356	16.61	-	-	432	10.55
Silver Chub	17	2.00	13	0.61	1	0.09	31	0.76
Speckled Chub	48	5.65	4	0.19	1	0.09	53	1.29
Emerald Shiner	163	19.20	603	28.14	934	84.83	1700	41.53
Fathead Minnow	19	2.24	8	0.37	7	0.64	34	0.83
Bullhead Minnow	22	2.59	208	9.71	99	8.99	329	8.04
Bluntnose Minnow	2	0.24	21	0.98	-	-	23	0.56
River Carpsucker	165	19.43	426	19.88	22	2.00	613	14.98
Channel Catfish	184	21.67	57	2.66	2	0.18	243	5.94
White Bass	20	2.36	23	1.07	1	0.09	44	1.08
Bluegill Sunfish	11	1.30	153	7.14	2	0.18	166	4.06
White Crappie	15	1.77	77	3.59	-	-	92	2.25
Freshwater Drum	46	5.42	54	2.52	-	-	100	2.44

carpsuckers about 16, and freshwater drum approximately 25. The highest densities of goldeye, smallmouth buffalo, shorthead redhorse, white bass, longear sunfish, black crappie, and freshwater drum for primary sites occurred in Dredge site 3 (Table 38).

In 1980, gizzard shad accounted for approximately 51% of all fishes collected per 1000 meters electrofishing upstream from Dredge 3, and 23% downstream (Table A4-5). In 1981, this species accounted for about 18% of all fishes above the dredge, and about 8% below (Table A4-9). River carpsuckers comprised about 14% of all fishes collected per 1000 meters electrofishing above the dredge in 1980, and about 22% below (Table A4-5). In 1981, this species accounted for approximately 21% of all fishes above the dredge, and about 22% below (Table A4-9). Freshwater drum comprised approximately 14% of all fishes collected per 1000 meters above the dredge in 1980, and about 17% below (Table A4-5). This species accounted for approximately 34% of all fishes collected per 1000 meters above the dredge in 1981, and about 51% below (Table A4-9).

White crappie were common in electrofishing samples in 1980, representing about 10% of all fishes collected per 1000 meters upstream from the dredge, and approximately 2% downstream (Table A4-5). In 1981, white crappie comprised about 3% of all fishes collected per 1000 meters above the dredge, and about 1% below (Table A4-9). White bass represented about 5% of all fishes collected per 1000 meters above the dredge in 1980, and 6% below (Table A4-5). In 1981, white bass comprised nearly 7% of all fishes collected per 1000 meters above the dredge, and approximately 1% below (Table A4-9).

Shovelnose sturgeon and river carpsuckers were the predominant species collected by trammel netting in 1980 and 1981. Four hundred thirteen shovelnose sturgeon were collected representing a frequency of nearly 78 per 100 hours of net time (Table 43). Fifty-six river carpsuckers were collected representing about eight per 100 hours of net time, respectively.

Thirteen species of young-of-year were collected by seining in June, July, and Auugust of 1979. Species included longnose gar, skipjack herring,

gizzard shad, goldeye, emerald shiner, river carpsucker, channel catfish, flathead catfish, stonecat, white bass, largemouth bass, sauger, and freshwater drum. Five species were collected in June, six species in July, and three species in August. Young of five species were collected from transect D3A, six species from D3D, and three species from D3E. Twenty-one species of young-of-year were collected by seining in May, June, July, and August of 1980. Species included gizzard shad, carp, creek chub, silver chub, speckled chub, suckermouth minnow, river shiner, red shiner, sand shiner, plains minnow, bullhead minnow, bluntnose minnow, bigmouth buffalo, smallmouth buffalo, river carpsucker, channel catfish, white bass, largemouth bass, bluegill sunfish, white crappie, and freshwater drum. One species was collected in May, 15 species in June, nine species in July, and three species in August. Young of ten species were collected from transect D3A, six species from D3D, and 17 species from D3E.

Partial Site (Turner)

Twenty-eight species were taken (at least once) from the Partial site. Sixteen species were collected by seining representing 835 fishes (Table 31). Nineteen species were collected by electrofishing from 1980 and 1981 combined representing 218 fishes (Table 35). Twelve species were collected by electrofishing only.

Two species were predominant based on percentage of total numbers of fishes collected by seining. Red shiners were the most common species, comprising approximately 46% of all fishes collected during the three-year period of this study. Emerald shiners comprised about 36% of all fishes collected by seining.

Sand shiners, channel catfish, and river carpsuckers were less common, comprising approximately 5%, 5%, and 3% of the total number of fishes collected by seining, respectively. Bullhead minnows, freshwater drum, and river shiners comprised about 2% each of all fishes collected exclusive of red shiners.

Gizzard shad, river carpsuckers, and freshwater drum were the most common species taken by electrofishing in 1980 and 1981 (Table 35). The density of gizzard shad was approximately 45 fish per 1000 meters, river carpsuckers about 28, and freshwater drum about 25.

In 1980, gizzard shad accounted for approximately 47% of all fishes collected per 1000 meters electrofishing (Table A4-5). River carpsuckers and freshwater drum comprised about 8% and 6% of all fishes collected per 1000 meters electrofishing, respectively. In 1981, gizzard shad comprised approximately 8%, river carpsuckers about 23%, and freshwater drum about 20% of all fishes collected per 1000 meters electrofishing (Table A4-9).

Other species commonly taken by electrofishing were carp, channel catfish, and flathead catfish. In 1980, carp accounted for about 11%, channel catfish about 4%, and flathead catfish approximately 6% of all fishes collected per 1000 meters electrofishing (Table A4-5). In 1981, carp comprised 6%, channel catfish 11%, and flathead catfish nearly 7% (Table A4-9). Thirty-seven percent of all flathead catfish collected by electrofishing were from the Partial site.

Four species representing 13 fishes were collected by electrofishing in 1979. These included carp (2), river carpsucker (7), white bass (2), and freshwater drum (2). 1979 is not included in the analysis for reasons given in the methods (introduction to electrofishing).

Young-of-year of eight species were collected by seining in August 1979. These included speckled chub, red shiner, sand shiner, stoneroller, channel catfish, bluegill sunfish, white crappie, and freshwater drum. In 1980, young-of-year representing four species were collected by seining in August. These included red shiner, smallmouth buffalo, river carpsucker, and bluegill sunfish.

b) <u>Changes in the Fish Fauna Across Sites</u>

Site-specific faunal differences based on seining, electrofishing, and trammel netting data are discussed in relation to habitat variability

between sites. Substrate affinities of fishes were computed for the 15 most common species collected by seining during 1979 and 1980. The 15 species comprised 98±2% of all fishes collected from a given site and year with the exception of Dredge 1 in 1979 (93%). Also, the Shannon diversity index was employed using the relative proportions of the 15 species to reflect trends in species diversity related to near-shore habitats.

Habitat

Differences between study sites with respect to the physical characteristics of habitats profoundly influenced the structure of the fish community within each site. The Control sites had wide channels, moderate current velocities, and shallow depths. Sand was the predominant substrate. The main channel, shallow backwaters, large snags, and ribbon channels were habitats frequently encountered.

Dredge site 1 was characterized by reduced channel width, variable current velocities, and increased depth. Sand was the predominant substrate, but rubble and silt increased during the years of study. The main channel, shallow ribbon channels, irregularities in the shoreline, and riffle areas were the most common habitats encountered.

Steep banks, increased depth, sluggish flow, and a predominance of silt substrate characterized Dredge site 2. The impoundment-like characteristics of this site were the result of a proportionately large dredge pit and a rock jetty below the site. The combination of these factors caused a reduction in velocity, stabilized water level, and increased silt deposition at this site.

Dredge site 3 was characterized by a variable channel width, steep banks, variable flow, and moderate depth. Silt was the predominant substrate upstream from the dredge, but commonly occurred in association with rubble at transects D3D and D3E, downstream from the dredge. The main channel, shallow embayments over rubble bars, riffle areas, and irregularities in the shoreline provided the principal habitats within this site. Habitats upstream from the dredge differed markedly from those downstream.

The Partial site was characterized by narrow channel width, steep banks, and moderate current velocities. The predominant substrates were silt and rubble, which occurred as discrete substrates and in combination. Shallow pools associated with rubble bars, riffles, and narrow stretches of unbroken flow (runs) encountered at this site were not found elsewhere between Dredge 3 and the mouth of the river.

Seining

Fifteen of 47 species were commonly collected by seining in all study sites through the three-year term of this study. These included gizzard shad, silver shub, speckled chub, emerald shiner, red shiner, sand shiner, fathead minnow, bullhead minnow, bluntnose minnow, river carpsucker, channel catfish, white bass, bluegill sunfish, white crappie, and freshwater drum. The 15 species comprised 98 ± 2% of all fishes collected from a given site and year with the exception of Dredge 1 in 1979 (93%).

Red shiners and sand shiners were the most common species collected by seining from all sites each year. Red shiners comprised approximately 69% of all fishes collected at the Control sites for all years combined, about 67% at Dredge 1, about 53% at Dredge 2, and about 62% at Dredge 3 (Tables 32, 36, 41, 44). Sand shiners accounted for approximately 19% of all fishes collected at the Control sites for all years combined, about 20% at Dredge 1, about 24% at Dredge 2, and about 15% at Dredge 3. Total density values (fish per 100 square meters) decreased progressively downstream through sites for both species (Table A3-1). Total densities of red shiners ranged from 269.32 fish per 100 square meters at transect D1E to 40.71 at transect D2D. Sand shiner total densities ranged from 94.92 fish per 100 square meters at transect C2A to 14.07 at transect D3D.

River carpsuckers were common at all sites each year, but diminished in numbers progressively downstream. This species decreased from approximately 9% of all fishes collected by seining over the three-year period at the Control sites to about 6% at Dredge 1 and Dredge 2, and about 3% at Dredge 3 (Tables 32, 36, 41, 44). Total density values decreased significantly in dredged areas, ranging from 36.66 fish per 100 square meters at transect C2A to 3.01 at transect D3D.

The numbers of emerald shiners increased in dredged areas, replacing the river carpsucker as the third most abundant species at Dredge 3. Exclusive of red shiners and sand shiners, emerald shiners comprised approximately 1% of all fishes collected by seining at the Control sites for all years combined, about 2% at Dredge 1 and Dredge 2, and approximately 42% at Dredge 3 (Tables 33, 37, 42, 45). Total density values for this species increased significantly in dredged areas, ranging from 0.06 fish per 100 square meters at transect C1A to 16.15 at transect D3E (Table A3-1).

Numbers of gizzard shad and bullhead minnow increased each year within all sites, and increased in dredged sites progressively farther downstream. Gizzard shad increased from approximately 2% of all fishes collected at the Control sites (exclusive of red shiners and sand shiners) for all years combined to about 5% at Dredge 1, about 22% at Dredge 2, and decreased to approximately 11% at Dredge 3 (Tables 33, 37, 42, 45). Bullhead minnows decreased from about 6% of all fishes collected at the control sites to about 3% at Dredge 1, and increased to approximately 10% and 8% at Dredge 2 and Dredge 3, respectively. Total density values (fish per 100 square meters) for gizzard shad increased downstream, ranging from 0.14 at transect D1E to 9.16 at transect D2A (Table A3-1). Bullhead minnow total densities also increased downstream, with the high and low values occurring within the Dredge 3 site.

Other species increasing in relative numbers and densities in dredged areas included the silver chub, fathead minnow, bluntnose minnow, channel catfish, white bass, bluegill sunfish, white crappie, and freshwater drum. Silver chub increased from less than 1% of all fishes collected by seining during all years (exclusive of red shiners and sand shiners) at the Control sites to approximately 1% at Dredge 1, about 6% at Dredge 2, and decreased to about 1% at Dredge 3. Total densities for this species ranged from 0.06 fish per 100 square meters at transect C1A to 6.80 at transect D2E (Table A3-1). The fathead minnow comprised less than 1% of all fishes collected by seining at the Control sites, Dredge 1, and Dredge 3, but increased to about 5% at Dredge 2. Total density values for this species ranged from 0.09 fish per 100 square meters at transect D1E to 5.64 at transect D2E. The bluntnose minnow increased from approximately 2% of all fish collected at

the Control and Dredge 1 sites to about 4% at Dredge 2, and decreased to less than 1% at Dredge 3. The total density values for this species ranged from 0.06 fish per 100 square meters at transect C1A to 3.12 at transect D2E. Channel catfish increased from about 2% of all fishes collected at the Control sites during all years to approximately 7% at Dredge 1 and Dredge 2, and decreased to about 6% at Dredge 3. Total density values for this species ranged from 0.35 fish per 100 suqare meters at transect C2A to 4.63 at transect D2D. White bass increased from less than 1% of all fishes collected during all years at the Control sites to about 1% at Dredge 1, about 3% at Dredge 2, and decreased to approximately 1% at Dredge 3. Total density values for white bass ranged from 0.05 fish per 100 square meters at transect D1E to 1.89 at transect D2E. Bluegill sunfish increased progressively downstream, from less than 1% of all fishes collected for all years at the Control sites to nearly 4% at Dredge 3. Total densities for this species increased from 0.02 fish per 100 square meters at transect C1B to 2.30 at transect D3E. Freshwater drum increased from less than 1% of all fishes collected for all years at the Control sites to about 1% at Dredge 1, about 4% at Dredge 2, and decreased to approximately 2% at Dredge 3. Total density values for freshwater drum ranged from 0.02 fish per 100 square meters at transect D1A to 2.84 at transect D2E. White crappie comprised approximately 1% of all fishes collected by seining for all years at the Control sites, about 16% at Dredge 1, about 1% at Dredge 2, and about 2% at Dredge 3. The significant increase in white crappie at Dredge 1 is the result of a single haul made in April 1980 at this site. Total density values for this species ranged from 0.04 fish per 100 square meters at transect C1A to 1.36 at transect D3E.

Speckled chub were most common in the Dredge 1 and Dredge 3 sites, comprising about 1% of all fishes collected by seining for all years combined exclusive of red shiners and sand shiners at these sites. Speckled chub were most common in the Dredge 1 and Dredge 3 sites, comprising about 1% of all fishes collected by seining for all years combined exclusive of red shiners and sand shiners at these sites. Speckled chub were scarce at Dredge 2, accounting for less than 0.1% of all fishes collected for the three-year period. Total density values (Fish per 100 square meters) for this species were highest in Dredge 1 and Dredge 3 sites, ranging from 0.02 at transect C1B to 1.22 at transect D3E.

Riffle-adapted species were collected by seining from Dredge 1 and Dredge 3 almost exclusively. In 1979, three sturgeon chub were taken from transects D3D and D3E in riffles associated with a large island. This species was not collected elsewhere in the study area, or from the Dredge 3 site during 1980 and 1981. The disappearance of the sturgeon chub in our collections after 1979 is probably associated with the removal of the island and adjacent riffle habitat in early 1980.

The stonecat and orangethroat darter were primarily collected at Dredge 1 and Dredge 3 in riffle areas associated with rubble bars. One stonecat was taken from transect C1A in 1980, and one orangethroat darter from transect D2A in 1980. One slender madtom, also a riffle inhabitant, was collected from transect D1A in 1979.

The plains minnow and western silvery minnow were collected exclusively from the Dredge 3 site and Partial site, with the exception of one western silvery minnow taken from transect D1E in 1980. These species prefer habitats characterized by firm bottoms covered by a layer of silt and organic matter. The rarity of these species at sites upstream may be due to competitive interactions with other species such as gizzard shad and river carpsucker. Also, Dredge 3 may represent the uppermost segment of river reached by migrants from the Missouri River, where these species are fairly common.

River shiners were collected predominantly from the Dredge 3 site and Partial site. One individual was taken from transect C1B in 1980. The river shiner is considered an increaser in the lower Kansas River, probably invading from the Missouri River. The river shiner is a big-river species preferring less turbid water and greater depths, conditions which prevail in the lowermost dredge sites.

Several less common pelagic species were collected by seining predominantly from dredge sites. These included skipjack herring, goldeye, creek chub, largemouth bass, green sunfish, longear sunfish, orangespotted sunfish, and black crappie. The greatest number of sunfishes often occurred at transects located near the mouths of tributaries.

Electrofishing

Eight of 25 species were commonly collected by electrofishing during 1980 and 1981 from all study sites. These included gizzard shad, carp, river carpsucker, channel catfish, white bass, bluegill sunfish, white crappie, and freshwater drum. The eight species comprised approximately 92% of all fishes collected over the two-year period. The greatest density and relative abundance values for species in each study site are presented to show trends.

Gizzard shad, white bass, bluegill sunfish, white crappie, and freshwater drum increased in abundance progressively downstream. The percentage of gizzard shad collected per 1,000 meters electrofishing across sites ranged from approximately 3% at Control 1 to nearly 38% from above (transects A-B) Dredge 2 (Table 39). Density values for this species ranged from 5.7 fish per 1,000 meters at Control 1 to about 85.2 above Dredge 2 (Table 38). The percentage of white bass collected per 1,000 meters electrofishing ranged from approximately 6% from Dredge 1 (transects D-E) to about 21% from above Dredge 3 and about 28% at the Partial site. Density values (fish per 1,000 meters) for white bass ranged from 1.2 below Dredge 1 to 4.0 above Dredge 3 and 5.4 at the Partial site. At the control sites, white bass densities were 1.3-1.7 fish per 1000 meters, and 6.7-8.7% of all fish caught by electrofishing at the control sites. Approximately 2% of all bluegill collected by electrofishing were from Control 2, about 43% were from Dredge 1, about 10% from below Dredge 2, and about 33% from the Partial site. The density of bluegill ranged from 0.3 fish per 1,000 meters at Control 2 to 5.9 below Dredge 1, 1.4 below Dredge 2, and 4.5 at the Partial site. Approximately 3% of all white crappie collected were from Control 1, about 14% from below Dredge 1, about 25% from above Dredge 2, 21% above Dredge 3, and about 26% from the Partial site. The density of white crappie varied from 0.6 fish per 1,000 meters at Control 1 to 2.9 below Dredge 1, 5.2 above Dredge 2, 4.3 above Dredge 3, and 5.4 at the Partial site. Approximately 7% of all freshwater drum collected per 1,000 meters electrofishing were from Control 1, about 10% from above Dredge 1, about 13% from above Dredge 3, about 28% below Dredge 3, and approximately 20% from the Partial site. The density of freshwater drum varied from 7.5 fish per

1,000 meters at Control 2 to 1.30 above Dredge 1, 7.0 above Dredge 2, 16.0 above Dredge 3, 35.4 below Dredge 3, and 24.8 at the Partial site.

The density of river carpsuckers tended to decrease progressively through downstream sites. Approximately 37% of all river carpsucker collected per 1,000 meters electrofishing were from Control 1, about 11% from below Dredge 1, about 6% from above Dredge 2, about 8% from below Dredge 3, and approximately 11% from the Partial site. Density values for this species varied from 94.9 fish per 1,000 meters electrofishing at Control 1 to 28.2 below Dredge 1, 15.3 above Dredge 2, 31.3 below Dredge 3, and 28.4 at the Partial site.

The percentage composition and density of carp did not change appreciably across sites, with the exception of low values at Dredge 2.

Several less common species were primarily collected from the dredged areas. These included skipjack herring, goldeye, bigmouth buffalo, smallmouth buffalo, shorthead redhorse, flathead catfish, green sunfish, orangespotted sunfish, longear sunfish, largemouth bass, black crappie, and sauger. The highest density of flathead catfish occurred in the Dredge 1, Dredge 3, and Partial sites.

Trammel Netting

Three species were commonly collected by trammel netting at Dredge 2 and Dredge 3 during 1980 and 1981: gizzard shad, carp, and river carpsucker (Table 43). Channel catfish were taken primarily in the Dredge 2 site, whereas shovelnose sturgeon were collected almost exclusively from the Dredge 3 site. Three species, goldeye, blue sucker, and bluegill sunfish were collected from Dredge 3 site only. Shorthead redhorse were taken from Dredge 2 site only.

Shovelnose sturgeon were abundant in late winter and early spring in the Dredge 3 site. Of 540 shovelnose sturgeon collected in 1980 and 1981, only one was taken from Dredge 2 site. The frequency of capture was about two sturgeon per 100 hours of net time at Dredge 2, and about 78 at

Dredge 3. Exclusive of 24-hour pit samples conducted in Dredge 3 site during February, March, April, and May of 1981, approximately 26 sturgeon were collected per 100 hours of net time at this site. The predominance of sturgeon at Dredge 3 is most likely due to the location of this dredge as the lowermost site within the study area, and the configuration of the pit where sampling was done.

Gizzard shad, river carpsucker, and channel catfish were most common in Dredge 2 site. Approximately nine gizzard shad were collected per 100 hours of net time from Dredge 2 site, and about two per 100 hours were taken from Dredge 3 site. River carpsuckers were captured at a frequency of 60 per 100 hours of net time from Dredge 2 site, and about eight from Dredge 3 site. Approximately 65 channel catfish were collected per 100 hours of net time from Dredge 2 site, and about one per 100 hours was taken from Dredge 3 site.

Carp were also more commonly collected by trammel netting from Dredge 2 site based on effort. Approximately 16 carp were collected per 100 hours from Dredge 2 site, about three per 100 hours were taken from Dredge 3 site.

Trammel netting represented the most efficient method of sampling in the Dredge 2 and Dredge 3 pit areas. The efficiency of seining and electrofishing in these sites was reduced as a result of greater channel depths and steeply sloping shorelines.

c) Substrate Affinities

Substrate affinities of fishes were computed for the 15 most common species collected by seining during 1979 and 1980 (Tables A5-1, A5-2). Nine substrate categories were defined and included silt, silt-sand, silt-rubble, sand, sand-gravel, gravel, gravel-rubble, rubble and miscellaneous. The miscellaneous category included rare and complex substrates. Values presented are based on the number of fishes collected per haul over a given substrate.

Channel catfish, gizzard shad, freshwater drum, silver chub, emerald shiner, bullhead minnow, bluntnose minnow, white bass, white crappie, and bluegill sunfish were primarily associated with silt component substrates. In 1979, approximately 49% of all channel catfish collected by seining were associated with silt or silt-sand substrate. Approximately 29% of all channel catfish collected in 1980 were associated with these two substrates. Channel catfish were also commonly associated with gravel and rubble substrates during both years. This association probably reflects preferential selection of these substrate categories by juveniles.

Approximately 63% of all gizzard shad collected in 1979 were over silt and silt-sand substrate. In 1980, about 75% were associated with these substrates. Approximately 94% of all freshwater drum in 1979 were collected over silt-component substrates, and about 98% were associated with silt, silt-sand, and silt-rubble in 1981. Nearly 71% of all silver chub in 1979 were collected over silt and silt-sand, with approximately 94% collected over these substrates in 1980. Approximately 60% of all emerald shiners collected in 1979 were associated with silt-component substrates (including silt-rubble), and about 69% occurred over these substrates in 1980. Emerald shiners also exhibited an affinity for larger substrate, with about 31% collected over gravel-rubble and rubble in 1979, and approximately 15% collected over gravel-rubble in 1980. Approximately 32% and 83% of all bullhead minnows were collected over silt, silt-sand, and silt-rubble in 1979 and 1980, respectively. Eighty-four percent of all bluntnose minnows were associated with silt-component substrates in 1979, and about 78% in 1980. Seventy percent of all white bass were collected over silt and silt-sand in 1979, and about 87% were associated with silt, silt-sand, and silt-rubble in 1980. Sixty-seven percent of all white crappie collected in 1979 were associated with silt-component substrates, and about 96% of all white crappie taken in 1980 were over these substrates. Nearly 89% and 79% of all bluegill were associated with silt, silt-sand, and silt-rubble in 1979 and 1980, respectively.

Approximately 89% of all speckled chubs were collected over sand and sand-gravel in 1979, and about 25% were associated with these substrates in 1980. Also, approximately 48% of all speckled chub were collected over gravel and gravel-rubble in 1980.

Sand shiners exhibited a strong preference for sand and gravel-component substrates in both years. Approximately 48% were collected over sand, sand-gravel, and gravel in 1979, and about 28% were over these substrates in 1980. Also, approximately 21% were associated with silt-sand in 1980.

In 1979, approximately 72% of all river carpsuckers were collected over silt, silt-sand, and silt-rubble. About 21% were associated with sand and sand-gravel. Approximately 61% were collected over silt-component substrates in 1979, with about 18% collected over sand and sand-gravel.

The red shiner and fathead minnow were commonly collected over all substrate categories during the two-year period and did not exhibit a strong affinity for any particular substrate.

d) Species Diversity

The Shannon diversity index was employed using the equation $H' = \Sigma P_i \log_e P_i$. The relative proportions of the 15 most common species collected by seining was the sample of interest. This index as used is based primarily on two assumptions: first, the number of species sampled is representative of all species occurring at a given site; second, diversity increases with an increase in equitable abundances. The analysis of diversity is subject to biased interpretations due to the singular method of sampling, sampling efficiency, and the temporal and spatial distribution of species in the river. For our purposes, the Shannon diversity index was used to reflect trends in the relative abundance of common species in near-shore habitats. To ease the interpretation of H' values, the antilog of the value represents the number of equivalent species in the community.

The Control sites maintained low species diversity through the term of this study (Table 32). Three species, the red shiner, sand shiner, and river carpsucker were predominant at this site. The greatest diversity attained was in 1979 (H'=1.09; = 2.97 equiv. sp.). Diversity decreased in 1980 and 1981 as the abundance of red shiners increased.

Diversity increased in dredged areas with an increase in equitable abundances. Pelagic species such as gizzard shad, emerald shiner, bullhead minnow, channel catfish, white bass, white crappie, and freshwater drum were more common in dredged areas, especially Dredge site 2 and Dredge site 3. Dredge 1 had diversity values similar to the Control sites. H' values ranged from 0.81 (2.24 equiv. sp.) in 1979 to 1.23 (3.41 equiv. sp.) in 1980, and 0.76 (2.15 equiv. sp.) in 1981 (Table 36). The greater value in 1980 reflects the increased abundance of white crappie. Diversity values in the Dredge 2 site ranged from 1.46 (4.30 equiv. sp.) in 1979 to 1.46 (4.31 equiv. sp.) in 1980, and 0.82 (2.26 equiv. sp.) in 1981 (Table 41). Diversity values in the Dredge 3 site ranged from 1.54 (4.68 equiv. sp.) in 1979 to 1.30 (3.67 equiv. sp.) in 1980, and 1.01 (2.75 equiv. sp.) in 1981 (Table 44).

e) Summary of Trends in the Fish Fauna Across Sites

The major trend in the fish fauna from the Control sites downstream through the dredge sites involved changes in the relative abundance of most species. The change in fish community structure is related to variation in habitat between study sites. The Control sites had wide, shallow channels, moderate currents, and sandy substrates. Dredged areas, especially Dredge 2 and Dredge 3, were characterized by narrow channel width, sluggish flow, and increased depths. Silt was the predominant substrate in the Dredge 2 and Dredge 3 sites. Sand was common in the Dredge 1 site, but decreased in near-shore areas over the three-year period of this study.

Species typically associated with pools (pelagic and benthic zones) increased in relative abundance in dredged areas. These included gizzard shad, silver chub, emerald shiner, fathead minnow, bullhead minnow, white bass, bluegill sunfish, white crappie, and freshwater drum. The increase in these species in dredged areas is reflected in the increase in species diversity as a result of greater species equivalency. The greatest numbers of gizzard shad, silver chub, fathead minnow, bluntnose minnow, white bass, and freshwater drum occurred in the Dredge 2 site. The emerald shiner, bullhead minnow, and bluegill sunfish attained the greatest density in the Dredge 3 site. Substrate affinities of these species indicated a preference

for silt-component substrates, with the exception of the fathead minnow which was commonly collected over a variety of substrates.

The red shiner, also a pelagic species, was the most common species collected by seining at all sites. The ubiquitous nature of the red shiner accounts for the predominance of this species in seining collections in nearly all habitats. This species attained the greatest density in the Control sites. The red shiner was collected over all substrate categories and did not exhibit a clear preference for any particular substrate.

The speckled chub, a shallow-water species, was commonly collected from the Control sites, Dredge site 1, and Dredge site 3. This species attained greatest density at Dredge 3, but declined in abundance each year at this site. The dredging of a large island complex in 1980, and high discharge rates in 1981 account for the decline in the number of this species collected by seining here. The lowest density of speckled chub was at the Dredge 2 site where shallow-water habitat became increasingly rare. Speckled chub were most commonly collected over sand and gravel substrates.

River carpsucker declined in numbers progressively through downstream sites in seining and electrofishing collections. This species was most commonly collected by seining over silt and sand substrate. The greatest density of river carpsuckers was attained in the Control sites. Young of this species invaded shallow ribbon channels and embayments where primary productivity (=periphyton) was high. The young were easily captured in these habitats and account for most of the individuals collected by seining. Shallow water habitat became increasingly rare in dredged areas, especially at the Dredge 2 site. The scarcity of such habitat in dredged areas probably accounts for the progressive decline of young carpsuckers downstream.

The sand shiner, a shallow water species preferring sand and sand-component substrates, attained greatest density in the Control sites. Actual numbers of this species tended to be high in dredged areas, but not their biomass. Those taken at Dredge 3 in 1981 averaged about 0.5 gram, notably smaller than sand shiners in Control areas (mostly greater than 1.0

gram). Thus they were juvenile, some perhaps passively dispersed downstream.

Other less common species were collected by seining almost exclusively from dredged areas. These included skipjack herring, goldeye, river shiner, plains minnow, western silvery minnow, flathead catfish, stonecat, longear sunfish, black crappie, and orangethroat darter. Skipjack herring, bigmouth buffalo, smallmouth buffalo, black crappie, and sauger were collected by electrofishing from dredge sites and the Partial site only. These species generally prefer pelagic or pool habitat with the exception of the stonecat and orangethroat darter which are riffle inhabitants.

The greatest number of fishes collected per 1,000 meters electrofishing in 1980 and 1981 occurred in the Partial site. The occurrence of shallow embayments over rubble bars, stretches of unbroken flow (runs), and riffles at the Partial site create habitat not found elsewhere between Dredge 3 and the mouth of the river. The greater density of fishes at this site probably reflects the local habitat diversity.

f) Potential effects of channel degradation and siltation on fish movement into tributaries.

Several small tributaries enter the Kansas River within the area surveyed. Their fish-faunas differ from that of the mainstream, and most individual fish of species characteristic of creeks remain there continuously. But during drought, these faunas retreat downstream with receding waterlevels, and the river may then become an important refuge for creek species that require permanent flow. When tributary flow is restored following drought, upstream migrants re-establish the fish population. Furthermore, many river fishes spawn in tributaries, as indicated in species accounts of gar, carp, and bigmouth buffalo. River fishes also enter creek-mouths when river backwater at these sites provides refuge from high, swift, turbid flows in the mainstream. It is important, therefore, that the lowermost parts of tributaries remain open, affording free access to and from the river at all flow-stages. One possible effect of mainstream degradation coupled with increased siltation, as a result of intensive

dredging or other causes, would be blockage of tributary mouths by silt-beds that the tributaries lack flow-capacity to scour. This effect could be severely harmful to many fishes throughout the lower part of the river basin. Our point is illustrated by Figs. 43, 44, 45, and 46.

Fig. 43. Mouth of Little Kaw Creek in September 1981, following recession of high flow. This tributary enters the Kansas River at mile 22.3, between transects C2B and D1A. Mainstream degradation in this segment has limited the accessibility of this tributary to river fishes except during high flow. Silt deposited during periods of high discharge blocks the mouth of the stream.

Fig. 44. View downstream toward the mouth of Quivira Creek (mile 14.5), 4 June 1981. This small stream, shown during a high flow stage, joins the Kansas River just beyond the vegetation in foreground. Unlike Little Kaw Creek (Fig. 43), this stream scours sediments at its mouth, permitting access by river fishes.

Fig. 45. View upstream into Quivira Creek (mile 14.5) from the same vantage point as in Fig. 44, approximately 40 meters above the mouth. This photograph was taken 5 June 1981, one day after that shown in Fig. 44. Overflow from Lake Quivira had receded, but the creek mouth remains open, permitting access to and from the river despite the low flow stage.

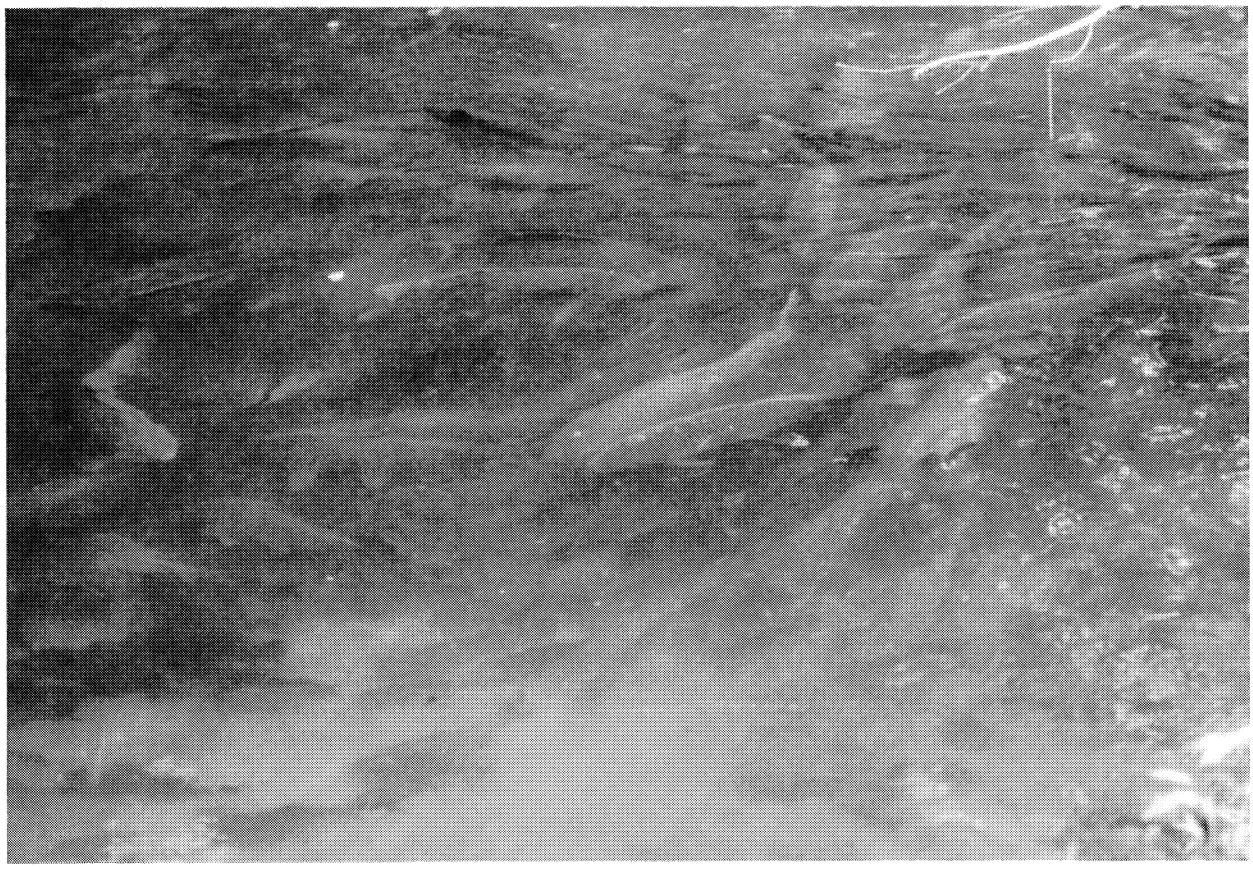


Fig. 46. Carp and bigmouth buffalo in pool of Quivira Creek on 5 June 1981. Shortnose gar and carp were spawning in this part of the stream on the previous day.

11. ACCOUNTS OF SPECIES: FISHES

Shovelnose sturgeon, Scaphirhynchus platorynchus (Rafinesque)

Shovelnose sturgeon were captured abundantly only in D3 Pit using trammel nets in late winter and spring 1981. A large congregation of sturgeon was discovered in D3 Pit on 21 February 1981, when 208 individuals were captured in trammel nets. Intensive sampling in the same pit on 8 March, 26 April, and 7 May (100 meters above pit) 1981 captured 116, 114, and 80 sturgeon, respectively. By 22 May 1981 most sturgeon had left the D3 Pit; only one specimen was taken in nets on this date. One sturgeon was also captured on 19 June 1981. Many individuals apparently remained in or near the D3 Pit until May, because several specimens tagged 8 March were recaptured at the same site in April and May. The length range in 1981 samples varied from 450 to 815 mm (mean=654mm). In 1980, no such concentration was detected at D3. Only one was captured in trammel nets in March, none in April, and two each in May and June. In other months of 1980, ten sturgeon were captured in a pit sample in August, one in September, and three in November. Only two sturgeon were found at sites other than D3. One was captured in a trammel net at D2 Pit on 20 May 1980. One sturgeon, and the only one caught by methods other than trammel netting, was caught in a seine in June 1979 at C1A.

The D3 pit in 1981 had these distinctive features that may have made it unusually attractive to sturgeons: 1) its location lateral to the main channel, bounded by the steep right bank of the river and by an exposed armoured bar that extended across most of the width of the riverbed immediately downstream from the pit, deflecting flow from the right to the left bank at this point (dredge-pits at other times and locations were in center-channel); and 2) proximity of this pit to shallow areas favorable for feeding.

Although sturgeon were abundant at particular seasons in dredge pits, the method of capture (trammel nets) employed in pit areas was also probably the most efficient. Although it is not evident from our data, sturgeon are likely common all along the lower Kansas River, but are widely dispersed except in winter and early spring.

Food organisms found in sturgeons from the D3 Pit lead us to believe that sturgeon moved out of the pit into adjacent shallow silty and rocky areas, where these organisms are found, in order to feed. Large numbers of sturgeon were captured directly upstream from D3 Pit in trammel nets left for 24 hours, supporting this belief. Trichopterans (Potamyia, Hydropsyche, Nectopsyche) were the predominant food items found in sturgeon from D3 Pit in 1981. Dipterans (Chironomidae) were also very abundant in stomachs from this site. Less frequent items included other Dipterans (Simulium, Chaoborus, Tipulidae, Tabanidae), Hemipterans (Corixidae), Ephemeropterans (Pentagenia, Stenonema, Caenis), Coleopterans (Elmidae), Plecopterans (Taeniopteridae), and Odonates (Coenagrionidae). Elsewhere, food of 74 shovelnose sturgeon, 445-610mm total length, from Mississippi was 75% Trichoptera, 17% Hexagenia spp., and 8% other insects (Carlander, 1969:52).

Shortnose gar, Lepisosteus platostomus (Rafinesque)

Shortnose gar were collected from all transects by electrofishing except D1A-B, D1D-E, and D3A-B. Of 11 captured, two were from C1, four from C2, one each from D2A-B and D2D-E, two from D3D-E, and one from Turner. On the basis of effort (fish per 1,000 meters), 0.9 were captured at the Control sites, 0.3 at D2 and D3, 0.5 at Turner, and 0.4 over all sites. Shortnose gar ranked 13th over all sites in electrofishing.

Nineteen shortnose gar were captured by seining; four from the Control sites, three from Dredge 1, three from Dredge 2, and six at the Partial site. This species ranked 27th in seining over all sites and years.

Condition coefficients for this slender species ranged from 0.26 in May to 0.37 in June.

Shortnose gar were often collected from shallow areas with mild currents. Although shortnose gar usually avoid the quiet backwaters inhabited by longnose gar (Cross, 1967), these two species were occasionally collected together.

The reproductive habits of shortnose gar are generally like those of the longnose gar. Seven gravid females (576mm to 944mm) were collected in May and June of 1980: one from transect C2B, one from D3E, and five from supplemental samples outside the study area. The number of ova ranged from about 11,200 to 16,100, with an average diameter of approximately 2.5mm. Ova of females (528mm to 704mm) collected in August ranged from approximately 5,300 to nearly 20,200 in number and averaged about 2.1mm in diameter. This suggests that spawning had previously occurred and the ova present would be over-wintered and shed the following year.

Young-of-year were collected at the Dredge 3 site during June 1981, and were associated with submerged vegetation in slack water areas along shore. Spawning was witnessed upstream from the Dredge 3 site on 4 June 1981 in a swollen stream originating at Quivira Lake.

Of 43 stomachs examined, 37 contained food. Fish were the predominant food item, occurring in 22 (59%) stomachs. These included gizzard shad, emerald shiner, red shiner, sand shiner, silvery minnow, river carpsucker, channel catfish, bluegill sunfish, white crappie, and freshwater drum. Less frequent food items included Ephemeropterans (Hexagenia), Trichopterans (Hydropsyche), hellgrammites (Corydalidae), June beetles (Scarabaeidae), crayfish (Orconectes), western spadefoot toad (Scaphiopus bombifrons), frogs (Rana spp.), northern water snake (Nerodia sipedon), and a black-capped chickadee (Parus atricapillus). Two stomachs examined contained fish hooks.

Longnose gar, Lepisosteus osseus (Linnaeus)

Longnose gar were collected from all transects by electrofishing except C1, D1A-B, D3A-B, D3D-E, and the Partial site. Of nine caught, one was from C2, three from D1D-E, three from D2A-B, and two from D2D-E. Catch per unit effort (fish per 1,000 meters) was low for this species; 0.2 at the Controls, 1.0 at D1, 0.7 at D2, and 0.4 over all sites. Two longnose gar were captured in pit trammel nets (one at D2, one at D3). Longnose gar ranked 15th in electrofishing, varying from 8th at D2D-E to 9th at D1D-E and Controls.

Sixteen longnose gar were captured by seining; four at the Control sites, three at Dredge 1, three at Dredge 2, and six at Dredge 3. They ranked 28th in seining samples over all sites and years.

Condition coefficients for this species ranged from 0.36 in May to 0.17 in July.

At low discharge rates, longnose gar were primarily collected in backwaters below sandbars and shallow embayments over rubble bars. Occasionally specimens were taken at the bases of riffles. During periods of increased flow, longnose gar were often distributed linearly along shore.

Netsch and Witt (1962) suggest that, in Missouri, the longnose gar migrates upstream for spawning. Spawning occurs during May and early June. Two gravid females occurred in supplemental samples beyond the study area in May 1980. The largest (1,111mm) contained approximately 16,500 eggs (average diameter = 2.98mm), and the smaller (687mm) contained about 3,700 eggs (average diameter = 2.80mm). One gravid female (757mm) taken in July 1981 from transect C2A contained about 17,600 eggs of three size classes, with the mid-range size predominating (average diameter = 1.78mm). A few larger eggs were present (average diameter = 3.08), indicating this specimen had recently spawned. The ovaries of each gravid female comprised approximately 7% of the body weight.

Sixteen young-of-year were collected by seining in June and July of 1980. Two young were taken from transect C2B, three from D2A, three from D3D, and eight from D3E.

Of 57 stomachs examined, 45 contained food. Fish were the predominant food item, occurring in 38 (84%) stomachs. These included shortnose gar, longnose gar, gizzard shad, creek chub, emerald shiner, red shiner, sand shiner, bullhead minnow, river carpsucker, shorthead redhorse, and channel catfish. A single young-of-year contained 17 larval shiners. Less frequent food items included Ephemeropterans (Hexagenia), and crayfish (Orconectes). Two stomachs contained fish hooks.

Skipjack herring, Alosa chrysochloris (Rafinesque)

Two skipjack herring were collected by electrofishing, both on 11 August 1980. One was taken from the Partial site, representing an effort value of 0.5 per 1000 meters. The other was taken from a supplemental sample approximately 3.0 river miles from the mouth of the Kansas River. The skipjack was the most rare species represented in electrofishing samples, ranking 16th at Turner and 22nd overall. Two young-of-year were captured by seining at D3D in June 1979 (23mm, 25mm). The stomach of the specimen from Turner contained four emerald shiners. According to Pflieger (1975), small fishes make up the bulk of the diet of adult skipjack herring, whereas the young probably feed on aquatic insects.

The skipjack was unknown in the Missouri River basin until 1955. It was first recorded from the Kansas River in 1971. Cross and Huggins (1975) attributed its invasion of the basin to altered river conditions resulting from impoundment--mainly deeper, swifter flows and reduced turbidity in the Missouri River mainstream. Elsewhere it inhabits the channels of large, relatively clear rivers (Ohio, Mississippi).

Gizzard shad, Dorosoma cepedianum (Le Sueur)

Distribution and Abundance. Gizzard shad were collected by electrofishing from all transects. Although common at all sites, they were most abundant from D2 downstream through the Partial site. Out of 666 total, 18 shad came from C1, 58 from C2, 10 from D1A-B, 22 from D1D-E, 279 from D2A-B, 56 from D2D-E, 85 from D3A-B, 39 from D3D-E, and 99 from Turner. On the basis of effort (fish per 1000 meters), 11.5 were taken at the Controls, 10.4 at D1, 48.2 at D2, 19.8 at D3, 44.6 at Turner, and 26.5 over all sites. Sixteen gizzard shad were captured in trammel nets in the D3 pit, four were caught at D2. Gizzard shad ranked second in electrofishing samples over all sites. Their lowest rank was at C1 (fifth), but shad were the most abundant species at D2A-B, D2D-E, D3A-B, and Turner.

In all years, 1501 gizzard shad were captured by seining; 127 at Control sites (seven in 1979, 101 in 1980, 19 in 1981), 142 at D1 (three in

1979, 139 in 1980, 846 at D2 (19 in 1979, 827 in 1980), and 432 at D3 (76 in 1979, 356 in 1980). Densities ranged from 0.14/100m^2 at D1E to 9.16/100m^2 at D2A. The mean density for all years was 2.67/100m^2. Gizzard shad ranked 6th in seining at Controls and D1, 4th at D2, and 5th at D3.

K-values. Condition coefficients for electrofishing averaged 0.92 over all sites, and ranged from 0.70 to 1.26. Average condition coefficients for 1980 seining samples ranged from 0.72 at D1E to 1.09 at D2D. Mean values were highest in August (1.09).

Habitat. Gizzard shad preferred quiet or slowly moving water of one to two meters in depth. They are primarily pelagic in their habits, and were never found in swift water or riffle habitats. They were usually found over a silt substrate, and at times of high water occupied flooded backwaters. Sixty percent of gizzard shad captured by seining were found over silt substrates, 30% over silt-sand and silt-rubble. Unlike all other species in electrofishing samples, gizzard shad reached their highest abundance at D2. This species probably benefits from the slower currents and deeper habitats created by dredging.

Reproduction. Two females examined had mature ovaries with eggs. One 354mm specimen was from Turner, collected 12 May 1981, and contained approximately 157,000 eggs having a mean diameter of 0.57mm (GSI=7.2). A 261mm female from C2B, collected 23 June 1980, contained approximately 61,600 eggs having a mean diameter of 0.50mm (GSI=3.8). There is evidence that gizzard shad spawned repeatedly in 1980; therefore the second specimen may have been refractory, between successive spawns.

Young-of-year were found at all dredge sites in one or more years, most frequently at D3. On 26-27 June 1980, young of similar size (20-25mm) were found at D1, D2, and D3. Young as small as these were taken in mid-July also, again at dredge sites, and at D3 in mid-August (21mm). Other, larger young continued to be captured from early-season spawns. We think it likely that reproduction occurred repeatedly, or asynchronously, in the river. Alternatively, young shad having different origins and growth histories may have entered the river with discharge from various reservoirs upstream. Some larval shad occurred in drift-net samples.

Goldeye, Hiodon alosoides (Rafinesque)

Distribution and Abundance. Goldeyes were collected from all transects by electrofishing except C2, D1A-B, D2 Pit, and D2D-E. Of 22 fish, two were from C1, one from D1D-E, two from D2A-B, four from D3A-B, two from D3D-E, and 11 from the Partial site, On the basis of effort (fish per 1000 meters), more were taken at Turner (5.0) and D3 (1.0) than at the upper three stations. Catch per unit effort values were low for the Controls (0.3), D1 (0.3), and D2 (0.3). Five goldeye were captured in trammel nets in the D3 Pit. This species ranked eleventh in abundance in electrofishing samples, varying from eighth at the Controls and D3A-B to fourteenth at D1D-E. Fourteen goldeye were collected by seining methods, from June and July of 1979 only. One was collected from transect C2A, five from D2A, three from D2E, one from D3D, and four from D3E.

K-values. Condition coefficients averaged 1.05 over all sites, for individuals collected electrofishing, ranging from 0.87 to 1.35. The range and mean of coefficients show no appreciable variation between sites. For seining, coefficients ranged from 0.79 at D3D to 1.28 at D2D.

Habitat. Most goldeyes were caught in open water, in current near the main channel, where depths averaged one to two meters. Others were caught in backwaters (little or no flow). Five were obtained from the D3 Pit, in average depths of three to four meters, in trammel nets: two on 23 August 1980, and three on 21 February 1981. Goldeyes were caught at all times of the year, but more were caught in May than in other months. They were captured over a variety of substrates. Smaller individuals and young-of-year occupied habitats characterized by silt substrates, slow currents, and depths of 30-100cm.

Reproduction and Growth. Goldeye move upstream to spawn in flowing water over rocky or gravelly bottoms in spring. Young an inch in length have been taken from the Missouri River in late May (Pflieger 1975). Our data suggest that goldeye spawned in March or April. One 377mm specimen collected from D2 on 23 November contained approximately 24,500 eggs having a mean diameter of 1.65 mm (GSI=9.6). Two females from D3, collected 21

February 1981 had enlarged ovaries. One (366mm) held approximately 20,000 eggs with a mean diameter of 1.86mm (GSI=10.7). The other, a 352mm female, contained approximately 9,000 eggs having a mean diameter of 1.95mm (GSI=7.0). Three females collected from the Partial site on 12 May 1981 were spent (see Table A6-1). Young-of-year were first collected on 20 June 1979, from transects C2A, D2A, D2D, D3D and D3E. Mean lengths ranged from 35 to 45mm in June and from 60 to 62mm in July.

Food. Of 26 stomachs examined, 17 contained food. The most frequent items were Trichopterans (Hydropsychidae, *Potamyia*), found in 12, or 71% of the stomachs with food. Hydropsychids were the most numerous food item; one stomach contained 882 individuals (maximum of 82 *Potamyia*). Though they were very frequent in stomachs from D3 and the Partial site, Hydropsychids were not found in goldeye examined from the other three sites. Hemipterans (Corixidae) were found in 10 stomachs (59%), but were less numerous (maximum of 139 individuals). They were the most frequent item found in fish from D2 and D3. Dipterans (Chironomidae) were found in eight fish (maximum of eight in one stomach). Terrestrial beetles were also found in eight goldeye, again with eight being the maximum number found in any one fish. Less frequent food items included Ephemeropterans (*Hexagenia*, *Pentagenia*, *Baetis*), Plecopterans (*Taenioema*), Odonates (Coenagrionidae, *Gomphus*), Dipterans (*Simulium*), and terrestrial insects (see Table A7-1).

Carp, *Cyprinus carpio* (Linnaeus)

Distribution and Abundance. Carp were found at all sites and transects by electrofishing. Of 157 carp, 30 were from C1, 20 from C2, seven from D1A-B, 13 from D1D-E, seven from D2A-B, 12 from D2D-E;, 10 from D3A-B, 26 from D3D-E, and 32 from Partial site. On the basis of effort (fish per 1000 meters), 7.6 carp were captured at Control sites, 6.5 at D1, 2.7 at D2, and 5.7 at D3. Approximately twice as many (14.4) carp were captured at the Partial site as at any other site. Twenty-four carp were captured in trammel nets; seven at D2 Pit, 17 at D3 Pit. Carp were common in both electrofishing and trammel net samples, ranking fifth in abundance. Rank varied from third at Control 1 and D2D-E to seventh at D1D-E. Twenty-two carp were captured by seining; 11 at Control sites, one at D1A, two at D1E, one at D2A, one at D3A, four at D3D, and two at D3E.

K-values. Condition coefficients averaged 1.61, ranging from 1.30 to 2.17. The range and mean of site coefficients show no appreciable variation between sites. Sexual and seasonal variations in condition were not noticeable, even among gravid females.

Habitat. Carp were found in diverse habitats, but were most abundant in slower currents. Many were caught in backwaters, especially over detritus inundated during periods of high flow. Numbers per unit effort (electrofishing) for combined years were lowest at D2A-B, D2D-E, and D3A-B. These areas are similar in having deeply silted, uniform bottoms with little cover. In 1981, however, 4.9 carp were caught at D2A-B, D2D-E and D3A-B combined, while 3.0 were caught at C1 and C2 and 0.0 at D1.

Reproduction. Only 12 of 44 carp dissected were females, a ratio of 3.7♂: 1♀. Ripe females were taken as early as 7 March and as late as 5 August. Mean gonadosomatic indices and egg counts were highest in April; most spawning probably occurred in mid to late spring. A ripe male was taken on 13 September (see Table A6-1).

Five ripe females caught in April 1980 were in backwater over detritus in water less than one meter deep. These fish and attendant males may have been spawning. On 4 June 1981, carp spawned in a swollen stream originating at Quivira Lake. Eggs adhering to submerged grasses and willows were collected, but attempts to rear them failed. Bigmouth buffalo were spawning concurrently in the stream. Spawning pairs of carp were observed depositing eggs on submerged grass. Repeated spawnings by individual pairs were noted. The water in the stream was clear owing to the short distance from the lake outlet. This stream joins the river, which was high and turbid at the time, about 40 meters below the point where these observations were made (Figs. 44-46). Young-of-year carp at D1A were 34mm and larger when caught on 13 July 1979. On 26-27 June 1980, young at C2B and D3E were 17-26mm long.

Food. Of 44 stomachs examined, 18 contained food. Sixteen (90%) contained detritus or other unidentified organic matter. This was most often the main component of the stomach contents. Small seeds were found in 12 stomachs, abundantly in some. Dipterans (Chironomidae) and Trichopterans

(Hydropsychidae) were found in six and four stomachs respectively, and were represented at all sites from which carp were examined. Less frequent food items included ants, wasps, terrestrial beetles, aquatic beetles (Gyrinidae), oligochaete worms, and corixids. In addition, three parasitic tapeworms (Cestoda) were found in one carp stomach from the Partial site. A complete list of food items by site may be found in Table A7-2.

Golden shiner, Notemigonus crysoleucas (Mitchill)

Eight golden shiners were caught, all by seining: two at C1, one at C2, two at D1, and three at D3. Probably the species occurs in low numbers throughout the area. Some occurrences may result from escapement from Kaw Valley Fish Farms, which produces this bait minnow commercially near Lawrence. Golden shiners inhabit pools and feed on plankton.

Creek chub, Semotilus atromaculatus (Mitchill)

Thirty creek chubs were taken by seining: one at C1, five at C2, eight at D1, eight at D2, and eight at D3. Twenty-seven were caught in May or June, two in July, and one in November. Fifteen were taken in 1979, three in 1980, 12 in 1981. This species normally inhabits pools of small upland streams; it spawns in April and May. Many creek chubs in our river samples were young-of-year, probably washed from tributaries. That would account for occurrences mainly in May and June of the wet years 1979 and 1981.

Silver chub, Hybopsis storeriana (Kirtland)

The silver chub ranked fifth in abundance among minnows (Cyprinidae). Three were taken at C1, 17 at C2, 30 at D1, 225 at D2, and 31 at D3. In 1979, 88% of silver chubs were found on substrates classified as silt (90% in 1980); none were taken on substrates coarser than sand-gravel. Both young and adults occurred in each year of the study. Based on samples taken in 1980, mean lengths of silver chubs were 26mm in June, 45mm in July, 58mm in August, and 76mm in September. Mean condition coefficients varied from 0.83 in June to 0.95 in September. The growth-rate is faster than that cited for Lake Erie by Carlander (1969:404); comparative data on condition

coefficients are lacking. The greatest mean density recorded was $0.71/M^2$, at D2 in June 1980. Generally, densities were less than $0.12/M^2$. Biomass never exceeded $0.09/M^2$.

Gravid females occurred in supplemental samples beyond the study area in April; probably they spawned in May.

As indicated in the historical account of the fish-fauna, this is the only species of chub that has maintained or increased its abundance in the past 30 years. Davis and Miller (in Copeia, 1967:1-39) inferred that the silver chub feeds largely by sight. Its principal food (as cited in Carlander, 1969:404) is zooplankton (in young), midge-larvae and burrowing mayflies (in adults). These preferences would account for its sustained abundance, especially in the nearly lentic habitat with silt substrate at D2.

Speckled chub, *Hybopsis aestivalis* (Girard)

The speckled chub occurred at all sites, but its numbers varied greatly with substrate-type. One-third of the total number captured (43 of 120) were found in 1979 at D3E. Their habitat was in small, shallow channels separated by islands, over sand or sand-gravel substrate. In 1980, that habitat was eliminated by dredging. Only seven additional specimens were found on all transects in all years at the D3 site; only one was found in 1981, when the prevailing substrates were silt, silt-sand, and silt-rubble. Elsewhere, 42 speckled chubs were taken at D1, 21 at the two Control sites, and three at D2. Eighty-eight percent of all specimens occurred on substrates classified as sand or sand-gravel. The areas occupied are shallow and swept by currents. The maximum density recorded was $0.14/M^2$, in August 1979 at D3E. Young-of-year were found in June at one Control site, at D1, and at D3. Mean lengths were approximately 21mm in June, 30mm in July, 35mm in August, 41mm in September, and 48mm in November. This growth rate is about equal to or slightly better than that reported for the Des Moines River, Iowa, by Carlander (1969:398).

Condition coefficients for this slender species varied from 0.57 to 0.88, average 0.70, in our samples.

Sturgeon chub, Hybopsis gelida (Girard)

Three sturgeon chubs were captured: one in May and one in August 1979 at D3E, and one in August 1979 at D3D. That habitat disappeared with dredging of the island area at Dredge site 3 in 1980. The sturgeon chub occupies swiftly flowing water over fine gravel substrates in the larger, turbid streams of the Missouri River Basin. Its abundance has declined severely in the Kansas River and elsewhere (Baxter and Simon, 1970:65; Brown, 1971:91). Factors causing the decline are thought to be altered habitats and clearer waters, more favorable to sight-feeding competitors and predators which increased in the rivers following impoundment. In the lower Kansas River, dredging compounds these problems by deepening the channel, slowing flows, and inducing siltation.

Suckermouth minnow, Phenacobius mirabilis (Girard)

The suckermouth minnow occurred in low abundance at the Control sites and D1, rarely at D2 and D3. It inhabits shallow riffles over coarse sand substrate. Eight specimens found at D2 and D3 were taken when discharge was low in 1980. Young-of-year were found in 1979 at C2A on 13 July (28mm); in 1980 at C1B, D1E, D2A, D2E, and D3E on 26-27 June (16-25mm); and in 1981 at C2A on 21-23 July (25-30mm).

Emerald shiner, Notropis atherinoides (Rafinesque)

Emerald shiners occurred at all transects, and ranked fourth in seining samples. Of 2162 captured, about 79% (1700) were found at D3. Although the Partial site represented the least amount of sampling effort, 14% (301) of all emerald shiners captured came from that site. Numbers of emerald shiners diminished at upstream sites; 4% (89) were captured at D2, 3% (57) at D1, and 3% (62) at Controls. Most were found in slow currents, and although substrate was variable, nearly all were found in combinations of silt, silt-sand, or silt-covered rubble. Forty-two percent of emerald shiners

were found over silt-rubble substrate, 18% over silt-sand. The highest density recorded was $4.30/m^2$ at D3A in April 1981. Average yearly densities ranged from a high of $1.26/m^2$ at D3A to less than $0.01/m^2$ at Controls, D1A, D1D, and D2A in 1981. The length range in samples varied from 25 to 86mm. Condition coefficients varied from 0.74 to 1.01 (average 0.78). Gravid females were taken in May. Average egg diameters of four May females ranged from 0.69 to 0.85mm. Young-of-year were taken in July and August (25-31mm). Stomach contents of eight emerald shiners examined included Dipterans (Chironomidae), Trichopterans, Hemipterans (Corixidae), Odonates (Zygoptera), Oligochaetes, Cladocerans, and Copepods.

Redfin shiner, Notropis umbratilis (Girard)

The redfin shiner occurred in significant numbers at only one place, the outflow from a small tributary onto the river bed along the left bank at D3E (46 of 59 specimens). Elsewhere, five redfin shiners were caught at D1A, and single specimens were recorded from eight other transects (all Control and dredge sites represented). This species is abundant in pools of small upland creeks in the region. Individuals found in the river probably are vagrant.

River shiner, Notropis blennius (Girard)

The river shiner was captured at C1 (1 specimen), D3 (19) and the Partial site (9). One was young-of-year (27mm, 18 July 1980 at D3D). The species inhabits large rivers. It is moderately abundant in silted backwaters behind dikes in the Missouri River, but has never been common in the Kansas River.

Red Shiner, Notropis lutrensis (Baird and Girard)

Red shiners occurred abundantly at all sites, and in virtually all habitats sampled by seining. Of 70,521 caught, 37,772 were from Control sites (3,689 in 1979, 19,069 in 1980, 15,014 in 1981), 14,445 from D1 (2,520, 6,355, 5,570), 8,562 from D2 (1,218, 6,188, 1,156), and 11,216 from D3 (1,528, 5,635, 4,053). Red shiners dominated seining collections at all

sites, comprising 69% of the total catch at Controls, 67% at D1, 53% at D2, and 62% at D3. Densities ranged from 40.7/100m^2 at D2D to 269.3/100m^2 at D1E and 267.2/100m^2 at C2A. Densities of red shiners were higher at all sites relative to other species. Red shiners were found commonly over all substrates, but most often over silt-sand (28%).

Red shiners probably spawned from early May to October. Young-of-year 20mm or less in total length were taken from 21 May to 18 November, and were found at various times at all sites. Adult females collected 21 May had varied stages of reproductive development. One 67mm specimen was fully ripe, containing eggs having a mean diameter of 0.87mm (GSI=14.1).

The diet of red shiners consisted mostly of Dipterans (Chironomidae) and Coleopterans. Less frequent items included Ephemeropterans and Megalopterans (Corydalidae). Stomachs of 12 specimens were examined.

Probably the red shiner has always been abundant in the Kansas River. However, we believe that its abundance relative to other species in the fauna has increased during the past 30 years.

Sand shiner, Notropis stramineus (Cope)

Sand shiners were abundant in seining samples from all transects, ranking second only to the red shiner. Of 21,300 captured, 49% (10,497) were taken at Control sites, 20% (4,206) at D1, 18% (3,840) at D2, and 13% (2,757) at D3. The highest density recorded was 21.82/m^2 at D1E in May 1981. Average yearly densities ranged from a high of 10.97/m^2 at D1E to 0.11/m^2 at D2E in 1981, 1.23/m^2 at D2D to 0.12/m^2 at D3E in 1980, and 3.18/m^2 at C2B to 0.04/m^2 at D3E in 1979. The length range in samples varied from 11 to 66mm. Over all transects, average condition coefficients ranged from 0.94 to 1.04. Sand shiners are ubiquitous in the lower Kansas River, but seem to prefer substrates of sand or silty sand to other substrate types. They were most abundant in water 30 to 60cm deep, in slow currents.

Sand shiners have a prolonged spawning period, with reproduction taking place probably from May through August. Young-of-year first appeared in

late June, and were taken from all sites. Females examined in mid-May were gravid, having average egg diameters ranging from 0.59 to 0.84mm (see Table A6-1). Stomach contents of 33 sand shiners contained mostly Dipterans (Chironomidae). Less frequent items included Trichopterans (Hydropsyche), Odonates (Gomphus), Coleopterans, and Lepidopterans.

Plains minnow, Hybognathus placitus (Girard)

The plains minnow was found at D3 and the Partial site. Thirty-five of a total of 39 specimens captured occurred in one sample, on transect D3E in November 1980. Young-of-year 29-32mm long were taken at D3D and D3E on 18 July 1980. As its name implies, this species formerly was one of the dominant fishes, characteristic of shallow, sandy rivers throughout the Plains region. It remained abundant in the Kansas River through the 1950's, but its populations declined dramatically during the past two decades. The plains minnow sustains its former abundance in unimpounded, widely fluctuating but permanently flowing, very turbid, shallow rivers with shifting sand bottoms (e.g., Canadian, Cimarron, upper Arkansas [in part], and Little Missouri rivers. Although dredging has adverse effects on the habitat of the plains minnow, dredging cannot account for its depletion in the Kansas River, because its decline extends upstream almost to the limits of the basin.

Western silvery minnow, Hybognathus argyritis (Girard)

The western silvery minnow was taken at D1 (1 specimen), D3 (11) and the Partial site (9). This species, like the plains minnow, has declined in numbers recently. It characteristically inhabits larger, deeper rivers than the plains minnow, and was never so abundant as the plains minnow in the Kansas River.

Fathead minnow, Pimephales promelas (Rafinesque)

The fathead minnow occurred at all sampling sites, and ranked seventh in abundance among minnows. Most specimens were captured at D2 (181, or 72% of total) and D3 (34, or 14%). This species usually occupied quiet waters,

but substrate-type varied widely. The number captured varied between years in a manner related inversely to discharge rate - 190 in 1980 (lowest discharge), 52 in 1979, 9 in 1981 (highest discharge). The highest density recorded was $0.27/M^2$, at D2E in 1980. Young-of-year were taken at all sites, and in each year, most often in July. The length range in samples varied from 15-57mm. Condition coefficients varied from 0.82 to 1.17 (average 0.95) with the exception of two specimens having a value of 1.4 in May 1980 (gravid females).

Probably the fathead minnow has always represented a minor part of the Kansas River fauna. The species is most abundant in pools of intermittent streams.

Bullhead minnow, Pimephales vigilax (Baird and Girard)

The bullhead minnow occurs in the Kansas River as a result of recent introduction; it did not occur naturally in the Missouri River Basin. The earliest captures of the species were at Topeka and Lawrence in 1976. Since that year it has spread throughout the mainstream from Junction City to the mouth.

For the period of our study, the bullhead minnow ranked fourth in abundance among minnows in the lower Kansas River. It was taken at every transect (all sites), mostly abundantly at C2, D2, and D3. The highest density recorded was $1.28/m^2$ at D2 in 1981; densities elsewhere were generally $0.02-0.38/m^2$. Ninety-three percent of all specimens were taken over substrates classified as silt, silt-sand, or sand.

Both young-of-year and adults, mostly the former, occurred throughout the study area in all years. Egg-laden females, 45-54mm in length, were taken at C2, D2, and D3 on 26-27 June, 1980, and at D1 on 12 July. Specimens in later samples were spent. Condition coefficients varied from 0.85-1.07 (average 0.96), except in June, when values of 1.12-1.27 were recorded. The high June coefficients reflect reproductive development. Otherwise, condition varied little seasonally or between sites.

Bullhead minnows fed mainly on benthic insects. Of 198 stomachs with food, 120 (61%) contained chironomid larvae, 50 (25%) contained trichopteran larvae, and 18 (9%) contained oligochaete worms. Items of less frequent occurrence were miscellaneous Diptera, Corixidae, Cladocera, Copepoda, Coleoptera, Ephemeroptera, Ostracoda, algae, and insect eggs.

In its native range, the bullhead minnow is most common in silty backwaters of large rivers (Carlander, 1969:443).

Bluntnose minnow, Pimephales notatus (Rafinesque)

The bluntnose minnow occurred at all sites except the Partial site, and ranked sixth in abundance among minnows. The largest numbers were taken at C2 (78), and D2 (143). Only three specimens were taken in 1981, however: two at the Control sites and one at D1. Collections included both juveniles and adults.

Young 17-21mm long were taken at C2A, D1E, and D2E on 12 July 1979; and, young 19-23mm occurred at C2B, D2A, and D3E on 26 June 1980. Condition coefficients of most specimens were in the range 0.83-1.12, (average 0.96). Mean values were highest in May (1.03).

Sixty-seven percent (1980) to 70% (1979) of the bluntnose minnows captured were on substrates designated as silt or silt-sand.

The bluntnose minnow is abundant in pools of rocky upland tributaries to the Kansas River, but is only an incidental component of the mainstream fauna. The river may, nevertheless, be a significant refugium for the species during drought. Nearly 95% of captures were made in 1980, a drought year.

Central stoneroller, Campostoma anomalum (Rafinesque)

The central stoneroller occurred at all sampling sites, although not at all transects. Of 42 captured, 22 came from near a creek mouth at D1A in July 1979. Eight were found at D3D. Specimens ranged in length from

23-42mm. Young-of-year 23-24mm in length were obtained from D1E on 13 July 1979 and 27 June 1980. This species is abundant in small streams tributary to the Kansas River. Most stonerollers residing in the river are probably vagrant.

Blue sucker, Cycleptus elongatus (LeSueur)

Two blue suckers were collected using electrofishing methods. One came from C1 on 5 August, 1980, and the other from C2 on 6 September 1980. Effort values (fish per 1000 meters) were accordingly low, with only 0.3 blue suckers caught at the Controls and less than 0.1 over all sites. One specimen was captured by trammel nets in D3 Pit on 8 March 1981. No young were taken by any method. This species ranked 12th at C1, ninth at C2, and 18th over all sites in electrofishing samples. Condition coefficients of the two specimens collected were 0.87 and 1.00, respectively, giving a mean of 0.94.

The blue suckers taken from the Controls were in the deep, swift current of the main channel over sand substrate. They were found at a depth of one to one and one-half meters. The specimen from D3 Pit was in sluggish current about four meters deep over a deeply silted substrate. This habitat is uncharacteristic of the species, and suggests blue suckers may move to deeper holes in winter.

Bigmouth buffalo, Ictiobus cyprinellus (Valenciennes).

Bigmouth buffalo were taken at D2A-B and D3A-B by electrofishing and trammel netting, and at Turner by electrofishing. Young-of-year were seined at D3 on 12 July 1979 (40mm, 0.7g) and 26 June 1980 (24mm, 0.17g; 29mm, 0.26g). Many additional bigmouth buffalo were seen, and some captured, in the mouth of a creek below Lake Quivira in June 1981 (Fig. 43); these fish undoubtedly entered the tributary from the river. The location is between the D2 and D3 study sites.

The size range in our samples was 24mm to 633mm, 0.17g to 5,857g. Condition factors varied from 1.58-2.31, average 1.87. Values of 1.69-1.88

have been reported from Gavins Point Reservoir (Carlander, 1969:499). Stomach contents of bigmouth buffalo consisted entirely of microorganisms (not identified). The species feeds mostly on bottom organisms and zooplankton (Carlander, 1969:502). The smallest mature female in our samples was 238mm, 682 grams when captured at D3 on 7 May 1981; specimens 313-331mm (248-262g) were immature when captured at the same site in August 1980.

This species probably is more abundant in the lower part of the river than our capture records indicate. Its preferred habitat (sluggish flow, deep water with silted bottom) is more prevalent there than upstream.

Smallmouth buffalo, Ictiobus bubalus (Rafinesque).

Smallmouth buffalo were taken at D3A-B and the Partial site by electrofishing, and by seining at both Control sites, D2, and D3. Young-of-year were found at C1 on 20 June 1979 (32mm, 0.40g), at D3 on 26th June 1980 (36mm, 0.47g), at C2 on 17 July 1980 (46mm, 1.37g), at D2 on 18 July 1980 (57mm), and at Turner on 11 August 1980 (50mm).

Stomach contents of a 356 mm smallmouth buffalo captured on 11 August 1980 at Turner consisted of larval insects: 181 Potamyia (Trichoptera), 59 chironomids (Diptera), 4 Hydropsychid larva and one pupa (Trichoptera), and one Baetid nymph (Ephemeroptera). A 333mm, 541g specimen, captured 20 May 1980 at D3, contained six larvae and six pupae of chironomids, one dipteran pupa of undetermined type, one Potamyia larva, and much unidentifiable organic matter. Smallmouth buffalo feed mostly on benthic invertebrates, especially over rocky substrate in streams.

This species may be more common than our samples indicate, especially in the lower part of the study area. On the other hand, historic records suggest a long term decline in its abundance.

River carpsucker, Carpiodes carpio (Rafinesque)

Distribution and Abundance. River carpsuckers were the most abundant species taken by electrofishing methods, and were found at all transects.

Of 699 caught, 299 carpsuckers came from C1, 77 from C2, 33 from D1A-B, 48 from D1D-E, 50 from D2A-B, 29 from D2D-E, 41 from D3A-B, 59 from D3D-E, and 63 from the Partial site. On the basis of effort (fish per 1000 meters), 57.0 were found at Controls, 26.3 at D1, 11.4 at D2, 15.9 at D3, 28.4 at the Partial site, and 27.8 over all sites. Although classified as abundant at all sites, carpsuckers were most numerous (by effort) at the Controls and D1, comprising 67% of all caught. Carpsuckers ranked as the most abundant species in electrofishing at the Controls, D1, and in the overall composition. They were second in abundance to gizzard shad at D2A-B, D2D-E, and at the Partial site. At D3D-E, carpsuckers were second behind freshwater drum, while at D3A-B were third behind gizzard shad and drum. A total of 82 carpsuckers were captured in pit trammel nets (26 at D2, 56 at D3), ranking them second to shovelnose sturgeon in net samples.

River carpsuckers were the third most abundant species captured by seining. Of 7902 caught, 5081 were captured at Control sites (670 in 1979, 4168 in 1980, 243 in 1981), 1379 at D1 (87 in 1979, 1087 in 1980, 205 in 1981), 1004 at D2 (163 in 1979, 778 in 1980, 63 in 1981), and 613 at D3 (165 in 1979, 426 in 1980, 22 in 1980). Densities ranged from 3.01/100m^2 at D3D to 36.66/100m^2 at C2A. The average density was 12.98/100m^2. The density of carpsuckers (by site) decreased progressively from Controls through D3. Carpsuckers ranked third in seining from all sites except D3, where it ranked fourth.

K-values. Condition coefficients averaged 1.43 over all sites, ranging from 1.06 to 1.67. There were no appreciable differences in condition between sites.

Habitat. River carpsuckers were found in a wide variety of habitats. Most were caught in backwaters, along shore in the mainstream, or anywhere there was reduced current. They preferred soft substrates, normally of sand or silt. Twenty-six percent of carpsuckers captured by seining were found over silt substrates, 28% over silt-sand, and 11% over sand. Large numbers of yearlings and young-of-year were collected from shallow bays extending onto sandbars and pools in slowly-flowing ribbon channels 20-40cm deep. Algal growths commonly covered substrates where these young were found. Their food consists of diatoms and other microorganisms.

Reproduction. Two females with eggs were examined. One 466mm specimen from the D3 pit, collected 11 April 1980, contained approximately 447,500 eggs having a mean egg diameter of 0.89mm (GSI=7.1). The other, a 441mm specimen, came from D1E on 23 June 1980; it contained approximately 129,500 eggs having a mean diameter of 0.98mm (GSI=11.4). One female, taken 5 August 1980 from D1E had already spawned (GSI=0.1).

Young-of-year river carpsuckers appeared in July samples each year at nearly all sites. In 1980, their average total lengths increased as follows, based on samples of 100 or more fish, from four to six sites each month: 17-18 July, 25.3mm; 13-14 August, 35.9mm; 13-14 September, 53.2mm; 1-2 November, 53.5mm. Juveniles of the previous year class, captured on 2 May 1980, were 52.0mm in average length, but grew to an average length of 64.1mm by May 22. We conclude that spawning occurred in late June, first-year growth terminated in September, and growth resumed in May. The young were very abundant in summer, often occurring in large schools in calm, shallow areas where daytime temperatures were much higher than in the mainstream. Young carpsuckers were important as forage for piscivorous fish species.

Quillback, *Carpiodes cyprinus* (Le Sueur)

This species so closely resembles the river carpsucker that the two were not distinguished in most field activities. Therefore the two are combined (as "carpsuckers") in all tabulated summaries in this report. The quillback was much less abundant than the river carpsucker, but occurred in small numbers at these transects and possibly at others: C1A, C1B, C2A, D1A, D1D, D2A, D2D, D2E, D3A, D3D, D3E, and the Partial site. Young-of-year were found at all of the sites listed and yearling to adult individuals were taken at many sites by electrofishing.

The quillback spawned earlier and its young grew more rapidly than the river carpsucker in 1980. Quillback young appeared in June, and averaged 30mm in total length (range 17-45mm) on 26-27 June. On 17-18 July their average length was 63.2mm (range 35-96); on 13 September 126mm (119-134); and on 2 November 152mm (138-163). Yearlings captured on 19 May 1981 had an average length of 175mm (range 147-204mm).

Records of quillback in the Kansas River basin are few and questionable prior to 1957, although the species is probably native to this river. Its numbers have increased continuously in the lower Kansas River during the past two decades.

Shorthead redhorse, Moxostoma macrolepidotum (Le Sueur)

Distribution and Abundance. The shorthead redhorse was found at all sites by electrofishing except the Controls and D3 Pit. Of 31 caught, one shorthead redhorse came from D1A-B, two from D1D-E, one each from D2A-B and D2D-E, six from D3A-B, five from D3D-E, and 15 from the Partial site. On the basis of effort (fish per 1000 meters), 1.0 were collected at D1, 0.3 at D2, 1.8 at D3, 6.8 at the Partial site, and 1.2 over all sites. One was captured in a trammel net at D2 Pit on 23 November 1980. Catch per unit effort data indicate this species is most abundant at the lower sites (D3 and Partial). This species is apparently widely dispersed during much of the year, but congregates in late spring for spawning; 27 of 32 were captured during May and June. No more than two fish were caught in any other month of the study. The shorthead redhorse ranked ninth in cumulative electrofishing samples, but would rank much lower were it not for these two months of peak abundance. Of 12 shorthead redhorses caught by seining, seven were from Control sites, three from D1, and one from D3. Young-of-year were taken on 13 July 1979 at D1E (33-34mm) and on 26-27 June 1980 at C1B (27mm) and D3E (23mm).

K-values. Condition coefficients averaged 1.33 over all sites, ranging from 1.08 to 1.26. The range and mean of coefficients did not vary between sites.

Habitat. The shorthead redhorse inhabited areas with a gravel, rock, or silt and rock combination substrate in moderate to fast currents. It was usually found at depths of one-half to one meter at the bottom of riffles or runs between bars.

Food. Like most suckers, the shorthead redhorse is a bottom feeder that ingests bottom material and then selectively rejects inedible portions.

It feeds on algae, aquatic insect larvae, and other small invertebrates. Of 17 stomachs examined, six contained food. Dipterans (Chironomidae) were the most frequent and abundant food items, occurring in all stomachs containing food. Trichopterans (Potamyia, Hydropsyche) were found in low numbers in two stomachs. Detritus was found in all stomachs from the Turner site, but was not found in fish from other sites. The stomach of one specimen from D1 contained nematodes, but it is not known if they were parasitic (see Table A7-3).

White sucker, Catostomus commersoni (Lacepede)

Two white suckers, young-of-year 35 and 45 mm long, were taken in seines at C1 on 20 June 1979. No other specimens of this fish, characteristic of small, clear tributaries were found. Perhaps these two entered the river from Cedar Creek, just upstream from the point of capture.

Black Bullhead, Ictalurus melas (Rafinesque)

Distribution and Abundance. Four black bullheads were collected by electrofishing, all between 21 and 22 May 1981 at high water. One was collected from C1, two from C2, and one from D3A-B. On the basis of effort (fish per 1000 meters), 0.5 bullheads were taken at Controls, 0.2 at D3, and 0.2 over all sites. All three fish from the Control sites were found in backwaters left as a remnant of receding high water, isolated from the main river. Several were found dead in drying pools, and were not included in our totals. The bullhead from D3A-B was caught supplementally inside the mouth of a small creek approximately 600 meters upstream from the dredge. Black bullheads ranked 18th in abundance in electrofishing, varying from 9th at C2 to 12th at C1 and D3.

Five additional black bullheads were captured by seining: one at C1 in May 1981; two at D1, also in May 1981; and two at D3 in August 1980.

K-values. Condition coefficients averaged 1.64, ranging from 1.41 to 2.18.

Reproduction. One adult female, 165mm in length, collected 21 May 1981 from C1A was found to contain approximately 2,470 eggs having a mean diameter of 1.00 mm (GSI=1.51). No young-of-year were recorded.

Food. One of four fish examined contained food, consisting of two sand shiners and two unidentified minnows. In general, black bullheads feed omnivorously much like the channel catfish.

Channel catfish, *Ictalurus punctatus* (Rafinesque)

Distribution and Abundance. Channel catfish were collected by electrofishing from all transects. Of 250 caught, 101 were from C1, 69 from C2, 12 each from D1A-B and D1D-E, nine from D2A-B, five from D2D-E, two from D3A-B, nine from D3D-E, and 31 from the Partial site. On the basis of effort (fish per 1000 meters), 25.8 channel cats were caught from Controls, 7.8 from D1, 2.0 from D2, 1.8 from D3, 14.0 from the Partial site, and 10.0 from all sites. Of 170 channel cats from Control sites, 140 were collected in a single sample in May 1981 (see Table A4-51). This unusually large sample of mostly juvenile channel cats caused results that may be misleading in terms of their abundance at Control sites relative to other sites. Twenty-eight channel cats were captured in trammel nets at D2. Of these 28, 18 were captured on 22 November 1980. Seven were captured in trammel nets at D3. Channel catfish were the fourth most abundant species taken by electrofishing. They ranked from second at Control sites to tenth at D3A-B, and ranked from third to sixth at the other sites.

In all years, 803 channel cats were captured by seining. Of these, 137 were caught at Control sites (74 in 1979, 34 in 1980, 29 in 1981), 204 at D1 (51 in 1979, 89 in 1980, 64 in 1981), 282 at D2 (260 in 1979, 11 in 1980 and 1981), 243 at D3 (184 in 1979, 57 in 1980, two in 1981). The number of channel catfish caught by seining declined from 1979-1981; about 71% were captured in 1979. Densities ranged from 0.35 at C2A to 4.63/100m^2 at D2D. The mean density over all years was 1.59/100m^2. Channel catfish ranked 6th in seining at Controls, 4th at D1, 6th at D2, and 7th at D3.

K-values. Condition coefficients for electrofishing averaged 0.89 over all sites in electrofishing, ranging from 0.68 to 1.32. Average condition coefficients for 1980 seining samples ranged from 0.75 at C2A to 1.12 at D2A. Mean values were highest in August. The range and mean of coefficients showed no appreciable difference between sites.

Habitat. Channel catfish occupied a variety of habitats, depending on age. Young-of-year and yearlings were most abundant in shallow water near shore in moderate currents at times of low discharge. They were most common over silt and rubble substrates. Forty-three percent of channel catfish caught seining were found over rubble substrates; 24% were found over silt. During high flow periods small channel cats moved into backwaters and creek mouths protected from strong current. Large individuals were collected in deeper water, occasionally in silted backwaters but more commonly in slow to moderate currents with flow broken by obstructions. Adults were found occasionally in the dredge pits.

Reproduction and Growth. Of 91 adult channel cats examined, 41 were female, giving a sex ratio of 1.2♂:1♀. Five females contained developing eggs. The earliest capture of a female (288mm) occurred at D2 Pit on 7 March, 1980. It contained approximately 4,300 eggs having a mean egg diameter of 1.04mm (GSI=1.3). One female (434mm) collected at D2B on 2 May, 1980 had approximately 10,000 eggs having a mean diameter of 2.08mm (GSI=2.1). Two ripe females were collected at the Partial site on 12 May 1981. One 403mm female contained approximately 10,700 eggs having a mean diameter of 1.98mm (GSI=6.7). The other (401mm) had approximately 10,100 eggs with a mean diameter of 2.63mm (GSI=11.1). A 395mm female collected at D2A on 20 May 1980 had approximately 9,500 eggs having a mean diameter of 2.24mm (GSI=7.1) (see Table A6-1).

Young-of-year were recorded at all sites and in all years of the study. Our first captures each year occurred in the July samples, when most young had lengths of 23-35mm.

Ages were determined for 13 channel catfish from Control sites, 12 from D1, 24 from D2, 15 from D3, and 13 from the Partial site. All year classes

from 1971 through 1981 were represented in the samples, with the exception of the 1973 year class. In general, channel catfish reached lengths of two to six inches in the first year of life, six to 10 inches in the second, nine to 14 in the third, 14 to 16 in the fourth. The largest fish aged were 17-18 inches long, and six to nine years old. We detect little difference in growth-rates between sites after the fish attain lengths greater than 200mm at age two. Young and yearling fish tend to be larger at sites downstream, although the evidence for this is ambiguous due to differences in dates of capture. April yearlings at Control sites were smaller than May yearlings at D1, June yearlings at D3, and May yearlings at Turner. April 2-year-olds at the Controls were smaller than March 2-year-olds at D2 and May 2-year-olds at the Partial site.

Food. The channel catfish had an omnivorous diet consisting primarily of aquatic insect larvae. Dipterans (primarily Chironomidae) occurred in 84% of 68 stomachs containing food, and were the most frequently found item at all sites. Trichopterans (primarily *Potamyia* and Hydropsychidae) were found in 62% of the stomachs and were the second or third most frequent item at all sites. Terrestrial insects, Ephemeropterans (mostly *Hexagenia*), and Hemipterans (Corixidae) followed in terms of frequency, occurring respectively in 32, 29 and 16% of the fish examined. In contrast to the flathead, which is highly predatory on smaller fishes, the channel cat does not extensively exploit this resource. Only three (4%) channel catfish had eaten fishes. A complete list of food items by site may be found in Table A7-4.

Many juvenile channel catfish collected from April through June 1981 were infested with a fungus-like disease. This malady, not observed in adults, produced reddish lesions in the area of the caudal and anal fins. Parasitic copepods (*Salmincola*) were found attached to the gills of two adult specimens captured in May 1980.

Flathead catfish, *Pylodictis olivaris* (Rafinesque)

Distribution and Abundance. Flatheads were collected by electrofishing from all transects except D2A. Of 70 fish, five flatheads were caught from

C1, eight from C2, six from D1A-B, 12 from D1D-E, two from D2D-E, three from D3A-B, eight from D3D-E, and 26 from the Partial site. Three flatheads were captured in pit trammel nets (one from D2, two from D3). On the basis of electrofishing effort (fish per 1000 meters), the larger number were taken from the Partial site (11.7) and D1 (5.8), possibly because of attractive habitats near bridges at those locations. There was little difference in the number caught per unit effort between the Controls (2.0) and D3 (1.8). The fewest flatheads were found at D2 (0.3). Overall, the flathead ranked sixth in electrofishing, varying from fourth at D1D-E to ninth at D3A-B. The Controls, D1A-B and the Partial site exhibited the overall rank for this species. Eight flatheads were captured by seining; four at D2A in July 1981, one at D2E in July 1979, two at D3D in May 1981, and one at D3E in July 1979.

K-values. Condition coefficients averaged 1.13, ranging from 0.82 to 1.48. The range and mean of coefficients showed no appreciable variation between sites. A slightly lower mean value at Turner (1.09) is attributable to a proportionally greater number of small flatheads found at that site.

Habitat. Most flatheads were associated with cover such as submerged trees, log-jams, boulders and rip-rap, or bridge supports where debris collects and pockets of deep water are formed by swirling currents. Most were collected from depths of one-half to two meters and in moderate currents, although some were taken from quiet pools and backwaters. Few were taken in the absence of nearby cover, with or without current; thus this habitat feature appears to be of prime importance.

Reproduction and Growth. Of 44 flatheds in which sex was discerned, 21 were females. Three females contained eggs; one 413mm specimen from D2 Pit collected 23 November 1980 contained unripe eggs (GSI =0.5), one (252mm) from the Partial site collected 12 May 1981 contained approximately 1,100 eggs having a mean diameter of 1.15mm (GSI=0.5). The largest flathead captured (1,001mm) was a ripe female from D3D-E, captured on 19 June 1981. It held approximately 47,000 eggs having a mean diameter of 3.20mm (GSI=87.9) (see Table A6-1). Two young-of-year flatheads were seined at D2E and D3E on 12 July 1979; their lengths were 23 and 39mm.

Ages were determined for 23 flathead catfish. Individuals two and four years old from C2 had lengths of 283mm and 414mm, respectively. A September yearling from D1 was 276mm long, a 2-year-old 324mm, and five 3-year-olds 305-473mm. A September yearling from D2 was 271mm long. Four 3-year-olds from D3 were 329-461mm long; one 1,001mm (39-inch, 29 pound) flathead from D3 was approximately 10 years old. At the Partial site, five 2-year-olds were 193-363mm long, and one 3-year-old 341mm. The fish from the Partial site were taken on 12 May 1981, whereas most flathead aged from other sites were caught in August or September, and had 3 or 4 months' additional growth at similar ages.

Food. The flathead is a predator, and unlike the channel catfish and bullhead, is seldom a scavenger. Of 71 flathead stomachs examined, 39 contained food. Twenty-three (59%) had eaten fish, most of which were juvenile channel catfish. Other fish used as forage included carpsuckers, drum, *Notropis* spp., emerald shiners, black bullheads, and green sunfish. Identification of digested remains of fish was not possible in some cases. Fishes occurred in stomachs as the most frequent item at all sites except the Partial site, where they ranked second. The second most common item over all sites were Trichopterans (*Potamyia*, Hydropsychidae), found in 13 (33%) of the stomachs with food. Dipterans (mainly Chironomidae) were found in five (13%) stomachs, and were numerous in those stomachs where they were found. No dipterans were found in stomachs of flatheads from the Controls, but occurred in 24% of the flatheads from D3 and the Partial site. Crayfish were found in four (10%) of the stomachs. Less frequent food items included Ephemeropterans (*Isonychia*, Baetidae, Heptageniidae, *Stenonema*), Odonates (Coenagrionidae), copepods (*Argulus*), terrestrial spiders (Araneida), and a few unidentifed terrestrial insects (see Table A7-5).

Food habits of flatheads varied with size. Aquatic insects were found primarily in flatheads less than 200mm long. The diet of larger individuals consisted mainly of other fish. Trichopterans were the main component of the diet at Turner because of the predominance of small flatheads examined at that site.

Mortality. On 3 June 1981 while we were at D3, several large dead flatheads, carp, drum and carpsuckers floated downstream. We investigated this fish kill the following day, finding thirty dead flatheads weighing 4 to 15kg between D3 and the Johnson County water intake structure, as well as lesser numbers of other species in about three hours on the river. None were seen at or above D2. One dredge operator told us that large fish had been floating by his dredge at the rate of five to ten per hour for three days prior to our arrival. He reported seeing two or three flatheads he estimated to weigh fifty to sixty pounds. One he had pulled from the river we guessed to weigh 45 to 50 pounds. No specific cause for the fish kill was found, and no other fish kills were observed during our study.

Stonecat, *Noturus flavus* Rafinesque

Forty stonecats were caught by seining: one at C1, 14 at D1, and 25 at D3. Twelve of those captured at D1 were from swift, rocky riffles at transect D1A, six of them on 16 September 1979. That series included both young-of-year and adults, 33-77mm in length. At D3, 20 stonecats were recorded from transect D3D in 1979, when habitat at that location consisted of shallow, braided riffles between islands near the center of the channel; none were taken on the relocated transect D3D following movement of dredging equipment to the original location of that transect in 1980. Five stonecats were recorded from D3E in September and November 1980. The species did not occur in our samples from this dredge site in 1981, but many were found in supplemental electrofishing efforts farther downstream, in an area of strong rapids with rubble substrate.

The stonecat is a characteristic inhabitant of the Kansas River, wherever favorable habitats occur. It conceals itself beneath large stones, or less often snags and detritus, where flow is strong enough to remove all silt.

One 49mm specimen caught 6 September 1980 at D1A was examined for food; it contained 4 *Potamyia* and one *Hydropsyche* (Trichoptera), and 11 chironomids (Diptera).

Slender madtom, Noturus exilis Nelson.

One slender madtom was found on transect D1A on 16 September 1979. Its length was 40 mm, weight 0.7g. The species is common in several tributaries to the lower Kansas River, but its occurrence in the mainstream is accidental.

White bass, Morone chrysops (Rafinesque)

Distribution and Abundance. White bass were captured by electrofishing from all transects except D1A-B. Of 60 caught, four came from C1, six from C2, two from D1D-E, seven from D2A-B, six from D2D-E, 14 from D3A-B, nine from D3D-E, and 12 from the Partial site. On the basis of effort (fish per 1000 meters), 1.5 white bass were captured at Controls, 0.6 at D1, 1.9 at D2, 3.7 at D3, 5.4 at the Partial site, and 2.4 over all sites. White bass increased in abundance at downstream sites in electrofishing samples. Seven white bass were caught in pit trammel nets; three at D2, four at D3. The white bass ranked seventh over all sites, varying from fifth at D2D-E, D3A-B, and D3D-E to tenth at D1D-E.

In all years, 196 white bass were captured by seining; 53 at Control sites (20 in 1979, 28 in 1980, five in 1981), 34 at D1 (two in 1979, 31 in 1980, one in 1981), 113 at D2 (45 in 1979, 68 in 1980, zero in 1981), and 44 at D3 (20 in 1979, 23 in 1980, one in 1981). Densities ranged from 0.10 at C1A and D1D to 1.89/100m^2 at D2E. The mean density for all years was 0.37/100m^2. White bass ranked 10th in seining at Controls, 13th at D1, 11th at D2, and 12th at the Partial site.

K-values. Condition coefficients for electrofishing averaged 1.44, ranging from 1.04 to 1.82. Average condition coefficients for 1980 seining samples ranged from 1.09 at D1E to 1.43 at C2A. We detected no significant differences in condition between sites.

Habitat. White bass preferred quiet or slowly moving water of depths of one-half to two meters. They were found in association with dredge sites more often than not, and were likely to be found over silt or silt-rubble

substrates. Sixty percent of white bass captured in seines were found over silt substrates, while 13% were found over silt-sand and silt-rubble. White bass were found in dredge pits at depths of three to five meters.

Reproduction and Growth. Five adult females collected at D3 on 22 May 1981 had recently spawned. One 285mm female, also from D3, collected 22 November 1980 was full of unripe eggs (GSI=1.6). Young-of-year white bass were found at C2B, D2A, D2E, and D3A. On 26 June 1980, white bass had minimal lengths of 27-34mm at several sites; in 1979, young as small as 21mm occurred as late as 13 July, but others ranging upward from 36mm were taken at the same site (D2) in June. Ages were determined for 35 older fish captured at C2 and various transects or pits at D1, D2, D3, and the Partial site. No site-specific differences in growth rate are apparent. Young attained lengths of 88-100mm at Turner by 11 August, and 133-153mm at C1, D2, and D3 by 7 September. A 165-mm young was taken at D3 on 22 November. A one year old white bass caught in May was 195mm long, yearlings in June samples were 158-205mm, and in August through November 168-230mm. Two-year-old fish varied from 228-277mm in May and June, 237-285mm in August -November. Most of these fish were from D2, D3 and the Partial site, but yearling and 2-year-old white bass occurred as far upstream as D1 and the Control sites. One 236mm male collected from D3 on 7 May 1981 was sexually mature, exuding milt (see Table A6-1).

Food. Small fish and Hemipterans (Corixidae) made up the bulk of the diet of white bass. Both of these items were found in 51% of 41 stomachs containing food, although Hemipterans were much more numerous. Trichopterans (*Hydropsyche*, *Potamyia*) were found in 10%. Dipterans (Chironomidae) and Ephemeropterans were also present in 10%. Less frequent items included Cladocerans, Copepods, and plant seeds. Corixids appeared to be the most important diet component of white bass, especially in mid and late summer (see Table A7-6).

Largemouth bass, *Micropterus salmoides* (Lacepede)

Distribution and Abundance. Five largemouth bass were collected by electrofishing, two from D1D-E on 21 May 1981 and three from the Partial

site on 11 August 1980. On the basis of effort (fish per 1000 meters), 0.6 were captured at D1, 1.4 at Turner, and 0.2 over all sites. Largemouth bass were rare in electrofishing samples, ranking 10th at D1D-E, 15th at the Partial site, and 17th overall.

Forty-six largemouth bass were captured by seining; nine at Control sites, six at D1A, one at D1D, four at D1E, seven at D2A, two at D2D, ten at D3A, four at D3D, two at D3E, and one at the Partial site.

K-values. Condition coefficients averaged 1.66, ranging from 1.62 to 1.68.

Habitat. Largemouth bass were found near cover, in pools or slowly moving water. At the Partial site, cover was afforded by rip-rap in the riverbed that created pools and log-jams. At D1D-E, bass were found in the mouth of a small stream. Lakes and ponds are the characteristic habitat of this species, and it is unlikely that they ever become abundant in the Kansas River.

Reproduction and Growth. Three of the five bass captured were females. One 211mm female from D1D-E taken 21 May 1981 contained approximately 17,000 eggs having a mean egg diameter of 0.83mm (GSI=4.6). One 215mm female from the Partial site, collected 11 August 1980 had spawned. The third female, also from the Partial site, was small (137mm) and not reproductively mature. One male from D1D-E, captured 21 May 1981, had enlarged mature testes (see Table A6-1).

Young-of-year were captured in one or more years at C1A, C1B, D1A, D1E, D3A, D3E, and the Partial site. Although young bass as small as 29mm were taken as late as 13 July (at D3A in 1979), others grew rapidly. Bass 119 and 137mm that were caught at the Partial site on 11 August 1980 appeared from scale-examinations to be young-of-year. A 215mm bass from the same location was one year old. At D1E, bass entering their third growing season were 211 and 247mm long when caught 21 May 1981.

Food. Four of five largemouth bass examined contained food items. The smallest specimen (137mm) was from the Partial site and contained two Hemipterans (Corixidae). The other three bass contained exclusively small fishes. One from D1D-E had eaten two red shiners and one emerald shiner. The remaining two held only unidentifiable fish remains (see Table A7-9).

Green sunfish, *Lepomis cyanellus* (Rafinesque)

Distribution and Abundance. Twelve green sunfish were collected by electrofishing methods: one at C2, two at D1D-E, one at D2D-E, one at D3A-B and seven at the Partial site. On the basis of effort (fish per 1000 meters), 0.2 were collected from Control sites, 0.6 from D1, 0.1 from D2, 0.2 from D3, 3.2 from the Partial site, and 0.5 over all sites. Although occurring at all stations, more than 60% (by effort) were collected at the Partial site. Of those few collected from other sites, almost all were found near tributary streams. Green sunfish were rare in electrofishing samples, ranking 12th in abundance. Fifty green sunfish were captured by seining: nine at Control sites, five at D1, 16 at D2, and 20 at D3.

K-values. Condition coefficients averaged 2.31, ranging from 1.85 to 2.89.

Habitat. The only study area to yield many green sunfish by electrofishing was the Partial site. This site is characterized by having a large number of pools and boulders in the riverbed that back up flow, as well as bridge supports that would enhance green sunfish habitat. Otherwise green sunfish were found in backwaters or near creek mouths with little flow. They were found principally over silt or silt-rubble substrates. In general, habitat conditions of the Kansas river are not favorable for green sunfish.

Reproduction. Two mature females were captured from the Kansas River, both from the Partial site. One (123mm) caught 12 May 1981 had approximately 10,600 eggs, having an averge egg diameter of 0.87mm (GSI=9.6). The other, an 83mm yearling, was caught 11 August 1980. It contained approximately 4,000 eggs, having an average diameter of 0.69mm

(GSI=10.2). Another female from D1E, captured 21 May 1981 had enlarged ovaries but no discrete ova (GSI=1.3). Two males collected from the Partial site (12 May 1981) and D1A (19 May 1981) freely released milt (see Table A6-1). Young-of-year occurred in seine samples each year of the study: in 1979 at D2E on 12 July (12mm); in 1980 at D1D on 27 June (19mm) and at D2E on 18 July (14-20mm) and 14 August (24mm); and in 1981 at C2A on 21 July (27mm).

Food. Green sunfish commonly feed on terrestrial and aquatic insects, and larger ones also consume small fishes. Of seven stomachs examined, 57% (four) contained Dipterans (mainly Chironomidae). Hemipterans (Corixiae) were found in 43% (three) green sunfish. Chironomid larvae were by far the most numerous food item, (48 in one stomach, 40 in one stomach, 61 in one stomach), compared to Corixids (1,4,5). Other food items included Trichopterans (*Potamyia*), Gastropoda, Diplopoda, Acarina, Nematomorpha, Lepidoptera and one *Notropis* sp., none of which occurred in more than one stomach (see Table A7-7).

Bluegill, *Lepomis macrochirus* (Rafinesque)

Distribution and Abundance. Bluegill were collected by electrofishing from all transects except D1A-B, D2 Pit, and D3A-B. Of 31 caught, two bluegill were from C1, one from C2, ten from D1D-E, two from D2A-B, five from D2D-E, one from D3D-E, and 10 from the Partial site. All but four were found in May and June. On the basis of effort (fish per 1000 meters), 0.5 bluegill were caught at Control sites, 3.2 at D1, 1.0 at D2, 0.2 at D3, 4.5 at the Partial site, and 1.2 over all sites. Most were found at transects near tributary streams (D1D-E, D2D-E) and at the Partial site. One bluegill was captured in a trammel net in the D3 Pit on 23 August 1980. Bluegill were uncommon and occurred infrequently in electrofishing samples. They ranked ninth in abundance overall in electrofishing, varying from sixth at D1D-E to fourteenth at D3D-E.

In all years, 300 bluegill were captured by seining. Of these, 22 were caught at Control sites (five in 1979, 10 in 1980, seven in 1981), 57 at D1 (18 in 1979, 32 in 1980, seven in 1981), 80 at D2 (five in 1979, 62 in 1980,

13 in 1981), and 166 at D3 (11 in 1979, 153 in 1980, two in 1981). Most bluegill were captured at dredge sites, and more were caught in 1980 (86%) than in other years. Densities ranged from 0.02 at C1B and 0.06 at D1D to 2.30/100m^2 at D3E, taken over all years. The mean density was 0.64/100m^2. Bluegill ranked 14th in seining at Controls, 8th at D1, 13th at D2, and 8th at D3.

K-values. Condition coefficients averaged 2.34 in electrofishing, ranging from 2.07 to 2.99. In 1980 seining samples, average condition coefficients ranged from 1.53 at C2A and D1E to 1.80 at D3E. Average values were slightly higher at all D3 transects than at other transects.

Habitat. Bluegill were found in pools and backwaters with minimal current in the mainstream, but were most common near or in the mouths of creeks entering the river. Seventy-three percent of bluegill caught by seines were found over silt or silt-rubble substrates. Young-of-year were located near shore over silt bottoms at depths of less than one meter. Bluegill have increased in abundance in the Kansas River basin, owing to extensive stocking in impoundments.

Reproduction. Four females containing eggs were collected in May and June 1981. One (110mm) from D1A, collected 19 May 1981 contained approximately 7,200 eggs having a mean egg diameter of 0.79mm (GSI=6.8). One (105mm) from D1E, captured 21 May 1981 contained approximately 4,100 eggs having a mean diameter of 0.78mm (GSI=5.5). Another from D1E (115mm) collected 28 June 1981, had approximately 2,600 eggs having a mean diameter of 0.79mm (GSI=3.9). One (148mm) from D2A, collected 19 June 1981 contained approximately 2,200 eggs having a mean diameter of 0.91mm (GSI=9.8). One 130mm male from D2E, collected 22 May 1980, had mature testes and exuded milt (see Table A6-1).

Young-of-year were found each year of the study: in 1979 at D1E on 13 July (19-25mm), in 1980 at D2A and D3D on 18 July (16-32mm) and at C2B, D2E, and D3A on 14 August (16-25mm).

Food. Bluegill fed primarily on aquatic insect larvae, the most frequent item being Dipterans (Chironomidae), occurring in 71% of 14 stomachs containing food. Trichopterans (Hydropsychidae, Potamyia) occurred in 29% of the stomachs, while Hemipterans (Corixidae) and Odonates (Coenagrionidae, Gomphus) occurred in 21%. A complete list of food items by site may be found in Table A7-8.

Longear Sunfish, Lepomis megalotis (Rafinesque)

One longear sunfish was captured by seining on transect D1E in July 1979, and one occurred in electrofishing samples at D3D-E in April 1981. The longear is an uncommon inhabitant of upland tributaries to the lower Kansas River. Presumably those found in the river are vagrant.

Orangespotted Sunfish, Lepomis humilis (Girard)

The orangespotted sunfish occurred in low numbers at all sites in most years. For the full term of the study, 16 were seined at Control sites, two at D1, 77 at D2, and 40 at D3. Two additional orangespots were taken by electrofishing at D2, which apparently afforded habitats more favorable than other sites for this species. Like most sunfish, L. humilis inhabits pools. It occurs most abundantly in sandy streams throughout its range. Its food consists of insects, both aquatic and terrestrial, and occasional small fishes. It spawns in late spring and summer; young as well as adults occurred in our samples. This species is a characteristic but minor part of the Kansas River fauna.

White crappie, Pomoxis annularis (Rafinesque)

Distribution and Abundance. White crappie were collected by electrofishing from all transects except C2. Of 56 fish, two were found at C1, one at D1A-B, five at D1D-E, 17 at D2A-B, one at D2D-E, 15 at D3A-B, three at D3D-E, and 12 at the Partial site. Eleven were captured supplementally at D1D-E. On the basis of effort (fish per 1000 meters), 0.3 were captured at Controls, 1.9 at D1, 2.6 at D2, 2.9 at D3, 5.4 at the Partial site, and 2.2 over all sites. The abundance of this species varied

considerably within sites (0.6 at C1, 0.0 at C2; 0.7 at D1A-B, 2.9 at D1D-E; 5.2 at D2A-B, 0.3 at D2D-E; 4.3 at D3A-B, 1.1 at D3D-E). The uneven distribution of white crappie within sites reflects habitat variability between transects. However, white crappie did increase in abundance progressively from Controls to the Partial site. Over all sites white crappie ranked eighth in electrofishing samples, varying from fourth at D2A-B and D3A-B to 11th at D2D-E. Nine white crappie were captured in trammel nets: two at D2 and seven at D3.

In all years, 245 white crappie were captured by seining; 93 at Control sites (22 in 1979, 47 in 1980, 24 in 1981), 462 at D1 (five in 1979, 450 in 1980, seven in 1981), 52 at D2 (12 in 1979, 33 in 1980, seven in 1981), and 92 at D3 (15 in 1979, 77 in 1980). Of 450 white crappie caught at D1 in 1980, 442 were caught supplementally in a creek mouth at D1E in April. Densities ranged from $0.04/100m^2$ at C1A to $1.36/100m^2$ at D3E. The mean density for all years was $0.45/100m^2$. White crappie ranked 8th in seining at Controls, 4th at D1, 14th at D2, and 10th at D3.

K-values. Condition coefficients for electrofishing averaged 1.33, ranging from 1.00 to 1.73. Average condition values were higher at D3 and the Partial site than at other sites. Average coefficients for 1980 seining samples ranged from 0.96 at C1B to 1.43 at D1D.

Habitat. Adult white crappie preferred fairly deep, slowly moving water over a silt substrate. This habitat type predominates at D2A-B and D3A-B. Many were found at D1D-E near the mouth of a small stream. White crappie were common near creek mouths and in backwaters having reduced flow. Over 76% of white crappie captured by seines were over silt, 13% over silt-sand. Our evidence suggests white crappie utilized dredge pits to some degree, but their presence is likely to depend on current more than depth. They were seldom found anywhere over sand or in very shallow water.

Reproduction and Growth. One 219mm female containing eggs was collected from D1E on 21 May 1981. It held approximately 72,600 eggs having a mean diameter of 0.77mm (GSI=9.1). One female from D3A (11 April 1980), and four from D1E (12 April 1980) had somewhat enlarged ovaries (GSI's=1.0,

1.4, 0.3, 0.6, and 1.1). Two females, one from D1E on 21 May 1981 (GSI=3.7) and the other from the Partial site on 12 May 1981 (GSI=1.4), were spent (see Table A6-1). Young-of-year were found each year: in 1979 at C2A on 12 July (20mm); in 1980 at C2B, D3A, and D3E on 26-27 June (25-33mm) and D3A on 13 August (29mm); in 1981 at C2A and D2D on 21-23 July (28-29mm).

Ages were determined for 16 white crappie; these are listed by site and date of capture, followed by fish length and age (in parentheses). D1E, 5 August 1980 - 206(2); D2 pit, 8 March 1980 -121(2), 188(3); D3 pit, 23 August 1980 - 141(1), 165(3), 179(2), 192(3), 195(2), 206(2); D3 pit, 21 February 1981 - 171(2); D3B, 8 March 1980 - 240(4); D3E, 6 August 1980 - 186(2); Partial site, 11 August 1980 - 152(2), 180(2), 189(2), 195(2). The most interesting aspect of these growth rates is their variability. Some individuals had grown rapidly, such as the two 206mm crappie (age 2) from dredge sites 1 and 3. Others had grown much more slowly, such as the 165mm, 3-year-old crappie from the same site and date as one of the 206mm, 2-year-old fish. We suspect that crappie redistribute themselves in the river, and may have grown elsewhere than at the point of capture. Some may have originated in impoundments. The differences in growth were not site-specific, and the rate as a whole seems good.

Food. Large white crappie were found to feed extensively on small fishes, while all sizes regularly fed on various aquatic insects. Of 57 stomachs examined, 51 contained food items. Of these, 55% had consumed fishes, including red shiners, sand shiners, drum, sunfish, and others unidentifiable. Hemipterans (Corixidae) were found in 61%, and were occasionally numerous in stomachs. Trichopterans (mostly *Hydropsyche*) were also found in 61%, Dipterans (Chironomidae) in 37%, and Ephemeropterans (mostly *Hexagenia*) in 22% (a complete list of food items by site may be found in Table A7-10). Food choice shifts slightly from upper to lower stations from fish being the most frequent item to aquatic insects being most frequent at D3 and Turner.

Black crappie, *Pomoxis nigromaculatus* (Le Sueur)

Distribution and Abundance. Black crappie were rare in electrofishing samples. Of 16 collected, four came from a supplemental sample in a creek

mouth at D1E in May 1980. Of specimens caught at regular sampling sites, one was from D2D-E, two each from D3A-B and D3D-E, and seven from the Partial site. On the basis of effort (fish per 1000 meters), 0.1 black crappie were collected at D2, 0.6 at D3, 3.2 at the Partial site and 0.5 over all sites. None were collected in regular samples from Control sites, D1, or in pit trammel nets. This species increased in abundance at lower stations, apparently preferring the deeper, slower flow characteristic of these locations. Black crappie ranked twelfth overall in electrofishing samples, varying from tenth at D3A to twelfth at the Partial site. Only two black crappie were captured by seining, at D1E in August 1979.

K-values. Condition coefficients averaged 1.53, ranging from 1.10 to 1.85.

Habitat. Most black crappie were caught at the Partial site, which has a habitat characterized by numerous pools and broken flow created by rip-rap in the riverbed. They were found in quiet water behind large rocks at depths of one-half to one meter. Four black crappie were collected supplementally from the mouth of a small stream at D1E. This stream has a steep bank, silt and silt-rock substrate, slow current and water normally clearer than the nearby river. The black crappie was introduced into the Kansas River prior to 1900 (Metcalf 1966:158). It is still stocked in many impoundments, accounting for its presence in the Kansas River.

Reproduction. Of five females examined, only one 192mm specimen taken 12 May 1981 from the Partial site had enlarged ovaries, but it appeared to be spent (GSI=2.0). Three additional females collected 11 August 1980 from the Partial site were reproductively inactive (GSI'S=0.29, 0.45, and 0.48) (see Table A6-1). We recorded no young-of-year.

Food. Of 14 black crappie stomachs examined, 7 contained food. Of these, four (57%) contained Trichopterans (*Hydropsyche*) and Hemipterans (Corixidae). Dipterans (Chironomidae), Ephemeropterans (*Hexagenia*), and fish were found in two, or 29%. Fish species in the diet included eight *Notropis* spp., one sand shiner and one *Carpiodes* spp. (see Table A7-11).

Sauger, Stizostedion canadense (Rafinesque)

Distribution and Abundance. The sauger is represented in electrofishing samples only from the D3 and Partial sites. Four were collected from D3D-E, while five were found at the Partial site. On the basis of effort (fish per 1000 meters), 0.6 saugers were collected at D3, 2.3 at the Partial site, and 0.4 over all sites. This species increases in abundance as it nears the Missouri River, where it is known to be more common. Over all sites the sauger ranked 15th in electrofishing samples. None were collected in trammel nets. Seven saugers were captured by seining; five at Control sites and one each at D2D and D3D, in May and June 1979. Saugers were collected only during the period May through October.

K-values. Condition coefficients averaged 0.87 over all sites. Mean values were slightly higher at the Partial site, but not significantly so. Saugers from D3 had the lowest (0.70), but also the highest (1.02) values in the range.

Habitat. Most saugers were collected in backwaters having a substrate of silt-covered rubble. A few were found in slow currents over the same type of substrate. They were seldom found in water over one-half meter in depth.

Reproduction and Growth. Only two of nine saugers examined were females. One 428mm female from D3, collected 26 June 1980 had already spawned (GSI=0.4). the other female, (374mm) also from D3, was collected 7 September 1980, and showed no signs of reproductive maturity. Young-of-year were caught at D2D and D3D on 4 June 1979 (18, 32mm), but none were found in 1980 or 1981. Six saugers that were 313 to 374mm long when captured in August 1980 at D3 and Turner were two years old.

Food. Saugers in our collections were wholly piscivorous. Food items were found in six of nine stomachs examined. Fish species found in sauger stomachs included small carpsuckers, drum, carp, red shiners, and sunfish. Presumably young saugers feed on small crustaceans and aquatic insects (see Table A7-12).

Walleye, Stizostedion vitreum (Mitchill).

One walleye was found on transect C1B on 20 June 1979. This young-of-year fish was 83mm in total length. Adult walleye are caught rarely on hook and line in the river. All large reservoirs in the basin have been stocked with walleye. Many escape, and congregate again on spring spawning runs in stilling basins below the outlets of some reservoirs. Self-sustaining, reproductive river populations independent of reservoir origins may become esablished, but the present rarity of the species makes it seem unlikely that such a population now exists in the lower Kansas River.

Logperch, Percina caprodes (Rafinesque).

One logperch was found on transect D3A in September 1980. Probably it was vagrant from Turkey Creek, which enters the river near this transect. The logperch inhabits tributaries to the lower Kansas River, but the mainstream affords important habitat for the species only during extreme drought.

Orangethroat darter, Etheostoma spectabile (Agassiz).

Orangethroat darters were found at three sites. One juvenile specimen was caught on 26 June 1980 at transect D2A, near the mouth of Mill Creek, where the species has been captured often in other surveys. We took another orangethroat darter at D1A in July 1980, and seven at D3E in June and July 1980. None occurred in collections made in 1979 or 1981. Presumably the eight individuals at D1A and D3E were vagrants that found rocky riffles in these locations to their liking. The species is common in many tributaries to the lower Kansas River, but the river constitutes important habitat for this species only at times of extreme drought.

Freshwater drum, Aplodinotus grunniens (Rafinesque)

Distribution and Abundance. Drum were collected by electrofishing from all transects, most abundantly at the downstream stations. Of 332 caught,

29 were from C1, 26 from C2, 18 from D1A-B, 18 from D1D-E, 24 from D2A-B, eight from D2D-E, 56 from D3A-B, 98 from D3D-E, and 55 from the Partial site. On the basis of effort (fish per 1000 meters), far more were taken at D3 (24.6) and the Partial site (24.8) than at other sites (8.3 at Controls, 11.7 at D1, and 4.6 at D2). Eight drum were collected by pit sampling with trammel nets (four at D2, four at D3). Drum were the third most common species collected by electrofishing. They ranged from fourth at the Controls and D2D-E to first at D3D-E, and ranked second or third at the other sites.

In all years, 297 drum were captured by seining. Of these, 31 were caught at Control sites (17 in 1979, 12 in 1980, two in 1981), 39 at D1 (27 in 1979, 10 in 1980, two in 1981), 135 at D2 (25 in 1979, 110 in 1980), and 100 at D3 (46 in 1979, 54 in 1980). Densities ranged from 0.02/100m^2 at D1A to 2.85/100m^2 at D2E. The mean density for all years was 0.62/100m^2. Drum ranked 11th in seining at Controls, 12th at D1, 10th at D2, and 9th at D3.

K-values. Condition coefficients for electrofishing averaged 1.29, ranging from 0.88 to 1.68. In 1980 seining samples, average condition coefficients ranged from 0.98 at D2A and D2E to 1.37 at C1B. There was no significant variation in condition between sites.

Habitat. Drum preferred silt-covered rubble bottoms to other substrates. Most were collected from backwaters or stretches of slowly moving water, although adults were also captured in swifter currents over rubble or gravel substrates. Sixty-nine percent of drum captured in seines were found over silt substrates, 23% were found over silt-rubble. Young-of-year and yearling fish were usually found along shore, behind bars or in backwaters out of direct current, over silt substrates.

Reproduction. No reproductively active individuals were captured, but two females captured in mid-May (12 May at Turner, 21 May at D1E) had enlarged ovaries (see Table A6-1). Young-of-year drum occurred frequently at nearly all sites. In 1979, young seined on 12-13 July at C2A, C2B, D1E, and D3A had lengths of 11-39 mm. In 1980, young 12-21mm long were taken at D2A, D2C, D2E, D3A, D3D, and D3E on 26 June.

Ages were determined for 36 drum representing all primary sites and Turner. Growth rates seemed reasonably consistent, without apparent variation between sites; we believe they are best regarded as a single population. Young attained a maximum length of 140mm, but most were much smaller. The size-range in older age-groups was as follows: age I -- 155-224mm; age II -- 224-256mm; age III -- 284-336mm; age IV -- 353-412mm.

Food. Dipterans (Chironomidae) and Trichopterans (mostly *Hydropsyche*) were the dominant food items found in drum, each occurring in 58% of 31 stomachs containing food. Burrowing mayflies (Ephemeroptera) were found in 48%. Fish made up a modest portion of the diet, occurring in 23%, and only in individuals greater than 180mm in length. Hemipterans (Corixidae) were found in 16% of the drum stomachs, and were common only in the summer and fall. Less frequent items included earthworms (Oligochaeta), crayfish (Decapoda), and aquatic snails (Gastropoda). A complete list of food items may be found in Table A7-13.

12. DISCUSSION AND CONCLUSIONS

Recapitulation

This report is based on investigations made between 30 May 1979 and 11 December 1981 in miles 9.3-25.0 of the Kansas River. Eight dredges obtain much of the sand and gravel used in the construction industry in the Kansas City metropolitan area from the river channel in that reach. The dredges operate from floating platforms. They use a chain-and-ladder device or drill bit to loosen the substrate, and hydraulic suction to move water, sand, and gravel to shore through a pipe suspended along a pontoon ramp. During this study dredges were located at (approximately) river miles 12.9, 14.0, 14.7, 16.0, 18.4, 19.3, 21.0, and 21.6. At least one of the dredges has operated at its present site (mile 18.4) since 1931. Formerly, most dredges were located farther downstream. Five of eight dredges active in this river segment in 1954 were located in miles 9.5 through 12. Annual production of sand and gravel has increased from approximately 0.51 million tons in 1940-45 to 1.42 million tons in 1950-55, 2.11 million tons in 1960-65, and 2.38 million tons in 1970-75 (B&M, 1982). During this study, operators of the eight dredges reported production of 2.9 million tons in 1979, 2.1 million tons in 1980, and 0.9 million tons prior to 1 September in 1981.

Channel dredging is facilitated by the aggraded, sandy character of the Kansas River. Its valley has alluvial deposits 30 feet or more in depth beneath the present channel (Schoewe, 1951). The channel is broad, shallow, and flow is often braided. Water depths at low flow stages vary generally from 0.5 to 2.0 meters, and exposed sandbars and islands occupy about half the channel width. Unstable sandy shoals less than 0.3 m deep cross the stream at intervals throughout its course. In 1853, Tidball recorded such shoals about as far downstream as mile 9.3 (Langsdorf, 1950). Aerial photographs taken in 1954 reveal bars and islands downstream to mile 9.3, but these disappeared in miles 9.3-12.0 by 1970.

Recent degradation of the river bed has occurred upstream at least to mile 23.7. Declining water surface elevations at equivalent rates of

discharge represent one measure of the extent of degradation. During the period 1962-1977, the surface elevation at a discharge rate of 9,500 cfs declined approximately 3 feet at mile 9.5, 6 feet at mile 14.0, 3.5 feet at mile 16.36, 6 feet at mile 21.0, and 4 feet at mile 23.70 (B&M, 1982). A USGS gaging station that operated from 1917 until 1973 at mile 20.3 provides the longest continuous basis for measurement of degradation rates. Degradation occurred at accelerating rates through that period. Prior to 1962 the average annual rate was 0.15 feet per year, but since 1962 the rate has been 0.46 per year at mile 20.3.

Dredging contributes to degradation because the annual rate of removal of sand and gravel has exceeded the rate of their deposition at least since 1962 (B&M, 1982). However, the rate of sand transport and deposition has declined also, indicating that factors other than dredging are involved (B&M, 1982). Impoundments on the major tributaries of the Kansas River now intercept sediments and alter the river's natural flow regime; for example, flood-flows having the capacity to move large amounts of sediment no longer occur, and such flows formerly were more or less annual events. Also, degradation in the channel of the Missouri River may be propagated upstream into the Kansas River (B&M, 1982).

Dredging of sand and gravel affects the river in several ways. Its depth increases at the point of extraction--the dredge-pit. The velocity of flow slackens in a large dredge-pit, but may increase immediately upstream from the pit. The proportion of various particle sizes in the river bed changes as sand and gravel are removed selectively. Where dredging has been intensive for long periods of time, sand is depleted, the channel is degraded but water-filled bank-to-bank, velocity diminishes, and the river bed acquires an overlay of fine sediment except where exposed patches of stoney substrate resist erosion and maintain swift, shallow flows.

These changes potentially affect water quality and habitat conditions for aquatic organisms. The objective of this study was to measure and describe these effects. Data were obtained periodically on physical and chemical characteristics of the river and its biota (phytoplankton, zooplankton, benthos, fishes) at five primary sites: two Control sites (C1

and C2) located in mile 24 and mile 23, upstream from dredging activity; at the dredge farthest upstream (D1, mile 21.6) in the series of eight dredges cited previously; and at the fifth (D2) and eighth (D3) dredge sites in the series, progressing downstream (approximately at miles 16.0 and 12.9, respectively). Data were taken on transects crossing the river at 200-meter intervals at each site: two transects at each Control site (designated C1A, C1B; C2A, C2B); and five transects at each Dredge site, beginning approximately 200 meters upstream from the dredge-pit and extending to 400 meters below the pit (designated D1A-E, D2A-E, D3A-E). Data on fish populations were obtained at an additional (partial) site near mile 9.3. Supplementary records and observations were made throughout the reach from mile 9.3 to DeSoto (mile 31.0), and near Eudora (mile 42) and Lawrence (mile 51).

Rates of discharge varied in the term of study, May 1979 through December 1981, as shown in Fig. 5. Flow cycles in 1979 and 1981 were roughly parallel: low in spring, high in early summer (>8,000 cfs from late June through early August), and relatively low in late summer and autumn except for brief peak flows in November. In 1980, peak flows occurred in April (>16,000 cfs) and early June (12,000 cfs) but were very low (<4,000 cfs) during the remainder of 1980. Day to day fluctuations were common. Obviously discharge rates were the same at all study sites, and their immediate effects relate only to water quality parameters.

Channel conditions in dredged and non-dredged areas.

Average depths of water on three of the four transects at the Control sites varied from 110-125 cm in 1979, 60-80 cm in 1980, and 115-180 cm in 1981. Depths varied in direct relation to changes in discharge rates in the three years, indicating stability in channel form and the generally shallow nature of these sites. One transect at the Control sites, C2B, was exceptional in that its average depth increased each year, from 105 cm in 1979 to 120 cm in 1980 (despite low flows) and 140 cm in 1981, suggesting minor downcutting of the channel on that transect.

Dredge 1 was installed at mile 21.6 in autumn 1978 and removed a small amount of sand in November before terminating operations overwinter. Thus 1979 was its first full year of operation. In 1979 average depths at the 5 transects (A-E, upstream-downstream) were 70, 270, 255, 110, and 150 cm. Thus the immediate effects of dredging were doubling of depths in the pit area (transects B and C), and 39% reduction in depth upstream from the pit (transect A) as compared with depths at Control sites in 1979. Transect D1A, like the lowermost Control transect (C2B), became progressively deeper, from 70 to 95 to 160 cm, in the three years of study. That increase reflects bed degradation and entrenchment of the stream upstream from the dredge pit. Depths at transects D1B and D1C became shallower with reduced discharge in 1980 but increased again in 1981; however, these transects remained deeper than the Control transects. In 1981, the average depth at D1C was 490 cm, about 2.7 times that of the deepest Control transect. Depths at D1D and D1E, downstream from the dredge, were approximately the same as, or slightly greater than, depths at the Control sites in all three years of study. Differences in depth between transects--that is, differences in depth within the Dredge 1 site--exceeded depth variations between transects at all the other study sites. Depths in the dredge pit were 2.4-3.8 times the depth at D1A, and approximately two to three times the depth at D1D and D1E.

At Dredge 2, the mean depths on transects D2A, D2D and D2E were approximately 50% greater than depths at the Control transects and transects A, D, and E at Dredge 1. The mean depth of the pit area (D2B and D2C) was 420 cm, substantially greater than the pit depth at Dredge 1 except for the 490 mm depth at D1C in the final year of study. At D2 the ratio of pit depth to depths on transects upstream and downstream from the dredge diminished from 1979 to 1981 (2.5:1 in 1979, 2.3:1 in 1980, 1.9:1 in 1981), indicating some "leveling out" of the Dredge 2 site over time.

At Dredge 3, the mean depth on transects A, D, and E (191 cm) was about the same as the depth on the same transects at Dredge 2 (189 cm). Thus these areas at D3 remained about 50% deeper than the Control sites. The pit area at D3 was relatively shallow, however, averaging 336 cm and varying little from year to year. The ratio of pit depth to depths elsewhere within

the site was 1.76:1, less than at the other two dredge sites. Thus D3 was more nearly uniform in depth than other dredge sites, but was 1.5 to 2.7 times as deep as the Control sites. The relative uniformity in depth resulted from longitudinal movement of dredging equipment within the permit zone of the D3 site.

Current velocities at the Control sites averaged 0.42 meters per second, and varied little between transects or years (extremes 0.40-0.46 m/sec).

At Dredge 1 velocities were generally greater than in the Control sites, with the exception of Transect C within the dredge pit. Velocities in 1979 increased to 0.55-0.61 m/sec at transects A and B, 38% greater than at the Control sites. Velocities at D1A and D1B diminished somewhat in 1980 and 1981 as the stream became entrenched above the dredge, but remained higher than at the Control sites. Velocities were also high at transect D and E in 1979--0.55 and 0.49 m/sec, respectively. These velocities downstream were associated with a shift in location of the mainstream from the left bank, upstream from the dredge, to the right bank downstream from the dredge. An early effect of dredging at this site was to draw flow across the river bed into the "hole" created by dredging near the right bank. Flow then continued along the right bank downstream. The former left-bank channel was vacated, downstream from the dredge, as the right-bank channel became more firmly established. Velocities at transects D and E diminished to 0.34-0.40 m/sec by 1981, slightly less than velocities at the Control sites.

At Dredge 2 velocities were lower on all transects than velocities on any transect at the Control sites or Dredge 1, including the D1 "pit". Extremes in mean annual velocities were 0.06 m/sec, at D2B in 1980, and 0.30 m/sec at D2D in 1979. For the full term of study the mean velocities varied from 0.10 m/sec at D2C to 0.22 m/sec at D2A. Thus velocities throughout this dredge site were approximately one-fourth to one-half the velocities at the Control sites.

At Dredge 3, velocities were relatively uniform, varying from 0.12 to 0.27 m/sec with the exception of a 0.37 m/sec velocity at D3E in 1981. Greater velocities at D3E were attributable to narrowing of the mainstream as it approached an armored bar downstream from the site. Longitudinal movement of the dredge during the study influenced velocities as it influenced depth at D3, leading to general uniformity. For the full term of the project, mean velocities on transects A through D varied only from 0.17 to 0.21 m/sec, about half the velocities at the Control sites.

Substrate composition at the Control sites was predominantly sand. Sand alone comprised 62% of the area on Control transects in each year of study. Sand and gravel together comprised 66%-78% of the substrate in the three years, whereas silt and silt-sand represented 20% in 1979, 27% in 1980, and 34% in 1981. Very coarse substrate (rubble) was present but rare at the Control sites, comprising no more than 3% of the total area in any year (Fig. 47a).

At Dredge 1, substrates differed markedly from those at the Control sites, and substrates upstream from the dredge differed from those downstream. As in all sites, the substrates measured were in watered areas, principally the mainstream; the measurements excluded bars exposed above waterlevel, but trends on those exposed areas were similar to trends in the mainstream, depending on the frequency with which bars were inundated by high flows. In 1979, sand and gravel comprised 58% of the substrate at D1A, 55% on D1D and D1E (Figs. 47b,c). Sand and gravel decreased both upstream and downstream from the dredge in 1980 and 1981, most precipitously upstream. Areas having rubble comprised 32% of the substrate at D1A in 1979, 55% in 1980, and 32% in 1981. Silt and silt-sand substrates increased from 9% in 1979 to 28% in 1980 and 68% in 1981 at D1A. Sand and gravel were eliminated as major components 200 m upstream from the dredge pit within three years after dredging began at this site. Sand and gravel diminished less rapidly at transects D and E, to 29% in 1980 and 20% in 1981 (Fig. 47c). Silt and silt-sand represented a greater proportion of the substrates at D1D and D1E than at D1A in 1979 and 1980, but not in 1981, when rubble substrate was exposed on 31% of the mainstream area at D1D and D1E.

Fig. 47a-g. Differences in substrate composition between years at the Control and Dredge study sites. In each pie diagram, the white area = sand and gravel; stippled area = silt and silt-sand; black area = rubble and other components with rubble; lined area = complex mixtures not named above. Numerals indicate the percentage in each category, based on substrates in areas seined.

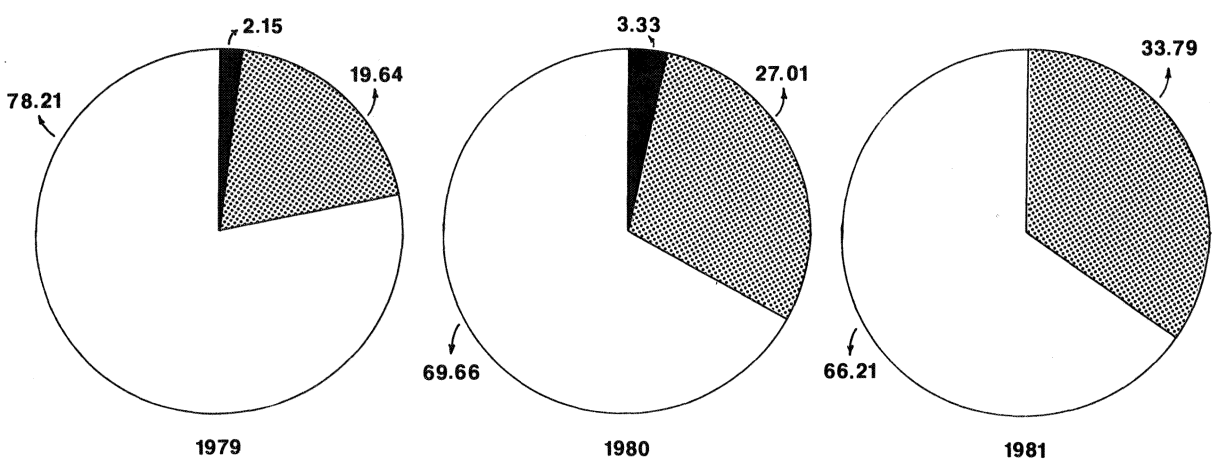


Fig. 47a. Composition of substrate at Control sites

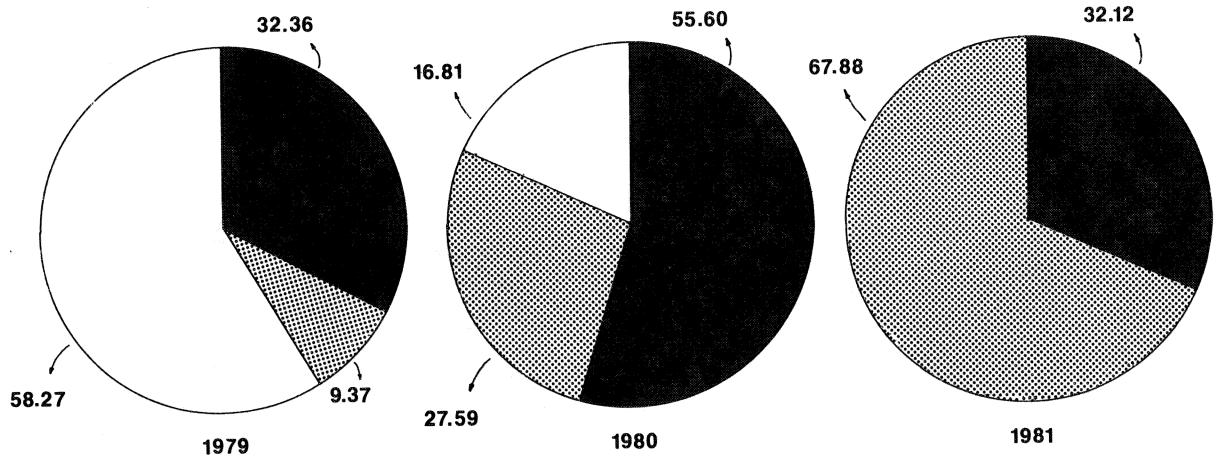


Fig. 47b. Composition of substrate at transect D1A (Dredge site 1)

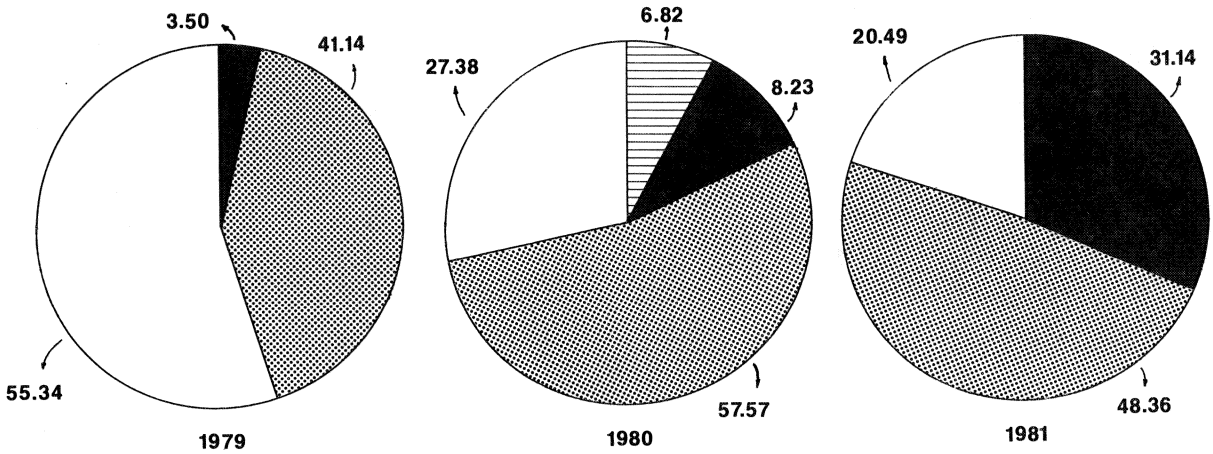


Fig. 47c. Composition of substrate at transect D1D and D1E (Dredge site 1)

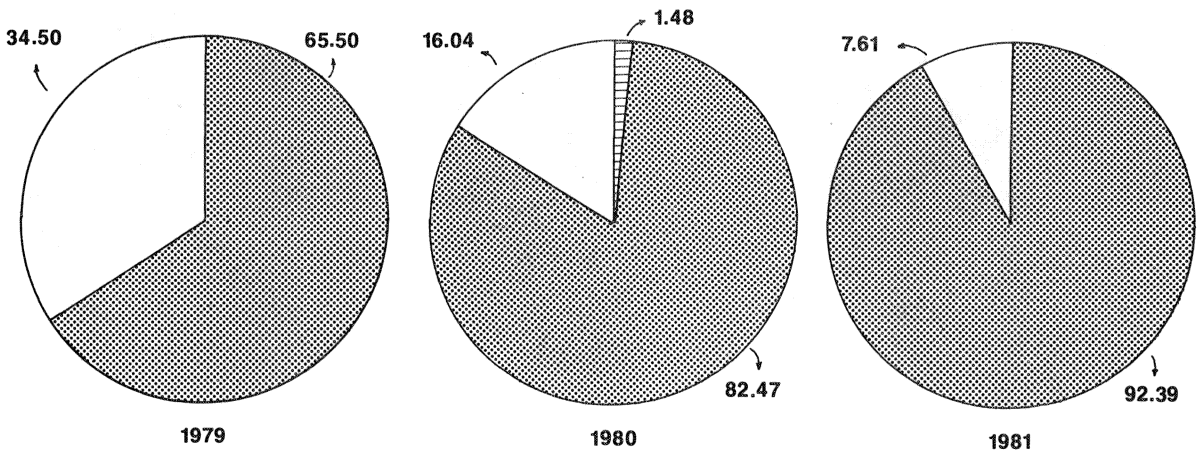


Fig. 47d. Composition of substrate at transect D2A (Dredge site 2)

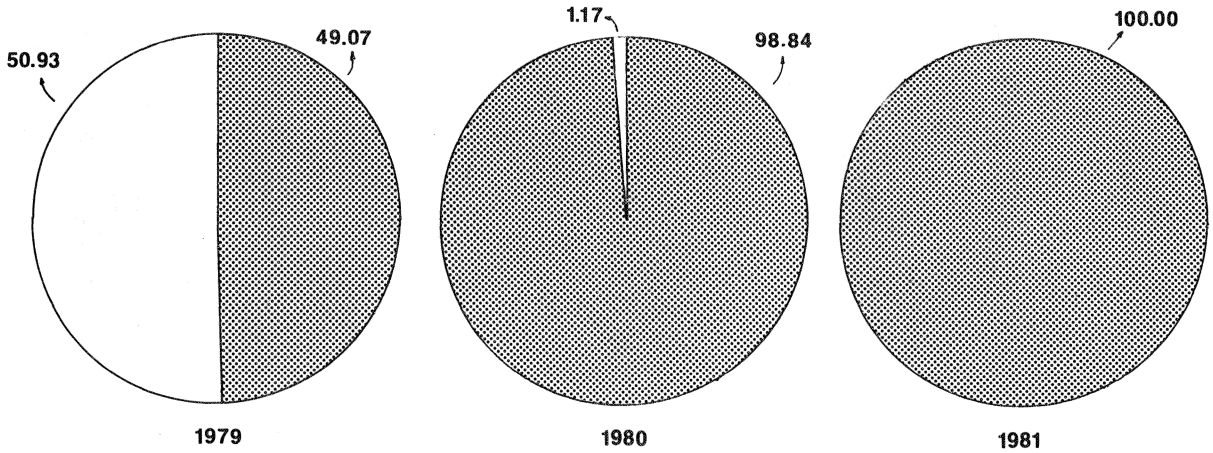


Fig. 47e. Composition of substrate at transect D2D and D2E (Dredge site 2)

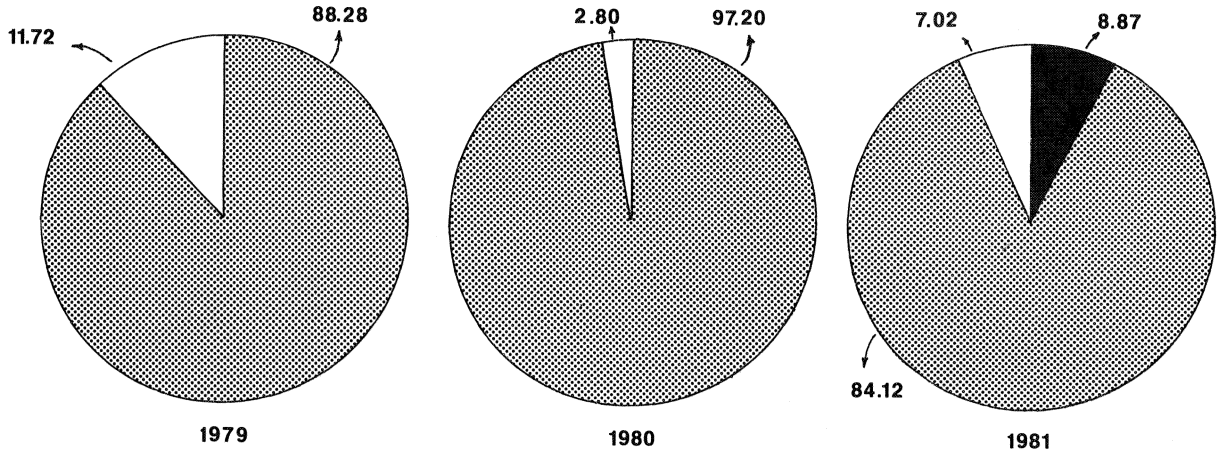


Fig. 47f. Composition of substrate at transect D3A (Dredge site 3)

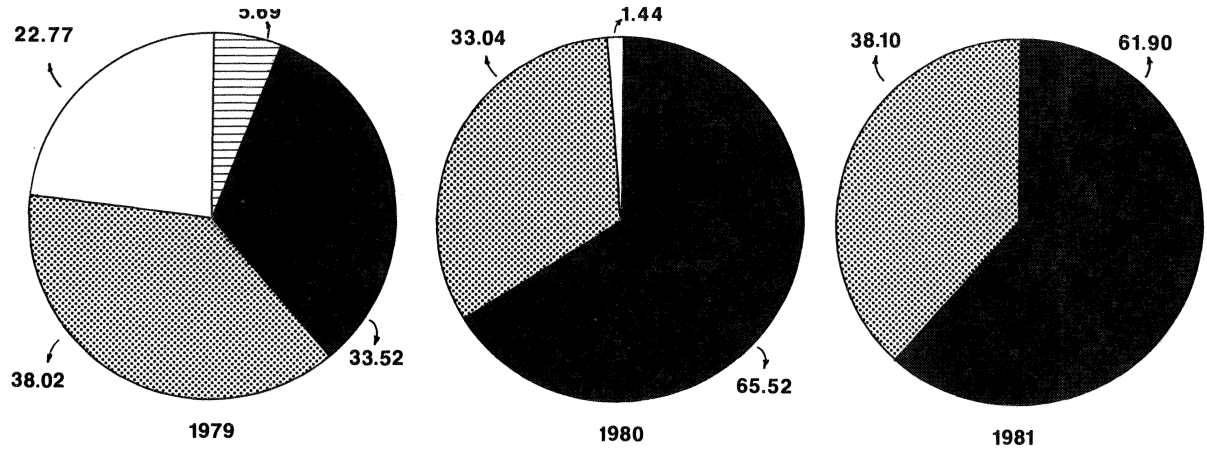


Fig. 47g. Composition of substrate at transect D3D and D3E (Dredge site 3)

At Dredge 2 in 1979, sand comprised approximately 34% of the substrate on transect D2A, upstream from the dredge, and 50% of that downstream on transects D2D and D2E. Sandy substrates occurred mainly along a gently sloping bar that extends outward from the right bank below Nelson Island at the Dredge 2 site. The remainder of the substrate at D2 in 1979 consisted of silt and silt-sand. By 1981, silt and silt-sand almost totally replaced other substrate types at this site. At D1A, substrates in 1981 were 92% silt or silt-sand, 8% gravel; at D2D and D2E, silt blanketed the surface of the river bed in 1981 (100% silt in areas sampled) (Figs. 47d,e). The extreme accumulation of silt at D2 probably resulted from dredging coupled with obstructions to flow of the river downstream from this dredge site. A diversion jetty at mile 15.0 acts as a low dam to maintain water levels high enough to serve the intake structure for the Johnson County Water District #1; it prevents scouring of silt from the Dredge 2 site at rates of discharge that occurred in 1980 and 1981. A temporary cofferdam installed during construction of a bridge for Interstate Highway 435, at mile 15.3, probably contributed to sedimentation downstream from the dredge, although the cofferdam was removed in 1980. In any case, dredging lowers the river bed and widens the channel at this site, without compensatory decline in the water surface elevation due to elevation control by the jetty at mile 15.0. Therefore, velocities of flow diminish and increasing proportions of the fine material transported by the river fall out at this site. The same tendency applies to fine sediments reintroduced by return flows from dredging activity, both within this site and upstream from it.

At Dredge 3, silt and silt-sand were the predominant substrates on transect D3A in each year of study (84%-97% of total); the remainder was principally sand (Fig. 47f). Downstream from the dredge on transects D3D and D3E, rubble and silt predominated (Fig. 47g). Sand and gravel comprised nearly 23% of the river bed on those transects in 1979, but disappeared as a major component by 1981. At transect D3E and downstream from it in mile 12 a broad armored bar affords partial channel control, deflecting flow through a narrow outlet against the left bank where it forms rocky rapids. In 1979 a transition zone of gravel, sand, and rubble substrate intervened between the armored bar and the dredge pit upstream; the dredge then operated at approximately mile 13.1. Flow was shallow and braided by low "islands" in

this intervening zone (Figs. 4d,e,f). Depths and current velocities, as well as substrates, varied greatly in the transition zone, which included several small riffle areas with adjacent eddies and pools. This zone was excavated in 1980 by two successive downstream movements of the dredge, which operated ultimately against the upper end of the armored bar at mile 12.66. Silt accumulated in the previous pit areas, and in 1981 the site consisted of a wide, moderately deep channel with sluggish flow and silted bed upstream from the armored bar. Rubble substrate on the bar itself was increasingly invested with silt except in the swift channel along the left bank. In 1979, rubble and gravel-rubble comprised 30% of the substrate area at D3E and no area was recorded as silt-rubble. In 1981, silt-rubble made up 52% of the substrate area, rubble 10%. In 1979 the substrate diversity value downstream from the dredge was 1.86, the equivalency value 6.44. These were the highest substrate diversity values found at any study site. By 1981 these values declined to 1.08 and 2.94, respectively. The dredge at this site discontinued operation in May 1981.

Physical and chemical parameters related to sediment and water quality.

Suspended solids concentrations varied with discharge, especially when high discharge resulted from direct runoff, and differed little at the Control and Dredge sites. The hydraulic mode of dredging used in the lower Kansas River scarcely affects its turbidity, except extremely locally where return flows of pumped water re-enter the river. Increased suspended solids concentrations at these points were not detectable 200 meters downstream. Turbidity sometimes decreased in passing through large dredge pits, and in passing from the Control sites through the dredged reach of the river. Slackened, less turbulent flow in the deeper dredged areas allowed part of the suspended solids to fall out there; the sedimentation rate in the dredged area exceeded that in Control sites. Present levels of suspended solids and turbidity are lower than those which characterized the river in its natural state, prior to the advent of impoundments and dredging.

Trace metal analyses on sediments from Control and Dredge sites indicated differences in the concentrations of some metals (magnesium, sodium, calcium, aluminum, iron), with higher concentrations recorded in

dredged areas. This was perhaps a function of the difference in substrate type (predominantly silt) at Dredge sites. Concentrations of these same metals were also much higher in the sediments than in the overlying river water, regardless of site. Values for some other chemical parameters in the sediments were higher than in the water column, and increased in dredged areas: chemical oxygen demand, biochemical oxygen demand, total nitrogen and phosphorus, ammonia and total organic carbon. Other chemical parameters measured in both the sediments and water column showed no increases with dredging nor were they higher in sediments than in water samples. These parameters included oil, grease, sulfides, phenolics, total volatile solids, immediate oxygen demand, and redox potential. Pesticides were detected only in very low concentrations in both the sediments and overlying water, and no increases were associated with dredging. Water quality parameters measured but not associated with sediment analyses included turbidity, dissolved oxygen, total dissolved solids, pH, alkalinity, chlorophyll a, total suspended solids, and Coulter counter particle counts. Dredge effluents entering the river differed from the river water in all these parameters, but the low volume of effluent water had no effect on the river water quality beyond the immediate area receiving the effluent.

No other effects of dredging could be demonstrated consistently for any of the water quality parameters that were measured in Control and Dredge sites. When upstream and downstream sites were sampled on successive days, differences were often noted but these were the result of changing river conditions rather than effects of dredging.

Plankton and periphyton

The phytoplankton community remained generally unchanged downstream from Control sites through the Dredge sites. Changes in phytoplankton composition occurred seasonally, and in periods when flow derived mainly from reservoirs, which added a new contingent of organisms to the community. Usually, phytoplankton was most abundant under low-flow conditions. The genera of phytoplankton that were most abundant at various times were *Cyclotella*, *Stichococcus*, *Synedra*, *Scenedesmus*, *Melosira*, *Actinastrum*, *Chlamydomonas*, and *Coelastrum*.

Measurement of the growth rate of these organisms in non-dredged and dredged areas revealed no consistent trends which can be associated with dredging activity.

Benthic algae which form thin mats (periphyton) were present in shallow areas where light penetrated to stable substrates under low-flow conditions. Organisms dominating these areas were generally filamentous, Chlorophyta and Cyanophyta. Shallow areas were more extensive in Control than in Dredge sites, so periphyton was quantitatively most important in the Control areas.

Zooplankton communities appeared to be unaffected by dredging operations. The distribution of these organisms varied more with season and lake discharge than with site. Cyclopoid copepods were the main constitutent of the zooplankton, but calanoid copepods were generally present in low numbers as were several genera of cladocerans and, less frequently, ostracods.

Benthic invertebrates

Benthic macroinvertebrates consisted mainly of aquatic insects and annelid worms (Oligochaeta). The local distribution and abundance of these organisms are controlled mainly by substrate type, in that most kinds are adapted to occupy either "erosional" habitats (coarse substrate) or "depositional" habitats (fine-grained substrates), but not both.

The Control sites had fewer taxa (20) and lower densities of benthic organisms (32 per square meter) than any of the Dredge sites. Midges (Chironomidae) predominated at the Control sites, comprising 60% of the organisms found there. The Chironomidae are not assignable as a group to either erosional or depositional substrates, because the family includes forms specialized for each type of substrate. Benthos at the Control sites included both erosional forms (e.g., *Potamyia*, *Stenonema*) and depositional forms (e.g., Oligochaeta, *Hexagenia*), but total numbers of these organisms were low. Sand is an inhospitable substrate for benthic invertebrates due to its molar action, and probably also because sandy substrates incorporate little organic matter usable as food by benthos. The prevalence of sand at

the Control sites explains the low diversity and low density of benthic insects at these sites.

The composition and density of the benthic communities at Dredge sites varied in direct relation to the diversity of substrates available at each Dredge site. All Dredge sites had a greater variety of substrate types, in one or more years of the study, than did the Control sites. At Dredge 1, silt, sand, gravel, and rubble occurred in all three years, but substrates were mainly erosional due to continuous degradation of the river bed through this site. Thirty-six taxa were recorded at Dredge 1; their average density was 179 organisms per square meter, in contrast to $32/m^2$ at the Control sites. Erosional forms were most abundant (e.g., Potamyia, $71/m^2$; Hydropsyche, $46/m^2$) both upstream and downstream from the dredge. Organisms characteristic of depositional substrates were few (e.g., Oligochaeta, $2/m^2$).

At Dredge 2, 31 taxa were recorded (21 upstream from the dredge, 27 downstream, of which 17 were shared). Their average density was 183 organisms per square meter. Organisms characteristic of depositional substrates predominated (e.g., Trichocorixa, $58/m^2$; Oligochaeta, $56/m^2$), indicative of the predominance of silt throughout the D2 site. The water boatman, Trichocorixa, is not truly a benthic organism, although it was included in the benthos list and density calculations because it occurred in benthos samples. Trichocorixa is a free-swimming hemipteran that is prevalent in lentic environments, which typically have silt substrates. Trichocorixa was several times more abundant at Dredge 2 than at any other site, in keeping with the pond-like habitat at Dredge 2. If Trichocorixa is excluded from the calculations, the total density ($125/m^2$) as well as the number of taxa found at the Dredge 2 site become substantially less than at the other two dredge sites, but remains greater than at Control sites. From 1979 to 1981 the dominance of depositonal organisms over erosional organisms increased at Dredge 2, as substrates at this site became uniformly silted. Two erosional forms that occurred at moderate densities in 1979 (Hydropsyche, $14.7/m^2$; Potamyia, $17.3/m^2$) declined abruptly in density in 1980 and were not found at all in 1981 at D2.

At Dredge 3, 39 taxa were recorded; 23 of these occurred upstream from the dredge and 33 occurred downstream, in one or more years of study. Depositional forms (Oligochaetes, Trichocorixa) predominated upstream, whereas erosional forms (Hydropsyche, Potamyia) predominated downstream. Silt was the predominant substrate upstream, whereas rubble was the primary substrate component downstream from the dredge. Both the number of taxa and the total densities of organisms at D3 ($198/m^2$) were higher than at other study sites. However, these values, cumulative for the full term of study, may be misleading. Greater internal differences (between transects) existed at D3 than at the other sites, and greater temporal change (1979-1981) in benthos composition occurred at D3 than at other sites. For the D3 site as a whole, erosional taxa comprised 70% of the total abundance of organisms in 1979, 50% in 1980, but only 17% in 1981. Downstream movements of the dredge through the D3 site during the study, described elsewhere, brought about greater depths, lower velocities, and increased silt deposition through most of the length of this site from 1979 to 1981; this accounts for the prevalence of depositional benthos (72% of total numbers) in 1981. Therefore, as at D2, the diversity of benthic organisms at D3 declined as silt accumulated throughout the site and the habitats became more homogeneous.

Fishes

Sixty-five species of fishes have been reported from the lower Kansas River, 49 of which were taken at one or more sites in this survey. Of the 16 species not found in this survey, the records of three species (mooneye, rock bass, western sand darter) are confined to the nineteenth century, are not supported by specimen evidence, and may not be valid. Three other species (lake sturgeon, highfin carpsucker, burbot) occurred only rarely, perhaps as vagrant individuals, in the late 1800's and early 1900's. Six species (chestnut lamprey, pallid sturgeon, flathead chub, sicklefin chub, silverband shiner, and plains killifish) persisted into the 1950's but have not been found recently in the lower Kansas River. Four species (paddlefish, American eel, bigmouth shiner, and blue catfish) probably still occur in the area surveyed although our samples failed to include them.

Records of two species caught in this study were combined; these two are the river carpsucker, Carpiodes carpio, and the quillback, C. cyprinus. The two are not easily distinguished in the field, especially as young. Therefore they were treated as one kind--carpsuckers--in effect reducing the number of "species" to 48 in our analyses. Specific identifications were made on enough specimens to verify that both species occurred at all study sites (two Control and three Dredge sites), and that the river carpsucker was much more abundant than the quillback.

Thirty-nine species occurred in seining and electrofishing samples at the Control sites, 36 at C1 and 33 at C2 (3 of which were not taken at C1). Forty-six species were recorded at one or more dredge sites: 37 at D1, 34 at D2, and 42 at D3. Twenty-five species were captured in dredge pits, including several captures while dredges were operating. All 49 species probably occur throughout the 16-mile reach of the river surveyed, because all have been taken recently as far upstream as Lawrence (mile 51). No species were found at the Partial study site (mile 9.3) that failed to occur also at sites upstream. Thus we have no evidence that the series of dredges limits dispersal of fishes from the Missouri River upstream through the lower Kansas River.

Population densities were estimated using data from seine hauls (expressed as number of fish of all kinds and sizes, per 100 square meters), and data from electrofishing samples (expressed as total number of fish per 100 meters of shoreline). Based on seining, the average density was 18 fish/100m^2 at the Control sites (15 at C1, 22 at C2), 15 fish/100m^2 at Dredge 1, 8 fish/100m^2 at Dredge 2, and 9 fish/100m^2 at Dredge 3. Based on electrofishing, average densities were 13/100m at the Control sites, 12/100m at D1, 8/100m at D2, and 9/100m at D3. Differences between the sites in the kinds and relative size of fishes are not revealed by the density values.

Trammel nets were used in dredge pits at D2 and D3, but not elsewhere because of shallow depths or excessive currents. One species that was not caught by seining or electrofishing at site D2 was taken there in a trammel net (shovelnose sturgeon, one specimen); and two species not recorded at site D3 by seining or electrofishing were taken there in trammel nets

(shovelnose sturgeon and blue sucker). The trammel net captures increase the number of species found at D2 to 35 and at D3 to 44 species. Both the shovelnose sturgeon and the blue sucker were captured by seining or electrofishing at sites other than D2 and D3.

Fifteen species comprised 96% to 99% of all fishes captured by seining at every site: red shiner, sand shiner, river carpsucker, emerald shiner, gizzard shad, bullhead minnow, channel catfish, silver chub, bluegill, freshwater drum, bluntnose minnow, fathead minnow, white crappie, white bass, and speckled chub. The species caught in greatest numbers by electrofishing were river carpsucker, gizzard shad, freshwater drum, channel catfish, carp, flathead catfish, white bass, and white crappie (93% of total catch from all sites).

Three species were abundant at all sites: the red shiner, sand shiner, and river carpsucker. Their populations declined from the Control sites through the Dredge sites, while the populations of several other species increased at Dredge sites. Five species--speckled chub, suckermouth minnow, white sucker, slender madtom, and walleye--were taken mainly at sites upstream from all dredges (transects C1A through D1A); but, the last three were caught only once or twice so their distributions are not especially meaningful. Juveniles of some species, notably river carpsucker and channel catfish, were caught in larger numbers at Control sites than at Dredge sites.

Except for the nine species cited in the paragraph above, all species were captured in greater numbers at Dredge sites than at Control sites. Many of the species that were most common at Dredge sites benefit from pools larger and deeper than the pools which existed at Control sites; several have a strong affinity for silt substrates, prevalent at Dredge sites; and a few species prefer rock substrates and turbulent flow--a habitat rare in the Kansas River except near some dredged areas. Examples of pelagic species that were prevalent at Dredge sites are gizzard shad, emerald shiner, bigmouth buffalo, white bass, and most sunfishes. Benthic species that were associated mainly with pools and with silt substrate were silver chub, bullhead minnow, river shiner, carp, and freshwater drum. Species found

most often on rocky riffles associated with armored bars near dredge sites were the stonecat, stoneroller minnow, blue sucker, and orangethroat darter; all four species were rare.

Several species recorded in this survey are much more common in upland tributaries than in the river: redfin shiner, creek shub, bluntnose minnow, stoneroller, white sucker, slender madtom, green sunfish, bluegill, longear sunfish, logperch, and orangethroat darter. Although these species were not numerically important in the river fauna, the river may serve as an important refuge for such tributary species during prolonged drought. Conversely, tributaries may function importantly as spawning sites for riverine species. Spawning aggregations of gars, carp, and buffalofishes occurred in Quivira Creek in Spring 1981.

Spawning was not observed in the river, but young-of-year of most species occurred at all five study sites. We found no evidence that dredging operations prevented adequate recruitment to populations of any species in the river during the three years of study.

Conclusions

Dredging for sand and gravel affects the fish community of the lower Kansas River by altering habitats. Water quality is not affected significantly. Water depths, velocities, and substrate types change as a result of dredging activities; these changes affect the species-composition and density of fishes in dredged areas as compared with undredged parts of the river. The effects are progressive, depending mainly on the age and location of the dredging operation. Natural and man-made restraints on degradation of the river bed (exposures of "lenses" of rubble substrate that resist erosion, and dikes installed to maintain water-surface elevations) modify the effects of age and location of individual dredges.

The effects of dredging on habitats and fish populations will be described in sequential stages, starting with the conditions in the unmodified river. In its natural state (as at Control sites), the lower Kansas River has limited habitat diversity, consisting primarily of shallow

flows over a nearly flat, sandy bed. Areas of relatively calm, shallow water are extensive at lowflow stages, and such areas acquire a veneer of fine sediment that is scoured by high flows. Deep pools and areas of coarse substrate (gravel and rubble) are few, small, and remote from one another. The food chain for fishes originates in aufwuchs (primarily periphyton), and particulate organic matter derived from the watershed. Benthic insects are scarce due to instability of the sandy substrate. Consequently the fish community is dominated by a few species well adapted to occupy shallow water over sandy substrates and feed on microorganisms or detritus--sand shiners, red shiners, and carpsuckers. These fish are mostly small but extremely abundant. Many other kinds of fishes, including several that attain large size, also inhabit the unmodified river, but their abundance is limited by the sparse distribution of habitats, other than sandy shallows.

When a dredge begins operating in the shallow, sandy riverbed a "hole" (the dredge pit) results from the removal of sand. Flow quickens just upstream from the pit and is directed toward it. In this way, at Dredge Site 1, the velocity increased on transect D1A and the mainstream was redirected from the left side of the channel into the dredge pit near the right bank of the river at mile 21.6. The intensified flow eroded the riverbed, transporting sand into the "hole." The stream became increasingly entrenched within the riverbed as the sand transported was removed from the "hole." The pit remained relatively small in its horizontal dimensions throughout this study. Flow out of the pit was diverted to the right side of the riverbed downstream from the dredge, and the outflow initiated erosion downstream from the dredge. Therefore the river became progressively more deeply entrenched, both upstream and downstream from the dredge. That tendency continued, especially during lowflow periods, until most of the sand was scoured from the stream bed for several hundred meters upstream and downstream from the dredge. Upstream, gravel and rubble remained in place as the principal substrate components; downstream from this dredge, firm clay and rubble were exposed on the stream bed. More sand was retained in the channel downstream from the dredge pit than upstream from it.

High flows inundated sandbars adjacent to the lowflow channel, redistributed sand over the width of the riverbed, and in the first year of

study refilled the dredge pit at this site. Receding flows restored the sand-depleting process described above. Over the three years of study the exposed bars became increasingly "armored" by rubble, apparently due to removal of sand by successive fluctuations in discharge. Movement of the dredge was unnecessary under these conditions, so the pit remained small; however, the pit became much deeper during 1981 because less sand entered it from the lowflow channel upstream, now floored by rubble rather than sand.

At this stage of development, a dredge site affords much greater habitat diversity than undredged areas of comparable size. Rocky riffles, runs, and a deep pool (dredge pit) occur in close proximity, and sandbars persist. Production of aufwuchs (periphyton) diminishes, but such organisms continue to enter the dredged area as "drift" scoured from the sandy riverbed upstream. Benthic insects characteristic of erosional substrates increase dramatically. Fishes characteristic of riffles (speckled chub, suckermouth minnow, stonecat) increase, as do pool-dwelling fishes (gizzard shad, bluegill, white bass).

At Dredge 1, species dominant on the sandy riverbed upstream diminished in abundance but remained dominant numerically. Probably, high populations of carpsuckers and sand shiners were sustained at the dredge site by downstream dispersal, induced by extreme densities of these species throughout the undredged parts of the channel. On the other hand, riffle- and pool-inhabitats increased slowly because of low populations of those species in the river, and low rates of dispersal. Compared with small aquatic invertebrates, fish communities respond slowly to abrupt changes in local habitats, because of differences between the two groups in population size, mode of dispersal, life span, and reproductive potential. Many years may elapse before a fish community attains equilibrium with new habitats and food sources, and that adjustment was not completed at Dredge Site 1 within the term of this study. A trend toward higher fish diversity values at D1 than at the Control sites was obvious but incipient. Dominant species decreased slightly, and rare species increased slightly; but the cycle had not run its full course so the composition of the fish population remained generally like that at Control sites.

The amount of sand and gravel transported downstream past Dredge site 1 was minor compared to the amount removed there. Reduction in the amount of sand over the site as a whole, and increasing depth of the dredge pit, indicated that this single dredge extracted more sand than the river transported during the years of study. Therefore the series of older dredge-sites located downstream from Dredge 1 received little if any new coarse sand and gravel to compensate for that removed from the channel. Past accumulations of sand were being extracted and not replaced. Probably for that reason the dredges at D2 and D3 moved widely and often over their allocated zones of riverbed, as contrasted with the nearly stationary operation of the dredge at D1. Therefore the dredge pits at D2 and D3 were much larger than the pit at D1.

In addition to the shifting positions of the dredges, a second factor probably causes enlargement of dredge pits where rates of extraction exceed replacement. The saturated alluvial riverbed probably behaves as a fluid and slumps into a pit along its margin, seeking a more uniform level--just as sediments refill a hole dug into a beach, without being carried into the depression by surface flow.

Whatever the mechanisms, deep areas expanded throughout the older dredge sites. Bars and islands disappeared from areas dredged continuously over long periods of time. Water-filled areas in the channel grew wider as well as deeper, even in segments that were not being dredged (areas between dredge sites). The sites coalesced even though the areas actually dredged were discontinuous.

Velocities of flow in the older dredged areas became uniformly sluggish as the water-filled channel became wider and deeper. Fine solids transported by the river settled out. Fine sediment pumped with the deeper sands in the dredging operation--and returned to the river with effluent water--were retained in the dredge sites. Thus silt became the prevalent substrate type at D2 and in the area dredged at D3.

These changes in habitat conditions for fishes resulted in 1) further decline in the abundance of species dominant in the undredged river, 2) loss

of species adapted to gravelly riffles, and 3) further increase in the abundance of species adapted to large pools and silt substrate. The number of species declined, but the number of individuals of each remaining species became more nearly equivalent. The total density of fishes declined but the fishes that remained were larger than at the Control sites and at Dredge 1. In 1981, only 16 species were taken at Dredge 2, less than half the number found there in 1979, and one-third the number recorded for the 16-mile river reach as a whole. Total densities (8 fish per 100 meters, both seining and electrofishing) were lower at D2 than at any other site. But diversity and equivalency values for the D2 site were higher than elsewhere (1.46, 4.34). Those values result from reduction in the number of sand shiners, carpsuckers, and red shiners, coupled with increase in the number of gizzard shad, carp, silver chub, emerald shiner, bluegill, white crappie, and freshwater drum. Other species that are characteristic of the unmodified river (sturgeon chub, speckled chub, plains minnow, stonecat) are now relatively rare, and were absent from the D2 site.

Deterioration of the D2 site was accelerated by a water diversion dike at mile 15.0, which impeded flow through the site, and probably by construction of the I-435 bridge. These structures tended to make this site a silt-trap. Dredging efficiency must have been affected adversely, because in 1981 the dredge worked mainly against Nelson Island, deepening the shoreline along the bank opposite the sand storage site. That island and the outlet of Mill Creek, opposite the dredge site, were the principal remaining habitat variables at this site. If continuous dredging were to eliminate the island the channel would become exceedingly broad and deeply silted, and further reduction in numbers of fishes inhabiting the site would be expected.

The aging process at the D3 site was less advanced than at D2 because of a massive rubble exposure in the channel just downstream from the dredge. In 1979, habitats at this site were more diverse than in any other area surveyed. Benthos- and fish-diversity values were also higher at D3 in 1979 than at any other place or time. However, dredging encroachment into the rubble bar during 1980 reduced the variety of available habitats, and several kinds of fishes present in 1979 subsequently disappeared from the

catch. The dredged area became uniform in depth, width, and substrate type (silt), but the rubble bar afforded radically different habitats adjacent to the dredged area. The dredge pit retained species characteristic of pools (gizzard shad, carp, emerald shiner, white crappie, white bass, freshwater drum) and served as an overwintering site for a large aggregation of sturgeons. Adjacent shallow, rocky areas still afforded habitats for blue suckers, stonecats, and other riffle-adapted species.

Therefore, despite its long establishment and location downstream from seven other dredges, the Dredge 3 site retained reasonably varied habitat conditions and fish populations. Speculation is warranted as to the conditions that would result if the armored bar were eliminated by further dredging at this site. We do not know what form the channel would assume in that eventuality. Habitat diversity and fish populations probably would deteriorate, because the bar is the only one remaining in this segment of the river. But, if degradation of the river bed were rejuvenated by removal of the bar, deep accumulations of silt would be scoured from the area previously dredged, upstream from the bar. Scouring might enhance habitats in the dredged area. On the other hand, if the renewed degradation stimulated installation of a structure to combat further degradation (as at D2), then habitats for fishes would deteriorate rapidly at this site.

13. ALTERNATIVES TO PRESENT DREDGING OPERATIONS, AND THE ANTICIPATED EFFECTS ON THE FISHERY.

The alternatives discussed stem from primary concern in this study with the effects of dredging on the biota of the lower Kansas River, primarily its fishes. Those effects are, sequentially and accumulatively:

1) Initially, the diversity of habitats, benthic organisms, and fishes increases in the vicinity of a dredging operation as the prevalence of sand substrate is reduced, as depth increases in the dredge pit, and as erosion upstream exposes gravel and rubble substrate.

2) Subsequently, habitat diversity diminishes gradually as sand is depleted and local movement of each dredge enlarges its pit area at the expense of nearby shallow areas, sandbars, and islands. Pool habitats expand but shallow areas that have coarse substrate and moderate to swift velocities remain, in or near the dredge site. The relative abundance of species in the benthos and fish population continues to change, but few if any species that occur in undredged parts of the channel are eliminated. Diversity indices remain high at the dredge sites. Large fishes, including several important food and game fishes (crappie, drum, white bass, carp) are proportionately more abundant than in undredged segments of the river.

3) Ultimately, continuous dredging creates nearly uniform habitats that are very different from those in undredged parts of the channel. The channel becomes wide and water-filled, with uniformly steep banks, sluggish flow, and silt substrate. Benthic organisms and fishes that are characteristic of shallow, sandy, braided channels decline, and many disappear. The total number of species declines to about half that in undredged segments of the river. Species that remain are characteristic of lakes, or rivers larger and deeper than the Kansas River. The dredge pit still affords habitat for pool-dwelling fishes and winter refugia for some additional species.

4) Potentially, the fauna is decimated as dredge sites are abandoned due to depletion of accessible sand and gravel. Deep pools that were maintained by dredging fill with silt, eliminating the remaining aspect of habitat diversity that sustains a reasonably valuable and diverse fish community at the dredge site. This result is most severe if low dams are installed below dredge sites to retard degradation of the river bed, and if new dredge sites are established upstream from those abandoned. Upstream migration of dredging activity lengthens the impacted reach of the river and reduces dispersal of fishes from unimpacted reaches into the dredged areas farthest downstream.

Economic effects of each Alternative are considered; but, due to the orientation and objectives of this study, the economic impacts were not investigated and are largely presumptive, based on observations incidental to the study. We assume that dredging economics are a function of the efficiency with which desirable materals can be extracted at a site, and the distance to markets. At a site downstream from several other dredges, the advantage of proximity to markets must decline as the dredge depletes the supply of sand that is exposed on the surface of the river bed, and an overburden of silt accumulates within its permit zone.

Alternative 1: No Action

The No Action alternative assumes continuance of sand and gravel dredging in the river channel essentially as in the past, without change in the existing regulatory arrangements.

Channel dredging, in any degree, has impacts on fish population dynamics in the river. To the degree that dredging activity increases the local diversity of habitats, increases benthic invertebrate populations available as food for fishes, and increases the relative abundance of large fishes useful for food or sport, channel dredging is acceptable biologically and may be considered desirable. That degree of dredging activity falls within stages 1) and 2) of the 4-stage analysis of the cumulative effects of dredging, described in the first paragraph of this section. As the dredging

impacts intensify through stage 3) to stage 4), however, channel dredging becomes undesirable due to losses of benthic organisms and fishes that are important parts of the natural river fauna, ultimately including most species important for food or sport.

If the eight dredges in the river reach studied continue to operate at their present sites, varied habitats for fishes may persist for several years over the series of dredge sites as a whole. However, the habitats and fish communities will deteriorate, first at the downstream sites, then progressively farther upstream. The dredges farthest downstream must eventually exhaust the supply of sand and gravel readily accessible within their permit zones, because sand and gravel are not being replenished at those sites. Therefore the sites at the downstream end of the series will evolve through stage 3) to stage 4), as indicated above. Sand and gravel will be utilized as fully as possible, throughout the downstream reach, to the detriment of fishes and other aquatic organisms that are not adapted to lentic habitats and silt substrates. Eventually, new sources of sand and gravel will be sought, probably in the channel upstream from other dredge sites. That has been the pattern in the past, as the zone of intensive dredging shifted westward from sites mainly downstream from river mile 12 to the present dredge locations in miles 12 through 21.6. Presumably, westward (upstream) progression of dredging will continue so long as a deficit exists between the amount of sand and gravel extracted and the amount transported downstream by the river.

The cumulative impacts of dredging on native fishes probably will increase as the longitudinal extent of the altered habitats increases. The importance of confining the longitudinal extent of any uniformly deep, silted channel may be illustrated by the following general example. The food chain of the river's native fishes originates largely in periphyton produced in shallow channels on sandbars. At present, periphyton produced on bars remaining at the uppermost dredge sites--and especially in undredged areas upstream from mile 21--still reaches existing dredge sites downstream as drift, sustaining organisms dependent on periphyton as food. Also, the distance between the essentially natural river conditions upstream from mile 21 and the altered conditions in existing dredge sites is not so great as to

prevent movement of fishes from one set of conditions to the other. As the shallow, sandy river bed recedes upstream, due to dredging and other degradation processes, the possibilities for such exchange of organisms will diminish.

The No Action alternative would be least disruptive of present dredging practices. It has the economic advantage of delaying relocation of dredges until dredging at each site proves unprofitable. Nevertheless, alternatives that leave dredged sections of the river less severely altered than this alternative should be sought.

Alternative 2: Cessation of channel dredging

At sites where dredging has been intensive and prolonged, the dredge pits are the most important remaining feature of habitat diversity. The pits in those sites fill with silt when dredging ceases, further reducing habitat diversity and fish populations. Elsewhere, the potential for limited dredging activity to create a favorable mix of shallow- and deep-water habitats for fishes would be lost under this alternative.

On the other hand, this alternative would conserve the remaining sand bars, rubble bars, and islands in areas now being dredged. Cessation of all dredging probably would retard, but not wholly eliminate, further degradation of the river bed upstream from the present dredge sites. Sand and gravel eroded upstream probably would be deposited in the abandoned dredged sites. The older dredged areas, now largely silted, might gradually regain sandy substrates. The dredged areas would also become shallower, and velocities of flow would increase. Fish populations should eventually resemble those in undredged segments of the channel.

This alternative would result in some losses and some benefits to the fishery, both immediately and over the long term. Economic impacts on the dredging industry would be severe, due to increased costs of off-channel dredge sites, transportation of sand and gravel from remote sites, or substitution of other construction materials.

Alternative 3: Continued channel dredging with restrictions

The most adverse effects of channel dredging, described in the "No Action" alternative, might be alleviated by any of several restraints on the extent of dredging activity at each location.

a) Restrict the amount of sand removed from a site each year. The objective would be to maximize the term of years in which dredging would continue at a site without depleting the resource. The advantage to the fishery would be maintenance of deep pools in areas that have already been dredged extensively. To obtain that advantage, dredging operations would have to be distributed over enough days each year to maintain deep pit areas against silt accumulations.

The alternative has several disadvantages. Estimation of individual allocations that would serve the intended purpose while allowing profitable operation of the dredges would be difficult. Administrative and monitoring costs might be excessive. Successful application of this alternative would have to take account of such variables as location of the site relative to probable markets, operating costs relative to the annual allocation, and external economic conditions relative to the industry as a whole.

b) Establish guidelines that limit the extent to which habitats are altered locally by dredging. Dredging might be permitted at a site only so long as coarse sediments remain in excess of a predetermined ratio. For example, permits might terminate when surface exposures of coarse sand and gravel declined to one-fourth of the permit area. Advantages to the fishery would be maintenance of variable substrates throughout the dredged zone. Individual dredging operations would retain flexibility in scheduling their production rates, and should be able to anticipate the time at which closure of a site would be necessary. The principal cost, as compared with present regulatory practices, would be advancement of the dates on which the sites would close for strictly economic reasons. Relocations would be more frequent, the river reach subjected to dredging would be extended more rapidly, but the dredged reach would remain suitable for more aquatic organisms.

c) Exclude specified areas from dredging within each permit zone. Areas that must be protected from dredging impacts might be designated when permits are issued and renewed. The armored bar in mile 12, and Nelson Island along with its trailing bar in miles 15 and 16, exemplify areas that should be protected from further encroachment by dredging. Permits for dredging the adjacent areas might stipulate that the sites would be closed if such bars receded beyond predetermined dimensions at specified water surface elevations. This limitation implies restraints on movement of dredging equipment within the permit zone. For the fishery, such restraint would have the added advantage of stabilizing the pit area as well as maintaining nearby bars or islands. Maintenance of sand substrates on areas adjacent to dredge pits might be impossible, especially in periods of high flow. Nevertheless this kind of restriction would perpetuate greater variability in depth and substrate type than unrestricted dredging throughout a site. As in option 3 b), the dredging operation would incur costs in that full depletion of the resource available within a permit zone would not be allowed; and, this mode of restricting use might inhibit removal of sand and gravel in the most cost-efficient manner within a site.

d) Space dredges more widely. The objective of this alternative would be maintenance of permanently shallow, sandy areas within the channel between successive dredge sites. The minimum spacing that would preserve such diversity is not known. All dredge sites downstream from mile 21.6 have tended to merge, in that bars between the sites have eroded and tended gradually to lose sand and acquire a veneer of silt. Thus the spacing necessary would exceed that between the existing dredges. The erosional effect of fluctuating discharge in the river may make it more difficult to maintain "bridges" of sand and gravel across the channel between dredge sites than to maintain bars that extend longitudinally along one bank of the river, through the areas being dredged. Nevertheless, increased spacing between dredge sites would retard the present rate of habitat deterioration. Downstream from mile 21.6, that deterioration results from the cumulative impacts of several dredges operating in close proximity. The dredging impacts would remain localized for longer periods if the dredges were spaced more widely, and the life of each dredging operation would be extended due to reduced competition for the same materials among dredges in the series.

Transportation costs would increase due to the expanded distance between dredges and the construction market. Degradation of the river bed would continue upstream, and eventually would include the spaces between dredging operations.

Alternative 4: Dredging off-channel rather than in the river bed

Dredging (quarrying) of sand and gravel on land adjacent to the river is a possible alternative to dredging in the channel. Areas adjoining the present dredge sites would seem most feasible for use. Advantages to the fishery would lie in retention of bars and islands that remain in the intensively dredged downstream reach of the river. The former dredge pits in the channel would fill with sediment, reducing pool habitats for fishes, but that loss would be avoided if the sites off-channel were joined to the river, allowing movement of fishes between the stream and the quarry pool. Maintenance of accessible pools is an important attribute of this alternative.

If channel dredging were reduced substantially by means of this alternative, the present rate of degradation should be retarded. Sand transported by the river might eventually allow intermittent dredging in the channel, as well as in the adjacent quarries, at sites where channel sands have now been depleted.

The principal costs of this alternative would be diversion of land areas for use as dredge sites. That cost might seem prohibitive at many sites, but the economic feasibility of land-dredging should improve as channel dredging is forced farther upstream, increasing transportation costs to markets in Kansas City. A land-based dredge has operated successfully at Lawrence for more than 20 years, adjacent to agricultural and urban development.

14. SUMMARY

This survey of the effects of dredging on the fishery of the lower Kansas River was conducted from May 1979 through December 1981 in river miles 9.3 - 25. Field investigations included measurements of channel characteristics (primarily depth, velocity of flow, and substrate composition); physico-chemical characteristics of water and sediment (suspended solids, turbidity, dissolved solids, pH, alkalinity, dissolved oxygen, temperature, trace metals, and pesticides); and qualitative and quantitative measurements of plankton, benthos, and fish populations. These measurements were made repetitively each year (usually eight to ten times annually) on a series of transects at two Control sites in river miles 23 and 24, and at three Dredge sites in river miles 21, 15-16, and 12-13. These study sites are designated C1, C2, D1, D2, and D3, respectively. Eight dredges that operated in miles 9.3-21.6 removed from the channel approximately 3 million tons of sand and gravel in 1979, 2 million tons in 1980, and one million tons in 1981. The rate of removal exceeds the rate at which sand is transported by the river and deposited in the dredged reach. Thus, degradation of the river bed is one result of channel dredging.

Degradational effects of dredging are compounded by man-made lakes on tributaries of the Kansas River which trap sediments and alter the river's flow regime, and by channel degradation in the Missouri River, which may be propagated upstream into the lower Kansas River.

Dredging had little or no demonstrable effect on water quality parameters except at points where return flows from the hydraulic dredging operations re-enter the river. Toxic levels of heavy metals and pesticides never were recorded from water or from sediments. Therefore the effects of dredging on chemical conditions in the river appeared to be either negligible or well within the range of tolerance defined by variance in chemical concentrations that were associated with natural fluctuations in rates of discharge (as in high flows following runoff).

Dredging had only minor effects on plankton composition and abundance in the river. Planktonic organisms were sometimes more numerous in Dredge

sites than in Control sites, but the abundance of plankton varied more with river stage than with site.

Dredging had important effects on benthic invertebrates and fishes. The effects were apparent mainly as differences in the abundance of many species, between Control sites and Dredge sites. These differences were traceable directly to changes in physical characteristics of the river channel as a function of the location of individual dredges and the duration of dredging activity. Basically, habitat conditions for benthos and fishes changed progressively downstream from Control sites through the series of dredge sites.

Dredging transforms habitats primarily by gradual depletion of sand, which comprised 62% of the substrate exposed in the Control sites. Where dredging has not occurred, the sandy river bed is broad, with shallow braided channels and moderate velocities of flow (0.40-0.46 ft/sec). Areas having gravel, rubble, or silt substrates, and depths greater than 1.8 meters, are small and isolated.

At the most recently established dredge site, farthest upstream in the existing series of dredges (D1, mile 21.6), dredging brought about the following changes during the course of this study: depth increased in the dredge pit; the velocity of flow increased immediately upstream from the dredge, intensifying erosion of sand, causing substrates to become increasingly "armored" by gravel and rubble; similar but less extreme erosion occurred downstream from the dredge; and silt as well as rubble ultimately increased, proportional to sand, as sand was removed selectively. The result of these changes was diversification of habitats for benthic organisms and fishes, with respect to the depths of water, current velocities, and substrate types that were available in close proximity. Therefore, species characteristic of pools, riffles, and substrates other than sand increased in the dredge site, relative to their abundance in areas of equivalent size in the unmodified channel.

At the older dredge sites, downstream from D1, continuous removal of sand and gravel at rates exceeding its replacement caused the dredge pits to

grow progressively more extensive. Thus average depths increased, current velocities diminished, and silt substrates became prevalent. Benthic invertebrates and fishes characteristic of pools and silt substrates increased, whereas species characteristic of all other habitats decreased in abundance. The rate of this progression was affected, at the dredge sites studied, by local factors other than the relative position of the dredge within the series and the duration of its operation. A rock dike that spanned the channel just downstream from Dredge 2 impeded flow and accelerated transformation of that site toward uniformly pond-like habitat distinctly different from (and less diverse than) that of the unmodified river. An erosion-resistant rubble bar just downstream from Dredge 3 maintained habitats more diverse than (but also different from) habitats in the unmodified river. Nevertheless, the effects of dredging on channel conditions and the fauna tended to be progressive through time at a single dredge location and cumulative through successive dredge sites in a downstream direction. The overall trend was from uniformly shallow, sandy habitats having low faunal diversity to mixed habitats having high faunal diversity to uniformly deep, heavily silted habitats having low faunal diversity.

Species of fishes that declined throughout the course of that habitat progression included red shiners, sand shiners, and river carpsuckers, predominant in the sandy, braided channels of the unmodified river. Species that increased in intermediate stages of the progression but then declined included shovelnose sturgeon, sturgeon chub, speckled chub, emerald shiner, blue sucker, northern redhorse, smallmouth buffalo, channel catfish, stonecat, flathead catfish, goldeye, and sauger. Fishes that increased in relative abundance throughout the progression included gars, gizzard shad, carp, silver chub, river shiner, bullhead minnow, bigmouth buffalo, white bass, white crappie, and bluegill. In the later, essentially pond-like stages of the progression the total number of species was less than in the unmodified river, as was the total density of fishes. However, several of the species that remain are valued food-and-sport fishes. Young-of-year of nearly all species were captured throughout the area surveyed, indicating that dredging does not prevent adequate recruitment of those species, at its present level of development. However, many of the species that occupied

pools in the older dredge sites are dependent on habitats elsewhere for spawning or food-production (e.g., tributaries, or other shallow areas with coarse substrates external to the dredge sites).

A primary concern relative to the changing conditions and fish populations in the oldest dredge sites is that the efficiency of the dredging operations themselves must decline as coarse subtrates are depleted within the permit zones. Thus sites must eventually be abandoned in favor of new sites in the channel that have not been dredged intensively. At the "older" sites, just prior to their abandonment, the expansive dredge pits constitute the most important habitats that remain--those occupied by "pool" fishes. The deep dredge pits farthest downstream fill rapidly with silt when they are vacated, and cease to function as habitats favorable for "pool" fishes or fishes characteristic of the original, sandy river channel. For that reason, several alternatives to past dredging practices are proposed, including various forms of restrictions that aim to maintain moderate habitat diversity in intensively dredged parts of the channel, and substitution of off-channel sites for at least some of the channel sites farthest downstream.

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APPENDIX 1 -- PHYSICAL AND CHEMICAL PARAMETERS

Table A1-1, turbidity

Table A1-2, dissolved oxygen

Table A1-3, total dissolved solids

Table A1-4, pH

Table A1-5, alkalinity

Table A1-6, chlorophyll a

Table A1-7, suspended solids

Table A1-8, suspended solids

Table A1-9, trace metals

Table A1-10, chemical analysis sediment cores

Table A1-11, chemical analysis water samples

Table A1-1. Monthly and annual averages of turbidity measurements from sampling sites in the lower Kansas River, Fishery-Dredging Project, May 1979 through July 1981. N.O. - dredge not operating. Two days required for each monthly sampling series.

TURBIDITY ntu

	C1A	C1B	C2A	C2B	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3B	D3C	D3EFF	D3D	D3E
MAY 1979	110.0	111.7	110.0	106.7	110.0				126.7		78.3		75.0	75.0	85.7	79.5	86.7	87.0	88.0		89.3	87.0
JUNE	36.3	40.5	37.0	39.7	39.3	43.5	40.5	N.O.	39.7	42.0	33.7	220.0	39.0	45.0	29.3	34.0	33.7	30.5	33.0	73.0	40.0	29.0
JULY	610.0	163.3	165.0	167.5	168.3	167.5	167.5	165.0	166.7	168.3	200.0	220.0	202.5	200.0	200.0	200.0	210.0	202.5	210.0	65.0	205.0	206.7
AUG.	56.0	54.3	53.7	56.3	58.0	58.0	61.0	75.0	59.0	57.7	60.0	210.0	54.5	52.5	58.7	56.7	54.0	56.5	57.0	98.0	55.0	55.0
SEPT.	21.7	21.3	22.3	20.7	17.7	19.0	20.0	N.O.	18.7	18.3	26.7	117.0	23.5	24.5	23.3	22.3	29.0	28.0	26.0	100.0	25.0	27.0
NOV.	79.7	75.3	78.0	77.0	75.3	80.5	79.0	N.O.	84.3	82.7	171.5	N.O.	93.5	84.0	91.7	89.3	96.3	93.0	106.0	370.0	92.0	105.7
Annual average	77.3	77.7	77.7	78.0	78.1	73.7	73.6	120.0	82.5	73.8	95.0	166.8	81.3	80.2	81.5	80.3	85.0	82.9	86.7	141.2	84.4	85.1

	C1A	C1B	C2A	C2B	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3B	D3C	D3EFF	D3D	D3E
JAN. 1980	22.7	22.7	22.3		22.2	22.5	22.0	N.O.	22.8	22.2	58.7	N.O.	22.6	22.5	26.4	28.9	116.3	31.0	29.0	N.O.	31.8	34.8
MAR.	59.0	59.0	60.3	58.3	58.7	59.0	59.0	N.O.	58.3	58.7	24.7	N.O.	29.0	31.0	25.7	26.3	29.3	28.0	30.0	N.O.	30.0	30.0
APRIL	97.7	96.3	96.3	95.7	98.3	101.0	98.0	280.0	101.0	100.7	104.0	3000.0	102.0	100.0	108.0	104.0	118.7	124.0	120.0	N.O.	121.3	118.7
MAY	77.7	65.3	64.3	65.3	65.0	68.0	64.5	208.0	63.0	65.7	37.0	684.0	29.0	28.5	26.7	21.3	33.0	26.0	26.0	196.0	34.0	37.3
JUNE	56.3	53.3	53.3	52.3	53.7	63.0	72.0	N.O.	73.7	130.3	808.0	1568.0	376.0	724.0	688.0	493.3	640.0	640.0	688.0	N.O.	542.0	736.0
AUG.	29.0	29.7	34.3	31.0	32.0	36.0	34.0	272.0	37.6	35.7	613.3	664.0	604.0	544.0	514.7	578.7	525.3	556.0	508.0	N.O.	533.3	525.3
SEPT.	59.0	61.3	61.7	66.3	64.0	68.0	63.0	N.O.	69.7	66.3	61.3	N.O.	53.5	40.0	55.7	51.3	49.7	44.5	56.0	N.O.	52.0	54.0
NOV.	-	-	-	-	24.7	25.0	25.0	N.O.	24.7	27.5	29.5	N.O.	23.5	27.0	28.3	26.0	31.3	31.0	-	N.O.	32.5	33.8
Annual average	57.3	55.4	56.1	60.5	52.3	55.3	54.7	253.3	56.4	63.4	217.1	1479.0	155.0	189.6	184.1	166.2	193.0	185.1	208.1	196.0	172.0	196.2

	C1A	C1B	C2A	C2B	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3B	D3C	D3EFF	D3D	D3E
MAR. 1981	-	-	17.7	17.7	-	-	-	-	-	-	-	-	-	-	-	-	26.0	25.0	27.5	N.O.	28.3	26.7
APRIL	-	-	39.7	41.0	-	-	-	-	-	-	-	-	-	-	-	-	51.0	47.0	47.5	N.O.	51.0	40.7
MAY	640.0	737.0	773.0	423.0	670.0	430.0	520.0	4400.0	813.0	1103.0	335.0	N.O.	335.0	313.0	322.0	307.0	298.0	270.0	335.0	N.O.	290.0	288.0
JUNE	673.0	747.0	700.0	687.0	887.0	600.0	865.0	800.0	687.0	1080.0	853.0	N.O.	900.0	1270.0	1387.0	-	867.0	890.0	980.0	N.O.	1013.0	853.0
JULY	-	-	468.0	500.0	-	-	-	-	-	-	540.0	11690.0	398.0	458.0	433.0	465.0	-	-	-	-	-	-
May-June average	656.5	742.0	736.5	555.0	778.5	539.3	692.5	2600.0	345.0	1092.0	594.0	-	617.5	791.5	854.5	803.5	582.5	580.0	657.5	-	651.5	570.5

units

Table A1-2. Monthly and annual averages of oxygen concentrations from sampling sites in the lower Kansas River, Fishery-Dredging Project, May 1979 through July 1981. N.O. - dredge not operating. Two days required for each monthly sampling series.

OXYGEN CONCENTRATION	C1A	C1B	C2A	C2B	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3B	D3C	D3EFF	D3D	D3E
MAY 1979	7.9	7.8	7.8	7.9	7.8				7.8		9.4		9.0	9.5	9.5	10.2	9.0	9.4	8.9		9.1	8.6
JUNE	12.5	11.1	12.7	12.9	12.9	12.0	12.2	N.O.	12.1	11.8	9.1	5.7	9.1	9.5	9.1	9.0	9.7	9.8	9.9	7.45	9.9	9.9
JULY	6.8	6.9	6.8	6.8	6.8	6.6	6.9	6.6	6.7	6.6	6.5	0.0	6.5	6.4	6.6	6.5	6.7	6.5	6.5	7.6	6.6	6.6
AUG.	7.7	7.7	7.4	7.8	8.1	8.2	8.2	7.4	8.0	8.3	9.1	5.8	9.4	9.4	9.3	9.5	7.6	7.4	7.5	7.5	7.3	7.4
SEPT.	11.6	12.3	12.4	12.4	9.6	9.4	9.4	N.O.	9.8	10.0	11.2	8.2	10.8	11.4	11.7	11.5	8.4	8.7	8.9	6.2	9.0	8.8
NOV.	10.5	10.4	10.4	10.4	10.4	10.3	10.4	N.O.	10.1	10.4	10.4	N.O.	10.7	10.7	10.6	10.3	10.5	10.6	10.6	10.8	10.3	10.4
Annual average	9.5	9.4	9.6	9.7	9.3	9.3	9.4	7.0	9.1	9.4	9.3	4.9	9.3	9.5	9.5	9.5	8.7	8.7	8.7	7.9	8.7	8.6

	C1A	C1B	C2A	C2B	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3B	D3C	D3EFF	D3D	D3E
JAN. 1980	12.1	12.6	12.6		12.2	11.9	12.3	N.O.	12.5	12.2	11.8	N.O.	11.8	11.8	12.0	11.8	11.7	12.0	12.0	N.O.	11.9	12.1
MAR.	12.0	11.8	12.2	11.7	11.6	11.5	11.5	N.O.	11.7	11.8	11.6	N.O.	11.7	11.4	11.6	11.5	11.7	12.0	11.6	N.O.	11.7	11.7
APRIL	9.7	9.8	10.0	10.0	10.6	10.6	10.5	9.2	9.8	10.9	11.2	TOO TURB	10.9	11.0	11.4	11.3	9.3	9.3	9.3	N.O.	9.4	9.2
MAY	12.2	12.8	13.4	13.6	12.9	13.6	13.1	TOO TURB	13.4	13.4	9.8	TOO TURB	10.1	10.3	10.3	10.0	9.9	10.4	10.3	6.0	10.3	10.4
JUNE	9.7	10.4	10.9	11.2	12.3	12.1	12.7	N.O.	12.8	12.7	7.2	6.9	6.5	7.2	6.6	7.2	7.2	6.5	7.0	N.O.	6.5	6.4
AUG.	6.6	6.7	7.2	7.7	9.1	9.1	9.5	6.4	8.0	9.1	5.5	2.4	5.6	5.1	5.7	5.0	5.3	5.6	5.5	N.O.	5.8	5.1
SEPT.	7.2	10.2	9.1	9.6	10.1	10.1	9.9	N.O.	10.2	10.5	6.0	N.O.	6.5	5.2	6.1	5.7	7.7	7.7	7.3	N.O.	7.1	7.1
NOV.	-	-	-	-	12.6	11.9	12.1	N.O.	12.0	12.3	10.8	N.O.	11.0	11.6	10.8	11.1	12.0	12.0	-	N.O.	11.5	12.0
Annual average	9.9	10.6	10.8	10.6	11.4	11.4	11.5	7.8	9.7	11.6	9.2	4.7	9.3	9.2	9.3	9.2	9.4	9.4	9.0	6.0	9.3	9.3

	C1A	C1B	C2A	C2B	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3B	D3C	D3EFF	D3D	D3E
MARCH 1981	-	-	13.3	13.1	-	-	-	-	-	-	-	-	-	-	-	-	14.9	14.5	14.3	N.O.	15.1	15.0
APRIL	-	-	11.3	11.5	-	-	-	-	-	-	-	-	-	-	-	-	10.5	10.1	9.0	N.O.	10.8	10.1
MAY	7.4	7.2	7.1	7.1	7.2	7.8	7.5	-	7.1	7.0	7.8	N.O.	7.5	7.5	7.5	7.7	7.7	7.8	7.8	N.O.	7.9	7.8
JUNE	6.5	6.4	6.4	6.5	6.4	6.3	6.3	7.3	6.0	6.0	6.0	N.O.	6.7	6.4	6.5	6.0	6.6	6.6	6.6	N.O.	6.7	6.6
JULY	-	-	7.1	6.9	-	-	-	-	-	-	7.0	1.4	7.0	7.0	7.0	6.8	-	-	-	-	-	-
May-June average	7.0	6.8	6.8	9.0	6.8	7.1	6.9	7.3	6.6	6.5	6.9	-	7.1	7.0	7.0	6.9	7.2	7.2	7.2	-	7.3	7.2

Table A1-3. Monthly and annual averages of total dissolved solids from sampling sites in the lower Kansas River, Fishery-Dredging Project, May 1979 through July 1981. N.O. - dredge not operating. Two days required for each monthly sampling series.

TOTAL DISSOLVED SOLIDS ppm

	C1A	C1B	C2A	C2B	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3B	D3C	D3EFF	D3D	D3E
MAY 1979	233	233	230	230	228				228		252		250	255	251	254	252	250	255		250	253
JUNE	280	283	280	278	280	280	280	N.O.	278	278	290	290	290	290	290	290	290	293	285	250	290	290
JULY	141	141	142	144	143	142	145	145	145	145	150	150	150	150	149	149	147	147	145	224	145	144
AUG	183	185	185	185	185	185	185	185	185	185	193	360	190	190	192	193	190	190	193	190	192	193
SEPT	258	257	258	258	255	258	258	N.O.	255	255	280	N.O.	273	280	277	280	272	270	275	275	270	273
NOV	210	210	210	210	210	210	205	N.O.	210	210	180		183	183	182	180	177	180	180	255	180	178
Annual average	218	218	218	218	217	215	215	165	217	215	224	267	223	225	224	224	221	222	222	239	221	222

	C1A	C1B	C2A	C2B	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3B	D3C	D3EFF	D3D	D3E
JAN 1980	333	334	333		333	330	330	N.O.	330	333	316	N.O.	325	324	325	320	314	321	321	N.O.	321	320
MAR	210	210	212	210	215	215	215	N.O.	215	215	218	N.O.	217	217	217	216	216	216	216	N.O.	215	216
APRIL	215	215	215	215	215	215	215	215	215	215	215	215	215	215	213	215	238	240	240	N.O.	240	240
MAY	230	232	232	230	230	230	230	230	230	230	224	225	230	230	230	228	230	228	230	230	230	230
JUNE	233	235	237	237	230	230	230	N.O.	230	230	190	190	200	185	182	180	185	142	143	N.O.	142	141
SEPT	300	299	299	297	299	300	300	N.O.	300	298	298	N.O.	300	300	300	300	300	300	300	N.O.	300	297
NOV	-	-	-	-	289	290	290	N.O.	287	290	296	N.O.	298	295	295	297	299	298	-	N.O.	299	288
Annual average	254	256	257	242	259	260	259	228	258	258	237	193	241	239	238	237	240	241	234	230	241	240

	C1A	C1B	C2A	C2B	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3B	D3C	D3EFF	D3D	D3E
MAR 1981	-	-	305	350	-	-	-	-	-	-	-	-	-	-	-	-	295	295	295	N.O.	292	288
APRIL	-	-	302	302													290	290	290	N.O.	290	290
MAY	420	420	420	420	420	420	420	420	420	420	420	N.O.	420	420	420	420	420	420	420	N.O.	420	420
JUNE	100	100	100	100	100	100	100	100	100	100	100	N.O.	100	100	100	100	100	100	100	N.O.	100	100
JULY	-	-	200	200	-	-	-	-	-	-	182	180	180	188	187	188	-	-	-	-	-	-
May-June average	260	260	260	260	260	260	260	260	260	260	260	-	260	260	260	260	260	260	260	-	260	260

Table A1-4. Monthly and annual averages of pH measurements from sampling sites in the lower Kansas River, Fishery-Dredging Project, May 1979 through July 1981. N.O. - dredge not operating. Two days required for each monthly sampling series.

pH	C1A	C1B	C2A	C2B	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3B	D3C	D3EFF	D3D	D3E
MAY 1979	8.2	8.2	8.2	8.2	8.2				8.2		8.7		8.7	8.6	8.6	8.7	8.7	8.8	8.8		8.7	8.7
JUNE	8.5	8.4	8.4	8.4	8.4	8.5	8.4	N.O.	8.4	8.4	8.2	7.9	8.2	8.2	8.1	8.3	8.3	8.3	8.4	7.3	8.3	8.4
JULY	8.0	8.0	8.0	8.0	8.0	8.0	8.0	8.0	7.9	8.0	7.9	7.9	7.9	7.9	7.9	7.9	7.9	8.0	7.9	7.5	7.9	7.9
AUG.	8.4	8.4	8.3	8.4	8.4	8.4	8.4	8.5	8.5	8.5	8.5	8.2	8.5	8.6	8.6	8.6	8.4	8.4	8.5	8.4	8.5	8.5
SEPT.	8.7	8.7	8.7	8.7	8.5	8.5	8.6	N.O.	8.5	8.6	8.6	8.1	8.6	8.6	8.6	8.6	8.5	8.5	8.5	7.1	8.5	8.4
NOV.	8.3	8.3	8.3	8.3	8.3	8.3	8.3	N.O.	8.3	8.3	8.2	N.O.	8.3	8.2	8.3	8.3	8.3	8.3	8.2	7.3	8.2	8.2
Annual average	8.4	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.3	8.4	8.4	8.0	8.4	8.4	8.4	8.4	8.4	8.4	8.4	7.4	8.4	8.4

pH	C1A	C1B	C2A	C2B	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3B	D3C	D3EFF	D3D	D3E
JAN. 1980	8.3	8.3	8.3		8.4	8.4	8.4	N.O.	8.3	8.3	8.2	N.O.	8.2	8.2	8.3	8.2	8.1	8.2	8.2	N.O.	8.3	8.2
MAR.	8.2	8.2	8.1	8.1	8.1	8.1	8.1	N.O.	8.1	8.1	8.3	N.O.	8.2	8.2	8.2	8.3	8.2	8.3	8.3	N.O.	8.2	8.2
APRIL	8.5	8.5	8.6	8.5	8.6	8.6	8.5	8.5	8.6	8.6	8.6	8.2	8.7	8.7	8.6	8.6	8.4	8.4	N.O.	8.4	8.4	8.4
MAY	8.3	8.4	8.5	8.5	8.5	8.5	8.5	8.2	8.5	8.5	8.3	7.7	8.0	8.0	8.0	8.0	8.1	8.2	8.2	7.1	8.2	8.2
JUNE	8.5	8.6	8.6	8.6	8.6	8.6	8.6	N.O.	8.7	8.7	7.6	7.7	7.5	7.7	7.4	7.6	7.7	7.6	7.6	N.O.	7.6	7.6
AUG.	7.7	7.7	7.6	8.0	8.2	8.4	8.5	7.8	8.4	8.4	7.6	7.7	7.7	7.6	7.7	7.7	7.6	8.3	8.3	N.O.	8.2	8.2
SEPT.	7.7	7.7	7.9	8.0	8.0	8.3	8.3	N.O.	8.3	8.4	8.0	N.O.	8.1	8.1	8.0	8.0	8.1	8.1	8.1	N.O.	8.1	8.0
NOV.	-	-	-	-	8.0	8.0	7.9	N.O.	8.2	7.9	8.1	N.O.	8.2	8.2	8.1	8.1	7.7	7.8.	-	N.O.	7.8	7.6
Annual average	8.2	8.2	8.2	8.3	8.3	8.4	8.4	8.2	8.4	8.4	8.1	7.8	8.1	8.1	8.0	8.1	8.0	8.0	8.0	7.8	8.0	8.0

pH	C1A	C1B	C2A	C2B	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3B	D3C	D3EFF	D3D	D3E
MAR. 1981	-	-	8.8	8.8	-	-	-	-	-	-	-	-	-	-	-	-	8.9	8.8	8.9	N.O.	8.8	8.4
APRIL	-	-	8.7	8.6	-	-	-	-	-	-	-	-	-	-	-	-	8.5	8.5	8.6	N.O.	8.5	8.4
MAY	7.1	7.1	7.1	7.3	7.2	6.9	7.2	7.1	7.0	6.9	7.4	N.O.	7.4	7.4	7.4	7.4	7.4	7.4	7.3	N.O.	7.2	7.2
JUNE	7.6	7.6	7.6	7.6	7.6	7.6	7.6	7.7	7.6	7.4	7.5	N.O.	7.6	7.6	7.6	7.6	7.7	7.8	7.8	N.O.	7.7	7.7
JULY	-	-	7.8	7.8	-	-	-	-	-	-	7.9	7.5	7.9	8.0	8.0	8.0	-	-	-	-	-	-
May-June average	7.4	7.4	7.4	7.5	7.4	7.3	7.4	7.4	7.3	7.2	7.5	-	7.5	7.5	7.5	7.5	7.6	7.6	7.6	-	7.5	7.5

Table A1-5. Monthly and annual averages of total and phenolphthalein alkalinity measurements from sampling sites in the lower Kansas River, Fishery-Dredging Project, May 1979 through January 1980. total/phenolphthalein; N.O. - dredge not operating. Two days required for each monthly sampling series.

ALKALINITY

units

	C1A	C1B	C2A	C2B	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3B	D3C	D3EFF	D3D	D3E
MAY 1979	173/0	178/0	171/0	170/0	178/0	—	—	—	176/0	—	912/14	—	191/17	192/12	190/14	188/16	190/16	188/14	188/14	—	191/15	187/14
JUNE	136/2	141/2	131/1	127/0	124/1	123/2	122/1	N.O.	121/1	122/0	130/0	214/0	124/0	128/3	131/0	129/0	129/0	132/0	129/4	341/0	128/0	133/4
JULY	155/0	155/0	153/0	153/0	153/0	164/0	146/0	154/0	153/0	153/0	157/0	170/0	165/0	153/0	158/0	155/0	148/0	151/0	151/0	282/0	147/0	148/0
AUG.	613/10	612/12	613/9	612/10	161/11	162/10	166/12	164/10	163/11	612/12	161/11	TOO TURB	160/9	161/10	163/14	152/11	158/8	159/5	161/10	167/6	157/7	159/7
SEPT.	147/10	144/13	143/11	144/11	145/7	150/4	148/10	N.O.	146/7	147/9	143/13	98/2	142/10	143/12	142/11	143/13	144/8	144/9	144/12	340/2	142/10	143/9
NOV.	177/4	179/4	179/4	178/4	179/4	179/4	180/4	N.O.	178/4	179/4	176/4	N.O.	169/4	167/4	169/4	171/4	171/4	169/4	168/2	326/0	177/1	170/2
JAN. 1980	219/10	218/11	217/12	-	223/9	214/12	215/14	N.O.	221/10	223/11	210/10	N.O.	218/9	213/9	214/8	212/9	207/8	217/11	209/10	N.O.	211/7	209/8
Annual average	167/4	168/6	165/5	156/4	166/5	165/5	163/7	159/5	165/5	164/6	167/7	161/1	167/7	165/7	167/7	164/8	164/6	166/6	164/7	291/2	165/6	164/6

Table A1-6. Monthly and annual averages of Chlorophyll a concentrations as a measure of algal biomass from sampling sites in the lower Kansas River, Fishery-Dredging Project, May 1979 through July 1981. N.O. - dredge not operating. Two days required for each monthly sampling series.

CHLOROPHYLL a µg/l

	C1A	C1B	C2A	C2B	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3B	D3C	D3EFF	D3D	D3E
MAY 1979	16.5	16.8	16.3	16.5	16.3				15.7		53.7		53.5	54.0	55.1	56.6	57.5	60.0	61.0		59.0	59.5
JUNE	55.3	55.3	54.3	56.7	55.3	6.20	60.0	N.O.	60.3	62.3	43.5	11.5	47.0	50.3	38.8	42.2	37.0	37.5	39.0	42.0	34.3	34.7
JULY	7.3	7.2	7.3	7.1	7.3	7.3	7.4	7.4	7.4	7.4	7.6	7.1	7.7	7.8	7.6	7.7	7.8	7.8	7.9	3.1	7.7	7.4
AUG.	16.9	16.5	17.9	19.8	21.3	22.4	25.1	22.6	24.9	26.0	29.1	8.8	31.2	30.8	30.2	30.9	21.6	21.0	21.2	18.6	21.1	21.0
SEPT.	78.7	79.3	79.0	77.0	74.3	73.5	74.5	N.O.	74.4	75.0	79.3	6.5	78.0	79.0	78.0	79.0	78.7	79.0	77.0	7.4	76.3	70.7
NOV.	5.9	5.9	5.8	5.9	6.0	6.1	6.2	N.O.	6.3	6.3	6.5	N.O.	5.8	5.7	5.8	5.8	5.7	5.8	5.9	5.3	6.2	6.0
Annual average	30.1	30.2	30.1	30.5	30.1	34.3	34.6	15.0	31.5	35.4	36.6	8.5	37.2	37.9	35.9	37.0	34.7	35.2	35.3	15.3	34.1	33.2

	C1A	C1B	C2A	C2B	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3B	D3C	D3EFF	D3D	D3E
JAN. 1980	10.4	11.4	11.3		11.38	12.2	12.5	N.O.	12.0	12.1	10.3	N.O.	10.3	10.4	10.2	10.3	13.8	10.7	10.7	N.O.	10.8	11.0
MAR.	7.4	7.7	7.8	7.6	8.0	8.0	8.0	N.O.	8.1	8.0	8.0	N.O.	8.3	8.4	8.3	8.4	8.8	8.8	8.8	N.O.	8.8	8.6
APRIL	41.3	42.3	43.0	43.7	49.0	50.0	51.0	41.0	53.0	54.3	44.0	8.0	44.5	44.0	43.3	45.3	31.7	33.0	32.0	N.O.	32.3	32.3
MAY	114.3	103.0	99.3	99.7	95.0	95.0	97.0	89.0	94.0	95.0	66.7	20.0	56.0	52.0	52.0	48.7	52.7	50.0	50.0	4.3	50.7	49.0
JUNE	88.3	87.7	86.0	84.3	72.3	89.0	90.0	N.O.	86.7	84.0	38.0	36.0	49.5	40.0	31.3	42.7	40.3	43.0	37.0	N.O.	40.0	34.3
AUG.	45.7	49.0	51.7	51.7	53.3	54.0	54.5	30.0	56.7	53.0	17.0	0.05	16.9	17.8	17.7	16.8	14.3	15.6	15.5	N.O.	15.5	16.4
SEPT.	43.7	44.0	47.3	49.0	50.7	53.0	53.5	N.O.	52.7	53.0	56.9	N.O.	44.0	57.0	54.3	54.3	55.5	56.0	55.0	N.O.	55.3	53.7
NOV.	-	-	-	-	15.8	14.5	15.0	N.O.	15.4	15.7	15.4	N.O.	15.2	15.5	15.6	15.5	15.0	14.0	-	N.O.	15.2	15.7
Annual average	50.2	49.3	49.5	56.0	44.4	47.0	47.7	53.3	47.3	46.9	32.0	16.0	30.6	30.6	29.1	30.3	29.0	28.9	29.3	4.3	29.1	27.6

	C1A	C1B	C2A	C2B	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3B	D3C	D3EFF	D3D	D3E
MARCH 1981	-	-	33.0	33.0	-	-	-	-	-	-	-	-	-	-	-	-	52.7	53.0	53.0	N.O.	52.7	54.3
APRIL	-	-	124.7	128.0	-	-	-	-	-	-	-	-	-	-	-	-	104.3	105.5	107.0	N.O.	104.0	107.3
MAY	8.8	8.4	8.3	8.6	9.1	11.0	10.5	6.3	7.0	7.3	10.1	N.O.	10.1	9.7	10.1	10.0	10.5	10.5	10.7	N.O.	10.6	10.6
JUNE	5.6	5.5	5.6	5.5	5.2	5.7	5.3	5.5	5.5	5.0	5.1	N.O.	5.3	4.7	4.8	4.8	5.5	5.5	5.7	N.O.	5.5	5.6
JULY	-	-	6.8	6.7	-	-	-	-	-	-	6.6	-	6.8	6.9	6.9	7.0	-	-	-	-	-	-
May-June average	7.2	7.0	7.0	7.0	7.2	8.4	7.9	5.9	6.3	6.2	7.6	-	7.7	7.2	7.5	7.4	8.0	8.0	8.2	-	8.1	8.1

Table A1-7. Monthly averages of USGS particle size analysis from sampling sites in the lower Kansas River, Fishery-Dredging Project, August 1979 through August 1981. The numbers in the table represent the percent of the total suspended solids with a fall diameter less than 0.962 mm and 0.125 mm and all size classes through 2.00. N.O.--dredge not operating. Two days required for each monthly sampling series.

	C1	C2	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3EFF	D3B	D3C	D3D	D3E
Aug. 1979																				
.062	100	100	84	100	100		100	100	100		100	100	100	100	100		100	100	100	100
.125 mm	94	93	73	88	95		86	86	97		98	92	98	97	98		98	99	99	93
Sept. 1979																				
.062	93	95	95					89	100					100	100	80				98
.125	100	100	100					100	100					100	100	100				100
Dec. 1979																				
.062	91	96	68				91		99					100	99	92				97
.125	100	100	97				100		100					100	100	100				100
.250			97																	
.500			100																	
March 1980																				
.062	87	89	81					65	68					97	97					96
.125	100	100	100					100	100					100	100					100
April 1980																				
.062	58	67	68					60	73	70				76	84					84
.125	63	72	72					65	87	79				81	88					88
.250	71	83	80					74	92	96				91	93					97
.500	84	94	88					89	98	100				99	100					100
1.00	98	100	98					99	100					100						
2.00	100		100					100												
May 1980																				
.062	91	88	89	85	89		88	78	98	89	97	98	97	99	94	21	96	88	95	93
.125	100	100	100	100	100		100	100	100	93	100	100	100	100	100	23	100	100	100	100
June 1980																				
.062	93	91	93	89	92		94	91	99		100	99	99	99	100		100	99	100	100
.125	100	100	100	100	100		100	100	100			100	100	100			100			
July 1980																				
.062	93	98	96	93	82		83	76	96		99	95	98	99	99	53	98	100	100	100

Table A1-7. Continued.

	C1	C2	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3EFF	D3B	D3C	D3D	D3E
Aug. 1980																				
.062	97	89	86	98	94		90	82	98		100	98	98	99	99	53	97	97	97	97
.125	100	100	100	100	100		100	100	100			100	100	100	100	100	100	100	100	100
Sept. 1980																				
.062	94	96	94				94	94	99				99	99	99				99	99
.0125	100	100	100				100	100	100				100	100	100				100	100
Nov. 1980																				
.062	91	96	91				97	100	100				100	100	100				99	100
.125	100	100	100				100												100	
March 1981																				
.062	91	87													91				97	98
.125	100	100													100				100	100
April 1981																				
.062	96	95													99		97	96	95	96
.125	100	100													100		100	100	100	100
May 1981																				
.062	96	91	94	95	96		96	97	98				98	98	96		98		98	98
.125	99	94	97	98	99		98	10	10				100	100	98		100		100	100
.250	100	96	100	100	100		100								100					
.500		100																		
June 1981																				
.062	98	97	97	96	95		98	98	99		99	100	100	100	100		100	99	99	100
.125	100	100	99	100	100		100	100	100		100							100	100	
.250			100																	
July 1981																				
.062	85	88	85	88	86		77	85	99		100	98	97	100						
.125	100	100	100	100	100		100	92	100			100	100							
.250								98												
.500								100												
Aug. 1981																				
.062	99	99							100		100	100	100	100						
.125	100	100																		

Table A1-8. Annual averages of USGS particle size analysis from sampling sites in the lower Kansas River, Fishery-Dredging Project, August 1979 through August 1981. The numbers in the table represent the percent of the total suspended solids with a fall diameter less than 0.962 mm and 0.125 mm and all size classes through 2.00. N.O.--dredge not operating. Two days required for each monthly sampling series.

	C1	C2	D1A	D1B	D1C	D1EFF	D1D	D1E	D2A	D2EFF	D2B	D2C	D2D	D2E	D3A	D3EFF	D3B	D3C	D3D	D3E
Annual Ave. 1979																				
.062	93	95	79	88	95		89	88	99		98	92	98	99	99	86	98	99	99	96
.125	100	100	94	100	100		100	100	100		100	100	100	100	100	100	100	100	100	100
.250			99																	
.500			100																	
Annual Ave. 1980																				
.062	88	89	87	91	89		91	81	95	80	99	98	99	99	99	42	98	96	98	98
.125	95	97	97	100	100		100	96	98	86	100	100	100	100	100	61	100	100	100	100
.250	96	98	98				97	99	97							70				
.500	98	99	99				99	100	99							77				
1.00	100	100	100				100	*	100							81				
2.00																86				
May-June Ave. 1981																				
.062	97	94	96	96	96		97	98	99		99	100	99	99	98		99	99	99	99
.125	100	97	98	99	100		99	100	100		100		100	100	98		100	100	100	100
.250		98	100	100			100								100					
.500		100																		

Table A1-9. Trace metal concentrations from sampling sites in the lower Kansas River, Fishery-Dredging Project, August 1979 through May 1980. * Level undetectable using present methods.

AUGUST
1979

	C1B	C2B	D1A	D1EFF	D1E	D2A	D2EFF	D2E	D3A	D3EFF	D3E
Silver ug/l	*	*	*	*	*	*	*	*	*	*	*
Aluminum ug/l	1000	1100	1310	3570	1220	1890	10100	1000	2180	5670	1510
Arsenic ug/l	*	*	*	*	*	*	*	*	*	*	*
Barium ug/l	129	136	143	189	141	145	717	143	154	520	145
Beryllium ug/l	*	*	*	*	*	*	*	*	*	*	*
Cadmium ug/l	4	*	*	*	7	*	3	*	*	* *	*
Chromium ug/l	6	*	*	*	6	*	17	*	*	11	*
Copper ug/l	30	27	18	48	35	12	32	32	20	21	10
Iron ug/l	893	951	1130	5220	1090	1810	9380	909	2100	15400	1430
Manganese ug/l	141	144	154	277	158	168	211	159	180	1860	160
Nickel ug/l	*	*	*	*	*	*	*	*	*	*	*
Lead ug/l	*	*	*	*	*	*	*	*	*	*	*
Antimony ug/l	*	*	*	*	*	*	*	*	*	*	*
Selenium ug/l	*	*	*	*	*	*	*	*	*	*	*
Thallium ug/l	*	*	*	*	*	*	*	*	*	*	*
Zinc ug/l	42	49	24	46	74	*	72	39	21	45	*
Calcium mg/l	50	55	56	59	56	55	68	58	56	94	56
Magnesium mg/l	14	15	15	16	16	15	12	16	15	16	15
Sodium mg/l	71	76	77	74	81	71	71	88	70	30	76
Mercury ug/l	0.4	0.2	*	*	*	*	0.3	*	*	*	0.2

Table A1-9. Continued.

SEPTEMBER
1979

	C1B	C2B	D1A	D1EFF	D1E	D2A	D2EFF	D2E	D3A	D3EFF	D3E
Silver ug/l	*	*	*		*	*	*	*	*	*	*
Aluminum ug/l	1550	1450	2490		1540	1790	1180	1620	2110	6600	2280
Arsenic ug/l	*	*	*		*	*	*	*	*	*	*
Barium ug/l	125	144	156		145	143	247	139	154	594	154
Beryllium ug/l	*	*	*		*	*	*	*	*	*	*
Cadmium ug/l	*	3	*		*	*	*	4	*	*	*
Chromium ug/l	6	7	11		*	9	9	10	44	15	8
Copper ug/l	18	52	34		31	34	32	48	2770	26	28
Iron ug/l	1360	1410	2290		1480	2100	1550	1690	235	22900	2660
Manganese ug/l	193	236	266		224	216	52	219	*	2100	237
Nickel ug/l	*	*	*		*	*	*	*	*	*	*
Lead ug/l	29	*	*		*	*	*	*	*	*	*
Antimony ug/l	*	*	*		*	*	*	*	*	*	*
Selenium ug/l	*	*	*		*	*	*	*	*	*	*
Thallium ug/l	*	*	*		*	*	*	*	48	*	*
Zinc ug/l	*	36	33		29	31	23	35	56	55	35
Calcium mg/l	52	58	59		57	54	141	55	16	115	57
Magnesium mg/l	13	16	17		16	16	13	16	74	18	16
Sodium mg/l	80	82	82		83	74	51	71	*	33	75
Mercury ug/l	*	*	*		*	*	*	*		*	*

Table A1-9. Continued.

NOVEMBER
1979

	C1B	C2B	D1A	D1EFF	D1E	D2A	D2EFF	D2E	D3A	D3EFF	D3E
Silver ug/l	3	3	*		*	*		*	*	*	3
Aluminum ug/l	4490	4390	4840		5210	5360		5180	5560	15600	5760
Arsenic ug/l	*	*	*		*	*		*	*	*	*
Barium ug/l	177	174	171		180	166		163	163	699	166
Beryllium ug/l	*	*	*		*	*		*	*	*	*
Cadmium ug/l	*	*	*		*	*		*	*	6	*
Chromium ug/l	*	8	8		*	*		6	7	20	11
Copper ug/l	8	9	14		5	8		4	5	16	7
Iron ug/l	3700	3580	3600		3840	4030		3900	4220	27800	4440
Manganese ug/l	106	110	111		109	121		123	119	2360	128
Nickel ug/l	*	19	*		*	*		18	*	27	*
Lead ug/l	37	*	33		*	*		*	*	*	*
Antimony ug/l	*	*	*		*	*		*	*	*	*
Selenium ug/l	*	*	*		*	*		*	*	*	*
Thallium ug/l	*	*	*		*	*		*	*	*	*
Zinc ug/l	*	*	*		*	*		*	*	59	*
Calcium mg/l	66	66	64		66	61		60	59	123	60
Magnesium mg/l	14	15	14		15	14		13	13	20	13
Sodium mg/l	46	44	44		47	35		33	32	36	31
Mercury ug/l	0.7	0.6	1.7		0.7	0.5		0.8	0.6	0.9	0.7

Table A1-9. Continued.

JANUARY
1980

	C1B	C2B	D1A	D1EFF	D1E	D2A	D2EFF	D2E	D3A	D3EFF	D3E
Silver ug/l	*	*	*		*	*		*	*		*
Aluminum ug/l	1630	1590	1560		1400	1650		1660	2190		2500
Arsenic ug/l	*	*	*		*	*		*	*		*
Barium ug/l	157	155	159		156	155		150	150		155
Beryllium ug/l	*	*	*		*	*		*	*		*
Cadmium ug/l	*	*	*		*	*		*	*		*
Chromium ug/l	*	*	*		*	*		*	7		*
Copper ug/l	*	*	*		*	*		*	17		*
Iron ug/l	1120	1100	1100		1040	1170		1240	1510		1750
Manganese ug/l	46	45	48		43	65		60	77		94
Nickel ug/l	*	*	*		*	*		*	*		*
Lead ug/l	*	*	*		*	*		*	*		*
Antimony ug/l	*	*	*		*	*		*	*		*
Selenium ug/l	*	*	*		*	*		*	*		*
Thallium ug/l	*	*	*		*	*		*	*		*
Zinc ug/l	40	*	*		*	*		*	*		*
Calcium mg/l	99	101	104		98	98		95	92		95
Magnesium mg/l	22	23	24		22	22		22	20		21
Sodium mg/l	105	107	110		105	100		98	93		96
Mercury ug/l	0.4	0.6	0.5		0.4	0.4		0.4	0.3		0.3

Table A1-9. Continued.

MARCH
1980

	C1B	C2B	D1A	D1EFF	D1E	D2A	D2EFF	D2E	D3A	D3EFF	D3E
Silver ug/l	*	*	*		*	*		*	*		*
Aluminum ug/l	2880	2120	2460		2940	2760		2540	2980		2700
Arsenic ug/l	*	*	*		*	*		*	*		*
Barium ug/l	130	131	135		138	131		130	134		133
Beryllium ug/l	*	*	*		*	*		*	*		*
Cadmium ug/l	*	*	*		*	*		*	*		*
Chromium ug/l	4	3	3		2	3		4	3		2
Copper ug/l	19	28	25		10	17		22	18		11
Iron ug/l	2140	1920	2220		2220	2060		6300	2260		2120
Manganese ug/l	61	62	70		66	65		79	74		69
Nickel ug/l	*	*	11		*	8		12	10		6
Lead ug/l	*	*	*		*	*		*	*		*
Antimony ug/l	*	*	*		*	*		*	*		*
Selenium ug/l	*	*	*		*	*		*	*		*
Thallium ug/l	*	*	*		*	*		*	*		*
Zinc ug/l	13	12	12		10	11		165	12		12
Calcium mg/l	71	71	72		74	71		71	72		75
Magnesium mg/l	17	18	18		19	17		18	18		19
Sodium mg/l	37	37	37		39	37		38	37		38
Mercury ug/l	0.2	*	0.2		0.3	0.3		0.4	0.3		*

Table A1 9. Continued.

MAY

1980

	C1B	C2B	D1A	D1EFF	D1E	D2A	D2EFF	D2E	D3A	D3EFF	D3E
Silver ug/l	*	*	*	*	*	*	*	*	*	*	*
Aluminum ug/l	2760	2800	3080	13980	2880	1830	56800	1078	1272	2060	1366
Arsenic ug/l	*	*	*	*	*	*	*	*	*	*	*
Barium ug/l	157	162	167	310	163	135	1852	121	122	516	124
Beryllium ug/l	*	*	*	*	*	*	3	*	*	*	*
Cadmium ug/l	*	*	*	5	*	*	30	*	*	3	*
Chromium ug/l	3	2	3	17	3	2	61	*	*	3	2
Copper ug/l	8	9	11	22	10	9	112	6	8	5	6
Iron ug/l	2060	2020	2220	17500	2040	1384	98800	930	1086	12800	1182
Manganese ug/l	123	126	132	580	127	104	1064	78	88	1738	90
Nickel ug/l	*	7	*	23	*	*	81	*	*	*	*
Lead ug/l	18	10	7	18	21	13	113	16	9	26	12
Antimony ug/l	*	*	*	*	*	*	*	*	*	*	*
Selenium ug/l	*	*	*	*	*	*	*	*	*	*	*
Thallium ug/l	*	*	*	*	*	*	*	*	*	*	*
Zinc ug/l	10	11	13	50	10	7	294	5	6	10	6
Calcium mg/l	66	68	68	87	66	58	178	52	54	103	53
Magnesium mg/l	19	20	20	21	21	18	28	18	18	16	18
Sodium mg/l	63	65	64	65	64	66	67	65	66	36	65
Mercury ug/l	*	*	*	*	*	*	*	*	*	*	*

Table A1=9. Continued.

APRIL
1980

	C1B	C2B	D1A	D1EFF	D1E	D2A	D2EFF	D2E	D3A	D3EFF	D3E
Silver ug/l	*	*	*	*	*	*	*	*	*		*
Aluminum ug/l	4920	5120	4660	9729	5520	5480	108000	5480	5940		5800
Arsenic ug/l	*	*	*	*	*	*	79	*	*		*
Barium ug/l	161	164	158	234	169	167	1910	170	179		173
Beryllium ug/l	*	*	*	*	*	*	6	*	*		*
Cadmium ug/l	*	*	*	2	*	*	50	*	*		*
Chromium ug/l	*	2	2	7	3	2	105	2	2		2
Copper ug/l	7	6	18	9	5	7	153	6	6		4
Iron ug/l	3620	3700	3600	8680	4000	3940	158200	4120	4360		4220
Manganese ug/l	130	130	127	244	139	136	2640	147	152		146
Nickel ug/l	*	*	9	9	*	*	134	*	*		*
Lead ug/l	*	*	*	*	*	*	35	10	7		*
Antimony ug/l	*	*	*	*	*	*	*	*	*		*
Selenium ug/l	*	*	*	*	*	*	33	*	*		*
Thallium ug/l	*	*	*	*	*	*	*	*	*		*
Zinc ug/l	17	14	18	33	13	15	462	15	17		15
Calcium mg/l	81	83	79	88	81	82	194	82	92		86
Magnesium mg/l	15	16	15	17	16	15	35	16	18		17
Sodium mg/l	49	50	48	50	48	50	54	51	63		61
Mercury ug/l	1.0	1.1	0.9	1.0	1.0	0.9	0.6	1.1	1.0		1.3

June 1980

	C1B	C2B	D1A	D1EFF	D1E	D2A	D2EFF	D2E	D3A	D3EFF	D3E
Silver ug/l	*	*	*		*	*		*	*		*
Aluminum ug/l	2460	2680	3440		6720	20600		23000	28600		44800
Arsenic ug/l	*	*	*		*	21		18	27		55
Barium ug/l	148	152	156		184	308		308	360		424
Beryllium ug/l	*	*	*		*	*		*	*		*
Cadmium ug/l	*	*	*		*	5		6	9		13
Chromium ug/l	4	4	5		7	22		24	31		49
Copper ug/l	30	13	9		11	22		21	25		31
Iron ug/l	1810	1888	1460		4800	20800		21800	28000		40200
Manganese ug/l	118	120	133		169	406		364	534		632
Nickel ug/l	*	*	*		*	20		17	26		31
Lead ug/l	*	6	*		*	7		*	29		*
Antimony ug/l	*	*	*		*	*		*	*		*
Selenium ug/l	*	*	*		*	*		*	*		*
Thallium ug/l	*	*	*		*	*		*	*		*
Zinc ug/l	9	8	10		16	59		64	82		112
Calcium mg/l	59	61	61		60	45		48	49		49
Magnesium mg/l	17	17	17		17	16		16	17		18
Sodium mg/l	79	79	79		78	56		61	59		56
Mercury ug/l	2.4	1.4	1.4		1.3	1.5		1.8	1.3		2.2

July 1980

	C1B	C2B	D1A	D1EFF	D1E	D2A	D2EFF	D2E	D3A	D3EFF	D3E
Silver ug/l	*	*	*	*	*	*	*	*	*		*
Aluminum ug/l	1682	2040	1948	18460	2120	28000	23400	30200	27600		26400
Arsenic ug/l	*	*	*	*	*	20	268	29	43		18
Barium ug/l	121	129	126	346	128	308	3440	316	288		284
Beryllium ug/l	*	*	*	*	*	*	12	*	*		*
Cadmium ug/l	*	*	*	10	*	9	150	11	9		9
Chromium ug/l	2	2	2	21	*	26	214	27	26		26
Copper ug/l	7	2	2	29	4	21	342	23	21		21
Iron ug/l	1208	1340	1320	25600	1408	24600	338000	26600	24000		23400
Manganese ug/l	162	169	161	916	162	532	5380	548	490		486
Nickel ug/l	*	*	*	28	*	25	252	28	25		24
Lead ug/l	*	*	6	17	*	15	35	10	11		11
Antimony ug/l	*	*	*	*	*	*	*	*	*		*
Selenium ug/l	*	*	*	*	*	*	*	*	*		*
Thallium ug/l	*	*	*	*	*	*	*	*	*		*
Zinc ug/l	8	6	6	67	6	72	950	78	74		73
Calcium mg/l	46	49	48	75	47	45	352	45	44		44
Magnesium mg/l	14	15	15	19	15	13	65	12	12		12
Sodium mg/l	85	91	90	91	86	45	43	41	40		40
Mercury ug/l	0.6	0.5	0.6	1.0	0.5	0.6	1.1	0.7	0.6		0.5

September 1980

	C1B	C2B	D1A	D1EFF	D1E	D2A	D2EFF	D2E	D3A	D3EFF	D3E
Silver ug/l	*	*	*		*	*		*	*		*
Aluminum ug/l	2860	2720	3160		2640	2340		2500	2920		2340
Arsenic ug/l	*	*	*		*	*		*	*		*
Barium ug/l	157	148	161		157	151		150	153		152
Beryllium ug/l	*	*	*		*	*		*	*		*
Cadmium ug/l	*	*	*		*	*		*	*		*
Chromium ug/l	3	2	3		3	3		2	3		3
Copper ug/l	6	3	6		4	8		6	6		5
Iron ug/l	2240	2180	2540		2120	2080		2150	2540		2100
Manganese ug/l	266	250	276		256	250		236	218		218
Nickel ug/l	*	*	*		*	6		6	*		6
Lead ug/l	*	8	6		*	*		*	*		9
Antimony ug/l	*	*	*		*	*		*	*		*
Selenium ug/l	*	*	*		*	*		*	*		*
Thallium ug/l	*	*	*		*	*		*	*		*
Zinc ug/l	14	9	11		10	18		14	13		11
Calcium mg/l	50	47	50		51	50		49	50		49
Magnesium mg/l	18	18	19		19	19		18	19		19
Sodium mg/l	126	125	129		129	126		129	125		127
Mercury ug/l	0.4	0.3	0.5		0.3	0.5		0.7	0.5		0.5

November 1980

	CIB	C2B	D1A	D1EFF	D1E	D2A	D2EFF	D2E	D3A	D3EFF	D3E
Silver ug/l			*		*	*		*	*		*
Aluminum ug/l			1410		1182	1266		1334	1396		1456
Arsenic ug/l			*		*	*		*	*		*
Barium ug/l			128		119	122		120	126		118
Beryllium ug/l			*		*	*		*	*		*
Cadmium ug/l			*		2	*		*	*		2
Chromium ug/l			8		3	5		4	3		5
Copper ug/l			24		*	4		*	2		2
Iron ug/l			1020		910	1014		1030	1182		1224
Manganese ug/l			150		80	92		88	81		91
Nickel ug/l			6		*	*		*	*		*
Lead ug/l			25		10	13		16	*		12
Antimony ug/l			*		*	*		*	*		*
Selenium ug/l			*		*	*		*	*		*
Thallium ug/l											
Zinc ug/l			2		*	19		2	8		*
Calcium mg/l			69		76	82		80	79		82
Magnesium mg/l			15		15	16		16	16		15
Sodium mg/l			83		93	102		101	104		105
Mercury ug/l					2.0	4.2		2.6	2.2		4.1

March 1981

	C1B	C2B	D1A	D1EFF	D1E	D2A	D2EFF	D2E	D3A	D3EFF	D3E
Silver ug/l	2	*							*		*
Aluminum ug/l	624	622							830		920
Arsenic ug/l	*	*							*		*
Barium ug/l	97	102							119		116
Beryllium ug/l	*	*							*		*
Cadmium ug/l	*	*							*		*
Chromium ug/l	4	4							4		6
Copper ug/l	*	*							4		3
Iron ug/l	506	516							776		828
Manganese ug/l	91	94							136		135
Nickel ug/l	*	*							*		*
Lead ug/l	12	6							9		11
Antimony ug/l	*	*							*		*
Selenium ug/l	*	*							*		*
Thallium ug/l											
Zinc ug/l	*	*							6		2
Calcium mg/l	80	80							83		79
Magnesium mg/l	16	16							18		19
Sodium mg/l	110	112							108		103
Mercury ug/l	0.8	1.9							1.2		0.7

	C1B	C2B	D1A	D1EFF	D1E	D2A	D2EFF	D2E	D3A	D3EFF	D3E
Silver ug/l	*	*							*		*
Aluminum ug/l	2820	2440							2080		1734
Arsenic ug/l	*	*							*		*
Barium ug/l	138	131							130		123
Beryllium ug/l	*	*							*		*
Cadmium ug/l	*	*							*		*
Chromium ug/l	5	3							2		*
Copper ug/l	2	2							*		*
Iron ug/l	2020	1944							1696		1468
Manganese ug/l	264	256							250		234
Nickel ug/l	8	6							*		*
Lead ug/l	*	*							*		*
Antimony ug/l	*	*							*		*
Selenium ug/l	*	*							*		*
Thallium ug/l											
Zinc ug/l	10	4							*		*
Calcium mg/l	71	70							72		69
Magnesium mg/l	19	18							19		18
Sodium mg/l	111	109							110		107
Mercury ug/l	1.8	3.0							1.1		1.9

May 1981

	CIB	C2B	D1A	D1EFF	D1E	D2A	D2EFF	D2E	D3A	D3EFF	D3E
Silver ug/l	*	*	*	*	*	*		*	*		*
Aluminum ug/l	32200	26400	29600	422000	54600	5460		17580	16700		16520
Arsenic ug/l	*	*	*	*	*	*		*	*		*
Barium ug/l	308	276	306	4600	518	137		238	238		240
Beryllium ug/l	*	*	*	21	*	*		*	*		*
Cadmium ug/l	*	*	*	*	*	*		*	*		*
Chromium ug/l	30	23	29	396	53	4		17	17		16
Copper ug/l	18	12	14	390	30	4		12	10		9
Iron ug/l	24800	18960	22000	450000	42200	5400		13260	13600		13460
Manganese ug/l	558	482	512	15680	824	212		318	338		330
Nickel ug/l	23	20	27	398	42	10		24	14		15
Lead ug/l	*	*	*	*	*	*		*	*		*
Antimony ug/l	*	*	*	*	*	*		*	*		*
Selenium ug/l	*	*	*	*	*	*		*	*		*
Thallium ug/l											
Zinc ug/l	66	50	57	1468	114	18		39	39		39
Calcium mg/l	61	61	62	660	49	36		55	59		60
Magnesium mg/l	13	13	14	89	14	6		11	11		11
Sodium mg/l	23	24	24	31	10	14		23	23		25
Mercury ug/l	0.4	0.2	0.3	0.7	0.3	0.4		0.3	0.7		13

	C1B	C2B	D1A	D1EFF	D1E	D2A	D2EFF	D2E	D3A	D3EFF	D3E
Silver ug/l	*	*	*	*	*	*		*	*		*
Aluminum ug/l	52500	59800	65800	61800	81400	63600		52800	60800		55200
Arsenic ug/l	*	*	*	*	*	*		*	*		*
Barium ug/l	520	546	608	604	836	602		458	502		500
Beryllium ug/l	*	2	2	2	3	2		*	*		*
Cadmium ug/l	*	*	*	*	*	*		*	*		*
Chromium ug/l	58	60	67	64	80	66		52	57		53
Copper ug/l	60	38	44	45	54	46		31	36		43
Iron ug/l	49900	50800	56000	53400	73600	53600		41800	45000		42400
Manganese ug/l	1120	1164	1278	1284	1816	1262		760	960		962
Nickel ug/l	56	49	52	54	72	51		35	42		42
Lead ug/l	*	*	*	*	*	*		*	*		*
Antimony ug/l	*	*	*	*	*	*		*	*		*
Selenium ug/l	*	*	*	*	*	*		*	*		*
Thallium ug/l											
Zinc ug/l	157	173	166	158	204	157		109	140		128
Calcium mg/l	61	66	68	70	98	66		53	76		77
Magnesium mg/l	16	16	18	18	21	18		14	18		18
Sodium mg/l	12	12	13	14	14	13		12	18		18
Mercury ug/l	1.0	1.4	1.2	1.1	1.4	1.2		1.2	1.5		1.3

July 1981

	C1B	C2B	D1A	D1EFF	D1E	D2A	D2EFF	D2E	D3A	D3EFF	D3E
Silver ug/l	*					*		*			
Aluminum ug/l	47400					9980		25800			
Arsenic ug/l	*					*		*			
Barium ug/l	291					196		290			
Beryllium ug/l	*					*		*			
Cadmium ug/l	*					*		*			
Chromium ug/l	55					10		25			
Copper ug/l	48					4		16			
Iron ug/l	46600					7420		17220			
Manganese ug/l	575					198		500			
Nickel ug/l	48					9		19			
Lead ug/l	*					*		*			
Antimony ug/l	*					*		*			
Selenium ug/l	*					*		*			
Thallium ug/l											
Zinc ug/l	169					19		57			
Calcium mg/l	52					63		72			
Magnesium mg/l	19					13		17			
Sodium mg/l	27					38		39			
Mercury ug/l	3.8					0.3		0.2			

Table A1-10. Chemical analysis of sediment core samples analyzed by the Environmental Protection Agency from sampling sites in the lower Kansas River, Fishery-Dredging project. September 1979 (top).

station number	C1B	C2B	D1E	D2A	D2E	D3A	D3E
Silver ug/1							
Aluminum ug/1							
Arsenic ug/1							
Barium ug/1							
Beryllium ug/1							
Cadmium ug/1							
Chromium ug/1							
Copper ug/1							
Iron ug/1							
Manganese ug/1			Data for trace metals not available				
Nickel ug/1							
Lead ug/1							
Antimony ug/1							
Selenium ug/1							
Thallium ug/1							
Zinc ug/1							
Calcium mg/1							
Magnesium mg/1							
Sodium mg/1							
Mercury ug/1							
TVS mg/1	5600	2500	7000	5600	9900	4500	3500
BOD mg/1	23	34	150	200	420	100	41
COD mg/1	174	703	150	200	420	100	41
IOD mg/1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
TKN	9	18	150	180	360	120	39
TP	2.4	12	132	82	138	71	23
NH3-N mg/1	< 7	< 7	< 20	< 20	20	< 10	< 6
NO2-NO3 mg/1	1.7	< .7	< 1	< 2	< 2	< 1	< .6
TOC mg/1	< 20	271	1350	1308	1710	491	290
Phenolics ug/1	< .09	< .09	0.66	.30	0.20	0.10	.07
Oil-Grse	0.01	0.01	0.02	0.02	0.01	0.00	0.01
Sulfides mg/1	< .07	< .07	0.83	1.1	0.62	0.36	.06
ORP mV	429	420	419	422	416	413	411
CN- mg/1	< .05	< .05	< .1	< .2	< .1	< .09	< .04
pH	7.8	7.7	8.3	8.1	8.0	8.3	8.2
Total Solids %	95.4	93.5	85.7	84.5	73.3	85.6	90.5

Table A1-10. Chemical analysis of sediment core samples analyzed by the Environmental Protection Agency from sampling sites in the lower Kansas River, Fishery-Dredging project. September 1979 (bottom).

station number	C1B	C2B	D1E	D2A	D2E	D3A	D3E
Silver ug/1							
Aluminum ug/1							
Arsenic ug/1							
Barium ug/1							
Beryllium ug/1							
Cadmium ug/1							
Chromium ug/1							
Copper ug/1							
Iron ug/1							
Manganese ug/1	Data for trace metals not available						
Nickel ug/1							
Lead ug/1							
Antimony ug/1							
Selenium ug/1							
Thallium ug/1							
Zinc ug/1							
Calcium mg/1							
Magnesium mg/1							
Sodium mg/1							
Mercury ug/1							
TVS mg/1	1500	2400	1300	1300	2600	1800	2200
BOD mg/1	15	19	21	14	24	12	2
COD mg/1	172	270	118	420	407	849	549
IOD mg/1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
TKN	20	8	6	10	9	20	19
TP	3.3	6.6	10	5.2	5.8	12	17
NH3-N mg/1	< 8	< 8	< 8	< 8	< 6	< 8	< 8
NO2-NO3 mg/1	1.0	< .8	1.0	< .8	< .6	1	< .8
TOC mg/1	< 20	213	53	92	68	168	133
Phenolics ug/1	< .1	< .1	.22	< .1	0.10	< .1	0.2
Oil-Grse	0.02	0.02	0.01	0.01	0.01	0.01	0.00
Sulfides mg/1	< .08	< .08	< .08	< .08	< .08	.08	0.20
ORP mV	417	413	409	419	410	410	411
CN- mg/1	< .06	< .06	< .06	< .06	< .05	< .06	< .06
pH	7.5	7.8	7.9	7.8	8.0	8.0	7.9
Total Solids %	87.7	86.2	84.6	86.3	84.8	83.0	83.3

Table A1-10. Chemical analysis of sediment core samples analyzed by the Environmental Protection Agency from sampling sites in the lower Kansas River, Fishery-Dredging project. August 1980 (top).

station number	C1B	C2B	D1E	D2A	D2E	D3A	D3E
Silver ug/1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aluminum ug/1	2490.0	2410.0	2780.0	11300.0	14900.0	15100.0	11000.0
Arsenic ug/1	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Barium ug/1	42.4	47.0	49.3	132.0	170.0	175.0	120.0
Beryllium ug/1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium ug/1	< 1.0	< 1.0	1.2	5.7	7.7	7.9	5.3
Chromium ug/1	< 5.0	< 5.0	< 5.0	11.2	14.4	15.2	10.6
Copper ug/1	2.8	2.3	2.7	13.1	16.9	17.0	12.3
Iron ug/1	2840.0	2870.0	3360.0	13600.0	16900.0	17300.0	12400.0
Manganese ug/1	302.0	152.0	120.0	299.0	392.0	403.0	247.0
Nickel ug/1	< 5.0	< 5.0	< 5.0	11.5	14.2	14.8	11.0
Lead ug/1	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Antimony ug/1	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Selenium ug/1	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Thallium ug/1	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Zinc ug/1	10.9	10.9	10.4	39.0	49.4	51.0	34.7
Calcium mg/1	8740.0	9630.0	13500.0	18100.0	23300.0	40600.0	18500.0
Magnesium mg/1	631.0	633.0	765.0	2960.0	4230.0	4770.0	3050.0
Sodium mg/1	111.0	94.0	102.0	185.0	338.0	310.0	265.0
Mercury ug/1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TVS mg/1	.35	.41	.41	2	2.8	2.9	1.3
BOD mg/1	40	25	27	530	550	570	410
COD mg/1	1110	1110	1360	9950	1320	1050	7130
IOD mg/1	< 10	< 10	< 10	64	< 10	< 10	< 10
TKN	59	65	61	701	953	981	381
TP	117	136	162	438	546	578	335
NH3-N mg/1	< 4	< 4	< 4	57	85	63	24
NO2-NO3 mg/1	.6	1	.4	< .4	< .6	< 1	< .5
TOC mg/1	123	51.1	120	250	62	180	104
Phenolics ug/1	< .05	< .04	.05	.10	.18	.10	.15
Oil-Grse	< .01	< .01	< .01	.02	.01	.01	.02
Sulfides mg/1	.06	< .07	< .07	.11	< .09	.51	.31
ORP mV	168	175	182	43	19	76	36
CN- mg/1	< .04	< .03	< .03	.05	< .04	< .05	< .04
pH							
Total Solids %	89.6	89.5	88.8	70.6	66.8	64	77.5

Table A1-10. Chemical analysis of sediment core samples analyzed by the Environmental Protection Agency from sampling sites in the lower Kansas River, Fishery-Dredging project. August 1980 (bottom).

station number	C1B	C2B	D1E	D2A	D2E	D3A	D3E
Silver ug/1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aluminum ug/1	945.0	1030.0	2130.0	4120.0	4550.0	7150.0	7950.0
Arsenic ug/1	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Barium ug/1	40.8	36.8	41.8	55.1	60.8	86.3	95.8
Beryllium ug/1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium ug/1	< 1.0	< 1.0	< 1.0	1.9	2.0	3.2	3.6
Chromium ug/1	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	6.8	8.5
Copper ug/1	1.2	1.2	2.2	4.7	4.3	7.2	7.6
Iron ug/1	1190.0	1250.0	2540.0	5460.0	5300.0	7890.0	8970.0
Manganese ug/1	56.9	181.0	84.1	132.0	133.0	199.0	203.0
Nickel ug/1	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	6.3	9.3
Lead ug/1	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Antimony ug/1	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Selenium ug/1	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Thallium ug/1	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Zinc ug/1	6.8	6.1	8.7	15.5	15.5	21.6	24.9
Calcium mg/1	8350.0	7800.0	10700.0	9100.0	15100.0	26100.0	13100.0
Magnesium mg/1	284.0	349.0	574.0	962.0	1140.0	2540.0	1820.0
Sodium mg/1	91.5	84.4	79.9	90.5	152.0	148.0	180.0
Mercury ug/1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
TVS mg/1	.18	.30	.31	.7	6.2	1.2	2.3
BOD mg/1	52	13	16	110	78	250	300
COD mg/1	199	291	955	4610	3550	6370	5280
IOD mg/1	< 10	< 10	< 10	< 10	< 10	< 10	< 10
TKN	5	20	55	204	138	383	301
TP	108	117	122	237	176	275	294
NH3-N mg/1	< 3	< 4	< 4	33	27	42	41
NO2-NO3 mg/1	< .3	.6	< .4	< .4	< .5	< .5	< .5
TOC mg/1	89	72	82	130	55	113	73
Phenolics ug/1	< .04	< .06	< .07	.12	< .05	.08	.24
Oil-Grse	< .01	.05	.02	< .01	.02	.01	.01
Sulfides mg/1	< .07	< .08	< .08	.14	.19	.27	.18
ORP mV	165	176	183	118	129	58	89
CN- mg/1	< .02	< .03	< .03	< .03	< .04	< .04	<. 04
pH							
Total Solids %	85.5	85.2	84.9	84.2	83.5	80.4	81.4

Table A1-10. Chemical analysis of sediment core samples analyzed by the Environmental Protection Agency from sampling sites in the lower Kansas River, Fishery-Dredging project. June 1981 (top).

station number	C1B	C2B	D1E	D2A	D2E	D3A
Silver ug/1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aluminum ug/1	1140.0	797.0	6160.0	9340.0	18700.0	8080.0
Arsenic ug/1	< 50	< 50	< 50	< 50	< 50	< 50
Barium ug/1	25.3	18.2	64.1	78.6	184.0	88.8
Beryllium ug/1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium ug/1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chromium ug/1	< 5.0	< 5.0	6.7	9.5	19.7	8.9
Copper ug/1	< 1.0	< 1.0	4.7	5.8	16.7	6.0
Iron ug/1	1930.0	1520.0	6640.0	9300.0	20000.0	8960.0
Manganese ug/1	30.7	25.6	147.0	202.0	583.0	209.0
Nickel ug/1	< 5.0	< 5.0	5.5	7.8	19.1	7.6
Lead ug/1	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Antimony ug/1	< 50	< 50	< 50	< 50	< 50	< 50
Selenium ug/1	< 50	< 50	< 50	< 50	< 50	< 50
Thallium ug/1	NOVALUE	NOVALUE	NOVALUE	NOVALUE	NOVALUE	NOVALUE
Zinc ug/1	4.8	3.1	19.2	24.5	64.7	23.8
Calcium mg/1	1840.0	1050.0	6430.0	6130.0	16300.0	8290.0
Magnesium mg/1	266.0	181.0	1220.0	1500.0	3820.0	1450.0
Sodium mg/1	81.4	68.4	107.0	117.0	182.0	117.0
Mercury ug/1	< .01	< .01	0.01	0.02	0.03	0.02
TVS mg/1						
BOD mg/1	11.5	7.1	70	317	361	161
COD mg/1	630	347	4520	9190	21100	4550
IOD mg/1						
TKN	22.5	17.5	271	487	1080	288
TP	112	72	257	273	485	255
NH3-N mg/1	3.1	1.7	6.6	16.4	28.4	9.6
NO2-NO3 mg/1	< 1	< 1	< 1	< 1	< 1	< 1
TOC mg/1	.02	.13	1.24	3.04	7.1	2.63
Phenolics ug/1	< 800	< 800	< 1000	< 900	< 1000	< 900
Oil-Grse	0	.01	.01	.02	.01	.01
Sulfides mg/1	.72	.84	.8	3.22	2.4	1.09
ORP mV	231.9	242.8	241.5	215.7	226	220
CN- mg/1	.1	< .05	.05	.08	.14	.07
pH						
Total Solids %						

Table A1-10. Chemical analysis of sediment core samples analyzed by the Environmental Protection Agency from sampling sites in the lower Kansas River, Fishery-Dredging project. June 1981 (bottom).

station number	C1B	C2B	D1E	D2A	D2E	D3A
Silver ug/1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aluminum ug/1	1100.0	920.0	1280.0	6760.0	9880.0	5600.0
Arsenic ug/1	< 50	< 50	< 50	< 50	< 50	< 50
Barium ug/1	24.6	28.7	30.8	71.4	96.8	65.4
Beryllium ug/1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium ug/1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chromium ug/1	< 5.0	< 5.0	< 5.0	7.5	10.1	6.1
Copper ug/1	< 1.0	< 1.0	< 1.0	4.6	6.1	3.6
Iron ug/1	1880.0	1840.0	2450.0	7880.0	9920.0	6830.0
Manganese ug/1	30.0	29.8	34.2	161.0	199.0	138.0
Nickel ug/1	< 5.0	< 5.0	< 5.0	6.6	8.0	6.0
Lead ug/1	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Antimony ug/1	< 50	< 50	< 50	< 50	< 50	< 50
Selenium ug/1	< 50	< 50	< 50	< 50	< 50	< 50
Thallium ug/1	NOVALUE	NOVALUE	NOVALUE	NOVALUE	NOVALUE	NOVALUE
Zinc ug/1	4.8	3.8	5.2	20.1	27.0	16.8
Calcium mg/1	1800.0	1160.0	2380.0	7270.0	14700.0	6880.0
Magnesium mg/1	259.0	196.0	330.0	1330.0	2150.0	1050.0
Sodium mg/1	81.2	87.8	82.5	102.0	171.0	94.7
Mercury ug/1	NOVALUE	< .01	< 0.01	0.01	0.01	< 0.01
TVS mg/1						
BOD mg/1	< 2.5	< 1	22	105	80	136
COD mg/1	165	164	3680	4770	5470	2710
IOD mg/1						
TKN	9.4	16.4	64	269	323	200
TP	75	69	96	240	329	221
NH3-N mg/1	4.2	4	4.9	11.5	10.2	20.8
NO2-NO3 mg/1	< 1	< 1	< 1	< 1	< 1	< 1
TOC mg/1	< .01	< .01	.87	.95	2.15	1.78
Phenolics ug/1	< 800	< 800	< 1000	< 900	< 900	< 900
Oil-Grse	.01	.01	.01	.01	.02	.01
Sulfides mg/1	.77	.7	.5	2.02	2.26	1.67
ORP mV	240.8	238.5	248	238.8	224.8	236.2
CN- mg/1	< .05	< .05	< .05	< .05	.05	< .05
pH						
Total Solids %						

Table A1-10. Chemical analysis of sediment core samples analyzed by the Environmental Protection Agency from sampling sites in the lower Kansas River, Fishery-Dredging project. September 1981 (top).

station number	C1B	C2B	D1E	D2A	D2E	D3A	D3E
Silver ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aluminum ug/l	3260.0	4390.0	5870.0	8410.0	13000.0	7790.0	11100.0
Arsenic ug/l	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Barium ug/l	45.3	55.1	64.7	114.0	134.0	136.0	146.0
Beryllium ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium ug/l	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chromium ug/l	< 5.0	5.1	7.0	9.4	14.0	10.6	14.2
Copper ug/l	27.8	3.7	5.0	8.1	11.1	8.4	10.9
Iron ug/l	4480.0	5230.0	6420.0	10700.0	14700.0	9220.0	11400.0
Manganese ug/l	82.1	123.0	147.0	270.0	360.0	292.0	286.0
Nickel ug/l	< 5.0	< 5.0	6.1	10.4	12.8	5.6	12.4
Lead ug/l	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Antimony ug/l	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Selenium ug/l	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Thallium ug/l	NOVALUE	NOVALUE	NOVALUE	NOVALUE	NOVALUE	NOVALUE	NOVALUE
Zinc ug/l	11.0	14.1	18.1	31.2	42.1	30.6	42.8
Calcium mg/l	6610.0	5170.0	7060.0	16200.0	12000.0	48800.0	16700.0
Magnesium mg/l	836.0	1040.0	1420.0	2130.0	2850.0	3270.0	3020.0
Sodium mg/l	456.0	366.0	476.0	641.0	798.0	2100.0	816.0
Mercury ug/l							
TVS mg/l	458000	608000	850000	204000	181000	145000	229000
BOD mg/l	22.8	28.5	66.9	130	369	564	375
COD mg/l	175	285	287	631	540	511	577
IOD mg/l	< 1	4.4	< 1	8.7	12.9	< 1	< 1
TKN	70	202	225	600	612	613	598
TP	180	195	224	410	377	437	417
NH3-N mg/l	6.9	16.0	8.5	37.8	59.3	84.5	10.3
NO2-NO3 mg/l	2.4	< .6	.6	.9	< .6	.9	< .6
TOC mg/l	210	980	2100	1400	5100	2800	5900
Phenolics ug/l	< .5	< .5	< .5	< .5	< .5	< .5	< .5
Oil-Grse	< .01	< .01	< .01	.02	.01	.01	lost data
Sulfides mg/l	.06	.11	.08	.12	.10	.16	.16
ORP mV				data not available			
CN- mg/l	< .08	< .08	.08	.1	< .1	< .1	< .1
pH							
Total Solids %							

Table A1-10. Chemical analysis of sediment core samples analyzed by the Environmental Protection Agency from sampling sites in the lower Kansas River, Fishery-Dredging project. September 1981 (bottom).

station number	C1B	C2B	D1E	D2A	D2E	D3A	D3E
Silver ug/1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aluminum ug/1	4840.0	1990.0	6020.0	10700.0	18000.0	4680.0	11300.0
Arsenic ug/1	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Barium ug/1	57.2	44.5	71.5	105.0	195.0	124.0	131.0
Beryllium ug/1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium ug/1	< 1.0	< 1.0	< 1.0	< 1.0	1.1	< 1.0	< 1.0
Chromium ug/1	6.1	< 5.0	7.4	11.3	21.0	5.7	14.2
Copper ug/1	4.6	1.7	5.6	8.5	17.2	49.5	10.5
Iron ug/1	5900.0	3270.0	7140.0	11400.0	19500.0	5270.0	12300.0
Manganese ug/1	140.0	40.6	172.0	282.0	562.0	247.0	314.0
Nickel ug/1	5.3	< 5.0	6.9	11.0	19.8	5.1	12.5
Lead ug/1	< 5.0	< .50	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Antimony ug/1	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Selenium ug/1	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Thallium ug/1	NOVALUE	NOVALUE	NOVALUE	NOVALUE	NOVALUE	NOVALUE	NOVALUE
Zinc ug/1	16.9	7.2	20.4	31.6	61.3	32.8	39.5
Calcium mg/1	5640.0	2880.0	7060.0	10100.0	17900.0	117000.0	8810.0
Magnesium mg/1	1050.0	444.0	1370.0	2120.0	4160.0	3290.0	2640.0
Sodium mg/1	440.0	277.0	516.0	674.0	871.0	1530.0	721.0
Mercury ug/1							
TVS mg/1	775000	139000	107000	154000	297000	189000	204000
BOD mg/1	41.0	24.8	101	432	777	346	309
COD mg/1	341	83	374	488	707	754	409
IOD mg/1	6.7	< 1	18.0	30.2	85.0	33.0	33.8
TKN	290	39	215	572	976	450	538
TP	224	133	231	327	503	349	458
NH3-N mg/1	33.5	6.0	17.5	49.8	85.9	48.4	16.5
NO2-NO3 mg/1	< .6	< .6	< .6	< .6	.8	< .6	< .6
TOC mg/1	2100	300	580	2500	13000	4100	7900
Phenolics ug/1	< .5	< .5	< .5	< .5	< .5	.56	< .5
Oil-Grse	< .01	.01	lost data	.01	< .01	< .01	.01
Sulfides mg/1	.08	.05	.06	.13	.11	.09	.10
ORP mV			data not available				
CN- mg/1	.08	.1	.09	< .1	< .1	< .1	< .1
pH							
Total Solids %							

Table A1-11. Chemical analysis of water samples analyzed by the Environmental Protection Agency from sampling sites in the lower Kansas River, Fishery-Dredging Project. September 1979.

Station Number	C1B	C2B	D1F	D2E	D3E
Silver ug/l	< 2	< 2	< 2	< 2	< 2
Aluminum ug/l	807	1030	905	1300	1450
Arsenic ug/l	< 50	< 50	< 50	< 50	< 50
Barium ug/l	119	136	137	145	144
Beryllium ug/l	< 2	< 2	< 2	< 2	< 2
Cadmium ug/l	< 2	< 5	< 2	< 5	< 2
Chromium ug/l	6	9	8	13	10
Copper ug/l	7	29	37	40	20
Iron ug/l	753	1010	916	1330	1510
Manganese ug/l	196	220	218	243	240
Nickel ug/l	< 10	< 10	< 10	< 10	< 10
Lead ug/l	< 20	< 20	< 20	< 20	< 20
Antimony ug/l	< 50	< 50	< 50	< 50	< 50
Selenium ug/l	< 50	< 50	< 50	< 50	< 50
Thallium ug/l	< 100	< 100	< 100	< 100	< 100
Zinc ug/l	< 20	< 24	35	31	< 20
Calcium mg/l	52	57	58	59	58
Magnesium mg/l	15	17	17	17	17
Sodium mg/l	79	87	87	95	82
Mercury ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
TVS mg/l	110	110	120	200	120
BOD mg/l	10	12	8.4	10	9.2
COD mg/l	46	77	52	41	45
IOD mg/l				0.1	0.1
TKN					
TP					
NH3-N mg/l	< .4	< .4	< .4	< .4	< .4
NO2-NO3 mg/l	.06	< .04	< .04	< .04	< .04
TOC mg/l	11	5	13	37	33
Phenolics ug/l	< .5	< .5	< .5	< .5	< .5
Oil-Grse mg/l	1.0	1.1	1.5	0.6	1.6
Sulfides mg/l	< .004	< .004	< .004	< .004	< .004
ORP mV	-1320	-1321	-1130	-1189	-1202
CN- mg/l	< .003	< .003	< .003	< .003	< .003
pH	7.7	7.9	7.7	8.3	8.0
NFS mg/l					

Table A1-11. Chemical analysis of water samples analyzed by the Environmental Protection Agency from sampling sites in the lower Kansas River, Fishery-Dredging Project. March 1980.

Station Number	C1B	C2B	D1E	D2E	D3E
Silver ug/l	< 1	< 1	< 1	< 1	< 1
Aluminum ug/l	2340	2640	2760	2300	3100
Arsenic ug/l	< 20	< 20	< 20	< 20	< 20
Barium ug/l	113	123	128	121	133
Beryllium ug/l	< 1	< 1	< 1	< 1	< 1
Cadmium ug/l	< 1	< 1	< 1	< 1	< 1
Chromium ug/l	3	4	3	2	4
Copper ug/l	12	26	28	28	27
Iron ug/l	1736	1934	2040	1712	2360
Manganese ug/l	52	58	59	55	77
Nickel ug/l	7	11	10	9	9
Lead ug/l	7	7	< 5	5	< 5
Antimony ug/l	< 20	< 20	< 20	< 20	< 20
Selenium ug/l	< 20	< 20	< 20	< 20	< 20
Thallium ug/l	< 20	< 20	< 20	< 20	< 20
Zinc ug/l	15	11	14	12	13
Calcium mg/l	63	67	69	67	69
Magnesium mg/l	15	17	18	17	18
Sodium mg/l	33	36	38	36	36
Mercury ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
TVS mg/l	83	82	93	87	93
BOD mg/l	1.5	1.4	1.2	1.9	1.4
COD mg/l	3	< 1	5	17	15
IOD mg/l	< 0.1	< 0.1	0.1	0.15	0.1
TKN	.8	.9	.7	.7	.7
TP	.22	.17	.16	.14	.15
NH3-N mg/l	< .4	< .4	< .4	< .4	< .4
NO2-NO3 mg/l	1.31	1.42	1.36	1.30	1.32
TOC mg/l	11.2	11.2	5.6	5.8	5.3
Phenolics ug/l	< 5	< 5	< 5	< 5	< 5
Oil-Grse mg/l	0.1	-	0.4	1.5	0.4
Sulfides mg/l	< .004	< .004	< .004	< .004	< .004
ORP mV	260	259	250	247	250
CN- mg/l	< .003	< .003	< .003	< .003	< .003
pH					
NFS mg/l	64	54	89	69	70

Table A-11. Chemical analysis of water samples analyzed by the Environmental Protection Agency from sampling sites in the lower Kansas River, Fishery-Dredging Project. August 1980.

Station Number	C1B	C2B	D1E	D2E	D3E
Silver ug/l	< 1	< 1	< 1	< 1	< 1
Aluminum ug/l	2580	2480	2780	3040	3740
Arsenic ug/l	< 20	< 20	< 20	< 20	< 20
Barium ug/l	126	126	127	131	136
Beryllium ug/l	< 1	< 1	< 1	< 1	< 1
Cadmium ug/l	< 1	< 1	< 1	< 1	< 1
Chromium ug/l	< 1	< 1	2	2	3
Copper ug/l	2	3	5	4	6
Iron ug/l	1956	1914	2180	2480	3540
Manganese ug/l	292	290	300	284	276
Nickel ug/l	6	< 5	7	7	11
Lead ug/l	< 5	< 5	< 5	< 5	< 5
Antimony ug/l	< 20	< 20	< 20	< 20	< 20
Selenium ug/l	< 20	< 20	< 20	< 20	< 20
Thallium ug/l	< 20	< 20	< 20	< 20	< 20
Zinc ug/l	10	9	15	18	23
Calcium mg/l	44	44	44	43	42
Magnesium mg/l	16	16	16	16	16
Sodium mg/l	70	70	70	67	64
Mercury ug/l	0.4	0.4	0.3	0.3	0.4
TVS mg/l	100	110	130	130	130
BOD mg/l	7.5	8.6	6.8	6.8	6.3
COD mg/l	38	37	44	36	34
IOD mg/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
TKN	1.9	1.7	1.8	1.8	1.8
TP	.61	.43	.50	.45	.52
NH3-N mg/l	< .4	< .4	< .4	< .4	< .4
NO2-NO3 mg/l	.19	< .04	< .04	< .04	< .04
TOC mg/l	23	14	13	10	12
Phenolics ug/l	< 5	< 5	< 5	< 5	< 5
Oil-Grse mg/l	2.2	1.1	0	1.8	0.9
Sulfides mg/l	8	7	6	9	0.9
ORP mV	158.5	155.4	165-8	166	163.6
CN- mg/l	< .003	< .003	< .003	< .003	< .003
pH					
NFS mg/l	83	110	100	100	96

Table A1-11. Chemical analysis of water samples analyzed by the Environmental Protection Agency from sampling sites in the lower Kansas River, Fishery-Dredging Project. June 1981.

Station Number	C1B	C2B	D1E	D2E	D3E
Silver ug/l	< 1	< 1	< 1	< 1	< 1
Aluminum ug/l	43600	42600	51000	13440	15200
Arsenic ug/l	< 100	< 100	< 100	< 20	< 20
Barium ug/l	444	414	472	218	228
Beryllium ug/l	2	< 1	< 1	< 1	< 1
Cadmium ug/l	< 4	< 4	< 4	< 1	< 1
Chromium ug/l	43	38	49	11	13
Copper ug/l	29	24	28	4	9
Iron ug/l	37200	33000	39200	9700	11600
Manganese ug/l	968	874	928	262	324
Nickel ug/l	38	32	39	12	12
Lead ug/l	< 5	< 5	< 5	< 5	< 5
Antimony ug/l	< 20	< 20	< 20	< 20	< 20
Selenium ug/l	< 100	< 100	< 100	< 20	< 20
Thallium ug/l					
Zinc ug/l	111	96	108	26	31
Calcium mg/l	76	77	72	73	73
Magnesium mg/l	16	16	16	13	13
Sodium mg/l	31	34	31	41	39
Mercury ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
TVS mg/l	280		232	160	212
BOD mg/l	2.7	2.6	2.3	2.2	2.6
COD mg/l	102	99	110	30	43
IOD mg/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
TKN	3.4	3.1	3.5	1.2	1.8
TP	1.21	1.06	1.16	0.44	0.56
NH3-N mg/l	0.06	0.04	0.11	< 0.04	0.04
NO2-NO3 mg/l	1.03	0.86	0.94	0.95	0.94
TOC mg/l	49	32	41	18	24
Phenolics ug/l	< 5	< 5	< 5	< 5	< 5
Oil-Grse mg/l	1	< 1	1	1	< 1
Sulfides mg/l	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
ORP mV	277.8	285.9	287.2	277.0	282.4
CN- mg/l	< 0.003	< 0.003	< 0.003	< 0.003	< 0.003
pH	7.6	7.5	7.5	7.8	7.6
NFS mg/l					

Table A-11. Chemical analysis of water samples analyzed by the Environmental Protection Agency from sampling sites in the lower Kansas River, Fishery-Dredging Project. September 1981.

Station Number	C1B	C2B	D1E	D2E	D3E
Silver ug/l	< 5	< 5	< 5	< 5	< 5
Aluminum ug/l	20900	28200	25800	17100	16700
Arsenic ug/l	< 50	< 50	< 50	< 50	< 50
Barium ug/l	255	304	285	234	244
Beryllium ug/l	< 2	< 2	< 2	< 2	< 2
Cadmium ug/l	< 2	< 2	< 2	< 2	< 2
Chromium ug/l	22	28	25	18	20
Copper ug/l	16	22	20	14	80
Iron ug/l	15300	20400	18500	13300	15100
Manganese ug/l	387	536	462	301	371
Nickel ug/l	20	27	25	21	22
Lead ug/l	< 50	< 50	< 50	< 50	< 50
Antimony ug/l	< 50	< 50	< 50	< 50	< 50
Selenium ug/l	< 50	< 50	< 50	< 50	< 50
Thallium ug/l	< 100	< 100	< 100	< 100	< 100
Zinc ug/l	54	90	63	40	58
Calcium mg/l	68	68	69	64	64
Magnesium mg/l	16	17	16	15	14
Sodium mg/l	28	26	28	27	26
Mercury ug/l	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
TVS mg/l	176	160	194	164	182
BOD mg/l	2.0	1.7	1.1	1.1	1.1
COD mg/l	53	48	61	42	58
IOD mg/l	< .1	< .1	< .1	< .1	< .1
TKN	1.7	2.0	2.0	1.6	1.9
TP	.83	.94	.93	1.51	1.59
NH3-N mg/l	.30	.16	.17	.12	.15
NO2-NO3 mg/l	.90	.94	.94	.92	1.02
TOC mg/l	5	5	15	8	9
Phenolics ug/l	< 5	< 5	< 5	< 5	< 5
Oil-Grse mg/l	2.4	< 2.0	< 2.0	< 2.0	< 2.0
Sulfides mg/l	< .003	< .003	< .003	< .003	< .003
ORP mV	417	370	353	328	330
CN- mg/l	< .003	< .003	< .003	< .003	< .003
pH					
NFS mg/l					

APPENDIX 2 -- BENTHOS

Table A2-1, taxonomic list

Table A2-2, abundance and density each taxon

Table A2-3, substrate analysis benthos samples

Table A2-4, substrate comparisons benthos vs seine samples

Table A2-5, substrates, percent composition each year

Table A2-6, percent composition by taxon, 3-year summary

Table A2-7, substrates, 3-year summary

Table A2-8, benthos composition by date and transect

Table A2-1. Summary of invertebrate taxa from the Kansas River Benthos.

- Phylum Annelida - segmented worms
  - Class Oligochaeta - earthworms
  - Class Hirudinea - leeches
- Phylum Arthropoda - joint-footed invertebrates
  - Class Crustacea
    - Order Amphipoda - scuds, sideswimmers
      - Family Talitridae
        - *Hyalella*
      - Family Gammaridae
    - Order Decapoda - crayfishes
      - Family Astacidae
        - *Orconectes*
  - Class Insecta - insects
    - Order Coleoptera - beetles
      - Family Elmidae
        - *Dubiraphia*
        - *Macronychus*
        - *Stenelmis*
      - Family Helodidae
    - Order Collembola - springtails
    - Order Diptera - flies, mosquitoes, midges
      - Family Ceratopogonidae
      - Family Chaoboridae
        - *Chaoborus*
      - Family Chironomidae
      - Family Empididae
        - *Hemerodromia*
      - Family Ephydridae
      - Family Simuliidae
        - *Simulium*
      - Family Tipulidae
    - Order Ephemeroptera - mayflies
      - Family Baetidae
        - *Apobaetis*
        - *Baetis*
        - *Centroptilum*

Family Caenidae

Brachycercus

Caenis

Family Ephemeridae

Hexagenia

Family Heptageniidae

Heptagenia

Stenacron

Stenonema

Family Leptophlebiidae

Choroterpes

Family Oligoneuridae

Homoeoneuria

Isonychia

Family Palingeniidae

Pentagenia

Family Polymitarcidae

Ephoron

Tortopus

Family Potamanthidae

Potamanthus

Family Tricorythidae

Tricorythodes

Order Hemiptera - true "bugs"

Family Corixidae

Trichocorixa

Family Notonectidae

Notonecta

Family Pleidae

Neoplea

Family Veliidae

Rhagovelia

Order Megaloptera - alderflies, dobsonflies

Family Corydalidae

Corydalus

Family Sialidae

Sialis

Order Odonata - dragonflies, damselflies
- Family Coenagrionidae
  - *Argia*
- Family Corduliidae
  - *Neurocordulia*
- Family Gomphidae
  - *Gomphus*
  - *Progomphus*

Order Plecoptera - stoneflies
- Family Perlidae
  - *Neoperla*
  - *Perlesta*
- Family Perlodidae
  - *Isoperla*

Order Trichoptera - caddisflies
- Family Hydropsychidae
  - *Cheumatopsyche*
  - *Hydropsyche*
  - *Potamyia*
- Family Leptoceridąe
  - *Nectopsyche*
- Family Polycentropodidae
  - *Neureclipsis*
  - *Cyrnellus*

Phylum Mollusca - mollusks

Class Gastropoda - snails

Order Basommatophora
- Family Lymnaeidae
  - *Lymnaea*
- Family Physidae
  - *Physa*

Class Pelecypoda - clams

Order Heterodonta
- Family Corbiculidae
  - *Corbicula*
- Family Pisidiidae

Table A2-2. Actual number (No.), percent of total abundance (%) and density in no./m^2 (Dn) of Common Invertebrate Taxa sampled by PIBS, for each year at Control and Dredge sites.

TAXON	CONTROL			DREDGE 1			DREDGE 2			DREDGE 3			
	No.	%	Dn	No.	%	Dn	No.	%	Dn	No.	%	Dn	
	10	11	1.8	-	-	-	111	21	16.8	16	2	2.4	1979
Oligochaeta	3	7	0.8	29	1	4.0	675	42	93.8	266	22	40.3	1980
	16	47	4.1	7	2	2.3	193	49	53.6	337	45	70.2	1981
	-	-	-	5	1	0.7	1	<1	0.2	10	1	1.5	
Stenelmis	-	-	-	4	<1	0.7	1	<1	0.1	11	1	1.7	
	1	3	0.3	1	<1	0.3	1	<1	0.3	2	<1	0.4	
	-	-	-	7	2	0.9	24	5	3.6	7	1	1.1	
Ceratopogonidae	17	39	4.7	13	1	1.8	20	1	2.8	12	1	1.8	
	1	3	0.3	-	-	-	1	<1	0.3	7	1	1.4	
	-	-	-	3	1	0.4	-	-	-	16	2	2.4	
Simulium	2	4	0.6	3	<1	0.4	-	-	-	3	<1	0.4	
	1	3	0.3	-	-	-	-	-	-	-	-	-	
	5	6	0.9	76	17	10.4	4	1	0.6	78	8	11.8	
Baetis	4	9	1.1	32	2	4.4	3	<1	0.4	111	9	16.8	
	-	-	-	2	1	0.7	1	<1	0.3	75	10	15.6	
	2	2	0.4	-	-	-	-	-	-	-	-	-	
Centroptilum	-	-	-	2	<1	0.3	1	<1	0.1	1	<1	0.2	
	-	-	-	1	<1	0.3	-	-	-	1	<1	0.2	
	22	24	3.9	26	6	3.5	61	12	9.2	71	8	10.8	
Caenis	-	-	-	50	3	6.9	1	<1	0.1	43	4	6.5	
	-	-	-	7	2	2.3	1	<1	0.3	9	1	1.9	
	4	4	0.7	-	-	-	36	7	5.4	2	<1	0.3	
Hexagenia	-	-	-	-	-	-	22	1	3.1	14	1	2.1	
	-	-	-	-	-	-	8	2	2.2	-	-	-	
	-	-	-	-	-	-	-	-	-	-	-	-	
Heptagenia	-	-	-	1	<1	0.1	-	-	-	-	-	-	
	-	-	-	1	<1	0.3	-	-	-	4	<1	0.8	

Table A2-2. Continued.

TAXON	CONTROL			DREDGE 1			DREDGE 2			DREDGE 3			
	No.	%	Dn	No.	%	Dn	No.	%	Dn	No.	%	Dn	
	-	-	-	-	-	-	-	-	-	-	-	-	1979
Stenacron	-	-	-	-	-	-	-	-	-	-	-	-	1980
	-	-	-	7	2	2.3	-	-	-	3	<1	0.6	1981
	-	-	-	24	5	3.2	2	<1	0.3	66	7	10.0	
Stenonema	4	9	1.1	17	1	2.2	-	-	-	77	6	11.7	
	-	-	-	-	-	-	1	<1	0.3	79	10	16.5	
	-	-	-	1	<1	0.1	-	-	-	-	-	-	
Isonychia	-	-	-	29	1	4.0	-	-	-	7	1	1.1	
	-	-	-	1	<1	0.3	-	-	-	7	1	1.5	
	7	8	1.2	1	<1	0.1	12	2	1.8	78	8	11.8	
Pentagenia	-	-	-	2	<1	0.3	2	<1	0.3	1	<1	0.2	
	1	3	0.3	-	-	-	7	2	1.9	1	<1	0.2	
	19	21	3.3	12	3	1.6	1	<1	0.2	8	1	1.2	
Ephoron	-	-	-	-	-	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	-	-	-	-	-	
	-	-	-	1	<1	0.1	-	-	-	3	<1	0.4	
Tricorythodes	-	-	-	4	<1	0.6	-	-	-	6	<1	0.9	
	-	-	-	-	-	-	-	-	-	1	<1	0.2	
	9	10	1.6	5	1	0.7	41	8	6.2	5	<1	0.8	
Trichocorixa	1	2	0.3	221	11	30.7	823	52	114.3	123	10	18.6	
	5	15	1.3	6	2	2.0	154	40	42.8	177	24	36.9	
	-	-	-	-	-	-	1	<1	0.2	-	-	-	
Argia	-	-	-	-	-	-	-	-	-	2	<1	0.3	
	-	-	-	1	<1	0.3	-	-	-	6	1	1.3	
	1	1	0.2	2	<1	0.3	1	<1	0.2	3	<1	0.4	
Gomphus	-	-	-	2	<1	0.3	18	1	2.5	6	1	0.9	
	6	18	1.5	2	1	0.7	16	4	4.4	7	1	1.5	
	-	-	-	4	1	0.5	2	<1	0.3	8	1	1.2	
Neoperla	-	-	-	8	<1	1.1	1	<1	0.1	-	-	-	
	-	-	-	-	-	-	-	-	-	-	-	-	
	-	-	-	4	2	0.5	-	-	-	-	-	-	
Perlesta	-	-	-	3	<1	0.4	-	-	-	5	<1	0.8	
	-	-	-	1	<1	0.3	-	-	-	-	-	-	

Table A2-2. Continued.

TAXON	CONTROL			DREDGE 1			DREDGE 2			DREDGE 3			
	No.	%	Dn	No.	%	Dn	No.	%	Dn	No.	%	Dn	
	-	-	-	1	<1	0.1	3	1	0.4	5	<1	0.8	1979
Isoperla	-	-	-	9	<1	1.2	-	-	-	13	1	2.0	1980
	-	-	-	-	-	-	-	-	-	-	-	-	1981
	-	-	-	29	6	3.9	6	1	0.9	7	1	1.1	
Cheumatopsyche	-	-	-	6	<1	0.8	-	-	-	9	1	1.4	
	1	3	0.3	2	1	0.7	-	-	-	2	<1	0.4	
	2	2	0.4	36	8	4.8	97	19	14.7	179	19	27.1	
Hydropsyche	-	-	-	549	28	76.2	12	1	1.7	368	31	55.8	
	2	6	0.5	231	64	77.0	-	-	-	3	<1	0.6	
	8	9	1.4	211	47	28.1	114	22	17.3	360	39	54.5	
Potamyia	13	30	3.6	948	49	131.7	9	1	1.2	124	10	18.8	
	-	-	-	88	25	29.3	-	-	-	27	4	5.6	
	-	-	-	1	<1	0.1	-	-	-	6	1	0.9	
Nectopsyche	-	-	-	4	<1	0.6	7	<1	1.0	3	<1	0.4	
	-	-	-	1	<1	0.3	-	-	-	1	<1	0.2	
	1	1	0.2	-	-	-	-	-	-	-	-	-	
Physa	-	-	-	-	-	-	-	-	-	1	<1	0.2	
	-	-	-	-	-	-	5	1	1.4	-	-	-	
	-	-	-	-	-	-	-	-	-	-	-	-	
Pisidiidae	-	-	-	-	-	-	1	<1	0.1	-	-	-	
	-	-	-	-	-	-	9	2	2.5	-	-	-	
	89	100	15.8	448	100	60.1	517	100	78.3	928	100	140.6	1979
Totals:	44	100	12.2	1936	100	268.9	1596	100	221.2	1197	100	181.4	1980
	33	100	8.7	359	100	119.7	397	100	110.3	751	100	156.4	1981
Total number		57			75			66			66		
PIBS samples:		36			72			72			66		
		39			30			36			48		
		0.92			0.79			0.89			0.86		
H':		0.68			0.64			0.44			0.90		
		0.71			0.49			0.53			0.72		

Table A2-3. Composition of the substrate at Control sites and Dredge sites, Lower Kansas River, 1979-1981. The area (m^2) sampled by PIBS composed of each substrate is listed as a percentage of total area sampled.

SUBSTRATES	CONTROL		D1A		D1E		D2A		D2E		D3A		D3E	
	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
CLAY	-	-	-	-	0.3	3.2	-	-	-	-	-	-	-	-
CLAY-RUBBLE	-	-	-	-	1.2	12.9	0.3	3.6	-	-	-	-	-	-
SILT	0.3	2.3	0.6	7.1	-	-	3.0	35.7	5.7	63.3	2.7	31.0	1.5	16.1
SILT-SAND	2.7	20.4	0.3	3.6	0.3	3.2	2.7	32.1	0.6	6.7	2.1	24.1	-	-
SILT-GRAVEL	-	-	-	-	-	-	-	-	-	-	-	-	0.3	3.2
SILT-RUBBLE	-	-	0.6	7.1	1.5	16.1	-	-	-	-	0.3	3.4	3.3	35.5
SAND	8.4	63.6	2.7	32.2	3.3	35.5	1.2	14.3	0.9	10.0	1.8	20.7	0.3	3.2
SAND-GRAVEL	1.5	11.4	0.3	3.6	1.2	12.9	-	-	-	-	1.5	17.2	0.6	6.5
SAND-RUBBLE	-	-	2.4	28.6	0.6	6.5	-	-	0.3	3.3	-	-	0.3	3.2
GRAVEL	-	-	-	-	-	-	-	-	-	-	0.3	3.4	0.3	3.2
GRAVEL-RUBBLE	-	-	-	-	-	-	-	-	-	-	-	-	0.9	9.7
RUBBLE	0.3	2.3	0.9	10.7	-	-	0.3	3.6	-	-	-	-	0.9	9.7
SAND-SILT-GRAVEL	-	-	-	-	-	-	0.9	10.7	1.5	16.7	-	-	0.3	3.2
SAND-CLAY-RUBBLE	-	-	-	-	0.3	3.2	-	-	-	-	-	-	-	-
SAND-SILT-RUBBLE	-	-	0.6	7.1	0.3	3.2	-	-	-	-	-	-	-	-
SAND-GRAVEL-RUBBLE	-	-	-	-	0.3	3.2	-	-	-	-	-	-	0.6	6.5
TOTALS:	13.2	100.0	8.4	100.0	9.3	100.0	8.4	100.0	9.0	100.0	8.7	100.0	9.3	100.0
H':	0.44		0.77		0.83		0.64		0.48		0.65		0.88	

Table A2-4. Substrate compositions as percent of total area sampled by PIBS and seine, Lower Kansas River 1979-1981 at Dredge sites, upstream of the dredge pit (A), downstream of the dredge pit (E) and all transects combined (T).

Sample Method	Substrate Type*	Dredge 1			Dredge 2			Dredge 3		
		A	E	T	A	E	T	A	E	T
PIBS	d	42.8	41.9	42.0	82.1	96.7	79.5	75.7	22.5	48.3
	e	53.5	45.0	49.2	7.2	3.3	5.2	6.8	67.8	38.3
Seine	d	48.3	53.5	72.4	98.7	100.0	99.3	98.8	34.8	64.0
	e	48.2	7.2	27.2	0.5	0.0	0.2	1.2	57.1	30.2

*e = erosional substrates = single-component gravel substrate and any substrate containing rubble.

d = depositional substrates = substrates containing any combination or single components of clay, silt and sand. This includes the substrate type silt-sand-gravel, but not sand-gravel or silt-gravel which are considered intermediate to depositional and erosional and are difficult to interpret as ecological influences on benthos fauna.

Table A2-5. Composition of the substrate totalled for each year at Control and Dredge sites. The area (m^2) sampled by PIBS composed of each substrate is listed as a percentage of total area sampled.

SUBSTRATE	CONTROL		DREDGE 1		DREDGE 2		DREDGE 3		
	Area	%	Area	%	Area	%	Area	%	
	-	-	-	-	-	-	-	-	1979
CLAY	-	-	0.3	4.2	-	-	-	-	1980
	-	-	-	-	-	-	-	-	1981
	-	-	0.3	4.0	0.3	4.5	-	-	
CLAY-RUBBLE	-	-	0.6	8.3	-	-	-	-	
	-	-	0.3	10.0	-	-	-	-	
	0.3	5.3	-	-	0.9	13.6	1.2	18.2	
SILT	-	-	0.3	4.2	4.2	58.3	1.8	27.3	
	-	-	0.3	10.0	3.6	100.0	1.2	25.0	
	1.5	26.3	0.3	4.0	1.2	18.2	-	-	
SILT-SAND	-	-	0.3	4.2	2.1	29.2	1.5	22.7	
	1.2	30.8	-	-	-	-	0.6	12.5	
	-	-	-	-	-	-	-	-	
SILT-GRAVEL	-	-	-	-	-	-	-	-	
	-	-	-	-	-	-	0.3	6.2	
	-	-	0.3	4.0	-	-	0.9	13.6	
SILT-RUBBLE	-	-	1.2	16.7	-	-	0.9	13.6	
	-	-	0.6	20.0	-	-	1.8	37.5	
	2.4	42.1	2.4	32.0	1.2	18.2	1.2	18.2	
SAND	3.3	91.7	2.7	37.5	0.9	12.5	-	-	
	2.7	69.2	0.9	30.0	-	-	0.9	18.8	
	1.2	21.0	1.5	20.0	-	-	1.5	22.7	
SAND-GRAVEL	0.3	8.3	-	-	-	-	0.6	9.1	
	-	-	-	-	-	-	-	-	
	-	-	1.2	16.0	0.3	4.5	-	-	
SAND-RUBBLE	-	-	1.5	20.8	-	-	0.3	4.5	
	-	-	0.3	10.0	-	-	-	-	

Table A2-5. Continued.

SUBSTRATE	CONTROL Area	CONTROL %	DREDGE 1 Area	DREDGE 1 %	DREDGE 2 Area	DREDGE 2 %	DREDGE 3 Area	DREDGE 3 %	
	-	-	-	-	-	-	0.6	9.1	1979
GRAVEL	-	-	-	-	-	-	-	-	1980
	-	-	-	-	-	-	-	-	1981
	-	-	-	-	-	-	0.9	13.6	
GRAVEL-RUBBLE	-	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	-	
	0.3	5.3	0.6	8.0	0.3	4.5	-	-	
RUBBLE	-	-	-	-	-	-	0.9	13.6	
	-	-	0.3	10.0	-	-	-	-	
	-	-	-	-	2.4	36.4	-	-	
SAND-SILT-GRAVEL	-	-	-	-	-	-	0.3	4.5	
	-	-	-	-	-	-	-	-	
	-	-	0.3	4.0	-	-	-	-	
SAND-CLAY-RUBBLE	-	-	-	-	-	-	-	-	
	-	-	-	-	-	-	-	-	
	-	-	0.3	4.0	-	-	-	-	
SAND-SILT-RUBBLE	-	-	0.3	4.2	-	-	-	-	
	-	-	0.3	10.0	-	-	-	-	
	-	-	0.3	4.0	-	-	0.3	4.5	
SAND-GRAVEL-RUBBLE	-	-	-	-	-	-	0.3	4.5	
	-	-	-	-	-	-	-	-	
	5.7	100.0	7.5	100.0	6.6	100.0	6.6	100.0	
TOTALS:	3.6	100.0	7.2	100.0	7.2	100.0	6.6	100.0	
	3.9	100.0	3.0	100.0	3.6	100.0	4.8	100.0	
	0.59		0.85		0.73		0.81		
H′:	0.12		0.75		0.41		0.81		
	0.27		0.80		0.0		0.63		

Table A2-6. Abundances (No.) of common invertebrate taxa and percent of total abundance (%) at Control and Dredge sites, Lower Kansas River, 1979-1981.

	Control		Dredge 1		Dredge 2		Dredge 3	
	No.	%	No.	%	No.	%	No.	%
Oligochaeta	29	6.9	36	1.1	979	30.7	619	17.4
Stenelmis	1	0.2	10	0.3	3	0.1	23	0.6
Ceratopogonidae	18	4.3	20	0.6	45	1.4	26	0.7
Chironomidae	256	60.7	429	13.5	679	21.3	677	19.0
Simulium	3	0.7	6	0.2	-	-	19	0.5
Baetis	9	2.1	110	3.5	8	0.2	264	7.4
Centroptilum	2	0.5	3	0.1	1	<0.1	2	0.1
Caenis	22	5.2	82	2.6	63	2.0	123	3.5
Hexagenia	4	0.9	-	-	66	2.1	16	0.4
Heptagenia	-	-	2	0.1	-	-	4	0.1
Stenacron	-	-	7	0.2	-	-	3	0.1
Stenonema	8	1.9	41	1.3	3	0.1	222	6.2
Isonychia	-	-	31	1.0	-	-	14	0.4
Pentagenia	4	0.9	3	0.1	21	0.7	80	2.2
Ephoron	19	4.5	12	0.4	1	<0.1	8	0.2
Tricorythodes	-	-	5	0.2	-	-	10	0.3
Trichocorixa	15	3.6	232	7.3	1018	31.9	305	8.6
Argia	-	-	1	<0.1	1	<0.1	8	0.2
Gomphus	7	1.7	6	0.2	35	1.1	16	0.4
Neoperla	-	-	12	0.4	3	0.1	8	0.2
Perlesta	-	-	8	0.3	-	-	5	0.1
Isoperla	-	-	10	0.3	3	0.1	18	0.5
Cheumatopsyche	-	-	37	1.2	6	0.2	18	0.5
Hydropsyche	4	0.9	816	25.7	109	3.4	550	15.4
Potamyia	21	5.0	1247	39.3	123	3.9	511	14.4
Nectopsyche	-	-	6	0.2	7	0.2	10	0.3
Physa	-	-	-	-	5	0.2	1	<0.1
Pisidiidae	-	-	-	-	10	0.3	-	-
Totals:	422	100	3172	100	3189	100	3560	100
H':	0.70	-	0.78	-	0.74	-	0.99	-
H'-modified:	1.04	-	0.70	-	0.65	-	0.97	-
Total sampling effort (P1BS):	132	-	177	-	174	-	180	-

Table A2-7. Substrate composition of total area sampled by PIBS is expressed as a percent total area sampled (%) at each site, Lower Kansas River, 1979-1981.

	Control		Dredge 1		Dredge 2		Dredge 3	
	Area	%	Area	%	Area	%	Area	%
CLAY	-	-	0.3	1.7	-	-	-	-
SILT	0.3	2.3	0.6	3.4	8.7	50.0	4.2	23.3
SILT-SAND	2.7	20.4	0.6	3.4	3.3	19.0	2.1	11.7
SILT-GRAVEL	-	-	-	-	-	-	0.3	1.7
SILT-RUBBLE	-	-	2.1	11.9	-	-	3.6	20.0
SAND	8.4	63.6	6.0	33.9	2.1	12.1	2.1	11.7
SAND-GRAVEL	1.5	11.4	1.5	8.5	-	-	2.1	11.7
SAND-RUBBLE	-	-	3.0	16.9	0.3	1.7	0.3	1.7
GRAVEL	-	-	-	-	-	-	0.6	3.3
GRAVEL-RUBBLE	-	-	-	-	-	-	0.9	5.0
RUBBLE	0.3	2.3	0.9	5.1	0.3	1.7	0.9	5.0
CLAY-RUBBLE	-	-	1.2	6.8	0.3	1.7	-	-
SAND-SILT-GRAVEL	-	-	-	-	2.4	13.8	0.3	1.7
SAND-CLAY-RUBBLE	-	-	0.3	1.7	-	-	-	-
SAND-SILT-RUBBLE	-	-	0.9	5.1	-	-	-	-
SAND-GRAVEL-RUBBLE	-	-	0.3	1.7	-	-	0.6	3.3
TOTALS:	13.2	100	17.7	100	17.4	100	18.0	100
H':	0.45	-	0.89	-	0.61	-	0.93	-

Table A2-8. Benthos samples, lower Kansas River, 1979-1981.

12, 14 June 1979*

C1A
12 PIBS

6 Oligochaeta
22 Chironomidae
2 Caenis
1 Trichocorixa
1 Hydropsyche
1 pupa

C1B
9 PIBS

66 Chironomidae
1 Tipulidae
3 Hexagenia
1 Ephoron
4 Trichocorixa

C2A
9 PIBS

1 Oligochaeta
10 Chironomidae
2 Baetis
6 Caenis
3 Ephoron
4 Trichocorixa
3 Potamyia
5 Pupae

C2B
9 PIBS

20 Chironomidae
13 Caenis
15 Ephoron
3 pupae

D1A
9 PIBS

1 Orconectes
5 Stenelmis
44 Chironomidae
1 Empididae
36 Baetis
9 Caenis
7 Stenonema
3 Ephoron
1 Tricorithodes
4 Trichocorixa

D1A (continued)

1 Sialis
3 Neoperla
4 Perlesta
22 Cheumatopsyche
25 Hydropsyche
81 Potamyia
1 Nectopsyche
1 Neureclipsis
5 Pupae

D1B
3 Ek. dr.

2 Chironomidae
1 Pupa

D1C
3 Ek.dr.

1 Potamyia
1 Pupa

D1D
9 PIBS

10 Chironomidae
2 Baetis
7 Caenis
6 Stenonema
9 Ephoron
1 Potamanthus
1 Gomphus
3 Cheumatopsyche
4 Hydropsyche
10 Potamyia
2 Pupae

D1E
9 PIBS

10 Chironomidae
2 Pupae

D2A
6 PIBS; 3 Ek.dr.

14 Oligochaeta
7 Chironomidae
1 Baetis
16 Caenis
1 Hexagenia
1 Pentagenia

D2A (continued)

1 Tortopus
1 Trichocorixa
1 Potamayia
2 Pupae

D2B
3 Ek.dr.

15 Chironomidae
1 Pupa

D2D
9 PIBS

3 Oligochaeta
1 Hirudinea
1 Stenelmus
26 Chironomidae
3 Tipulidae
18 Caenis
1 Ephoron
2 Potamyia
9 Pupae

D2E
9 PIBS

10 Chironomidae
9 Caenis
1 Hydropsyche
4 Pupae

D3A
3 PIBS; 6 Ek.dr.

5 Oligochaeta
10 Chironomidae
1 Caenis

D3B
3 Ek.dr.

1 Oligochaeta
1 Stenelmus
3 Chironomidae
1 Caenis
1 Hydropsyche
3 Potamyia

Table A2-8. Continued.

12, 14 June 1979* (continued)

D3C
3 Ek.dr.

1	Chrionomidae
1	Pentagenia
1	Potamyia

D3D
9 PIBS

1	Orconectes
8	Stenelmus
37	Chironomidae
25	Baetis
18	Caenis
19	Stenonema
2	Ephoron
1	Tortopus
1	Tricorythodes
1	Gomphus
3	Neoperla
4	Cheumatopsyche
101	Hydropsyche
184	Potamyia
13	Pupae
3	Ceratopogonidae

D3E
9 PIBS

5	Oligochaeta
1	Stenelmus
22	Chironomidae
42	Baetis
35	Caenis
35	Stenonema
47	Pentagenia
6	Ephoron
3	Tortopus
1	Tricorithodes
1	Gomphus
3	Neoperla
24	Potamyia
18	Pupae

*No drift samples were taken on this collection date.

Table A2-8. Continued.

20, 21 August 1979

C1B

PIBS	1 Drift
None taken	54 Potamyia
	15 Hydropsyche
	6 Caenis
	3 Tricorythodes
	6 Baetis
	99 Pupae
	3 Stenelmis

C2A

9 PIBS	Drift
1 Gomphus	None taken
2 Centroptilum	
1 Hexagenia	
12 Pupae	
3 Oligochaeta	
4 Potamyia	
1 Hydropsyche	
1 Caenis	
4 Pentagenia	
3 Baetis	
3 Chaoborus	
25 Chironomidae	

D1A

9 PIBS	1 Drift
3 Potamyia	17 Pupae
1 Baetis	4 Baetis
11 Chironomidae	5 Potamyia
6 Pupae	3 Chironomidae
1 Ceratopogonidae	1 Ceratopogonidae
1 Caenis	2 Hydropsyche

D1B

9 PIBS	1 Drift
1 Caenis	30 Potamyia
1 Ceratopogonidae	8 Hydropsyche
1 Pupa	28 Baetis
	43 Pupae
	1 Tricorythodes
	1 Caenis
	2 Chironomidae
	2 Stenonema
	1 Notonecta

D1C

3 PIBS	1 DRIFT
20 Baetis	28 Potamyia
7 Caenis	8 Baetis
1 Stenonema	8 Caenis
7 Potamyia	8 Chironomidae
2 Chironomidae	8 Pupae
3 Pupae	

D1E

9 PIBS	1 Drift
5 Ceratopogonidae	5 Caenis
6 Pupae	15 Baetis
16 Baetis	5 Hydropsyche
3 Stenonema	70 Pupae
6 Potamyia	20 Chironomidae
8 Chironomidae	

D2A

3 PIBS; 6 Ek.dr.	1 Drift
2 Baetis	6 Baetis
1 Dubiraphia	2 Nectopsyche
8 Chironomidae	2 Chironomidae
4 Pupae	2 Pupae
3 Oligochaeta	
1 Potamyia	
1 Caenis	
1 Tipulidae	

D2C

PIBS	1 Drift
None taken	1 Potamyia
	2 Hydropsyche
	1 Pentagenia
	6 Baetis
	1 Corydalus
	11 Pupae

D2E

3 PIBS; 6 Ek.dr.	1 Drift
17 Caenis	16 Nectopsyche
7 Pentagenia	7 Pentagenia
14 Potamyia	4 Caenis
6 Chironomidae	15 Pupae
2 Pupae	
2 Hexagenia	
12 Ceratopogonidae	
27 Oligochaeta	

Table A2-8. Continued.

20, 21 August 1979 (continued)

D3A

9 PIBS	1 Drift
14 Caenis	1 Nectopsyche
2 Stenonema	1 Chironomidae
4 Baetis	2 Pupae
2 Hexagenia	
8 Pentagenia	
3 Potamyia	
17 Chironomidae	
5 Pupae	
3 Oligochaeta	
1 Gomphus	
1 Nectopsyche	

D3E

9 PIBS	1 Drift
3 Stenonema	21 Pupae
21 Pentagenia	3 Hydropsyche
4 Baetis	2 Baetis
2 Caenis	1 Ephydridae
1 Tricorythodes	3 Chironomidae
18 Potamyia	
2 Nectopsyche	
21 Chironomidae	
6 Pupae	
3 Ceratopogonidae	
2 Oligochaeta	

Table A2-8. Continued.

28, 29 May 1981

C2B

9 PIBS	2 Drift
2 Chironomidae	3 Hydropsyche
1 Hydropsyche	1 Chironomidae
	3 Pupae
	1 Cheumatopsyche

D1A

6 PIBS; 3 Pet.dr.	2 Drift
5 Potamyia	1 Trichocorixa
4 Hydropsyche	3 Hydropsyche
9 Chironomidae	1 Chaoborus
2 Oligochaeta	1 Chironomidae
4 Caenis	1 Pupa

D1E

6 PIBS; 3 Pet.dr.	2 Drift
1 Centroptilum	8 Hydropsyche
6 Trichocorixa	3 Chironomidae
5 Oligochaeta	1 Pupa
227 Hydropsyche	2 Potamyia
74 Potamyia	
2 Cheumatopsyche	
2 Caenis	
1 Gomphus	
1 Chironomidae	
1 Pupa	

D2A

6 PIBS; 3 Pet.dr.	2 Drift
8 Trichocorixa	9 Trichocorixa
5 Chironomidae	1 Caenis
4 Pisidiidae	8 Chironomidae
29 Oligochaeta	3 Pupae
1 Progomphus	
1 Stenonema	
1 Stenelmis	

D2E

9 PIBS	2 Drift
146 Trichocorixa	5 Trichocorixa
46 Chironomidae	15 Physa
5 Physa	1 Hirudinea
97 Oligochaeta	1 Potamyia
5 Pisidiidae	4 Chironomidae
1 Caenis	1 Oligochaeta
2 Pupae	1 Neoplea
1 Gomphus	

D3A

9 PIBS	2 Drift
1 Gomphus	1 Hexagenia
1 Potamyia	18 Trichocorixa
60 Trichocorixa	1 Chaoborus
15 Chironomidae	10 Chironomidae
1 Ceratopogonidae	2 Simuliidae
11 Oligochaeta	1 Pupa
1 Argia	
8 Caenis	
1 Tricorythodes	
2 Pupae	

D3E

9 PIBS	2 Drift
84 Trichocorixa	11 Trichocorixa
23 Chironomidae	4 Potamyia
1 Ceratopogonidae	2 Hydropsyche
34 Oligochaeta	1 Chaoborus
1 Stenelmis	3 Chrionomidae
8 Potamyia	1 Simuliidae
2 Cheumatopsyche	
1 Hydropsyche	
1 Baetis	
2 Stenonema	

Table A2-8. Continued.

19 September 1981

C2A

9 PIBS	2 Drift
13 Chironomidae	10 Chironomidae
1 Chaoborus	58 Chaoborus
1 Stenelmis	2 Potamyia
6 Gomphus	8 Nectopsyche
	4 Baetis
	2 Hexagenia

C2B

9 PIBS	2 Drift
1 Chironomidae	16 Chironomidae
1 Ceratopogonidae	8 Chaoborus
1 Simuliidae	1 Simulium
1 Hydropsyche	1 Hydropsyche
1 Cyrnellus	3 Nectopsyche
1 Pentagenia	5 Baetis
4 Oligochaeta	1 Stenacron
	1 Brachycercus
	1 Hexagenia

D1A

6 PIBS	2 Drift
21 Chironomidae	Nothing
1 Chaoborus	
9 Potamyia	
1 Nectopsyche	
2 Baetis	
1 Apobaetis	
1 Heptagenia	
7 Stenacron	
1 Stenelmis	
1 Argia	
1 Perlesta	

D1E

6 PIBS	2 Drift
1 Chironomidae	15 Chironomidae
1 Hydropsychidae	1 Ceratopogonidae
1 Caenis	3 Chaoborus
1 Isonychia	4 Hydropsychidae
1 Gomphus	1 Hydropsyche
	1 Potamyia
	8 Nectopsyche
	3 Baetis
	1 Stenonema
	1 Isonychia
	1 Helodidae
	2 Tricorythodes

D2A

6 PIBS; 3 Pet.dr.	2 Drift
1 Chironomidae	2 Chironomidae
2 Brachycercus	1 Chaoborus
7 Pentagenia	2 Nectopsyche
3 Gomphus	2 Hydropsychidae
1 Neoplea	1 Baetis
51 Oligochaeta	

D2E

6 PIBS; 3 Pet.dr.	2 Drift
10 Chironomidae	1 Potamyia
1 Ceratopogonidae	1 Caenis
1 Baetis	1 Oligochaeta
1 Apobaetis	
1 Brachycercus	
8 Hexagenia	
12 Gomphus	
16 Oligochaeta	

D3A

9 PIBS	2 Drift
3 Chironomidae	1 Chironomidae
1 Nectopsyche	1 Corixidae
1 Centroptilum	
2 Brachycercus	
1 Pentagenia	
2 Gomphus	
2 Corixidae	
2 Cobicula	
22 Oligochaeta	

D3E

9 PIBS	2 Drift
4 Chironomidae	14 Chironomidae
2 Hydropsyche	1 Chaoborus
18 Potamyia	2 Hydropsychidae
74 Baetis	1 Baetis
4 Heptagenia	
77 Stenonema	
3 Stenacron	
7 Isonychia	
1 Stenelmis	
2 Gomphus	
2 Neurocordulia	
5 Argia	
1 Corydalus	
2 Oligochaeta	

Table A2-8. Continued.

14, 15 November 1980

C2A

9 PIBS		2 Drift	
74	Chironomidae	15	Oligochaeta
13	Potamyia	1	Rhagovelia
1	Trichocorixa	12	Trichocorixa
3	Baetis	17	Chironomidae
4	Stenonema	4	Pupae
2	Simulium	1	Stenelmis
1	Pupa	63	Potamyia
2	Oligochaeta	15	Hydropsyche

D1A

9 PIBS		2 Drift	
211	Potamyia	1	Simulium
35	Hydropsyche	13	Trichocorixa
68	Chironomidae	5	Chironomidae
9	Oligochaeta	1	Oligochaeta
1	Pupa	1	Baetis
1	Trichocorixa	17	Potamyia
1	Gomphus	1	Hydropsyche
		5	Pupae
		3	Rhagovelia
		1	Hirudinea

D1E

9 PIBS		2 Drift	
3	Trichocorixa	7	Trichocorixa
99	Potamyia	3	Pupae
35	Chironomidae	10	Potamyia
1	Stenelmis	3	Chironomidae
16	Oligochaeta		
18	Hydropsyche		
1	Stenonema		
1	Collembola		

D2A

6 PIBS; 3 Pet.dr.		2 Drift	
3	Trichocorixa	22	Trichocorixa
1	Pupa	1	Pupa
24	Chironomidae	2	Chironomidae
190	Oligochaeta	3	Oligochaeta
1	Pisidiidae		

D2E

6 PIBS; 3 Pet.dr.		2 Drift	
275	Oligochaeta	24	Trichocorixa
51	Trichocorixa	15	Oligochaeta
56	Chironomidae		
1	Hexagenia		
7	Ceratopogonidae		
1	Lymnaea		

D3A

6 PIBS; 3 Pet.dr.		2 Drift	
59	Trichocorixa	1	Tipulidae
199	Oligochaeta	1	Chironomidae
1	Physa	4	Trichocorixa
156	Chironomidae	2	Oligochaeta
1	Hexagenia		
1	Pupa		

D3E

3 PIBS; 3 Pet.dr.		Drift
25	Chironomidae	none taken
7	Stenelmis	
2	Stenonema	
39	Potamyia	
6	Hydropsyche	
1	Cheumatopsyche	
7	Oligochaeta	

Table A2-8. Continued.

29 March 1981*

C2A

6 PIBS	2 Drift
11 Chironomidae	15 Stenonema
2 Tipulidae	1 Hydropsyche
1 Pupa	9 Potamyia
5 Trichocorixa	4 Nectopsyche
10 Oligochaeta	1 Isoperla
	47 Chironomidae
	10 Pupae
	1 Argia

C2B

6 PIBS	2 Drift
4 Chironomidae	10 Trichocorixa
6 Pupae	1 Stenonema
2 Oligochaeta	1 Hexagenia
	20 Chironomidae
	17 Pupae
	2 Nectopsyche
	1 Physa Hawnii
	1 Oligochaeta

D3A

6 PIBS	2 Drift
56 Oligochaeta	3 Trichocorixa
1 Caenis	5 Nectopsyche
7 Trichocorixa	1 Potamyia
1 Tipulidae	19 Chironomidae
6 Chironomidae	21 Pupae
3 Ceratopogonidae	2 Tipulidae
1 Pupa	1 Ceratopogonidae
	1 Collembola
	11 Oligochaeta

D3E

6 PIBS	2 Drift
26 Trichocorixa	Nothing
6 Chironomidae	
2 Ceratopogonidae	
212 Oligochaeta	
2 Gomphus	

*High current velocity prevented benthic sampling at midpoint of all transects.

Table A2-8. Continued.

11, 12 June 1980

C2A

3 PIBS; 6 Pet.dr.	2 Drift
1 Ceratopogonidae	2 Caenis
2 Hydropsychidae	1 Stenelmis
	2 Hydropsychidae
	1 Baetidae
	1 Caenis

D1A

6 PIBS; 3 Pet.dr.	2 Drift
1 Ceratopogonidae	5 Pupae
2 Pupae	8 Chironomidae
29 Chironomidae	1 Caenis
1 Baetidae	2 Hydropsychidae
8 Caenis	
1 Isonychia	
33 Hydropsychidae	
3 Perlidae	
1 Simulium	
1 Elmidae	
2 Leptophlebiidae	
13 Isonychia	
2 Tricorythodes	

D1E

9 PIBS	2 Drift
4 Hydropsyche	1 Argia
2 Cheumatopsyche	6 Chironomidae
8 Potamyia	1 Physa
3 Perlesta	1 Tricorythodes
9 Chironomidae	2 Hydropsyche
5 Pupae	1 Potamyia
14 Isonychia	1 Caenis
2 Pentagenia	1 Baetis
1 Stenonema	
1 Baetis	
2 Tricorythodes	
39 Caenis	

D2A

6 PIBS; 3 Pet.dr.	2 Drift
1 Hexagenia	23 Hydropsyche
1 Gomphus	2 Potamyia
2 Ceratopogonidae	1 Neureclipsis
2 Oligochaeta	1 Perlesta
13 Chironomidae	4 Pupae
1 Caenis	2 Hemerodromia
	20 Chironomidae

D2A (continued)

	1 Stenelmis
	1 Stenonema
	1 Baetis
	7 Caenis
	3 Tricorythodes

D2E

9 PIBS	2 Drift
3 Baetidae	1 Centroptilum
8 Trichocorixa	3 Hydropsyche
2 Chironomidae	4 Chironomidae
37 Oligochaeta	1 Pupa
1 Hexagenia	1 Cheumatopsyche
2 Gomphus	1 Stenonema
1 Pupa	
1 Ceratopogonidae	

D3A

6 PIBS; 3 Pet.dr.	2 Drift
5 Hexagenia	1 Simulium
2 Gomphus	1 Hexagenia
7 Chironomidae	1 Caenis
4 Oligochaeta	1 Trichocorixa
1 Hydropsychidae	2 Chironomidae
11 Trichocorixa	1 Pupa
1 Centoptilum	1 Macronychus

D3E

6 PIBS	2 Drift
83 Chironomidae	3 Hydropsyche
3 Pupae	3 Caenis
4 Ceratopogonidae	2 Tricorythodes
3 Simulium	3 Pupae
3 Gomphus	
8 Trichocorixa	
139 Hydropsyche	
1 Pentagenia	
6 Tricorythodes	
40 Caenis	
39 Potamyia	
8 Cheumatopsyche	
1 Progomphus	
1 Argia	
3 Perlesta	
1 Tipulidae	
5 Isonychia	
1 Stenonema	
2 Baetis	

Table A2-8. Continued.

1 August 1980

C2A

9 PIBS		2 Drift	
2	Pupae	1	Nectopsyche
13	Ceratopogonidae	3	Baetis
2	Chironomidae	4	Pupae
4	Homoeoneuria	2	Chironomidae
1	Baetis	1	Trichocorixa

D1A

9 PIBS		2 Drift	
28	Chironomidae	1	Baetis
2	Pupae	1	Nectopsyche
6	Ceratopogonidae	3	Potamyia
213	Trichocorixa	1	Hydropsyche
2	Centroptilum	8	Trichocorixa
1	Oligochaeta		
134	Potamyia		
1	Gomphus		
2	Baetis		
3	Stenonema		

D1E

9 PIBS		2 Drift	
487	Hydropsyche	3	Hydropsyche
463	Potamyia	18	Potamyia
1	Neoperla	1	Baetis
27	Chironomidae	1	Trichocorixa
2	Stenelmis	1	Chironomidae
1	Corydalus	2	Pupae
29	Baetis	1	Ceratopogonidae
1	Caenis	1	Baetidae
1	Stenonema		
4	Trichocorixa		
1	Heptagenia		
1	Pupa		
1	Homoeoneuria		
5	Ceratopogonidae		

D2A

6 PIBS; 3 Pet.dr.		2 Drift	
477	Trichocorixa	55	Trichocorixa
5	Oligochaeta		
2	Ephemeridae		
47	Chironomidae		
2	Pupae		
1	Pelecypoda		
1	Ceratopogonidae		
1	Nectopsyche		

D2E

6 PIBS; 3 Pet.dr.		2 Drift	
241	Trichocorixa	47	Trichocorixa
4	Hexagenia	1	Nectopsyche
1	Pentagenia		
132	Oligochaeta		
46	Chironomidae		
1	Centroptilum		
1	Ceratopogonidae		
2	Pupae		
2	Gomphus		
1	Nectopsyche		

D3A

6 PIBS; 3 Pet.dr.		2 Drift	
8	Hexagenia	4	Trichocorixa
1	Potamyia	8	Pupae
1	Nectopsyche	1	Potamyia
17	Trichocorixa	1	Oligochaeta
126	Chironomidae		
38	Oligochaeta		
3	Hydropsychidae		
2	Ephemeridae		
4	Pupae		
1	Ceratopogonidae		

D3E

9 PIBS		2 Drift	
23	Trichocorixa	61	Pupae
108	Baetis	2	Chironomidae
16	Chironomidae	1	Caenis
5	Oligochaeta	1	Argia
30	Potamyia	4	Potamyia
223	Hydropsyche	4	Nectopsyche
50	Stenonema	4	Trichocorixa
3	Caenis	2	Hydropsychidae
4	Stenelmis		
1	Hemerodromia		
1	Nectopsyche		
1	Isonychia		
1	Argia		
1	Pupa		

Table A2-8. Continued.

22 March 1980

C2A

9 PIBS	1 Drift
3 Ceratopogonidae	4 Chironomidae
5 Chironomidae	1 Hydropsyche
1 Oligochaeta	1 Cheumatopsyche

D1A

6 PIBS; 3 Pet.dr.	1 Drift
2 Nectopsyche	1 Pupa
5 Hydropsyche	4 Chironomidae
4 Cheumatopsyche	1 Chaoborus
33 Potamyia	
48 Chironomidae	
3 Neoperla	
4 Isoperla	
2 Stenonema	
1 Caenis	
1 Simulium	
4 Pupae	
1 Certopogonidae	
1 Atherix	
1 Stenelmis	

D1E

9 PIBS	1 Drift
58 Hydropsychidae	1 Chironomidae
2 Nectopsyche	1 Potamyia
4 Neoperla	1 Hydropsyche
5 Isoperla	1 Trichocorixa
31 Chironomidae	
2 Pupae	
3 Ephemeridae	
1 Isonychia	
9 Stenonema	
1 Caenis	
1 Stenelmis	
3 Oligochaeta	
1 Dubiraphia	
1 Simulium	

D2A

6 PIBS; 3 Pet.dr.	1 Drift
1 Gomphus	nothing
16 Trichocorixa	
7 Hexagenia	
37 Chironomidae	
4 Pupae	
1 Ceratopogonidae	
7 Oligochaeta	
1 Potamyia	
1 Stenelmis	

D2E

3 PIBS; 6 Pet.dr.	1 Drift
19 Hexagenia	1 Baetis
95 Hydropsyche	20 Hydropsyche
95 Potamyia	37 Potamyia
167 Chironomidae	3 Cheumatopsyche
1 Argia	2 Trichocorixa
57 Oligochaeta	13 Chironomidae
1 Ceratopogonidae	1 Hyalella
1 Pupa	
1 Gomphus	
4 Pentagenia	
1 Dubiraphia	
6 Cheumatopsyche	
2 Neoperla	
3 Isoperla	
1 Baetis	
1 Stenonema	

D3A

6 PIBS	1 Drift
1 Nectopsyche	73 Hexagenia
11 Hydropsyche	1 Stenonema
3 Potamyia	27 Potamyia
2 Stenonema	7 Trichocorixa
11 Chrionomidae	4 Argia
13 Simulium	2 Chaoborus
1 Isoperla	1 Simulium
	5 Pupae
	368 Chironomidae
	12 Oligochaeta
	1 Notonecta

D3E

9 PIBS	1 Drift
124 Potamyia	7 Potamyia
66 Hydropsyche	1 Hydropsyche
3 Cheumatopsyche	1 Stenonema
5 Trichocorixa	1 Neoperla
15 Chironomidae	2 Simulium
5 Steonomea	4 Chironomidae
2 Neoperla	1 Micrasema
4 Isoperla	1 Notonecta
3 Simulium	1 Trichocorixa
1 Ceratopogonidae	1 Oligochaeta
2 Nectopsyche	
3 Baetis	
1 Pentagenia	

Table A2-8. Continued.

3, 4 November 1979

C2A

6 PIBS; 3 Pet.dr.	1 Drift
3 Pentagenia	4 Chironomidae
1 Chironomidae	3 Potamyia
1 Potamyia	

D1A

9 PIBS	1 Drift
27 Chironomidae	2 Chaoborus
10 Potamyia	7 Chironomidae
1 Hydropsyche	8 Potamyia
1 Cheumatopsyche	1 Hydropsyche

D1E

9 PIBS	1 Drift
1 Pentagenia	11 Potamyia
7 Stenonema	1 Hydropsyche
1 Baetis	5 Chironomidae
1 Isonychia	1 Tipulidae
1 Neoperla	
1 Isoperla	
3 Simulium	
17 Chironomidae	
1 Chaoborus	
1 Pupa	
92 Potamyia	
6 Hydropsyche	
3 Cheumatopsyche	
1 Gomphus	
1 Trichocorixa	

D2A

6 PIBS; 3 Pet.dr.	1 Drift
14 Hexagenia	3 Hydropsyche
40 Trichocorixa	5 Potamyia
1 Potamyia	5 Chironomidae
1 Hydropsyche	13 Trichocorixa
75 Chironomidae	2 Hexagenia
11 Ceratopogonidae	1 Baetis
7 Oligochaeta	1 Oligochaeta
1 Tipulidae	
1 Stenonema	

D2E

6 PIBS; 3 Pet.dr.	1 Drift
27 Trichocorixa	1 Nectopsyche
5 Nectopsyche	
1 Pupa	
75 Chironomidae	
27 Oligochaeta	
12 Gomphus	
12 Hydropsyche	
8 Potamyia	
9 Hexagenia	
1 Pentagenia	
7 Ceratopogonidae	
1 Dubiraphia	
1 Neoperla	

D3A

6 PIBS; 3 Pet.dr.	1 Drift
2 Isoperla	2 Potamyia
15 Chironomidae	1 Nectopsyche
1 Pupa	1 Isoperla
1 Trichocorixa	1 Caenis
14 Potamyia	1 Leptophlebiidae
1 Nectopsyche	6 Chironomidae
5 Oligochaeta	1 Pupa

D3E

9 PIBS	1 Drift
1 Baetis	nothing
1 Isonychia	
24 Stenonema	
2 Leptophlebiidae	
1 Potamyia	
2 Perlesta	
11 Isoperla	
55 Chironomidae	
1 Neoplea	
4 Trichocorixa	
1 Dubiraphia	
7 Ceratopogonidae	
1 Gomphus	
12 Hydropsychidae	
2 Pupae	
3 Ephemeridae	
8 Oligochaeta	

APPENDIX 3 -- FISH, SEINE SAMPLES

Table A3-1,	catch/unit effort 15 species
Table A3-2 through A3-4	density by year and site 15 species
Table A3-5 through A3-47	fishes captured by species, date and transect
Table A3-48 through A3-50	density by month and year (seasonal variation)

Table A3-1. Catch per unit effort (number of fish per square meter x 100) for the fifteen species that were most common in seining samples from the lower Kansas River, 1979-1981.

SITE:	C1A	C1B	C2A	C2B	D1A	D1D	D1E	D2A	D2D	D2E	D3A	D3D	D3E	Mean Density
SPECIES:														
Gizzard Shad	-	0.41	0.35	1.53	0.58	2.28	0.14	9.16	4.29	3.89	3.69	2.78	2.94	2.67
Silver Chub	0.06	-	0.07	0.22	0.14	0.23	0.75	0.23	0.71	6.80	0.31	0.05	0.30	0.82
Speckled Chub	0.21	0.02	0.09	0.07	0.37	0.34	0.66	0.02	-	0.07	0.10	-	1.22	0.29
Emerald Shiner	0.06	0.41	0.52	0.24	0.28	0.23	1.74	0.29	1.52	0.67	13.87	6.76	16.15	3.29
Red Shiner	77.66	195.32	267.20	175.17	119.80	98.66	269.32	58.69	40.71	69.46	76.71	73.83	99.72	124.79
Sand Shiner	33.69	26.33	94.92	37.64	39.86	31.53	63.67	14.95	28.38	47.71	26.14	14.07	16.65	36.58
Fathead Minnow	-	0.10	0.17	0.19	0.12	0.11	0.09	0.29	0.03	5.64	0.10	0.50	0.17	0.63
Bullhead Minnow	0.83	1.78	3.16	1.77	0.90	0.80	0.80	3.43	1.35	4.06	4.08	1.40	0.50	1.91
Bluntnose Minnow	0.06	0.29	0.94	0.41	0.35	0.28	0.61	0.36	1.01	3.12	0.09	0.23	0.25	0.62
Carpsucker	23.26	15.51	36.66	19.16	13.54	17.00	7.49	5.62	5.95	10.82	4.65	3.01	6.01	12.98
Channel Catfish	1.06	0.70	0.35	0.56	2.07	0.66	1.23	0.63	4.63	3.47	0.78	0.98	3.52	1.59
White Bass	0.10	0.19	0.44	0.24	0.23	0.11	0.05	0.40	0.17	1.89	0.41	0.23	0.30	0.37
Bluegill Sunfish	-	0.02	0.10	0.26	0.18	0.06	1.04	0.54	0.57	0.91	0.93	0.73	2.30	0.64
White Crappie	0.04	0.36	0.56	0.75	0.14	0.14	0.47	0.17	0.51	0.39	0.33	0.60	1.36	0.45
Freshwater Drum	-	0.29	0.12	0.20	0.02	0.31	0.85	0.65	0.17	2.84	1.15	0.25	0.61	0.62
Mean Density	12.46	17.27	27.04	15.89	11.91	10.18	23.26	6.36	6.43	10.78	8.89	7.53	10.13	

Table A3-2. Density relationships of the fifteen most common species in seining samples from the lower Kansas River, 1979. Numerals in each column represent the average number of fish (of each species) caught per 100 square meters, subtended by the average biomass of that species in grams per 100 square meters.

SITE:	C1A	C1B	C2A	C2B	D1A	D1D	D1E	D2A	D2D	D2E	D3A	D3D	D3E
SPECIES:													
Gizzard Shad	-	2	*	1	-	1	*	2	-	-	3	1	4
	-	6	3	7	-	5	49	21	-	-	25	9	106
Silver Chub	-	-	*	-	8	-	2	2	1	6	1	-	1
	-	-	*	-	2	-	1	1	*	2	2	-	3
Speckled Chub	2	-	-	-	2	1	*	*	-	-	1	-	9
	2	-	-	-	1	*	*	*	-	-	*	-	9
Emerald Shiner	-	-	-	2	-	*	1	2	*	-	8	2	3
	-	-	-	1	-	*	1	1	1	-	10	2	6
Red Shiner	25	66	13	373	232	45	170	58	18	12	12	93	19
	33	77	8	157	173	43	98	32	13	12	9	41	14
Sand Shiner	36	48	16	318	69	7	6	5	8	10	7	13	4
	32	34	5	109	48	3	4	3	4	4	5	6	3
Fathead Minnow	-	1	1	*	4	1	-	10	*	*	1	4	*
	-	*	1	*	1	1	-	4	*	*	*	2	*
Bullhead Minnow	-	-	-	3	1	-	-	1	*	-	1	1	*
	-	-	-	1	*	-	-	1	1	-	1	2	1
Bluntnose Minnow	*	1	3	4	5	3	1	-	-	7	*	*	-
	*	*	1	2	1	1	1	-	-	1	*	*	-
Carpsucker	2	7	25	30	21	3	2	2	2	6	6	3	1
	20	37	7	41	12	38	64	62	13	31	34	80	*
Channel Catfish	4	3	1	1	11	9	4	3	16	12	6	12	17
	44	23	4	10	28	16	14	7	32	8	16	18	11
White Bass	1	*	2	-	-	1	-	3	*	1	2	1	1
	1	1	10	-	-	2	-	3	3	1	3	15	7
Bluegill Sunfish	-	-	1	1	-	*	7	1	-	1	1	*	1
	-	-	1	1	-	*	6	*	-	1	1	*	11
White Crappie	1	1	1	1	-	*	1	1	1	*	*	2	-
	8	5	4	2	-	*	14	3	26	17	5	10	-
Freshwater Drum	-	2	1	1	2	3	7	1	*	2	3	1	2
	-	37	125	5	3	1	3	9	4	28	51	10	144

* less than 1
\- no fish collected

Table A3-3. Density relationships of the fifteen most common species in seining samples from the lower Kansas River, 1980. Numerals in each column represent the average number of fish (of each species) caught per 100 square meters, subtended by the average biomass of that species in grams per 100 square meters.

SITE:	C1A	C1B	C2A	C2B	D1A	D1D	D1E	D2A	D2D	D2E	D3A	D3D	D3E
SPECIES:													
Gizzard Shad	-	2	1	5	3	4	2	34	49	11	12	6	6
	-	16	14	13	16	49	24	54	84	33	152	127	130
Silver Chub	*	-	-	1	-	1	-	3	1	36	2	*	1
	2	-	-	1	-	1	-	*	2	6	1	*	*
Speckled Chub	*	1	1	1	1	2	2	-	-	1	2	-	*
	*	*	*	*	*	1	1	-	-	*	*	-	*
Emerald Shiner	*	3	3	1	*	2	7	5	13	2	9	8	32
	*	1	*	1	*	2	3	5	8	1	7	8	45
Red Shiner	167	465	203	219	61	163	223	165	128	121	83	94	201
	71	143	85	88	29	81	107	41	44	32	22	34	113
Sand Shiner	44	31	29	20	20	60	45	62	123	87	19	23	12
	22	13	12	11	11	29	18	15	26	18	4	10	5
Fathead Minnow	-	*	3	1	*	-	1	*	-	27	-	1	2
	-	*	*	*	*	-	1	*	-	1	-	1	3
Bullhead Minnow	10	13	9	4	2	3	2	13	12	13	9	2	2
	3	4	3	3	*	1	1	4	3	5	4	*	*
Bluntnose Minnow	*	1	4	2	1	*	2	4	15	7	*	1	1
	*	*	3	*	*	*	2	1	4	1	*	*	8
Carpsucker	47	36	94	31	11	27	12	14	36	13	7	8	11
	37	22	133	71	29	62	55	17	25	28	5	15	169
Channel Catfish	1	3	*	1	1	*	2	1	3	1	4	1	3
	1	3	2	1	7	1	1	3	3	1	2	3	10
White Bass	*	10	1	1	1	-	1	1	1	7	1	7	1
	9	22	34	5	8	4	160	4	10	12	4	22	7
Bluegill Sunfish	-	*	1	2	2	-	-	3	4	4	3	3	11
	-	*	*	2	1	-	-	3	2	2	3	4	5
White Crappie	-	1	-	2	*	*	2	1	1	1	1	1	4
	-	11	-	20	3	18	70	10	4	02	22	30	33
Freshwater Drum	-	2	-	2	-	*	-	15	1	28	5	*	1
	-	148	-	34	-	21	-	2	4	6	21	18	6

* less than 1
\- no fish collected

Table A3-4. Density relationships of the fifteen most common species in seining samples from the lower Kansas River, 1981. Numerals in each column represent the average number of fish (of each species) caught per 100 square meters, subtended by the average biomass of that species in grams per 100 square meters.

SITE:	C1A	C1B	C2A	C2B	D1A	D1D	D1E	D2A	D2D	D2E	D3A	D3D	D3E
SPECIES:													
Gizzard Shad	-	-	4	6	-	-	-	-	-	-	-	-	-
	-	-	4	5	-	-	-	-	-	-	-	-	-
Silver Chub	-	-	1	1	-	-	-	1	3	1	-	1	-
	-	-	*	*	-	-	-	*	2	*	-	4	-
Speckled Chub	-	-	1	-	-	-	-	-	-	-	8	-	-
	-	-	*	-	-	-	-	-	-	-	10	-	-
Emerald Shiner	0	0	1	1	*	1	31	0	40	4	126	56	56
	0	0	1	1	1	4	90	0	51	12	117	90	69
Red Shiner	406	28	987	326	453	302	3143	1273	81	56	579	121	349
	355	16	340	95	211	234	2569	490	33	50	262	184	231
Sand Shiner	237	20	425	49	146	94	1097	98	40	11	247	46	154
	299	22	321	45	134	97	1507	50	21	6	98	23	77
Fathead Minnow	-	-	1	-	-	1	-	-	-	-	7	2	-
	-	-	*	-	-	3	-	-	-	-	2	*	-
Bullhead Minnow	-	-	8	4	4	5	-	128	2	11	38	12	2
	7	-	*	-	-	-	2	-	-	-	-	-	-
Bluntnose Minnow	3	-	1	-	-	-	2	-	-	-	-	-	-
	7	-	*	-	-	-	2	-	-	-	-	-	-
Carpsucker	11	1	16	4	33	11	43	56	31	15	9	2	1
	75	5	49	52	26	33	115	30	81	98	15	25	52
Channel Catfish	15	-	2	8	21	5	-	7	20	3	5	-	-
	110	-	13	2	124	34	-	27	92	2	23	-	-
White Bass	-	-	1	-	-	1	-	-	-	-	2	-	-
	-	-	16	-	-	3	-	-	-	-	82	-	-
Bluegill Sunfish	-	-	*	4	*	1	12	-	6	3	2	-	1
	-	-	*	2	10	8	28	-	14	1	1	-	1
White Crappie	-	1	4	3	2	1	5	-	5	-	-	-	-
	-	2	37	2	58	156	12	-	85	-	-	-	-
Freshwater Drum	-	-	1	*	-	2	-	-	-	-	-	-	-
	-	-	18	*	-	107	-	-	-	-	-	-	-

* less than 1
\- no fish collected

Table A3-5. Fishes captured by seining at Transect C1A (Control Site 1) in the lower Kansas River, in 1979.

SITE: C1A	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:							
Shovelnose Sturgeon	-	1	-	-	-	-	1
Shortnose Gar	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-
Golden Shiner	-	-	-	-	-	-	-
Creek Chub	-	1	-	-	-	-	1
Silver Chub	-	-	-	-	-	-	-
Speckled Chub	-	-	-	-	-	10	10
Sturgeon Chub	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	-	-
Emerald Shiner	-	-	-	-	-	-	-
Redfin Shiner	-	-	-	-	-	-	-
River Shiner	-	-	-	-	-	-	-
Red Shiner	82	166	-	15	4	16	283
Sand Shiner	19	144	-	-	-	141	304
Plains Minnow	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-
Fathead Minnow	-	-	-	-	-	-	-
Bullhead Minnow	-	-	-	-	-	-	-
Bluntnose Minnow	-	-	-	1	-	-	1
Central Stoneroller	-	1	-	-	-	-	1
Bigmouth Buffalo	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-
Carpsucker*	-	6	-	1	1	9	17
Shorthead Redhorse	-	-	-	-	-	-	-
White Sucker	-	2	-	-	-	-	2
Black Bullhead	-	-	-	-	-	-	-
Channel Catfish	29	-	-	-	-	8	37
Flathead Catfish	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-
White Bass	-	-	-	3	-	-	3
Largemouth Bass	-	1	-	-	-	-	1
Green Sunfish	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-
White Crappie	1	-	-	-	1	-	2
Black Crappie	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	-
TOTAL:	131	322	-	20	6	184	663

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-6. Fishes captured by seining at Transect C1A (Control Site 1) in the lower Kansas River, in 1980.

SITE: C1A	JAN	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:										
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	-	-	-	-	-
Carp	-	1	-	-	-	-	-	-	-	1
Golden Shiner	-	-	-	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	-	-	-	-	-	-
Silver Chub	-	-	-	-	-	-	1	2	-	3
Speckled Chub	-	-	-	-	-	-	-	-	1	1
Sturgeon Chub	-	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	3	2	-	-	5
Emerald Shiner	-	-	-	-	-	-	-	1	-	1
Redfin Shiner	-	-	-	-	-	-	-	-	-	-
River Shiner	-	-	-	-	-	-	-	-	-	-
Red Shiner	-	-	-	144	19	162	93	482	2479	3379
Sand Shiner	1	6	-	79	43	227	65	173	670	1264
Plains Minnow	-	-	-	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-	-	-	-
Fathead Minnow	-	-	-	-	-	-	-	-	-	-
Bullhead Minnow	-	-	-	2	-	-	-	40	1	43
Bluntnose Minnow	-	-	-	-	-	-	-	1	-	1
Central Stoneroller	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Carpsucker*	-	-	-	27	26	657	168	201	105	1184
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	11	1	1	-	13
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	1	-	-	1
Slender Madtom	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	1	-	-	-	1	-	2
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	-	-	-	-	-
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	-	-	-	-
TOTAL:	1	7	-	253	88	1060	331	902	3256	5898

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-7. Fishes captured by seining at Transect C1A (Control Site 1) in the lower Kansas River, in 1981.

SITE: C1A	FEB	MARCH	APRIL	MAY	JULY	AUG	SEPT	TOTAL	ALL YEARS
SPECIES:									
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	1
Shortnose Gar	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-	-	1
Golden Shiner	-	-	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	-	-	-	-	1
Silver Chub	-	-	-	-	-	-	-	-	3
Speckled Chub	-	-	-	-	-	-	-	-	11
Sturgeon Chub	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	-	-	-	5
Emerald Shiner	-	-	-	-	-	-	-	-	1
Redfin Shiner	-	-	-	-	-	-	-	-	-
River Shiner	-	-	-	-	-	-	-	-	-
Red Shiner	-	-	-	245	-	130	-	375	4115
Sand Shiner	-	-	-	154	-	29	-	183	1751
Plains Minnow	-	-	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-	-	-
Fathead Minnow	-	-	-	-	-	-	-	-	-
Bullhead Minnow	-	-	-	-	-	-	-	-	43
Bluntnose Minnow	-	-	-	1	-	-	-	1	3
Central Stoneroller	-	-	-	-	-	-	-	-	1
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-
Carpsucker*	-	-	-	7	-	1	-	8	1209
Shorthead Redhorse	-	-	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-	-	2
Black Bullhead	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	5	-	-	-	5	55
Flathead Catfish	-	-	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-	-	1
Slender Madtom	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-	-	5
Largemouth Bass	-	-	-	-	-	-	-	-	1
Green Sunfish	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	-	-	-	2
Black Crappie	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	-	-	-
TOTAL:	-	-	-	412	-	160	-	572	7133

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-8. Fishes captured by seining at Transect C1B (Control Site 1) in the lower Kansas River, in 1979.

SITE: C1B	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:							
Shovelnose Sturgeon	-	-	-	-	-	-	-
Shortnose Gar	-	-	1	-	-	-	1
Longnose Gar	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	4	-	-	4
Goldeye	-	-	-	-	-	-	-
Carp	-	-	-	1	-	-	1
Golden Shiner	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	-	-	-
Silver Chub	-	-	-	-	-	-	-
Speckled Chub	-	-	-	-	-	-	-
Sturgeon Chub	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	-	-
Emerald Shiner	-	-	-	-	-	-	-
Redfin Shiner	-	-	-	-	-	-	-
River Shiner	-	-	-	-	-	-	-
Red Shiner	216	432	88	57	18	27	838
Sand Shiner	101	124	116	60	-	76	477
Plains Minnow	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-
Fathead Minnow	-	-	-	2	-	-	2
Bullhead Minnow	-	-	-	-	-	-	-
Bluntnose Minnow	-	1	-	2	-	-	3
Central Stoneroller	-	-	-	1	-	-	1
Bigmouth Buffalo	-	-	-	-	-	-	-
Smallmouth Buffalo	-	1	-	-	-	-	1
Carpsucker*	3	64	1	4	-	2	74
Shorthead Redhorse	-	1	-	-	-	-	1
White Sucker	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-
Channel Catfish	8	-	4	-	-	-	12
Flathead Catfish	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-
White Bass	-	-	-	1	-	-	1
Largemouth Bass	-	7	-	-	-	-	7
Green Sunfish	1	-	-	-	-	-	1
Bluegill Sunfish	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	1	-	-	-	-	1
White Crappie	-	3	-	-	-	-	3
Black Crappie	-	-	-	-	-	-	-
Sauger	2	-	-	-	-	-	2
Walleye	-	1	-	-	-	-	1
Logperch	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-
Freshwater Drum	6	3	-	-	-	-	9
TOTAL:	337	638	210	132	18	105	1440

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-9. Fishes captured by seining at Transect C1B (Control Site 1) in the lower Kansas River, in 1980.

SITE: C1B	JAN	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:										
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	8	-	-	2	2	1	-	13
Goldeye	-	-	-	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-	-	-	-
Golden Shiner	-	-	-	2	-	-	-	-	-	2
Creek Chub	-	-	-	-	-	-	-	-	-	-
Silver Chub	-	-	-	-	-	-	-	-	-	-
Speckled Chub	-	-	-	-	-	-	-	-	1	1
Sturgeon Chub	-	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	1	-	-	-	-	1
Emerald Shiner	-	-	-	1	-	14	-	2	-	17
Redfin Shiner	-	-	-	-	-	1	-	-	-	1
River Shiner	-	-	-	1	-	-	-	-	-	1
Red Shiner	264	1	24	139	91	127	306	1940	4296	7188
Sand Shiner	71	52	18	17	15	73	31	77	192	546
Plains Minnow	-	-	-	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-	-	-	-
Fathead Minnow	-	-	-	1	1	-	-	-	-	2
Bullhead Minnow	-	-	-	-	-	16	9	47	2	74
Bluntnose Minnow	2	-	-	1	-	7	-	-	1	11
Central Stoneroller	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Carpsucker*	-	1	2	38	8	374	65	37	44	569
Shorthead Redhorse	-	-	-	-	3	-	-	-	-	3
White Sucker	-	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	17	-	-	-	-	-	17
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	5	-	1	-	1	-	7
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
Green Sunfish	-	-	-	-	-	-	-	1	-	1
Bluegill Sunfish	-	-	-	-	-	1	-	-	-	1
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	4	6	-	-	-	-	-	10
White Crappie	-	-	-	-	-	-	-	-	-	-
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	-	-	-	-
TOTAL:	337	54	56	228	119	616	413	2109	4536	8468

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-10. Fishes captured by seining at Transect C1B (Control Site 1) in the lower Kansas River, in 1981.

SITE: C1B	FEB	MARCH	APRIL	MAY	JULY	AUG	SEPT	TOTAL	ALL YEARS
SPECIES:									
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	1
Longnose Gar	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	-	-	17
Goldeye	-	-	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-	-	1
Golden Shiner	-	-	-	-	-	-	-	-	2
Creek Chub	-	-	-	-	-	-	-	-	-
Silver Chub	-	-	-	-	-	-	-	-	-
Speckled Chub	-	-	-	-	-	-	-	-	1
Sturgeon Chub	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	-	-	-	1
Emerald Shiner	-	-	-	-	-	-	-	-	17
Redfin Shiner	-	-	-	-	-	-	-	-	1
River Shiner	-	-	-	-	-	-	-	-	1
Red Shiner	-	-	-	22	-	89	-	111	8137
Sand Shiner	-	-	-	42	-	32	-	74	1097
Plains Minnow	-	-	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-	-	-
Fathead Minnow	-	-	-	-	-	-	-	-	4
Bullhead Minnow	-	-	-	-	-	-	-	-	74
Bluntnose Minnow	-	-	-	-	-	-	-	-	14
Central Stoneroller	-	-	-	-	-	-	-	-	1
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	1
Carpsucker*	-	-	-	-	-	3	-	3	646
Shorthead Redhorse	-	-	-	-	-	-	-	-	4
White Sucker	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-	29
Flathead Catfish	-	-	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-	-	8
Largemouth Bass	-	-	-	-	-	-	-	-	7
Green Sunfish	-	-	-	-	-	-	-	-	2
Bluegill Sunfish	-	-	-	-	-	-	-	-	1
Longear Sunfish	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-	-	11
White Crappie	-	-	-	-	-	2	-	2	5
Black Crappie	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	2
Walleye	-	-	-	-	-	-	-	-	1
Logperch	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	-	-	12
TOTAL:	-	-	-	64	-	126	-	190	10098

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-11. Fishes captured by seining at Transect C2A (Control Site 2) in the lower Kansas River, in 1979.

SITE: C2A	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:							
Shovelnose Sturgeon	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-
Gizzard Shad	-	-	1	-	1	-	2
Goldeye	-	1	-	-	-	-	1
Carp	-	1	-	-	-	-	1
Golden Shiner	-	-	-	-	-	-	-
Creek Chub	-	-	1	-	-	-	1
Silver Chub	-	1	-	-	-	-	1
Speckled Chub	-	-	-	-	-	-	-
Sturgeon Chub	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	1	-	-	-	1
Emerald Shiner	-	-	-	-	-	-	-
Redfin Shiner	-	-	-	-	-	-	-
River Shiner	-	-	-	-	-	-	-
Red Shiner	53	16	44	17	44	13	187
Sand Shiner	13	12	194	13	18	23	273
Plains Minnow	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-
Fathead Minnow	1	-	3	-	-	-	4
Bullhead Minnow	-	-	-	-	-	-	-
Bluntnose Minnow	-	-	16	-	2	-	18
Central Stoneroller	-	1	3	-	-	-	4
Bigmouth Buffalo	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-
Carpsucker*	-	3	315	1	40	38	397
Shorthead Redhorse	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-
Channel Catfish	1	-	4	-	1	4	10
Flathead Catfish	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-
White Bass	-	1	14	1	-	-	16
Largemouth Bass	-	-	-	-	-	-	-
Green Sunfish	-	1	-	-	-	-	1
Bluegill Sunfish	-	-	1	-	2	-	3
Longear Sunfish	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-
White Crappie	2	2	4	1	6	-	15
Black Crappie	-	-	-	-	-	-	-
Sauger	3	-	-	-	-	-	3
Walleye	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-
Freshwater Drum	2	-	3	-	1	-	6
TOTAL:	75	39	604	33	115	78	944

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-12. Fishes captured by seining at Transect C2A (Control Site 2) in the lower Kansas River, in 1980.

SITE: C2A	JAN	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:										
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	1	-	-	-	-	1
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	3	-	-	-	3	3	-	9
Goldeye	-	-	-	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-	-	-	-
Golden Shiner	-	-	-	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	-	1	-	-	-	1
Silver Chub	-	-	-	-	-	-	-	-	-	-
Speckled Chub	2	-	-	-	1	-	-	-	1	4
Sturgeon Chub	-	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	1	-	-	-	-	1
Emerald Shiner	-	-	-	2	-	23	-	1	1	27
Redfin Shiner	-	-	-	-	-	-	-	-	-	-
River Shiner	-	-	-	-	-	-	-	-	-	-
Red Shiner	-	6	64	94	61	70	48	996	2547	3886
Sand Shiner	1	34	13	28	44	38	56	264	233	711
Plains Minnow	-	-	-	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-	-	-	-
Fathead Minnow	-	-	-	-	-	5	-	-	-	5
Bullhead Minnow	-	-	-	-	-	-	3	56	24	83
Bluntnose Minnow	-	-	-	-	-	4	2	1	28	35
Central Stoneroller	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Carpsucker*	-	5	9	-	13	234	186	214	842	1503
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	1	-	-	-	-	-	-	1
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-	4	-	4
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	2	-	-	2
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	-	-	-	-	-
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	-	-	-	-
TOTAL:	3	45	90	124	121	375	300	1539	3676	6273

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-13. Fishes captured by seining at Transect C2A (Control Site 2) in the lower Kansas River, in 1981.

SITE: C2A	FEB	MARCH	APRIL	MAY	JULY	AUG	SEPT	TOTAL	ALL YEARS
SPECIES:									
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	1
Longnose Gar	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	9	-	-	9	20
Goldeye	-	-	-	-	-	-	-	-	1
Carp	-	-	-	-	-	-	-	-	1
Golden Shiner	-	-	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	-	-	-	-	2
Silver Chub	-	-	-	-	1	2	-	3	4
Speckled Chub	-	-	-	1	-	-	-	1	5
Sturgeon Chub	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	1	-	-	1	3
Emerald Shiner	-	1	-	1	-	1	-	3	30
Redfin Shiner	-	-	1	-	-	-	-	1	1
River Shiner	-	-	-	-	-	-	-	-	-
Red Shiner	1000	3741	2360	3310	708	121	-	11240	15313
Sand Shiner	248	2237	373	1556	36	6	-	4456	5440
Plains Minnow	-	-	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-	-	-
Fathead Minnow	-	-	-	1	-	-	-	1	10
Bullhead Minnow	4	1	4	81	4	4	-	98	181
Bluntnose Minnow	-	1	-	-	-	-	-	1	54
Central Stoneroller	-	-	-	-	-	-	-	-	4
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-
Carpsucker*	4	48	79	59	6	5	-	201	2101
Shorthead Redhorse	-	-	-	1	-	-	-	1	1
White Sucker	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	1	-	-	-	1	1
Channel Catfish	-	-	-	5	2	2	-	9	20
Flathead Catfish	-	-	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	2	3	-	5	25
Largemouth Bass	-	-	-	-	-	-	-	-	-
Green Sunfish	-	-	-	-	1	-	-	1	2
Bluegill Sunfish	-	-	-	-	1	-	-	1	6
Longear Sunfish	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	1	-	1	1
White Crappie	-	-	-	-	13	4	-	17	32
Black Crappie	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	3
Walleye	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	1	-	-	-	1	7
TOTAL:	1256	6029	2817	5017	784	149	-	16052	23269

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-14. Fishes captured by seining at Transect C2B (Control Site 2) in the lower Kansas River, in 1979.

SITE: C2B	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:							
Shovelnose Sturgeon	-	-	-	-	-	-	-
Shortnose Gar	1	-	-	-	-	-	1
Longnose Gar	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	1	1
Goldeye	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-
Golden Shiner	-	-	-	-	-	-	-
Creek Chub	-	1	-	-	-	1	2
Silver Chub	-	-	-	-	-	-	-
Speckled Chub	-	-	-	-	-	-	-
Sturgeon Chub	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	-	-
Emerald Shiner	-	1	-	-	-	3	4
Redfin Shiner	-	-	-	-	-	-	-
River Shiner	-	-	-	-	-	-	-
Red Shiner	250	117	114	16	59	1825	2381
Sand Shiner	15	10	252	-	-	991	1268
Plains Minnow	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-
Fathead Minnow	1	-	-	-	-	-	1
Bullhead Minnow	-	-	-	-	-	3	3
Bluntnose Minnow	-	-	2	1	-	7	10
Central Stoneroller	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-
Carpsucker*	12	4	159	-	-	7	182
Shorthead Redhorse	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-
Channel Catfish	11	-	3	-	1	-	15
Flathead Catfish	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-
Green Sunfish	-	-	-	-	-	4	4
Bluegill Sunfish	-	-	-	-	-	2	2
Longear Sunfish	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-
White Crappie	-	-	-	-	1	1	2
Black Crappie	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-
Freshwater Drum	1	-	1	-	-	-	2
TOTAL:	291	133	531	17	61	2845	3878

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-15. Fishes captured by seining at Transect C2B (Control Site 2) in the lower Kansas River, in 1980.

SITE: C2B	JAN	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:										
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	3	-	1	-	-	4
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	4	61	-	13	1	-	79
Goldeye	-	-	-	-	-	-	-	-	-	-
Carp	-	-	-	-	7	1	-	-	-	8
Golden Shiner	-	-	-	1	-	-	-	-	-	1
Creek Chub	-	-	-	-	1	-	-	-	-	1
Silver Chub	-	-	-	4	7	-	-	-	-	11
Speckled Chub	-	-	1	-	-	1	-	-	2	4
Sturgeon Chub	-	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	-	-	-	-	-
Emerald Shiner	-	-	-	-	-	1	-	3	5	9
Redfin Shiner	-	-	-	-	-	-	-	-	-	-
River Shiner	-	-	-	-	-	-	-	-	-	-
Red Shiner	-	76	339	125	85	46	157	1051	2736	4615
Sand Shiner	-	129	63	23	47	9	33	49	96	449
Plains Minnow	-	-	-	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-	-	-	-
Fathead Minnow	-	-	1	2	6	1	-	-	-	10
Bullhead Minnow	-	-	12	8	3	7	3	43	1	77
Bluntnose Minnow	-	-	8	1	3	1	-	1	-	14
Central Stoneroller	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	1	-	-	-	1
Carpsucker*	-	2	1	284	162	41	112	191	119	912
Shorthead Redhorse	-	-	-	-	3	-	-	-	-	3
White Sucker	-	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	1	-	-	1	1	-	-	3
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	1	10	3	-	-	-	14
Largemouth Bass	-	-	-	-	-	-	1	-	-	1
Green Sunfish	-	-	-	-	-	-	-	1	-	1
Bluegill Sunfish	-	-	-	-	-	-	2	5	-	7
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	2	25	8	1	1	-	-	37
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	6	-	3	-	-	-	9
TOTAL:	-	207	428	484	406	117	324	1345	2959	6270

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-16. Fishes captured by seining at Transect C2B (Control Site 2) in the lower Kansas River, in 1981.

SITE: C2B	FEB	MARCH	APRIL	MAY	JULY	AUG	SEPT	TOTAL	ALL YEARS
SPECIES:									
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	1
Longnose Gar	-	-	-	-	-	-	-	-	4
Skipjack Herring	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	10	-	-	10	90
Goldeye	-	-	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-	-	8
Golden Shiner	-	-	-	-	-	-	-	-	1
Creek Chub	-	-	-	-	-	-	-	-	3
Silver Chub	-	-	-	-	1	1	-	2	13
Speckled Chub	-	-	-	-	-	-	-	-	4
Sturgeon Chub	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	1	-	1	-	2	2
Emerald Shiner	-	-	-	1	-	-	-	1	14
Redfin Shiner	-	-	1	-	-	-	-	1	1
River Shiner	-	-	-	-	-	-	-	-	-
Red Shiner	-	69	540	290	2325	64	-	3288	10284
Sand Shiner	-	121	174	109	82	7	-	493	2210
Plains Minnow	-	-	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-	-	-
Fathead Minnow	-	-	-	-	-	-	-	-	11
Bullhead Minnow	-	-	2	10	10	2	-	24	104
Bluntnose Minnow	-	-	-	-	-	-	-	-	24
Central Stoneroller	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	1
Carpsucker*	-	1	11	13	5	1	-	31	1125
Shorthead Redhorse	-	-	-	-	-	-	-	-	3
White Sucker	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	15	-	-	15	33
Flathead Catfish	-	-	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-	-	14
Largemouth Bass	-	-	-	-	-	-	-	-	1
Green Sunfish	-	-	-	-	-	-	-	-	5
Bluegill Sunfish	-	-	-	-	6	-	-	6	15
Longear Sunfish	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	4	-	-	4	4
White Crappie	-	-	-	-	5	-	-	5	44
Black Crappie	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	1	-	-	1	12
TOTAL:	-	191	728	424	2464	76	-	3883	14031

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-17. Fishes captured by seining at Transect D1A (Study Site D1) in the lower Kansas River, in 1979.

SITE: D1A	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:							
Shovelnose Sturgeon	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-
Longnose Gar	-	1	-	-	-	-	1
Skipjack Herring	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	-	-
Carp	-	-	1	-	-	-	1
Golden Shiner	-	-	-	-	-	-	-
Creek Chub	-	3	1	-	-	-	4
Silver Chub	-	-	6	-	-	-	6
Speckled Chub	-	-	1	-	-	2	3
Sturgeon Chub	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	8	-	-	-	8
Emerald Shiner	-	-	-	-	-	-	-
Redfin Shiner	-	-	-	-	-	-	-
River Shiner	-	-	-	-	-	-	-
Red Shiner	210	317	732	43	13	2	1317
Sand Shiner	88	44	193	3	-	8	336
Plains Minnow	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-
Fathead Minnow	-	-	3	-	-	-	3
Bullhead Minnow	1	-	-	-	-	-	1
Bluntnose Minnow	-	-	4	-	-	-	4
Central Stoneroller	-	-	22	-	-	-	22
Bigmouth Buffalo	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-
Carpsucker*	2	47	15	-	-	-	64
Shorthead Redhorse	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-
Channel Catfish	-	-	16	-	-	2	18
Flathead Catfish	-	-	-	-	-	-	-
Stonecat	2	-	-	-	6	-	8
Slender Madtom	-	-	-	-	1	-	1
White Bass	-	-	-	-	-	-	-
Largemouth Bass	-	1	3	-	-	-	4
Green Sunfish	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	-	-
Black Crappie	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-
Freshwater Drum	-	-	2	-	1	-	3
TOTAL:	303	413	1007	46	21	14	1804

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-18. Fishes captured by seining at Transect D1A (Study Site D1) in the lower Kansas River, in 1980.

SITE: D1A	JAN	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:										
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	3	-	2	-	17	3	-	25
Goldeye	-	-	-	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-	-	-	-
Golden Shiner	-	-	-	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	-	-	-	-	-	-
Silver Chub	-	-	-	-	-	-	-	-	-	-
Speckled Chub	2	-	-	-	-	-	1	3	7	13
Sturgeon Chub	-	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	1	-	-	-	1	2
Emerald Shiner	-	-	-	-	-	6	1	1	3	11
Redfin Shiner	-	-	-	-	-	4	-	-	1	5
River Shiner	-	-	-	-	-	-	-	-	-	-
Red Shiner	3	4	51	42	53	39	449	625	206	1472
Sand Shiner	25	24	33	48	35	67	58	123	174	587
Plains Minnow	-	-	-	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-	-	-	-
Fathead Minnow	-	-	-	-	-	2	-	-	-	2
Bullhead Minnow	-	-	1	-	-	1	13	6	6	27
Bluntnose Minnow	-	-	-	2	-	1	6	1	1	11
Central Stoneroller	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Carpsucker*	6	3	2	9	14	117	70	16	49	346
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	9	1	-	-	1	1	-	12
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-	2	-	2
Slender Madtom	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	2	1	1	6	-	-	-	10
Largemouth Bass	-	-	-	-	1	-	1	-	-	2
Green Sunfish	-	-	-	-	-	-	-	-	1	1
Bluegill Sunfish	5	-	-	-	-	-	2	-	-	7
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-	1	1	2
White Crappie	-	-	1	1	-	-	-	1	-	3
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	1	-	-	-	1
Freshwater Drum	-	-	-	-	-	-	-	-	-	-
TOTAL:	41	31	102	104	107	304	619	783	450	2541

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-19. Fishes captured by seining at Transect D1A (Study Site D1) in the lower Kansas River, in 1981.

SITE: D1A	FEB	MARCH	APRIL	MAY	JULY	AUG	SEPT	TOTAL	ALL YEARS
SPECIES:									
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	1
Skipjack Herring	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	-	-	25
Goldeye	-	-	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-	-	1
Golden Shiner	-	-	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	-	-	-	-	4
Silver Chub	-	-	-	-	-	-	-	-	6
Speckled Chub	-	-	-	-	-	-	-	-	16
Sturgeon Chub	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	1	-	-	-	1	11
Emerald Shiner	-	-	-	1	-	-	-	1	12
Redfin Shiner	-	-	-	-	-	-	-	-	5
River Shiner	-	-	-	-	-	-	-	-	-
Red Shiner	-	-	-	2310	-	106	-	2416	5205
Sand Shiner	-	-	-	803	-	5	-	808	1731
Plains Minnow	-	-	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-	-	-
Fathead Minnow	-	-	-	-	-	-	-	-	5
Bullhead Minnow	-	-	-	11	-	-	-	11	39
Bluntnose Minnow	-	-	-	-	-	-	-	-	15
Central Stoneroller	-	-	-	-	-	-	-	-	22
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-
Carpsucker*	-	-	-	176	-	2	-	178	588
Shorthead Redhorse	-	-	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	60	-	-	-	60	90
Flathead Catfish	-	-	-	-	-	-	-	-	-
Stonecat	-	-	-	1	-	1	-	2	12
Slender Madtom	-	-	-	-	-	-	-	-	1
White Bass	-	-	-	-	-	-	-	-	10
Largemouth Bass	-	-	-	-	-	-	-	-	6
Green Sunfish	-	-	-	1	-	-	-	1	2
Bluegill Sunfish	-	-	-	1	-	-	-	1	8
Longear Sunfish	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-	-	2
White Crappie	-	-	-	-	-	3	-	3	6
Black Crappie	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-	-	1
Freshwater Drum	-	-	-	-	-	-	-	-	3
TOTAL:	-	-	-	3365	-	117	-	3482	7827

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-20. Fishes captured by seining at Transect D1D (Study Site D1) in the lower Kansas River, in 1979.

SITE: D1D	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:							
Shovelnose Sturgeon	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-
Longnose Gar	-	1	-	-	-	-	1
Skipjack Herring	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	2	-	-	2
Goldeye	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-
Golden Shiner	-	-	-	-	-	-	-
Creek Chub	-	3	-	-	-	-	3
Silver Chub	-	-	-	-	-	-	-
Speckled Chub	-	-	1	-	-	-	1
Sturgeon Chub	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	-	-
Emerald Shiner	-	-	-	1	-	-	1
Redfin Shiner	-	-	-	-	-	-	-
River Shiner	-	-	-	-	-	-	-
Red Shiner	67	198	9	29	21	91	415
Sand Shiner	18	12	1	4	-	37	72
Plains Minnow	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-
Fathead Minnow	-	-	-	3	-	-	3
Bullhead Minnow	-	-	-	-	-	-	-
Bluntnose Minnow	-	-	-	6	2	-	8
Central Stoneroller	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-
Carpsucker*	6	-	-	5	-	5	16
Shorthead Redhorse	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-
Channel Catfish	-	-	14	-	-	2	16
Flathead Catfish	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-
White Bass	-	-	-	2	-	-	2
Largemouth Bass	-	-	-	-	-	-	-
Green Sunfish	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	1	-	-	1
Longear Sunfish	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-
White Crappie	-	-	-	1	-	-	1
Black Crappie	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	7	-	-	7
TOTAL:	91	214	25	61	23	135	549

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-21. Fishes captured by seining at Transect D1D (Study Site D1) in the lower Kansas River, in 1980.

SITE: D1D	JAN	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:										
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	1	72	5	-	78
Goldeye	-	-	-	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-	-	-	-
Golden Shiner	-	-	-	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	-	-	-	-	-	-
Silver Chub	-	-	-	-	-	-	8	-	-	8
Speckled Chub	-	1	-	-	-	1	1	-	8	11
Sturgeon Chub	-	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	-	-	-	-	-
Emerald Shiner	-	-	-	1	-	-	-	-	5	6
Redfin Shiner	-	-	-	-	-	1	-	-	-	1
River Shiner	-	-	-	-	-	-	-	-	-	-
Red Shiner	4	3	53	178	21	15	112	1026	1111	2523
Sand Shiner	5	13	11	99	9	2	47	21	673	880
Plains Minnow	-	-	-	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-	-	-	-
Fathead Minnow	-	-	-	-	-	-	-	-	-	-
Bullhead Minnow	-	-	-	-	-	-	1	15	3	19
Bluntnose Minnow	-	-	-	2	-	-	-	-	-	2
Central Stoneroller	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Carpsucker*	-	2	1	122	4	-	250	64	129	572
Shorthead Redhorse	-	-	-	-	-	-	-	1	-	1
White Sucker	-	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	1	-	-	1	-	1	3
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	1	-	-	1
Largemouth Bass	-	-	-	-	-	-	1	-	-	1
Green Sunfish	-	-	-	-	2	-	-	-	-	2
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	-	-	1	-	1
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	1	1	-	2
TOTAL:	9	19	65	403	36	20	495	1134	1930	4111

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-22. Fishes captured by seining at Transect D1D (Study Site D1) in the lower Kansas River, in 1981.

SITE: D1D	FEB	MARCH	APRIL	MAY	JULY	AUG	SEPT	TOTAL	ALL YEARS
SPECIES:									
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	1
Skipjack Herring	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	-	-	80
Goldeye	-	-	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-	-	-
Golden Shiner	-	-	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	-	-	-	-	-
Silver Chub	-	-	-	-	-	-	-	-	3
Speckled Chub	-	-	-	-	-	-	-	-	8
Sturgeon Chub	-	-	-	-	-	-	-	-	12
Suckermouth Minnow	-	-	-	-	-	-	-	-	-
Emerald Shiner	-	-	-	1	-	-	-	1	8
Redfin Shiner	-	-	-	-	-	-	-	-	1
River Shiner	-	-	-	-	-	-	-	-	-
Red Shiner	-	-	-	172	-	354	-	526	3464
Sand Shiner	-	-	-	117	-	38	-	155	1107
Plains Minnow	-	-	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-	-	-
Fathead Minnow	-	-	-	1	-	-	-	1	4
Bullhead Minnow	-	-	-	5	-	4	-	9	28
Bluntnose Minnow	-	-	-	-	-	-	-	-	10
Central Stoneroller	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-
Carpsucker*	-	-	-	9	-	-	-	9	597
Shorthead Redhorse	-	-	-	-	-	-	-	-	1
White Sucker	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	2	-	-	-	2	2
Channel Catfish	-	-	-	4	-	-	-	4	23
Flathead Catfish	-	-	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	1	-	1	4
Largemouth Bass	-	-	-	-	-	-	-	-	1
Green Sunfish	-	-	-	-	-	-	-	-	2
Bluegill Sunfish	-	-	-	1	-	-	-	1	2
Longear Sunfish	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	1	-	1	-	2	4
Black Crappie	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	2	-	-	-	2	11
TOTAL:	-	-	-	315	-	398	-	713	5373

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-23. Fishes captured by seining at Transect D1E (Study Site D1) in the lower Kansas River, in 1979.

SITE: D1E	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:							
Shovelnose Sturgeon	-	-	-	-	-	-	-
Shortnose Gar	-	-	5	-	-	-	5
Longnose Gar	-	-	1	-	-	-	1
Skipjack Herring	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	1	-	-	1
Goldeye	-	-	-	-	-	-	-
Carp	1	1	-	-	-	-	2
Golden Shiner	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	-	-	-
Silver Chub	-	2	6	-	-	-	8
Speckled Chub	-	-	-	-	1	-	1
Sturgeon Chub	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	-	-
Emerald Shiner	-	1	-	-	-	-	1
Redfin Shiner	-	-	-	-	-	-	-
River Shiner	-	-	-	-	-	-	-
Red Shiner	442	67	249	-	30	-	788
Sand Shiner	1	19	7	-	1	-	28
Plains Minnow	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-
Fathead Minnow	-	-	-	-	-	-	-
Bullhead Minnow	-	-	-	-	-	-	-
Bluntnose Minnow	-	1	3	-	-	-	4
Central Stoneroller	-	-	1	-	-	-	1
Bigmouth Buffalo	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-
Carpsucker*	-	3	2	2	-	-	7
Shorthead Redhorse	-	-	2	-	-	-	2
White Sucker	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-
Channel Catfish	6	-	10	1	-	-	17
Flathead Catfish	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-
Largemouth Bass	-	1	2	-	-	-	3
Green Sunfish	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	17	-	-	-	17
Longear Sunfish	-	-	1	-	-	-	1
Orange-spotted Sunfish	-	-	-	-	-	-	-
White Crappie	-	-	3	1	-	-	4
Black Crappie	-	-	-	2	-	-	2
Sauger	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-
Freshwater Drum	-	-	18	-	-	-	18
TOTAL:	450	95	327	7	32	-	911

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-24. Fishes captured by seining at Transect D1E (Study Site D1) in the lower Kansas River, in 1980.

SITE: D1E	JAN	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:										
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	2	-	-	-	-	-	-	2
Goldeye	-	-	-	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-	-	-	-
Golden Shiner	-	-	-	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	-	-	-	-	-	-
Silver Chub	-	-	-	-	-	8	-	-	-	8
Speckled Chub	3	3	-	-	2	-	-	1	4	13
Sturgeon Chub	-	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	1	-	1	-	-	2
Emerald Shiner	-	-	-	-	-	21	-	-	2	23
Redfin Shiner	-	-	2	1	-	-	-	-	-	3
River Shiner	-	-	-	-	-	-	-	-	-	-
Red Shiner	1	25	599	276	34	92	87	543	642	2299
Sand Shiner	-	38	123	23	43	64	26	23	63	403
Plains Minnow	-	-	-	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	1	-	-	-	1
Fathead Minnow	-	-	-	-	-	2	-	-	-	2
Bullhead Minnow	-	-	2	2	1	1	4	4	3	17
Bluntnose Minnow	-	-	2	4	-	2	-	-	-	8
Central Stoneroller	-	-	-	-	1	-	-	-	-	1
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Carpsucker*	-	-	1	2	14	61	37	6	12	133
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	1	5	2	1	-	9
Flathead Catfish	-	-	-	-	-	-	1	-	1	2
Stonecat	-	-	-	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	1	-	-	-	-	-	1
Largemouth Bass	-	-	-	-	-	1	-	-	-	1
Green Sunfish	-	-	-	-	1	-	-	-	-	1
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	3	-	-	-	-	1	-	4
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	-	-	-	-
TOTAL:	4	66	734	309	98	258	158	579	727	2933

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-25. Fishes captured by seining at Transect D1E (Study Site D1) in the lower Kansas River, in 1981.

SITE: D1E	FEB	MARCH	APRIL	MAY	JULY	AUG	SEPT	TOTAL	ALL YEARS
SPECIES:									
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	5
Longnose Gar	-	-	-	-	-	-	-	-	1
Skipjack Herring	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	-	-	3
Goldeye	-	-	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-	-	2
Golden Shiner	-	-	-	2	-	-	-	2	2
Creek Chub	-	-	-	1	-	-	-	1	1
Silver Chub	-	-	-	-	-	-	-	-	16
Speckled Chub	-	-	-	-	-	-	-	-	14
Sturgeon Chub	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	-	-	-	2
Emerald Shiner	-	-	-	13	-	-	-	13	37
Redfin Shiner	-	-	-	43	-	-	-	43	46
River Shiner	-	-	-	-	-	-	-	-	-
Red Shiner	-	-	-	2594	-	34	-	2628	5715
Sand Shiner	-	-	-	916	-	4	-	920	1351
Plains Minnow	-	-	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-	-	1
Fathead Minnow	-	-	-	-	-	-	-	-	2
Bullhead Minnow	-	-	-	-	-	-	-	-	17
Bluntnose Minnow	-	-	-	1	-	-	-	1	13
Central Stoneroller	-	-	-	1	-	-	-	1	3
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-
Carpsucker*	-	-	-	18	-	-	-	18	158
Shorthead Redhorse	-	-	-	-	-	-	-	-	2
White Sucker	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-	26
Flathead Catfish	-	-	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-	-	2
Slender Madtom	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-	-	1
Largemouth Bass	-	-	-	-	-	-	-	-	4
Green Sunfish	-	-	-	-	-	-	-	-	2
Bluegill Sunfish	-	-	-	5	-	-	-	5	22
Longear Sunfish	-	-	-	-	-	-	-	-	1
Orange-spotted Sunfish	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	2	-	-	-	2	10
Black Crappie	-	-	-	-	-	-	-	-	2
Sauger	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	-	-	18
TOTAL:	-	-	-	3596	-	38	-	3634	7478

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-26. Fishes captured by seining at Transect D2A (Study Site D2) in the lower Kansas River, in 1979.

SITE: D2A	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:							
Shovelnose Sturgeon	-	-	-	-	-	-	-
Shortnose Gar	2	-	-	-	-	-	2
Longnose Gar	-	1	-	-	-	-	1
Skipjack Herring	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	11	-	1	12
Goldeye	-	4	1	-	-	-	5
Carp	-	1	-	-	-	-	1
Golden Shiner	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	-	-	-
Silver Chub	-	5	1	-	-	-	6
Speckled Chub	-	-	1	-	-	-	1
Sturgeon Chub	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	-	-
Emerald Shiner	-	-	-	-	2	-	2
Redfin Shiner	-	-	-	-	-	-	-
River Shiner	-	-	-	-	-	-	-
Red Shiner	144	254	36	2	60	-	496
Sand Shiner	15	15	17	7	-	1	55
Plains Minnow	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-
Fathead Minnow	-	18	-	-	-	-	18
Bullhead Minnow	1	1	-	-	-	-	2
Bluntnose Minnow	-	-	-	-	-	-	-
Central Stoneroller	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-
Carpsucker*	3	6	-	6	1	2	18
Shorthead Redhorse	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-
Channel Catfish	-	-	25	1	-	2	28
Flathead Catfish	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-
White Bass	-	11	-	1	-	-	12
Largemouth Bass	-	7	-	-	-	-	7
Green Sunfish	-	1	-	-	-	-	1
Bluegill Sunfish	-	-	-	-	1	-	1
Longear Sunfish	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-
White Crappie	1	-	-	-	-	-	1
Black Crappie	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-
Freshwater Drum	-	-	1	-	-	2	3
TOTAL:	166	324	82	28	64	8	672

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-27. Fishes captured by seining at Transect D2A (Study Site D2) in the lower Kansas River, in 1980.

SITE: D2A	JAN	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:										
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	1	-	-	-	1
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	1	496	80	4	-	581
Goldeye	-	-	-	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-	-	-	-
Golden Shiner	-	-	-	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	-	-	-	-	-	-
Silver Chub	-	-	-	-	7	-	-	-	-	7
Speckled Chub	-	-	-	-	-	-	-	-	-	-
Sturgeon Chub	-	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	2	-	-	-	-	2
Emerald Shiner	-	-	2	-	-	3	-	-	12	17
Redfin Shiner	-	-	-	-	-	1	-	-	-	1
River Shiner	-	-	-	-	-	-	-	-	-	-
Red Shiner	4	9	217	84	5	20	111	1231	678	2359
Sand Shiner	-	18	82	14	6	8	17	578	125	848
Plains Minnow	-	-	-	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-	-	-	-
Fathead Minnow	-	1	-	-	-	-	-	-	-	1
Bullhead Minnow	-	-	-	-	3	5	7	133	20	168
Bluntnose Minnow	-	-	-	-	-	3	-	20	-	23
Central Stoneroller	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Carpsucker*	41	14	12	7	3	87	85	58	15	322
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	2	-	2	2	-	6
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	1	10	2	1	-	-	14
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
Green Sunfish	-	-	-	-	-	1	-	2	1	4
Bluegill Sunfish	-	-	-	-	-	13	13	2	6	34
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	1	10	3	14
White Crappie	-	-	-	-	3	6	-	1	-	10
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	1	-	-	-	-	1
Freshwater Drum	-	-	-	-	39	-	-	-	-	39
TOTAL:	45	42	313	106	82	646	317	2041	860	4452

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-28. Fishes captured by seining at Transect D2A (Study Site D2) in the lower Kansas River, in 1981.

SITE: D2A	FEB	MARCH	APRIL	MAY	JULY	AUG	SEPT	TOTAL	ALL YEARS
SPECIES:									
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	2
Longnose Gar	-	-	-	-	-	-	-	-	2
Skipjack Herring	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	-	-	593
Goldeye	-	-	-	-	-	-	-	-	5
Carp	-	-	-	-	-	-	-	-	1
Golden Shiner	-	-	-	-	-	-	-	-	-
Creek Chub	-	-	-	6	-	-	-	6	6
Silver Chub	-	-	-	-	2	-	-	2	15
Speckled Chub	-	-	-	-	-	-	-	-	1
Sturgeon Chub	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	-	-	-	2
Emerald Shiner	-	-	-	-	-	-	-	-	19
Redfin Shiner	-	-	-	-	-	-	-	-	1
River Shiner	-	-	-	-	-	-	-	-	-
Red Shiner	-	-	-	734	194	17	-	945	3800
Sand Shiner	-	-	-	58	6	1	-	65	968
Plains Minnow	-	-	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-	-	-
Fathead Minnow	-	-	-	-	-	-	-	-	19
Bullhead Minnow	-	-	-	51	1	-	-	52	222
Bluntnose Minnow	-	-	-	-	-	-	-	-	23
Central Stoneroller	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-
Carpsucker*	-	-	-	22	-	2	-	24	364
Shorthead Redhorse	-	-	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	2	5	-	-	7	41
Flathead Catfish	-	-	-	-	4	-	-	4	4
Stonecat	-	-	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-	-	26
Largemouth Bass	-	-	-	-	-	-	-	-	7
Green Sunfish	-	-	-	-	-	-	-	-	5
Bluegill Sunfish	-	-	-	-	-	-	-	-	35
Longear Sunfish	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	2	-	-	-	2	16
White Crappie	-	-	-	-	-	-	-	-	11
Black Crappie	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-	-	1
Freshwater Drum	-	-	-	-	-	-	-	-	42
TOTAL:	-	-	-	875	212	20	-	1107	6231

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-29. Fishes captured by seining at Transect D2D (Study Site D2) in the lower Kansas River, in 1979.

SITE: D2D	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:							
Shovelnose Sturgeon	-	-	-	-	-	-	-
Shortnose Gar	1	-	-	-	-	-	1
Longnose Gar	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	-
Goldeye	-	1	2	-	-	-	3
Carp	-	-	-	-	-	-	-
Golden Shiner	-	-	-	-	-	-	-
Creek Chub	-	2	-	-	-	-	2
Silver Chub	1	13	2	-	-	-	16
Speckled Chub	-	-	-	-	-	-	-
Sturgeon Chub	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	-	-
Emerald Shiner	1	-	-	-	-	-	1
Redfin Shiner	-	-	-	-	-	-	-
River Shiner	-	-	-	-	-	-	-
Red Shiner	195	111	22	9	72	25	434
Sand Shiner	101	9	46	5	4	21	186
Plains Minnow	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-
Fathead Minnow	-	-	1	-	-	-	1
Bullhead Minnow	-	1	-	-	-	-	1
Bluntnose Minnow	-	-	-	-	-	-	-
Central Stoneroller	-	1	-	-	-	-	1
Bigmouth Buffalo	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-
Carpsucker*	1	22	12	1	3	1	40
Shorthead Redhorse	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-
Channel Catfish	6	-	128	-	-	-	134
Flathead Catfish	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-
White Bass	1	2	-	-	1	-	4
Largemouth Bass	-	2	-	-	-	-	2
Green Sunfish	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-
White Crappie	3	4	-	-	-	-	7
Black Crappie	-	-	-	-	-	-	-
Sauger	1	-	-	-	-	-	1
Walleye	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-
Freshwater Drum	1	1	1	-	-	1	4
TOTAL:	312	169	214	15	80	48	838

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-30. Fishes captured by seining at Transect D2D (Study Site D2) in the lower Kansas River, in 1980.

SITE: D2D	JAN	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:										
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	68	14	45	-	127
Goldeye	-	-	-	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-	-	-	-
Golden Shiner	-	-	-	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	-	-	-	-	-	-
Silver Chub	-	-	-	-	-	1	-	-	-	1
Speckled Chub	-	-	-	-	-	-	-	-	-	-
Sturgeon Chub	-	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	-	-	-	-	-
Emerald Shiner	-	-	-	-	-	2	2	38	-	42
Redfin Shiner	-	-	-	-	-	-	-	-	-	-
River Shiner	-	-	-	-	-	-	-	-	-	-
Red Shiner	1	-	-	14	-	60	64	431	139	709
Sand Shiner	19	-	-	-	-	56	4	497	40	616
Plains Minnow	-	-	-	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-	-	-	-
Fathead Minnow	-	-	-	-	-	-	-	-	-	-
Bullhead Minnow	-	-	-	-	-	3	1	20	14	38
Bluntnose Minnow	-	-	-	-	-	5	-	25	-	30
Central Stoneroller	-	-	-	-	-	-	-	1	-	1
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Carpsucker*	-	-	-	-	-	63	2	49	3	117
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	2	-	-	-	2
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	1	-	-	-	1
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
Green Sunfish	-	-	-	-	-	-	2	-	-	2
Bluegill Sunfish	-	-	-	-	-	-	4	4	-	8
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-	21	1	22
White Crappie	-	-	-	-	-	-	-	1	-	1
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	1	-	-	-	1
TOTAL:	20	-	-	14	-	262	93	1131	198	1718

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-31. Fishes captured by seining at Transect D2D (Study Site D2) in the lower Kansas River, in 1981.

SITE: D2D	FEB	MARCH	APRIL	MAY	JULY	AUG	SEPT	TOTAL	ALL YEARS
SPECIES:									
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	1
Longnose Gar	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	-	-	127
Goldeye	-	-	-	-	-	-	-	-	3
Carp	-	-	-	-	-	-	-	-	-
Golden Shiner	-	-	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	-	-	-	-	2
Silver Chub	-	-	-	-	3	1	-	4	21
Speckled Chub	-	-	-	-	-	-	-	-	-
Sturgeon Chub	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	-	-	-	-
Emerald Shiner	-	-	-	2	-	-	-	2	45
Redfin Shiner	-	-	-	-	-	-	-	-	-
River Shiner	-	-	-	-	-	-	-	-	-
Red Shiner	-	-	-	8	48	6	-	62	1205
Sand Shiner	-	-	-	1	37	-	-	38	840
Plains Minnow	-	-	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-	-	-
Fathead Minnow	-	-	-	-	-	-	-	-	1
Bullhead Minnow	-	-	-	-	1	-	-	1	40
Bluntnose Minnow	-	-	-	-	-	-	-	-	30
Central Stoneroller	-	-	-	-	-	-	-	-	2
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-
Carpsucker*	-	-	-	-	19	-	-	19	176
Shorthead Redhorse	-	-	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	1	-	-	-	1	137
Flathead Catfish	-	-	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-	-	5
Largemouth Bass	-	-	-	-	-	-	-	-	2
Green Sunfish	-	-	-	-	2	-	-	2	4
Bluegill Sunfish	-	-	-	-	4	5	-	9	17
Longear Sunfish	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	1	6	1	-	8	30
White Crappie	-	-	-	-	4	3	-	7	15
Black Crappie	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	1
Walleye	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	-	-	5
TOTAL:	-	-	-	13	124	16	-	153	2709

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-32. Fishes captured by seining at Transect D2E (Study Site D2) in the lower Kansas River, in 1979.

SITE: D2E	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:							
Shovelnose Sturgeon	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	1	-	1
Goldeye	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-
Golden Shiner	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	-	-	-
Silver Chub	-	1	24	-	1	-	26
Speckled Chub	-	-	-	-	-	-	-
Sturgeon Chub	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	-	-
Emerald Shiner	-	-	-	-	1	-	1
Redfin Shiner	-	-	-	-	-	-	-
River Shiner	-	-	-	-	-	-	-
Red Shiner	39	46	39	1	151	9	285
Sand Shiner	36	9	35	-	7	2	89
Plains Minnow	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-
Fathead Minnow	-	-	-	-	-	1	1
Bullhead Minnow	-	-	-	-	-	-	-
Bluntnose Minnow	-	-	13	-	-	-	13
Central Stoneroller	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-
Carpsucker*	1	1	34	-	61	-	97
Shorthead Redhorse	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-
Channel Catfish	3	-	68	3	12	11	97
Flathead Catfish	-	-	1	-	-	-	1
Stonecat	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-
White Bass	-	2	1	-	3	-	6
Largemouth Bass	-	-	-	-	-	-	-
Green Sunfish	-	-	1	-	-	1	2
Bluegill Sunfish	-	-	1	-	2	1	4
Longear Sunfish	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-
White Crappie	-	1	-	-	3	-	4
Black Crappie	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-
Freshwater Drum	1	-	8	-	8	1	18
TOTAL:	80	60	225	4	250	26	645

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-33. Fishes captured by seining at Transect D2E (Study Site D2) in the lower Kansas River, in 1980.

SITE: D2E	JAN	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:										
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	1	-	-	-	1
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	3	79	23	5	-	110
Goldeye	-	-	-	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-	-	-	-
Golden Shiner	-	-	-	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	-	-	-	-	-	-
Silver Chub	-	-	-	-	163	4	-	-	-	167
Speckled Chub	-	-	-	-	2	-	-	-	-	2
Sturgeon Chub	-	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	2	1	-	-	-	3
Emerald Shiner	-	-	-	-	-	12	1	1	3	17
Redfin Shiner	-	-	-	1	-	-	-	-	-	1
River Shiner	-	-	-	-	-	-	-	-	-	-
Red Shiner	436	222	143	58	14	104	14	161	513	1665
Sand Shiner	78	49	127	29	9	15	15	685	263	1270
Plains Minnow	-	-	-	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-	-	-	-
Fathead Minnow	5	4	150	-	-	-	-	1	-	160
Bullhead Minnow	-	-	-	-	4	8	5	48	48	113
Bluntnose Minnow	-	-	1	-	1	73	-	-	1	76
Central Stoneroller	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Carpsucker*	1	2	47	2	6	29	108	1	12	208
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	1	-	1	-	-	-	-	2
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	1	44	3	-	-	-	48
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
Green Sunfish	-	-	-	-	-	4	1	-	-	5
Bluegill Sunfish	-	-	-	-	-	-	15	2	2	19
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	1	-	-	14	15	30
White Crappie	-	-	1	-	2	1	2	1	-	7
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	64	-	-	-	-	64
TOTAL:	520	277	470	91	316	334	184	919	857	3968

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-34. Fishes captured by seining at Transect D2E (Study Site D2) in the lower Kansas River, in 1981.

SITE: D2E	FEB	MARCH	APRIL	MAY	JULY	AUG	SEPT	TOTAL	ALL YEARS
SPECIES:									
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	1
Skipjack Herring	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	-	-	111
Goldeye	-	-	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-	-	-
Golden Shiner	-	-	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	-	-	-	-	-
Silver Chub	-	-	-	-	-	1	-	1	194
Speckled Chub	-	-	-	-	-	-	-	-	2
Sturgeon Chub	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	-	-	-	3
Emerald Shiner	-	-	-	1	-	-	-	1	19
Redfin Shiner	-	-	-	-	-	-	-	-	1
River Shiner	-	-	-	-	-	-	-	-	-
Red Shiner	-	-	-	29	-	4	-	33	1983
Sand Shiner	-	-	-	3	-	-	-	3	1362
Plains Minnow	-	-	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-	-	-
Fathead Minnow	-	-	-	-	-	-	-	-	161
Bullhead Minnow	-	-	-	3	-	-	-	3	116
Bluntnose Minnow	-	-	-	-	-	-	-	-	89
Central Stoneroller	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-
Carpsucker*	-	-	-	4	-	-	-	4	309
Shorthead Redhorse	-	-	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	3	-	3	102
Flathead Catfish	-	-	-	-	-	-	-	-	1
Stonecat	-	-	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-	-	54
Largemouth Bass	-	-	-	-	-	-	-	-	-
Green Sunfish	-	-	-	-	-	-	-	-	7
Bluegill Sunfish	-	-	-	-	-	3	-	3	26
Longear Sunfish	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	1	-	-	-	1	31
White Crappie	-	-	-	-	-	-	-	-	11
Black Crappie	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	-	-	82
TOTAL:	-	-	-	41	-	11	-	52	4665

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-35. Fishes captured by seining at Transect D3A (Study Site D3) in the lower Kansas River, in 1979.

SITE: D3A	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:							
Shovelnose Sturgeon	-	-	-	-	-	-	-
Shortnose Gar	3	1	-	-	-	-	4
Longnose Gar	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-
Gizzard Shad	-	1	-	50	8	5	64
Goldeye	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-
Golden Shiner	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	-	-	-
Silver Chub	-	1	8	-	-	-	9
Speckled Chub	-	-	-	-	-	2	2
Sturgeon Chub	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	-	-
Emerald Shiner	1	10	-	-	7	71	89
Redfin Shiner	-	-	-	-	-	-	-
River Shiner	-	-	-	-	-	-	-
Red Shiner	15	34	145	1	1	66	262
Sand Shiner	12	4	37	1	-	69	123
Plains Minnow	-	-	-	-	-	1	1
W. Silvery Minnow	-	-	-	-	-	1	1
Fathead Minnow	-	-	2	-	-	-	2
Bullhead Minnow	-	-	-	-	-	3	3
Bluntnose Minnow	-	-	-	-	-	1	1
Central Stoneroller	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	1	-	-	-	1
Smallmouth Buffalo	-	-	-	-	-	-	-
Carpsucker*	1	8	122	3	2	2	138
Shorthead Redhorse	-	1	-	-	-	-	1
White Sucker	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-
Channel Catfish	-	-	23	-	-	-	23
Flathead Catfish	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-
White Bass	-	-	9	7	-	-	16
Largemouth Bass	-	-	10	-	-	-	10
Green Sunfish	-	-	-	-	-	2	2
Bluegill Sunfish	-	-	1	-	-	8	9
Longear Sunfish	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-
White Crappie	-	-	1	2	-	-	3
Black Crappie	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-
Freshwater Drum	-	-	32	4	2	-	38
TOTAL:	32	60	391	68	20	231	802

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-36. Fishes captured by seining at Transect D3A (Study Site D3) in the lower Kansas River, in 1980.

SITE: D3A	JAN	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:										
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	5	-	-	-	1	57	80	7	-	150
Goldeye	-	-	-	-	-	-	-	-	-	-
Carp	-	-	-	-	1	-	-	-	-	1
Golden Shiner	-	-	-	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	1	-	-	-	-	1
Silver Chub	-	-	-	-	5	4	-	-	-	9
Speckled Chub	-	-	-	-	3	-	-	-	-	3
Sturgeon Chub	-	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	-	-	-	-	-
Emerald Shiner	9	4	9	-	-	19	39	55	17	152
Redfin Shiner	-	-	-	-	1	-	-	-	-	1
River Shiner	-	-	-	-	-	-	-	-	-	-
Red Shiner	-	13	79	7	12	11	55	1304	285	1766
Sand Shiner	-	6	65	7	5	2	18	268	43	414
Plains Minnow	-	-	-	-	-	-	1	-	-	1
W. Silvery Minnow	-	-	-	-	-	-	-	-	-	-
Fathead Minnow	-	-	-	-	-	-	-	-	-	-
Bullhead Minnow	6	-	35	1	3	9	2	92	20	168
Bluntnose Minnow	-	-	1	1	-	-	-	2	-	-
Central Stoneroller	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Carpsucker*	1	-	1	-	-	14	69	29	3	117
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	2	-	-	-	-	19	-	-	-	21
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	4	2	-	1	-	7
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
Green Sunfish	-	-	1	-	-	-	1	2	-	4
Bluegill Sunfish	1	-	-	-	-	-	20	22	1	44
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-	24	-	24
White Crappie	-	-	4	-	5	2	4	1	-	16
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	1	-	1
Orange-throated Darter	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	1	-	25	3	-	-	-	29
TOTAL:	24	23	196	16	66	142	289	1808	369	2933

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-37. Fishes captured by seining at Transect D3A (Study Site D3) in the lower Kansas River, in 1981.

SITE: D3A	FEB	MARCH	APRIL	MAY	JULY	AUG	SEPT	TOTAL	ALL YEARS
SPECIES:									
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	4
Longnose Gar	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	-	-	214
Goldeye	-	-	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-	-	1
Golden Shiner	-	-	-	1	-	-	-	1	1
Creek Chub	-	-	-	2	-	-	-	2	3
Silver Chub	-	-	-	-	-	-	-	-	18
Speckled Chub	-	-	-	1	-	-	-	1	6
Sturgeon Chub	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	-	-	-	-
Emerald Shiner	15	160	377	5	-	-	7	564	805
Redfin Shiner	-	-	-	-	-	-	-	-	1
River Shiner	-	1	2	-	-	-	-	3	3
Red Shiner	7	193	2006	196	-	-	22	2424	4452
Sand Shiner	4	407	553	16	-	-	-	980	1517
Plains Minnow	-	-	-	-	-	-	-	-	2
W. Silvery Minnow	-	-	-	-	-	-	-	-	1
Fathead Minnow	-	-	1	3	-	-	-	4	6
Bullhead Minnow	-	3	53	3	-	-	7	66	237
Bluntnose Minnow	-	-	-	-	-	-	-	-	5
Central Stoneroller	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	1
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-
Carpsucker*	-	1	11	3	-	-	-	15	270
Shorthead Redhorse	-	-	-	-	-	-	-	-	1
White Sucker	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	1	1	-	-	-	2	46
Flathead Catfish	-	-	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-	-	-
White Bass	-	-	1	-	-	-	-	1	24
Largemouth Bass	-	-	-	-	-	-	-	-	10
Green Sunfish	-	-	-	-	-	-	-	-	6
Bluegill Sunfish	-	-	-	-	-	-	1	1	54
Longear Sunfish	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-	-	24
White Crappie	-	-	-	-	-	-	-	-	19
Black Crappie	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	1
Orange-throated Darter	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	-	-	67
TOTAL:	26	765	3005	231	-	-	37	4064	7799

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-38. Fishes captured by seining at Transect D3D (Study Site D3) in the lower Kansas River, in 1979.

SITE: D3D	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:							
Shovelnose Sturgeon	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-
Longnose Gar	-	1	-	-	-	-	1
Skipjack Herring	-	2	-	-	-	-	2
Gizzard Shad	-	-	-	3	3	-	6
Goldeye	-	1	-	-	-	-	1
Carp	-	2	-	-	-	-	2
Golden Shiner	-	1	-	-	-	-	1
Creek Chub	-	4	-	-	-	-	4
Silver Chub	-	-	-	-	-	-	-
Speckled Chub	-	-	-	-	-	-	-
Sturgeon Chub	-	-	-	1	-	-	1
Suckermouth Minnow	-	-	-	-	-	-	-
Emerald Shiner	1	2	-	2	10	2	17
Redfin Shiner	-	1	-	-	-	-	1
River Shiner	-	-	-	-	-	-	-
Red Shiner	359	519	8	34	66	11	997
Sand Shiner	41	63	-	2	5	3	114
Plains Minnow	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-
Fathead Minnow	-	14	-	-	-	1	15
Bullhead Minnow	1	-	-	-	-	-	1
Bluntnose Minnow	-	-	-	-	1	-	1
Central Stoneroller	-	1	-	-	-	-	1
Bigmouth Buffalo	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-
Carpsucker*	6	11	-	2	2	-	21
Shorthead Redhorse	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-
Channel Catfish	10	1	14	2	6	1	34
Flathead Catfish	-	-	-	-	-	-	-
Stonecat	2	2	-	11	5	-	20
Slender Madtom	-	-	-	-	-	-	-
White Bass	1	2	-	-	-	-	3
Largemouth Bass	-	2	-	-	-	-	2
Green Sunfish	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	1	-	1
Longear Sunfish	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-
White Crappie	-	3	-	-	9	-	12
Black Crappie	-	-	-	-	-	-	-
Sauger	1	-	-	-	-	-	1
Walleye	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-
Freshwater Drum	1	-	-	-	2	-	3
TOTAL:	423	632	22	57	110	18	1262

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-39. Fishes captured by seining at Transect D3D (Study Site D3) in the lower Kansas River, in 1980.

SITE: D3D	JAN	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:										
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	2	1	-	-	-	-	3
Longnose Gar	-	-	-	-	1	3	-	-	-	4
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	3	-	51	46	2	3	105
Goldeye	-	-	-	-	-	-	-	-	-	-
Carp	-	-	-	-	2	-	-	-	-	2
Golden Shiner	-	-	-	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	-	-	-	-	-	-
Silver Chub	-	-	-	-	1	-	-	-	-	1
Speckled Chub	-	-	-	-	-	-	-	-	-	-
Sturgeon Chub	-	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	-	-	-	-	-
Emerald Shiner	-	12	5	-	-	3	36	33	17	106
Redfin Shiner	-	-	-	-	-	-	-	-	-	-
River Shiner	-	-	-	-	-	1	-	-	-	1
Red Shiner	20	40	550	47	52	133	98	232	143	1315
Sand Shiner	11	28	115	3	13	26	93	19	22	330
Plains Minnow	-	-	-	-	-	1	-	-	-	1
W. Silvery Minnow	-	-	1	-	-	2	-	-	-	3
Fathead Minnow	-	-	-	-	-	1	-	-	1	2
Bullhead Minnow	-	-	1	-	-	2	10	9	2	24
Bluntnose Minnow	-	-	2	-	-	4	2	-	-	8
Central Stoneroller	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Carpsucker*	-	-	18	-	5	17	55	1	-	96
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	4	1	-	-	-	5
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	3	-	3	-	6
Largemouth Bass	-	-	-	-	-	2	-	-	-	2
Green Sunfish	-	-	-	-	-	-	2	1	-	3
Bluegill Sunfish	-	-	-	-	-	3	13	9	3	28
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	6	1	1	8
White Crappie	-	-	1	1	-	1	7	2	-	12
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	1	5	1	-	-	-	7
TOTAL:	31	80	693	57	84	255	368	312	192	2072

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-40. Fishes captured by seining at Transect D3D (Study Site D3) in the lower Kansas River, in 1981.

SITE: D3D	FEB	MARCH	APRIL	MAY	JULY	AUG	SEPT	TOTAL	ALL YEARS
SPECIES:									
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	3
Longnose Gar	-	-	-	-	-	-	-	-	5
Skipjack Herring	-	-	-	-	-	-	-	-	2
Gizzard Shad	-	-	-	-	-	-	-	-	111
Goldeye	-	-	-	-	-	-	-	-	1
Carp	-	-	-	-	-	-	-	-	4
Golden Shiner	-	-	-	-	-	-	-	-	1
Creek Chub	-	-	-	1	-	-	-	1	5
Silver Chub	-	-	-	1	-	-	-	1	2
Speckled Chub	-	-	-	-	-	-	-	-	-
Sturgeon Chub	-	-	-	-	-	-	-	-	1
Suckermouth Minnow	-	-	-	-	-	-	-	-	-
Emerald Shiner	-	-	35	112	-	-	-	147	270
Redfin Shiner	-	-	-	-	-	-	-	-	1
River Shiner	-	-	-	-	-	-	-	-	1
Red Shiner	-	-	50	586	-	-	-	636	2948
Sand Shiner	-	-	42	76	-	-	-	118	562
Plains Minnow	-	-	-	-	-	-	-	-	1
W. Silvery Minnow	-	-	-	-	-	-	-	-	3
Fathead Minnow	-	-	-	3	-	-	-	3	20
Bullhead Minnow	-	-	19	12	-	-	-	31	56
Bluntnose Minnow	-	-	-	-	-	-	-	-	9
Central Stoneroller	-	-	-	7	-	-	-	7	8
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-
Carpsucker*	-	-	1	2	-	-	-	3	120
Shorthead Redhorse	-	-	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-	39
Flathead Catfish	-	-	-	2	-	-	-	2	2
Stonecat	-	-	-	-	-	-	-	-	20
Slender Madtom	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-	-	9
Largemouth Bass	-	-	-	-	-	-	-	-	4
Green Sunfish	-	-	-	-	-	-	-	-	3
Bluegill Sunfish	-	-	-	-	-	-	-	-	29
Longear Sunfish	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	1	-	-	-	1	9
White Crappie	-	-	-	-	-	-	-	-	24
Black Crappie	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	1
Walleye	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	-	-	10
TOTAL:	-	-	147	803	-	-	-	950	4284

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-41. Fishes captured by seining at Transect D3E (Study Site D3) in the lower Kansas River, in 1979.

SITE: D3E	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:							
Shovelnose Sturgeon	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	6	6
Goldeye	-	1	3	-	-	-	4
Carp	-	-	1	-	-	-	1
Golden Shiner	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	-	-	-
Silver Chub	5	-	2	1	-	-	8
Speckled Chub	28	-	-	14	1	-	43
Sturgeon Chub	1	-	-	1	-	-	2
Suckermouth Minnow	-	-	-	-	-	-	-
Emerald Shiner	-	1	-	1	2	11	15
Redfin Shiner	-	-	-	-	-	-	-
River Shiner	-	-	-	-	-	-	-
Red Shiner	89	37	46	6	16	20	214
Sand Shiner	1	2	7	5	5	10	30
Plains Minnow	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-
Fathead Minnow	-	-	1	-	-	-	1
Bullhead Minnow	-	-	1	-	-	-	1
Bluntnose Minnow	-	-	-	-	-	-	-
Central Stoneroller	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-
Carpsucker*	-	1	-	-	-	-	1
Shorthead Redhorse	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-
Channel Catfish	6	-	95	-	-	1	102
Flathead Catfish	-	-	1	-	-	-	1
Stonecat	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-
White Bass	-	-	-	1	-	-	1
Largemouth Bass	-	-	-	-	-	-	-
Green Sunfish	-	-	-	-	-	-	-
Bluegill Sunfish	-	1	-	-	-	-	1
Longear Sunfish	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	-	-
Black Crappie	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-
Freshwater Drum	-	-	5	-	-	-	5
TOTAL:	130	43	162	29	24	48	436

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-42. Fishes captured by seining at Transect D3E (Study Site D3) in the lower Kansas River, in 1980.

SITE: D3E	JAN	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:										
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	1	-	-	-	-	-	-	1
Longnose Gar	-	-	1	-	-	-	-	-	-	1
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	32	-	34	25	7	-	2	100
Goldeye	-	-	-	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-	1	-	1
Golden Shiner	-	-	1	-	-	-	-	-	-	1
Creek Chub	-	-	-	-	-	-	-	-	-	-
Silver Chub	-	-	-	-	3	-	-	-	-	3
Speckled Chub	-	-	-	-	-	1	-	-	-	1
Sturgeon Chub	-	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	3	-	-	-	-	3
Emerald Shiner	-	7	151	4	-	-	3	27	153	345
Redfin Shiner	-	-	-	-	-	-	-	-	-	-
River Shiner	-	1	-	-	-	-	-	-	2	3
Red Shiner	123	326	175	10	19	9	76	761	1017	2516
Sand Shiner	3	56	24	7	23	18	6	2	35	174
Plains Minnow	-	-	-	-	-	-	-	-	35	35
W. Silvery Minnow	-	1	-	-	-	3	-	-	-	4
Fathead Minnow	1	2	-	-	-	-	-	-	3	6
Bullhead Minnow	-	2	1	-	-	7	-	5	-	15
Bluntnose Minnow	-	1	1	-	3	-	1	2	1	9
Central Stoneroller	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	2	-	-	-	-	2
Smallmouth Buffalo	-	-	-	-	1	-	-	-	-	1
Carpsucker*	-	-	78	17	71	26	15	-	5	212
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	2	-	-	2
Channel Catfish	-	-	-	-	-	6	6	11	2	25
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-	3	2	5
Slender Madtom	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	2	-	6	-	2	-	-	10
Largemouth Bass	-	-	-	-	2	-	-	-	-	2
Green Sunfish	-	-	-	-	-	-	10	1	-	11
Bluegill Sunfish	-	-	-	-	-	-	51	29	1	81
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	4	1	2	7
White Crappie	-	-	27	-	11	1	10	-	-	49
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	4	3	-	-	-	7
Freshwater Drum	-	-	1	2	14	-	-	-	-	17
TOTAL:	127	396	495	40	196	99	194	842	1260	3649

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-43. Fishes captured by seining at Transect D3E (Study Site D3) in the lower Kansas River, in 1981.

SITE: D3E	FEB	MARCH	APRIL	MAY	JULY	AUG	SEPT	TOTAL	ALL YEARS
SPECIES:									
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	1
Longnose Gar	-	-	-	-	-	-	-	-	1
Skipjack Herring	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	-	-	106
Goldeye	-	-	-	-	-	-	-	-	4
Carp	-	-	-	-	-	-	-	-	2
Golden Shiner	-	-	-	-	-	-	-	-	1
Creek Chub	-	-	-	-	-	-	-	-	-
Silver Chub	-	-	-	-	-	-	-	-	11
Speckled Chub	-	-	-	-	-	-	-	-	44
Sturgeon Chub	-	-	-	-	-	-	-	-	2
Suckermouth Minnow	-	-	-	-	-	-	-	-	3
Emerald Shiner	1	204	18	-	-	-	-	223	583
Redfin Shiner	-	-	-	-	-	-	-	-	-
River Shiner	-	12	-	-	-	-	-	12	15
Red Shiner	-	820	173	-	-	-	-	993	3723
Sand Shiner	-	394	6	-	-	-	-	400	604
Plains Minnow	-	-	-	-	-	-	-	-	35
W. Silvery Minnow	1	2	-	-	-	-	-	3	7
Fathead Minnow	-	-	-	-	-	-	-	-	7
Bullhead Minnow	-	2	-	-	-	-	-	2	18
Bluntnose Minnow	-	-	-	-	-	-	-	-	9
Central Stoneroller	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	2
Smallmouth Buffalo	-	-	-	-	-	-	-	-	1
Carpsucker*	-	1	3	-	-	-	-	4	217
Shorthead Redhorse	-	-	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	2
Channel Catfish	-	-	-	-	-	-	-	-	127
Flathead Catfish	-	-	-	-	-	-	-	-	1
Stonecat	-	-	-	-	-	-	-	-	5
Slender Madtom	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-	-	11
Largemouth Bass	-	-	-	-	-	-	-	-	2
Green Sunfish	-	-	-	-	-	-	-	-	11
Bluegill Sunfish	-	1	-	-	-	-	-	1	83
Longear Sunfish	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-	-	7
White Crappie	-	-	-	-	-	-	-	-	49
Black Crappie	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-	-	7
Freshwater Drum	-	-	-	-	-	-	-	-	22
TOTAL:	2	1436	200	-	-	-	-	1638	5723

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-44. Fishes collected by seining at Turner Bridge (Partial Site) in the lower Kansas River, in 1979.

SITE: PARTIAL	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:							
Shovelnose Sturgeon	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-
Golden Shiner	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	-	-	-
Silver Chub	-	-	-	-	-	-	-
Speckled Chub	-	-	-	4	-	-	4
Sturgeon Chub	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	-	-
Emerald Shiner	-	-	-	-	-	-	-
Redfin Shiner	-	-	-	-	-	-	-
River Shiner	-	-	-	-	-	-	-
Red Shiner	-	-	-	6	-	-	6
Sand Shiner	-	-	-	2	-	-	2
Plains Minnow	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-
Fathead Minnow	-	-	-	-	-	-	-
Bullhead Minnow	-	-	-	-	-	-	-
Bluntnose Minnow	-	-	-	-	-	-	-
Central Stoneroller	-	-	-	1	-	-	1
Bigmouth Buffalo	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-
Carpsucker*	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-
Channel Catfish	-	-	-	39	-	-	39
Flathead Catfish	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-
Green Sunfish	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	1	-	-	1
Longear Sunfish	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-
White Crappie	-	-	-	2	-	-	2
Black Crappie	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	9	-	-	9
TOTAL:	-	-	-	64	-	-	64

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-45. Fishes collected by seining at Turner Bridge (Partial Site) in the lower Kansas River, in 1980.

SITE: PARTIAL	JAN	MARCH	APRIL	MAY	JUNE	JULY	AUG	SEPT	NOV	TOTAL
SPECIES:										
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	4	-	-	4
Goldeye	-	-	-	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-	-	-	-
Golden Shiner	-	-	-	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	-	-	-	-	-	-
Silver Chub	-	-	-	-	-	-	-	-	-	-
Speckled Chub	-	-	-	-	-	-	-	-	-	-
Sturgeon Chub	-	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	-	-	-	-	-
Emerald Shiner	-	-	-	-	-	-	27	-	-	27
Redfin Shiner	-	-	-	-	-	-	1	-	-	1
River Shiner	-	-	-	-	-	-	37	-	-	37
Red Shiner	-	-	-	-	-	-	-	-	-	-
Sand Shiner	-	-	-	-	-	-	-	-	-	-
Plains Minnow	-	-	-	-	-	-	1	-	-	1
W. Silvery Minnow	-	-	-	-	-	-	4	-	-	4
Fathead Minnow	-	-	-	-	-	-	-	-	-	-
Bullhead Minnow	-	-	-	-	-	-	11	-	-	11
Bluntnose Minnow	-	-	-	-	-	-	-	-	-	-
Central Stoneroller	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Carpsucker*	-	-	-	-	-	-	3	-	-	3
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-	-	-
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	1	-	-	1
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	1	-	-	1
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	-	-	-	-	-
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	-	-	-	-
TOTAL:	-	-	-	-	-	-	90	-	-	90

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-46. Fishes collected by seining at Turner Bridge (Partial Site) in the lower Kansas River, in 1981.

SITE: PARTIAL	FEB	MARCH	APRIL	MAY	JULY	AUG	SEPT	TOTAL	ALL YEARS
SPECIES:									
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	-	-	4
Goldeye	-	-	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-	-	-
Golden Shiner	-	-	-	-	-	-	-	-	-
Creek Chub	-	-	-	-	-	-	-	-	-
Silver Chub	-	-	-	-	-	-	-	-	-
Speckled Chub	-	-	-	-	-	-	-	-	4
Sturgeon Chub	-	-	-	-	-	-	-	-	-
Suckermouth Minnow	-	-	-	-	-	-	-	-	-
Emerald Shiner	-	-	-	274	-	-	-	274	301
Redfin Shiner	-	-	-	-	-	-	-	-	-
River Shiner	-	-	-	8	-	-	-	8	9
Red Shiner	-	-	-	337	-	-	-	337	380
Sand Shiner	-	-	-	39	-	-	-	39	41
Plains Minnow	-	-	-	-	-	-	-	-	1
W. Silvery Minnow	-	-	-	5	-	-	-	5	9
Fathead Minnow	-	-	-	-	-	-	-	-	-
Bullhead Minnow	-	-	-	-	-	-	-	-	11
Bluntnose Minnow	-	-	-	-	-	-	-	-	-
Central Stoneroller	-	-	-	-	-	-	-	-	1
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-
Carpsucker*	-	-	-	18	-	-	-	18	21
Shorthead Redhorse	-	-	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-	39
Flathead Catfish	-	-	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	1
Green Sunfish	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-	-	2
Longear Sunfish	-	-	-	-	-	-	-	-	-
Orange-spotted Sunfish	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	-	-	-	2
Black Crappie	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-
Orange-throated Darter	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	-	-	9
TOTAL:	-	-	-	681	-	-	-	681	835

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-47. Fishes captured in supplemental seining samples from 1979 to 1981, lower Kansas River.

SITE: PARTIAL	D1ES	D2AS	D2BS	D2CS	D3BS	D3DS	TOTAL
SPECIES:							
Shovelnose Sturgeon	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	1	-	1
Longnose Gar	-	2	-	-	1	-	3
Skipjack Herring	-	-	-	-	-	-	-
Gizzard Shad	34	13	3	-	1	-	51
Goldeye	-	-	-	-	-	-	-
Carp	-	-	-	-	-	-	-
Golden Shiner	5	-	-	-	-	-	5
Creek Chub	-	-	-	-	-	-	-
Silver Chub	-	-	-	1	-	-	1
Speckled Chub	-	-	1	-	-	1	2
Sturgeon Chub	-	-	-	-	-	-	-
Suckermouth Minnow	-	122	-	1	-	-	123
Emerald Shiner	-	2	5	-	-	12	19
Redfin Shiner	-	-	-	-	-	-	-
River Shiner	-	1	-	-	-	-	1
Red Shiner	16	939	758	4	1	19	1782
Sand Shiner	17	503	146	2	-	17	685
Plains Minnow	-	-	-	-	-	-	-
W. Silvery Minnow	-	-	-	-	-	-	-
Fathead Minnow	-	-	-	-	-	-	-
Bullhead Minnow	-	1	12	1	1	15	30
Bluntnose Minnow	8	1	-	-	-	-	9
Central Stoneroller	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-
Carpsucker*	36	59	155	2	1	-	253
Shorthead Redhorse	-	-	-	-	-	-	-
White Sucker	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-
Channel Catfish	65	2	12	-	6	9	94
Flathead Catfish	-	-	-	-	-	-	-
Stonecat	-	-	-	-	-	-	-
Slender Madtom	-	-	-	-	-	-	-
White Bass	19	3	4	4	-	-	30
Largemouth Bass	-	-	-	-	-	-	-
Green Sunfish	-	-	-	-	-	-	-
Bluegill Sunfish	25	1	3	-	-	-	29
Longear Sunfish	-	1	-	-	-	-	1
Orange-spotted Sunfish	5	1	6	-	-	-	12
White Crappie	442	-	17	1	-	-	460
Black Crappie	7	-	-	-	-	-	7
Sauger	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-
Orange-throated Darter	-	1	-	-	-	-	1
Freshwater Drum	8	1	2	6	1	-	18
TOTAL:	732	1653	1124	22	13	73	3617

* River Carpsucker and Quillback, not all of which were distinguished in the field.

Table A3-48. Density relationships of the fifteen most common species in seining samples from the lower Kansas River, 1979. Numerals in each column represent the average number of fish (of each species) caught per 100 square meters, subtended by the average biomass of that species in grams per 100 square meters.

MONTH:	May	June	July	Aug	Sept	Nov
SPECIES:						
Gizzard Shad	-	*	*	3	1	2
	-	8	*	23	13	38
Silver Chub	1	1	4	1	-	-
	4	1	1	1	-	-
Speckled Chub	11	-	2	14	1	2
	9	-	*	19	*	1
Emerald Shiner	1	1	-	1	2	9
	1	2	-	*	3	14
Red Shiner	100	99	107	13	18	195
	55	92	87	8	12	71
Sand Shiner	16	20	53	5	3	103
	7	14	35	2	1	36
Fathead Minnow	1	8	1	1	-	1
	1	4	*	*	-	*
Bullhead Minnow	1	1	*	-	-	2
	1	1	1	-	-	1
Bluntnose Minnow	-	1	4	2	1	4
	-	*	1	*	1	3
Carpsucker	2	8	35	1	3	3
	84	41	13	25	3	29
Channel Catfish	4	*	18	2	1	2
	33	5	20	2	2	4
White Bass	1	2	3	1	*	-
	18	1	12	2	2	-
Bluegill Sunfish	-	1	2	*	1	1
	-	11	2	*	*	1
White Crappie	1	1	1	*	2	1
	9	17	8	4	3	3
Freshwater Drum	1	1	3	2	*	*
	88	21	39	1	2	9

* less than 1
\- no fish collected

Table A3-49. Density relationships of the fifteen most common species in seining samples from the lower Kansas River, 1980. Numerals in each column represent the average number of fish (of each species) caught per 100 square meters, subtended by the average biomass of that species in grams per 100 square meters.

MONTH:	Jan	Mar	April	May	June	July	Aug	Sept	Nov
Gizzard Shad	2	-	4	1	3	34	11	5	2
	29	-	135	10	1	79	117	31	40
Silver Chub	-	-	-	1	13	1	1	*	-
	-	-	-	1	2	2	1	2	-
Speckled Chub	2	2	1	-	2	1	*	1	1
	1	1	*	-	*	*	*	1	1
Emerald Shiner	4	5	17	1	-	5	5	8	17
	6	9	28	1	-	1	4	5	19
Red Shiner	99	39	211	40	16	29	59	289	669
	26	13	75	21	12	9	23	108	310
Sand Shiner	18	15	60	10	12	19	14	109	106
	8	10	23	5	3	5	4	23	49
Fathead Minnow	4	1	51	*	1	1	-	1	2
	2	*	*	1	*	*	-	1	4
Bullhead Minnow	3	2	10	1	1	3	2	16	10
	3	1	3	1	2	*	1	5	3
Bluntnose Minnow	1	1	2	1	1	4	1	4	3
	*	*	1	1	*	1	*	1	2
Carpsucker	5	1	10	10	8	54	34	50	54
	9	6	91	66	30	44	24	40	105
Channel Catfish	1	-	2	1	1	3	1	1	2
	*	-	7	1	3	2	1	6	7
White Bass	-	-	1	*	5	1	*	1	-
	-	-	16	30	6	5	5	35	-
Bluegill Sunfish	1	-	-	-	-	1	5	4	2
	1	-	-	-	-	1	2	3	4
White Crappie	-	-	3	1	2	1	2	1	-
	-	-	24	13	30	10	16	26	0
Freshwater Drum	-	-	*	1	12	1	*	1	-
	-	-	7	8	15	26	1	96	-

* less than 1
\- no fish collected

Table A3-50. Density relationships of the fifteen most common species in seining samples from the lower Kansas River, 1981. Numerals in each column represent the average number of fish (of each species) caught per 100 square meters, subtended by the average biomass of that species in grams per 100 square meters.

MONTH:	Feb	Mar	April	May	July	Aug	Sept
SPECIES:							
Gizzard Shad	- -	- -	- -	- -	5 5	- -	- -
Silver Chub	- -	- -	- -	1 4	2 1	1 *	- -
Speckled Chub	- -	- -	- -	5 1	- -	- -	- -
Emerald Shiner	6 4	1 11	55 40	23 41	- -	* *	7 6
Red Shiner	288 113	835 317	621 251	1235 828	436 127	82 42	52 21
Sand Shiner	72 37	512 200	191 86	365 422	32 24	13 8	- -
Fathead Minnow	- -	- -	1 1	4 2	- -	- -	- -
Bullhead Minnow	2 1	2 *	31 16	45 31	3 2	2 2	16 4
Bluntnose Minnow	- -	1 -	- -	3 5	- -	- -	- -
Carpsucker	2 3	16 21	9 37	34 48	17 77	1 24	- -
Channel Catfish	- -	- -	- -	12 66	4 2	2 15	- -
White Bass	- -	- -	2 82	- -	1 29	1 3	- -
Bluegill Sunfish	- -	- -	- -	4 15	3 8	5 4	2 1
White Crappie	- -	- -	- -	3 3	5 5	2 2	- -
Freshwater Drum	- -	- -	- -	2 63	* *	- -	- -

* less than 1
\- no fish collected

APPENDIX 4 -- FISH, ELECTROFISHING SAMPLES

Table A4-1, catch by species and site, 1979

Table A4-2, catch by species and site, 1980

Table A4-3, catch/unit effort, 1980

Table A4-4, percent composition between sites, 1980

Table A4-5, percent composition within sites, 1980

Table A4-6, catch by species and site, 1981

Table A4-7, catch/unit effort, 1981

Table A4-8, percent composition between sites, 1981

Table A4-9, percent composition within sites, 1981

Table A4-10 through A4-21 seasonal summaries of catch by site, May - October

Table A4-22 through A4-25 seasonal summaries of catch by site, November - April

Table A4-26 through A4-56 catch by date and transect

Table A4-1. Electrofishing summary for the year 1979. Numerals indicate numbers of fish caught using this method.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	1.0	-	-	1.0	-	-	2.0
Shortnose Gar	-	-	-	1.0	-	-	1.0	4.0	-	6.0
Gizzard Shad	-	-	-	-	-	17.0	-	19.0	-	36.0
Skipjack Herring	-	-	-	-	-	-	-	1.0	-	1.0
Goldeye	-	-	-	-	-	1.0	-	1.0	-	2.0
Common Carp	-	-	-	2.0	-	1.0	-	14.0	2.0	19.0
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	-	-	-	4.0	2.0	2.0	-	11.0	7.0	26.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	2.0	-	1.0	-	-	3.0
Flathead Catfish	-	-	-	-	-	-	-	1.0	-	1.0
White Bass	-	-	-	-	-	-	-	-	2.0	2.0
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	1.0	-	-	-	1.0
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	2.0	-	2.0
Freshwater Drum	-	-	-	4.0	2.0	-	6.0	7.0	2.0	21.0
Total Fish	-	-	-	12.0	6.0	22.0	9.0	60.0	13.0	122.0
Fish/1000 m	-	-	-	60.0	30.0	-	-	-	13.0	-
Elec. Eft. (meters)	-	-	-	200.0	200.0	-	-	-	1000.0	-

Table A4-2. Electrofishing summary for the year 1980. Numerals indicate numbers of fish caught using this method.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	3.0	1.0	1.0	-	-	-	5.0
Shortnose Gar	2.0	4.0	-	-	1.0	1.0	-	2.0	1.0	11.0
Gizzard Shad	15.0	54.0	5.0	4.0	261.0	42.0	64.0	27.0	81.0	553.0
Skipjack Herring	-	-	-	-	-	-	-	-	1.0	1.0
Goldeye	1.0	-	-	1.0	1.0	-	1.0	1.0	2.0	7.0
Common Carp	28.0	14.0	7.0	13.0	3.0	1.0	6.0	18.0	19.0	109.0
Blue Sucker	1.0	1.0	-	-	-	-	-	-	-	2.0
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	1.0	1.0	2.0
Shorthead Redhorse	-	-	1.0	-	-	-	-	-	1.0	2.0
River Carpsucker	25.0	34.0	14.0	19.0	24.0	6.0	17.0	26.0	13.0	178.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	7.0	2.0	1.0	-	2.0	2.0	-	4.0	7.0	25.0
Flathead Catfish	5.0	8.0	5.0	9.0	-	2.0	1.0	4.0	11.0	45.0
White Bass	4.0	6.0	-	-	7.0	4.0	6.0	7.0	8.0	42.0
Green Sunfish	-	-	-	1.0	-	1.0	-	-	1.0	3.0
Bluegill Sunfish	-	-	-	5.0	1.0	1.0	-	-	1.0	8.0
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	3.0	3.0
White Crappie	2.0	-	1.0	2.0	12.0	-	12.0	2.0	4.0	35.0
Black Crappie	-	-	-	-	-	1.0	2.0	1.0	5.0	9.0
Sauger	-	-	-	-	-	-	-	4.0	4.0	8.0
Freshwater Drum	15.0	7.0	8.0	8.0	10.0	2.0	17.0	20.0	11.0	98.0
Total Fish	105.0	130.0	42.0	65.0	323.0	64.0	126.0	117.0	174.0	1146.0
Fish/1000 m	57.5	62.7	44.9	47.3	159.5	26.7	58.6	62.6	101.2	70.0
Elec. Eft. (meters)	1825.0	2075.0	935.0	1375.0	2025.0	2400.0	2150.0	1870.0	1720.0	16375.0

Table A4-3. Electrofishing summary for the year 1980. Numerals indicate numbers of fish caught per 1000 meters of electrofishing effort.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	2.2	0.5	0.4	-	-	-	0.3
Shortnose Gar	1.1	1.9	-	-	0.5	0.4	-	1.1	0.6	0.7
Gizzard Shad	8.2	26.0	5.3	2.9	128.9	17.5	29.8	14.4	47.1	33.8
Skipjack Herring	-	-	-	-	-	-	-	-	0.6	0.1
Goldeye	0.5	-	-	0.7	0.5	-	0.5	0.5	1.2	0.4
Common Carp	15.3	6.7	7.5	9.5	1.5	0.4	2.8	9.6	11.0	6.7
Blue Sucker	0.5	0.5	-	-	-	-	-	-	-	0.1
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	0.5	0.6	0.1
Shorthead Redhorse	-	-	1.1	-	-	-	-	-	0.6	0.1
River Carpsucker	13.7	16.4	15.0	13.8	11.9	2.5	7.9	13.9	7.6	10.9
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	3.8	1.0	1.1	-	1.0	0.8	-	2.1	4.1	1.5
Flathead Catfish	2.7	3.9	5.3	6.5	-	0.8	0.5	2.1	6.4	2.7
White Bass	2.2	2.9	-	-	3.5	1.7	2.8	3.7	4.7	2.6
Green Sunfish	-	-	-	0.7	-	0.4	-	-	0.6	0.2
Bluegill Sunfish	-	-	-	3.6	0.5	0.4	-	-	0.6	0.5
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	1.7	0.2
White Crappie	1.1	-	1.1	1.5	5.9	-	5.6	1.1	2.3	2.1
Black Crappie	-	-	-	-	-	0.4	0.9	0.5	2.9	0.5
Sauger	-	-	-	-	-	-	-	2.1	2.3	0.5
Freshwater Drum	8.2	3.4	8.6	5.8	4.9	0.8	7.9	10.7	6.4	6.0
Total Fish	105.0	130.0	42.0	65.0	323.0	64.0	126.0	117.0	174.0	1146.0
Fish/1000 m	57.5	62.7	44.9	47.3	159.5	26.7	58.6	62.6	101.2	70.0
Elec. Eft. (meters)	1825.0	2075.0	935.0	1375.0	2025.0	2400.0	2150.0	1870.0	1720.0	16375.0

Table A4-4. Electrofishing summary for the year 1980. The distribution of each species across sites is shown as a percentage of the total number of that species caught (per 1000 meters).

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		(%)
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	71.0	16.1	13.0	-	-	-	100.0
Shortnose Gar	19.6	33.9	-	-	8.9	7.1	-	19.6	10.7	100.0
Gizzard Shad	2.9	9.3	1.9	1.0	46.0	6.2	10.6	5.1	16.8	100.0
Skipjack Herring	-	-	-	-	-	-	-	-	100.0	100.0
Goldeye	12.8	-	-	17.9	12.8	-	12.8	12.8	30.8	100.0
Common Carp	23.8	10.4	11.7	14.8	2.3	0.6	4.4	14.9	17.1	100.0
Blue Sucker	50.0	50.0	-	-	-	-	-	-	-	100.0
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	45.5	54.5	100.0
Shorthead Redhorse	-	-	64.7	-	-	-	-	-	35.3	100.0
River Carpsucker	13.3	16.0	14.6	13.4	11.6	2.4	7.7	13.5	7.4	100.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	27.3	7.2	7.9	-	7.2	5.8	-	15.1	29.5	100.0
Flathead Catfish	9.6	13.8	18.8	23.0	-	2.8	1.8	7.2	22.7	100.0
White Bass	10.2	13.5	-	-	16.3	7.9	13.0	17.2	21.9	100.0
Green Sunfish	-	-	-	41.2	-	23.5	-	-	35.3	100.0
Bluegill Sunfish	-	-	-	70.6	9.8	7.8	-	-	11.8	100.0
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	100.0	100.0
White Crappie	5.9	-	5.9	8.1	31.7	-	30.1	5.9	12.4	100.0
Black Crappie	-	-	-	-	-	8.5	19.1	10.6	61.7	100.0
Sauger	-	-	-	-	-	-	-	47.7	52.3	100.0
Freshwater Drum	14.5	6.0	15.2	10.2	8.6	1.4	13.9	18.9	11.3	100.0
Total Fish	105.0	130.0	42.0	65.0	323.0	64.0	126.0	117.0	174.0	1146.0
Fish/1000 m	9.3	10.1	7.2	7.6	25.7	4.3	9.4	10.1	16.3	100.0
Elec. Eft. (meters)	1825.0	2075.0	935.0	1375.0	2025.0	2400.0	2150.0	1870.0	1720.0	16375.0

Table A4-5. Electrofishing summary for the year 1980. Relative species composition at each site is shown as a percentage of all fish caught (per 1000 meters) at that site.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	4.7	0.3	1.5	-	-	-	0.4
Shortnose Gar	1.9	3.0	-	-	0.3	1.5	-	1.8	0.6	1.0
Gizzard Shad	14.3	41.5	11.8	6.1	80.8	65.5	50.9	23.0	46.5	48.3
Skipjack Herring	-	-	-	-	-	-	-	-	0.6	0.1
Goldeye	0.9	-	-	1.5	0.3	-	0.9	0.8	1.2	0.6
Common Carp	26.6	10.7	16.7	20.1	0.9	1.5	4.8	15.3	10.9	9.6
Blue Sucker	0.9	0.8	-	-	-	-	-	-	-	0.1
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	0.8	0.6	0.1
Shorthead Redhorse	-	-	2.4	-	-	-	-	-	0.6	0.1
River Carpsucker	23.8	26.7	33.4	29.2	7.5	9.4	13.5	22.2	7.5	15.6
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	6.6	1.6	2.4	-	0.6	3.0	-	3.4	4.1	2.1
Flathead Catfish	4.7	6.2	11.8	13.7	-	3.0	0.9	3.4	6.3	3.9
White Bass	3.8	4.6	-	-	2.2	6.4	4.8	6.0	4.6	3.7
Green Sunfish	-	-	-	1.5	-	1.5	-	-	0.6	0.3
Bluegill Sunfish	-	-	-	7.6	0.3	1.5	-	-	0.6	0.7
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	1.7	0.3
White Crappie	1.9	-	2.4	3.2	3.7	-	9.6	1.8	2.3	3.0
Black Crappie	-	-	-	-	-	1.5	1.5	0.8	2.9	0.7
Sauger	-	-	-	-	-	-	-	3.4	2.3	0.7
Freshwater Drum	14.3	5.4	19.2	12.3	3.1	3.0	13.5	17.1	6.3	8.6
Total Fish	105.0	130.0	42.0	65.0	323.0	64.0	126.0	117.0	174.0	1146.0
Fish/1000 m (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Elec. Eft. (meters)	1825.0	2075.	935.0	1375.0	2025.0	2400.0	2150.0	1870.0	1720.0	16375.0

Table A4-6. Electrofishing summary for the year 1981. Numerals indicate numbers of fish caught using this method.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	1.0	-	-	2.0	1.0	-	-	-	4.0
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	3.0	4.0	5.0	18.0	18.0	14.0	21.0	12.0	18.0	113.0
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	1.0	-	-	-	1.0	-	3.0	1.0	9.0	15.0
Common Carp	2.0	6.0	-	-	4.0	11.0	4.0	8.0	13.0	48.0
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	1.0	-	1.0	-	1.0	3.0
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	2.0	1.0	1.0	6.0	5.0	14.0	29.0
River Carpsucker	274.0	43.0	19.0	29.0	26.0	23.0	24.0	33.0	50.0	521.0
Black Bullhead	1.0	2.0	-	-	-	-	1.0	-	-	4.0
Channel Catfish	94.0	67.0	11.0	12.0	7.0	3.0	2.0	5.0	24.0	225.0
Flathead Catfish	-	-	1.0	3.0	-	-	2.0	4.0	15.0	25.0
White Bass	-	-	-	2.0	-	2.0	8.0	2.0	4.0	18.0
Green Sunfish	-	1.0	-	1.0	-	-	1.0	-	6.0	9.0
Bluegill Sunfish	2.0	1.0	-	5.0	1.0	4.0	-	1.0	9.0	23.0
O.-spotted Sunfish	-	-	-	-	-	2.0	-	-	-	2.0
Longear Sunfish	-	-	-	-	-	-	-	1.0	-	1.0
Largemouth Bass	-	-	-	2.0	-	-	-	-	-	2.0
White Crappie	-	-	-	3.0	5.0	1.0	3.0	1.0	8.0	21.0
Black Crappie	-	-	-	-	-	-	-	1.0	2.0	3.0
Sauger	-	-	-	-	-	-	-	-	1.0	1.0
Freshwater Drum	14.0	19.0	10.0	10.0	14.0	6.0	39.0	78.0	44.0	234.0
Total Fish	391.0	144.0	46.0	87.0	80.0	68.0	115.0	152.0	218.0	1301.0
Fish/1000 m	295.1	104.7	102.2	267.7	64.0	53.3	85.2	168.9	436.0	148.7
Elec. Eft. (meters)	1325.0	1375.0	450.0	325.0	1250.0	1275.0	1350.0	900.0	500.0	8750.0

Table A4-7. Electrofishing summary for the year 1981. Numerals indicate numbers of fish caught per 1000 meters of electrofishing effort.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	0.7	-	-	1.6	0.8	-	-	-	0.5
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	2.3	2.9	11.1	55.4	14.4	11.0	15.6	13.3	36.0	12.9
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	0.8	-	-	-	0.8	-	2.2	1.1	18.0	1.7
Common Carp	1.5	4.4	-	-	3.2	8.6	3.0	8.9	26.0	5.5
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	0.8	-	0.7	-	2.0	0.3
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	6.2	0.8	0.8	4.4	5.6	28.0	3.3
River Carpsucker	206.8	31.3	42.2	89.2	20.8	18.0	17.8	36.7	100.0	59.5
Black Bullhead	0.8	1.5	-	-	-	-	0.7	-	-	0.5
Channel Catfish	70.9	48.7	24.4	36.9	5.6	2.4	1.5	5.6	48.0	25.7
Flathead Catfish	-	-	2.2	9.2	-	-	1.5	4.4	30.0	2.9
White Bass	-	-	-	6.2	-	1.6	5.9	2.2	8.0	2.1
Green Sunfish	-	0.7	-	3.1	-	-	1.5	-	12.0	1.0
Bluegill Sunfish	1.5	0.7	-	15.4	0.8	3.1	-	1.1	18.0	2.6
O.-spotted Sunfish	-	-	-	-	-	1.6	-	-	-	0.2
Longear Sunfish	-	-	-	-	-	-	-	1.1	-	0.1
Largemouth Bass	-	-	-	6.2	-	-	-	-	-	0.2
White Crappie	-	-	-	9.2	4.0	0.8	2.2	1.1	16.0	2.4
Black Crappie	-	-	-	-	-	-	-	1.1	4.0	0.3
Sauger	-	-	-	-	-	-	-	-	2.0	0.1
Freshwater Drum	10.6	13.8	22.2	30.8	11.2	4.7	28.9	86.7	88.0	26.7
Total Fish	391.0	144.0	46.0	87.0	80.0	68.0	115.0	152.0	218.0	1301.0
Fish/1000 m	295.1	104.7	102.2	267.7	64.0	53.3	85.2	168.9	436.0	148.7
Elec. Eft. (meters)	1325.0	1375.0	450.0	325.0	1250.0	1275.0	1350.0	900.0	500.0	8750.0

Table A4-8. Electrofishing summary for the year 1981. The distribution of each species across sites is shown as a percentage of the total number of that species caught (per 1000 meters).

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		(%)
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	22.6	-	-	51.6	25.8	-	-	-	100.0
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	1.4	1.8	6.9	34.2	8.9	6.8	9.6	8.2	22.2	100.0
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	3.5	-	-	-	3.5	-	9.6	4.8	78.6	100.0
Common Carp	2.7	7.9	-	-	5.8	15.5	5.4	16.0	46.8	100.0
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	22.9	-	20.0	-	57.1	100.0
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	13.5	1.7	1.7	9.6	12.2	61.1	100.0
River Carpsucker	36.7	5.6	7.5	15.8	3.7	3.2	3.2	6.5	17.8	100.0
Black Bullhead	26.7	50.0	-	-	-	-	23.3	-	-	100.0
Channel Catfish	29.1	20.0	10.0	15.1	2.3	1.0	0.6	2.3	19.7	100.0
Flathead Catfish	-	-	4.7	19.5	-	-	3.2	9.3	63.4	100.0
White Bass	-	-	-	25.9	-	6.7	24.7	9.2	33.5	100.0
Green Sunfish	-	4.0	-	17.9	-	-	8.7	-	69.4	100.0
Bluegill Sunfish	3.7	1.7	-	37.9	2.0	7.6	-	2.7	44.3	100.0
O.-spotted Sunfish	-	-	-	-	-	100.0	-	-	-	100.0
Longear Sunfish	-	-	-	-	-	-	-	100.0	-	100.0
Largemouth Bass	-	-	-	100.0	-	-	-	-	-	100.0
White Crappie	-	-	-	27.6	12.0	2.4	6.6	3.3	48.0	100.0
Black Crappie	-	-	-	-	-	-	-	21.6	78.4	100.0
Sauger	-	-	-	-	-	-	-	-	100.0	100.0
Freshwater Drum	3.6	4.6	7.5	10.4	3.8	1.6	9.7	29.2	29.6	100.0
Total Fish	391.0	144.0	46.0	87.0	80.0	68.0	115.0	152.0	218.0	1301.0
Fish/1000 m	18.7	6.6	6.5	17.0	4.1	3.4	5.4	10.7	27.6	100.0
Elec. Eft. (meters)	1325.0	1375.0	450.0	325.0	1250.0	1275.0	1350.0	900.0	500.0	8750.0

Table A4-9. Electrofishing summary for the year 1981. Relative species composition at each site is shown as a percentage of all fish caught (per 1000 meters) at that site.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	0.7	-	-	2.5	1.5	-	-	-	0.3
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	0.8	2.8	10.9	20.7	22.5	20.6	18.3	7.9	8.3	8.7
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	0.3	-	-	-	1.3	-	2.6	0.7	4.1	1.1
Common Carp	0.5	4.2	-	-	5.0	16.1	3.5	5.3	6.0	3.7
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	1.3	-	0.8	-	0.5	0.2
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	2.3	1.3	1.5	5.2	3.3	6.4	2.2
River Carpsucker	70.1	29.9	41.3	33.3	32.5	33.8	20.9	21.7	22.9	40.0
Black Bullhead	0.3	1.4	-	-	-	-	0.8	-	-	0.3
Channel Catfish	24.0	46.5	23.9	13.8	8.8	4.5	1.8	3.3	11.0	17.3
Flathead Catfish	-	-	2.2	3.4	-	-	1.8	2.6	6.9	2.0
White Bass	-	-	-	2.3	-	3.0	6.9	1.3	1.8	1.4
Green Sunfish	-	0.7	-	1.2	-	-	1.8	-	2.8	0.7
Bluegill Sunfish	0.5	0.7	-	5.8	1.3	5.8	-	0.7	4.1	1.7
O.-spotted Sunfish	-	-	-	-	-	3.0	-	-	-	0.1
Longear Sunfish	-	-	-	-	-	-	-	0.7	-	<0.1
Largemouth Bass	-	-	-	2.3	-	-	-	-	-	0.1
White Crappie	-	-	-	3.4	6.3	1.5	2.6	0.7	3.7	1.6
Black Crappie	-	-	-	-	-	-	-	0.7	0.9	0.2
Sauger	-	-	-	-	-	-	-	-	0.5	<0.1
Freshwater Drum	3.6	13.2	21.7	11.5	17.5	8.8	33.9	51.3	20.2	18.0
Total Fish	391.0	144.0	46.0	87.0	80.0	68.0	115.0	152.0	218.0	1301.0
Fish/1000 m (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Elec. Eft. (meters)	1325.0	1375.0	450.0	325.0	1250.0	1275.0	1350.0	900.0	500.0	8570.0

Table A4-10. Electrofishing seasonal summary for May through October 1980-81. Numerals indicate numbers of fish caught using this method.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	1.0	-	1.0	3.0	2.0	-	-	-	7.0
Shortnose Gar	2.0	4.0	-	-	1.0	1.0	-	2.0	1.0	11.0
Gizzard Shad	18.0	58.0	9.0	22.0	102.0	54.0	71.0	39.0	99.0	472.0
Skipjack Herring	-	-	-	-	-	-	-	-	1.0	1.0
Goldeye	2.0	-	-	1.0	1.0	-	2.0	1.0	11.0	18.0
Common Carp	20.0	19.0	7.0	8.0	7.0	11.0	9.0	19.0	32.0	132.0
Blue Sucker	1.0	1.0	-	-	-	-	-	-	-	2.0
Bigmouth Buffalo	-	-	-	-	1.0	-	1.0	-	1.0	3.0
Smallmouth Buffalo	-	-	-	-	-	-	-	1.0	1.0	2.0
Shorthead Redhorse	-	-	1.0	2.0	1.0	1.0	6.0	5.0	15.0	31.0
River Carpsucker	298.0	76.0	31.0	48.0	46.0	23.0	34.0	57.0	63.0	676.0
Black Bullhead	1.0	2.0	-	-	-	-	1.0	-	-	4.0
Channel Catfish	101.0	69.0	12.0	12.0	9.0	5.0	2.0	9.0	31.0	250.0
Flathead Catfish	5.0	8.0	6.0	12.0	-	2.0	3.0	8.0	26.0	70.0
White Bass	4.0	6.0	-	2.0	3.0	6.0	12.0	8.0	12.0	53.0
Green Sunfish	-	1.0	-	1.0	-	1.0	1.0	-	7.0	11.0
Bluegill Sunfish	2.0	1.0	-	10.0	2.0	5.0	-	1.0	10.0	31.0
O.-spotted Sunfish	-	-	-	-	-	2.0	-	-	-	2.0
Longear Sunfish	-	-	-	-	-	[illegible]	-	1.0	-	1.0
Largemouth Bass	-	-	-	2.0	-	-	-	-	3.0	5.0
White Crappie	2.0	-	-	5.0	7.0	1.0	6.0	3.0	12.0	36.0
Black Crappie	-	-	-	-	-	1.0	1.0	2.0	7.0	11.0
Sauger	-	-	-	-	-	-	-	4.0	5.0	9.0
Freshwater Drum	27.0	26.0	18.0	15.0	24.0	8.0	49.0	98.0	55.0	320.0
Total Fish	483.0	272.0	84.0	141.0	207.0	123.0	198.0	258.0	392.0	2158.0
Fish/1000 m	175.6	93.0	77.4	117.5	86.3	43.5	80.8	114.7	176.6	107.3
Elec. Eft. (meters)	2750.0	2925.0	1085.0	1200.0	2400.0	2825.0	2450.0	2250.0	2220.0	20105.0

Table A4-11. Electrofishing seasonal summary for May through October 1980-81. Numerals indicate numbers of fish caught per 1000 meters of electrofishing effort.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	0.3	-	0.8	1.3	0.7	-	-	-	0.4
Shortnose Gar	0.7	1.4	-	-	0.4	0.4	-	0.9	0.5	0.5
Gizzard Shad	6.5	19.8	8.3	18.3	42.5	19.1	29.0	17.3	44.6	23.5
Skipjack Herring	-	-	-	-	-	-	-	-	0.5	0.1
Goldeye	0.7	-	-	0.8	0.4	-	0.8	0.4	5.0	0.9
Common Carp	7.3	6.5	6.5	6.7	2.9	3.9	3.7	8.4	14.4	6.6
Blue Sucker	0.4	0.3	-	-	-	-	-	-	-	0.1
Bigmouth Buffalo	-	-	-	-	0.4	-	0.4	-	0.5	0.1
Smallmouth Buffalo	-	-	-	-	-	-	-	0.4	0.5	0.1
Shorthead Redhorse	-	-	0.9	1.7	0.4	0.4	2.4	2.2	6.8	1.5
River Carpsucker	108.4	26.0	28.6	40.0	19.2	8.1	13.9	25.3	28.4	33.6
Black Bullhead	0.4	0.7	-	-	-	-	0.4	-	-	0.2
Channel Catfish	36.7	23.6	11.1	10.0	3.8	1.8	0.8	4.0	14.0	12.4
Flathead Catfish	1.8	2.7	5.5	10.0	-	0.7	1.2	3.6	11.7	3.5
White Bass	1.5	2.1	-	1.7	1.3	2.1	4.9	3.6	5.4	2.6
Green Sunfish	-	0.3	-	0.8	-	0.4	0.4	-	3.2	0.5
Bluegill Sunfish	0.7	0.3	-	8.3	0.8	1.8	-	0.4	4.5	1.5
O.-spotted Sunfish	-	-	-	-	-	0.7	-	-	-	0.1
Longear Sunfish	-	-	-	-	-	-	-	0.4	-	0.1
Largemouth Bass	-	-	-	1.7	-	-	-	-	1.4	0.2
White Crappie	0.7	-	-	4.2	2.9	0.4	2.4	1.3	5.4	1.8
Black Crappie	-	-	-	-	-	0.4	0.4	0.9	3.2	0.5
Sauger	-	-	-	-	-	-	-	1.8	2.3	0.4
Freshwater Drum	9.8	8.9	16.6	12.5	10.0	2.8	20.0	43.6	24.8	15.9
Total Fish	483.0	272.0	84.0	141.0	207.0	123.0	198.0	258.0	392.0	2158.0
Fish/1000 m	175.6	93.0	77.4	117.5	86.3	43.5	80.8	114.7	176.6	107.3
Elec. Eft. (meters)	2750.0	2925.0	1085.0	1200.0	2400.0	2825.0	2450.0	2250.0	2220.0	20105.0

Table A4-12. Electrofishing seasonal summary for May through October 1980-81. The distribution of each species across sites is shown as a percentage of the total number of that species caught (per 1000 meters).

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		(%)
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	9.7	-	25.8	41.9	22.6	-	-	-	100.0
Shortnose Gar	16.3	32.6	-	-	9.3	9.3	-	20.9	11.6	100.0
Gizzard Shad	3.2	9.6	4.0	8.9	20.7	9.3	14.1	8.4	21.7	100.0
Skipjack Herring	-	-	-	-	-	-	-	-	100.0	100.0
Goldeye	8.6	-	-	9.9	4.9	-	9.9	5.0	61.7	100.0
Common Carp	12.1	10.8	10.8	11.1	4.8	6.5	6.1	13.9	23.9	100.0
Blue Sucker	57.1	42.9	-	-	-	-	-	-	-	100.0
Bigmouth Buffalo	-	-	-	-	30.8	-	30.8	-	38.4	100.0
Smallmouth Buffalo	-	-	-	-	-	-	-	44.4	55.5	100.0
Shorthead Redhorse	-	-	6.1	11.5	2.7	2.7	16.2	14.9	45.9	100.0
River Carpsucker	36.4	8.7	9.6	13.4	6.4	2.7	4.7	8.5	9.5	100.0
Black Bullhead	26.7	46.6	-	-	-	-	26.7	-	-	100.0
Channel Catfish	34.7	22.3	10.5	9.5	3.6	1.7	0.8	3.8	13.2	100.0
Flathead Catfish	4.8	7.3	14.8	26.9	-	1.9	3.2	9.7	31.5	100.0
White Bass	6.7	9.3	-	7.5	5.8	9.3	21.7	15.9	23.9	100.0
Green Sunfish	-	5.9	-	15.7	-	7.8	7.8	-	62.7	100.0
Bluegill Sunfish	4.2	1.8	-	49.4	4.8	10.7	-	2.4	26.8	100.0
O.-spotted Sunfish	-	-	-	-	-	100.0	-	-	-	100.0
Longear Sunfish	-	-	-	-	-	-	-	100.0	-	100.0
Largemouth Bass	-	-	-	54.8	-	-	-	-	45.2	100.0
White Crappie	4.0	-	-	24.3	16.8	2.3	13.9	7.5	31.2	100.0
Black Crappie	-	-	-	-	-	8.2	8.2	18.4	65.3	100.0
Sauger	-	-	-	-	-	-	-	43.9	56.1	100.0
Freshwater Drum	6.6	6.0	11.1	8.4	6.7	1.9	13.4	29.3	16.6	100.0
Total Fish	483.0	272.0	84.0	141.0	207.0	123.0	198.0	258.0	392.0	2158.0
Fish/1000 m	18.2	9.6	8.0	12.2	8.9	4.5	8.4	11.9	18.3	100.0
Elec. Eft. (meters)	2750.0	2925.0	1085.0	1200.0	2400.0	2825.0	2450.0	2250.0	2220.0	20105.0

Table A4-13. Electrofishing seasonal summary for May through October 1980-81. Relative species composition at each site is shown as a percentage of all fish caught (per 1000 meters) at that site.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	0.3	-	0.7	1.5	1.6	-	-	-	0.4
Shortnose Gar	0.4	1.5	-	-	0.5	0.9	-	0.8	0.3	0.5
Gizzard Shad	3.7	21.3	10.7	15.6	49.2	43.9	35.9	15.1	25.3	21.9
Skipjack Herring	-	-	-	-	-	-	-	-	0.3	0.1
Goldeye	0.4	-	-	0.7	0.5	-	1.0	0.3	2.8	0.8
Common Carp	4.2	7.0	8.4	5.7	3.4	9.0	4.6	7.3	8.2	6.2
Blue Sucker	0.2	0.3	-	-	-	-	-	-	-	0.1
Bigmouth Buffalo	-	-	-	-	0.5	-	0.5	-	0.3	0.1
Smallmouth Buffalo	-	-	-	-	-	-	-	0.3	0.3	0.1
Shorthead Redhorse	-	-	1.2	1.4	0.5	0.9	3.0	1.9	3.9	1.4
River Carpsucker	61.7	28.0	37.0	34.0	22.2	18.6	17.2	22.1	16.1	31.3
Black Bullhead	0.2	0.8	-	-	-	-	0.5	-	-	0.2
Channel Catfish	20.9	25.4	14.3	8.5	4.4	4.1	1.0	3.5	7.9	11.6
Flathead Catfish	1.0	2.9	7.1	8.5	-	1.6	1.5	3.1	6.6	3.3
White Bass	0.9	2.3	-	1.4	1.5	4.8	6.1	3.1	3.1	2.4
Green Sunfish	-	0.3	-	0.7	-	0.9	0.5	-	1.8	0.5
Bluegill Sunfish	0.4	0.3	-	7.1	0.9	4.1	0	0.3	2.5	1.4
O.-spotted Sunfish	-	-	-	-	-	1.6	-	-	-	0.1
Longear Sunfish	-	-	-	-	-	-	-	0.3	-	0.1
Largemouth Bass	-	-	-	1.4	-	-	-	-	0.8	0.2
White Crappie	0.4	-	-	3.6	3.4	0.9	3.0	1.1	3.1	1.7
Black Crappie	-	-	-	-	-	0.9	0.5	0.8	1.8	0.5
Sauger	-	-	-	-	-	-	-	1.6	1.3	0.4
Freshwater Drum	5.6	9.6	21.4	10.6	11.6	6.4	24.8	38.0	14.0	14.8
Total Fish	483.0	272.0	84.0	141.0	207.0	123.0	198.0	258.0	392.0	2158.0
Fish/100 m (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Elec. Eft. (meters)	2750.0	2925.0	1085.0	1200.0	2400.0	2825.0	2450.0	2250.0	2220.0	20105.0

Table A4-14. Electrofishing seasonal summary for May through October 1980. Numerals indicate numbers of fish caught using this method.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	1.0	1.0	1.0	-	-	-	3.0
Shortnose Gar	2.0	4.0	-	-	1.0	1.0	-	2.0	1.0	11.0
Gizzard Shad	15.0	54.0	4.0	4.0	84.0	40.0	50.0	27.0	81.0	359.0
Skipjack Herring	-	-	-	-	-	-	-	-	1.0	1.0
Goldeye	1.0	-	-	1.0	-	-	1.0	-	2.0	5.0
Common Carp	18.0	14.0	7.0	8.0	3.0	-	5.0	11.0	19.0	85.0
Blue Sucker	1.0	1.0	-	-	-	-	-	-	-	2.0
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	1.0	1.0	2.0
Shorthead Redhorse	-	-	1.0	-	-	-	-	-	1.0	2.0
River Carpsucker	24.0	34.0	12.0	19.0	20.0	-	10.0	24.0	13.0	156.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	7.0	2.0	1.0	-	2.0	2.0	-	4.0	7.0	25.0
Flathead Catfish	5.0	8.0	5.0	9.0	-	2.0	1.0	4.0	11.0	45.0
White Bass	4.0	6.0	-	-	3.0	4.0	4.0	6.0	8.0	35.0
Green Sunfish	-	-	-	-	-	1.0	-	-	1.0	2.0
Bluegill Sunfish	-	-	-	5.0	1.0	1.0	-	-	1.0	8.0
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	3.0	3.0
White Crappie	2.0	-	-	2.0	2.0	-	3.0	2.0	4.0	15.0
Black Crappie	-	-	-	-	-	1.0	1.0	1.0	5.0	8.0
Sauger	-	-	-	-	-	-	-	4.0	4.0	8.0
Freshwater Drum	13.0	7.0	8.0	5.0	10.0	2.0	10.0	20.0	11.0	86.0
Total Fish	92.0	130.0	38.0	54.0	127.0	55.0	85.0	106.0	174.0	861.0
Fish/1000 m	64.6	74.3	59.8	61.7	110.4	35.5	58.6	78.5	101.2	72.3
Elec. Eft. (meters)	1425.0	1750.0	635.0	875.0	1150.0	1550.0	1450.0	1350.0	1720.0	11905.0

Table A4-15. Electrofishing seasonal summary for May through October 1980. Numerals indicate numbers of fish caught per 1000 meters of electrofishing effort.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	1.1	0.9	0.6	-	-	-	0.3
Shortnose Gar	1.4	2.3	-	-	0.9	0.6	-	1.5	0.6	0.9
Gizzard Shad	10.5	30.9	6.3	4.6	73.0	25.8	34.5	20.0	47.1	30.2
Skipjack Herring	-	-	-	-	-	-	-	-	0.6	0.1
Goldeye	0.7	-	-	1.1	-	-	0.7	-	1.2	0.4
Common Carp	12.6	8.0	11.0	9.1	2.6	-	3.4	8.1	11.0	7.1
Blue Sucker	0.7	0.6	-	-	-	-	-	-	-	0.2
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	0.7	0.6	0.2
Shorthead Redhorse	-	-	1.6	-	-	-	-	-	0.6	0.2
River Carpsucker	16.8	19.4	18.9	21.7	17.4	-	6.9	17.8	7.6	13.1
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	4.9	1.1	1.6	-	1.7	1.3	-	3.0	4.1	2.1
Flathead Catfish	3.5	4.6	7.9	10.3	-	1.3	0.7	3.0	6.4	3.8
White Bass	2.8	3.4	-	-	2.6	2.6	2.8	4.4	4.7	2.9
Green Sunfish	-	-	-	-	-	0.6	-	-	0.6	0.2
Bluegill Sunfish	-	-	-	5.7	0.9	0.6	-	-	0.6	0.7
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	1.7	0.3
White Crappie	1.4	-	-	2.3	1.7	-	2.1	1.5	2.3	1.3
Black Crappie	-	-	-	-	-	0.6	0.7	0.7	2.9	0.7
Sauger	-	-	-	-	-	-	-	3.0	2.3	0.7
Freshwater Drum	9.1	4.0	12.6	5.7	8.7	1.3	6.9	14.8	6.4	7.2
Total Fish	92.0	130.0	38.0	54.0	127.0	55.0	85.0	106.0	174.0	861.0
Fish/1000 m	64.6	74.3	59.8	61.7	110.4	35.5	58.6	78.5	101.2	72.3
Elec. Eft. (meters)	1425.0	1750.0	635.0	875.0	1150.0	1550.0	1450.0	1350.0	1720.0	11905.0

Table A4-16. Electrofishing seasonal summary for May through October 1980. The distribution of each species across sites is shown as a percentage of the total number of that species caught (per 1000 meters).

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		(%)
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	42.3	34.6	23.1	-	-	-	100.0
Shortnose Gar	19.2	31.5	-	-	12.3	8.2	-	20.5	8.2	100.0
Gizzard Shad	4.2	12.2	2.5	1.8	28.9	10.2	13.7	7.9	18.6	100.0
Skipjack Herring	-	-	-	-	-	-	-	-	100.0	100.0
Goldeye	18.9	-	-	29.7	-	-	18.9	-	32.4	100.0
Common Carp	19.1	12.2	16.7	13.8	4.0	0.0	5.2	12.3	16.7	100.0
Blue Sucker	53.8	46.2	-	-	-	-	-	-	-	100.0
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	53.8	46.2	100.0
Shorthead Redhorse	-	-	72.7	-	-	-	-	-	27.3	100.0
River Carpsucker	13.3	15.3	14.9	17.2	13.8	-	5.5	14.1	6.0	100.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	27.7	6.2	9.0	-	9.6	7.3	-	16.9	23.2	100.0
Flathead Catfish	9.3	12.2	21.0	27.3	-	3.4	1.9	8.0	17.0	100.0
White Bass	12.0	14.6	-	-	11.2	11.2	12.0	18.9	20.2	100.0
Green Sunfish	-	-	-	-	-	50.0	-	-	50.0	100.0
Bluegill Sunfish	-	-	73.1	11.5	7.7	-	-	-	7.7	100.0
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	100.0	100.0
White Crappie	12.4	-	-	20.4	15.0	-	18.6	13.3	20.4	100.0
Black Crappie	-	-	-	-	-	12.2	14.3	14.3	59.2	100.0
Sauger	-	-	-	-	-	-	-	56.6	43.4	100.0
Freshwater Drum	13.1	5.8	18.1	8.2	12.5	1.9	9.9	21.3	9.2	100.0
Total Fish	92.0	130.0	38.8	54.0	127.0	55.0	85.0	106.0	174.0	861.0
Fish/1000 m	10.0	11.5	9.3	9.6	17.1	5.5	9.1	12.2	15.7	100.0
Elec. Eft. (meters)	1425.0	1750.0	635.0	875.0	1150.0	1550.0	1450.0	1350.0	1720.0	11905.0

Table A4-17. Electrofishing seasonal summary for May through October 1980. Relative species composition at each site is shown as a percentage of all fish caught (per 1000 meters) at that site.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	1.8	0.8	1.7	-	-	-	0.4
Shortnose Gar	2.2	3.1	-	-	0.8	1.7	0	1.9	0.6	1.2
Gizzard Shad	16.3	41.6	10.5	7.5	66.1	72.7	58.9	25.5	46.5	41.8
Skipjack Herring	-	-	-	-	-	-	-	-	0.6	0.1
Goldeye	1.1	-	-	1.8	-	-	1.2	-	1.2	0.6
Common Carp	19.5	10.8	18.4	14.7	2.4	-	5.8	10.3	10.9	9.8
Blue Sucker	1.1	0.8	-	-	-	-	-	-	-	0.3
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	0.9	0.6	0.3
Shorthead Redhorse	-	-	2.7	-	-	-	-	-	0.6	0.3
River Carpsucker	26.0	26.1	31.6	35.2	15.8	0	11.8	22.7	7.5	18.1
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	7.6	1.5	2.7	-	1.5	3.7	-	3.8	4.1	2.9
Flathead Catfish	5.4	6.2	13.2	16.7	-	3.7	1.2	3.8	6.3	5.3
White Bass	4.3	4.6	-	-	2.4	7.3	4.8	5.6	4.6	4.0
Green Sunfish	-	-	-	-	-	1.7	-	-	0.6	0.3
Bluegill Sunfish	-	-	-	9.2	0.8	1.7	-	-	0.6	1.0
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	1.7	0.4
White Crappie	2.2	0	0	3.7	1.5	-	3.6	1.9	2.3	1.8
Black Crappie	-	-	-	-	-	1.7	1.2	0.9	2.9	1.0
Sauger	-	-	-	-	-	-	-	3.8	2.3	1.0
Freshwater Drum	14.1	5.4	21.1	9.2	7.9	3.7	11.8	18.9	6.3	10.0
Total Fish	92.0	130.0	38.0	54.0	127.0	55.0	85.0	106.0	174.0	861.0
Fish/1000 m (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Elec. Eft. (meters)	1425.0	1750.0	635.0	875.0	1150.0	1550.0	1450.0	1350.0	1720.0	11905.0

Table A4-18. Electrofishing seasonal summary for May through October 1981. Numerals indicate numbers of fish caught using this method.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	1.0	-	-	2.0	1.0	-	-	-	4.0
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	3.0	4.0	5.0	18.0	18.0	14.0	21.0	12.0	18.0	113.0
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	1.0	-	-	-	1.0	-	1.0	1.0	9.0	13.0
Common Carp	2.0	5.0	-	-	4.0	11.0	4.0	8.0	13.0	47.0
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	1.0	-	1.0	-	1.0	3.0
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	2.0	1.0	1.0	6.0	5.0	14.0	29.0
River Carpsucker	274.0	42.0	19.0	29.0	26.0	23.0	24.0	33.0	50.0	520.0
Black Bullhead	1.0	2.0	-	-	-	-	1.0	-	-	4.0
Channel Catfish	94.0	67.0	11.0	12.0	7.0	3.0	2.0	5.0	24.0	225.0
Flathead Catfish	-	-	1.0	3.0	-	-	2.0	4.0	15.0	25.0
White Bass	-	-	-	2.0	-	2.0	8.0	2.0	4.0	18.0
Green Sunfish	-	1.0	-	1.0	-	-	1.0	-	6.0	9.0
Bluegill Sunfish	2.0	1.0	-	5.0	1.0	4.0	-	1.0	9.0	23.0
O.-spotted Sunfish	-	-	-	-	-	2.0	-	-	-	2.0
Longear Sunfish	-	-	-	-	-	-	-	1.0	-	1.0
Largemouth Bass	-	-	-	2.0	-	-	-	-	-	2.0
White Crappie	-	-	-	3.0	5.0	1.0	3.0	1.0	8.0	21.0
Black Crappie	-	-	-	-	-	-	-	1.0	2.0	3.0
Sauger	-	-	-	-	-	-	-	-	1.0	1.0
Freshwater Drum	14.0	19.0	10.0	10.0	14.0	6.0	39.0	78.0	44.0	234.0
Total Fish	391.0	142.0	46.0	87.0	80.0	68.0	113.0	152.0	218.0	1297.0
Fish/1000 m	295.1	120.9	102.2	267.7	64.0	53.3	113.0	168.9	436.0	158.2
Elec. Eft. (meters)	1325.0	1175.0	450.0	325.0	1250.0	1275.0	1000.0	900.0	500.0	8200.0

Table A4-19. Electrofishing seasonal summary for May through October 1981. Numerals indicate numbers of fish caught per 1000 meters of electrofishing effort.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	0.9	-	-	1.6	0.8	-	-	-	0.5
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	2.3	3.4	11.1	55.4	14.4	11.0	21.0	13.3	36.0	13.8
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	0.8	-	-	-	0.8	-	1.0	1.1	18.0	1.6
Common Carp	1.5	4.3	-	-	3.2	8.6	4.0	8.9	26.0	5.7
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	0.8	-	1.0	-	2.0	0.4
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	6.2	0.8	0.8	6.0	5.6	28.0	3.5
River Carpsucker	206.8	35.7	42.2	89.2	20.8	18.0	24.0	36.7	100.0	63.4
Black Bullhead	0.8	1.7	-	-	-	-	1.0	-	-	0.5
Channel Catfish	70.9	57.0	24.4	36.9	5.6	2.4	2.0	5.6	48.0	27.4
Flathead Catfish	-	-	2.2	9.2	-	-	2.0	4.4	30.0	3.0
White Bass	-	-	-	6.2	-	1.6	8.0	2.2	8.0	2.2
Green Sunfish	-	0.9	-	3.1	-	-	1.0	-	12.0	1.1
Bluegill Sunfish	1.5	0.9	-	15.4	0.8	3.1	-	1.1	18.0	2.8
O.-spotted Sunfish	-	-	-	-	-	1.6	-	-	-	0.2
Longear Sunfish	-	-	-	-	-	-	-	1.1	-	0.1
Largemouth Bass	-	-	-	6.2	-	-	-	-	-	0.2
White Crappie	-	-	-	9.2	4.0	0.8	3.0	1.1	16.0	2.6
Black Crappie	-	-	-	-	-	-	-	1.1	4.0	0.4
Sauger	-	-	-	-	-	-	-	-	2.0	0.1
Freshwater Drum	10.6	16.2	22.2	30.8	11.2	4.7	39.0	86.7	88.0	28.5
Total Fish	391.0	142.0	46.0	87.0	80.0	68.0	113.0	152.0	218.0	1297.0
Fish/1000 m	295.1	120.9	102.2	267.7	64.0	53.3	113.0	168.9	436.0	158.2
Elec. Eft. (meters)	1325.0	1175.0	450.0	325.0	1250.0	1275.0	1000.0	900.0	500.0	8200.0

Table A4-20. Electrofishing seasonal summary for May through October 1981. The distribution of each species across sites is shown as a percentage of the total number of that species caught (per 1000 meters).

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		(%)
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	27.3	-	-	48.5	24.2	-	-	-	100.0
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	1.4	2.0	6.6	33.0	8.6	6.6	12.5	7.9	21.4	100.0
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	3.7	-	-	-	3.7	-	4.6	5.1	82.9	100.0
Common Carp	2.7	7.6	-	-	5.7	15.2	7.1	15.8	46.0	100.0
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	21.1	-	26.3	-	52.6	100.0
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	13.1	1.7	1.7	12.7	11.8	59.1	100.0
River Carpsucker	36.1	6.2	7.4	15.6	3.6	3.1	4.2	6.4	17.4	100.0
Black Bullhead	22.9	48.6	-	-	-	-	28.6	-	-	100.0
Channel Catfish	28.0	22.5	9.7	14.6	2.2	0.9	0.8	2.2	19.0	100.0
Flathead Catfish	-	-	4.6	19.2	-	-	4.2	9.2	62.8	100.0
White Bass	-	-	-	23.8	-	6.2	30.8	8.5	30.8	100.0
Green Sunfish	-	5.3	-	18.2	-	-	5.9	-	70.6	100.0
Bluegill Sunfish	3.7	2.2	-	37.8	2.0	7.6	-	2.7	44.1	100.0
O.-spotted Sunfish	-	-	-	-	-	100.0	-	-	-	100.0
Longear Sunfish	-	-	-	-	-	-	-	100.0	-	100.0
Largemouth Bass	-	-	-	100.0	-	-	-	-	-	100.0
White Crappie	-	-	-	27.0	11.7	2.3	8.8	3.2	46.9	100.0
Black Crappie	-	-	-	-	-	-	-	21.6	78.4	100.0
Sauger	-	-	-	-	-	-	-	-	100.0	100.0
Freshwater Drum	3.4	5.2	7.2	10.0	3.6	1.5	12.6	28.0	28.4	100.0
Total Fish	391.0	142.0	46.0	87.0	80.0	68.0	113.0	152.0	218.0	1297.0
Fish/1000 m	18.2	7.5	6.3	16.5	3.9	3.3	7.0	10.4	26.9	100.0
Elec. Eft. (meters)	1325.0	1175.0	450.0	325.0	1250.0	1275.0	1000.0	900.0	500.0	8200.0

Table A4-21. Electrofishing seasonal summary for May through October 1981. Relative species composition at each site is shown as a percentage of all fish caught (per 1000 meters) at that site.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	0.7	-	-	2.5	1.5	-	-	-	0.3
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	0.8	2.8	10.9	20.7	22.5	20.6	18.6	7.9	8.3	8.7
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	0.3	-	-	-	1.3	-	0.9	0.7	4.1	1.0
Common Carp	0.5	3.6	-	-	5.0	16.1	3.5	5.3	6.0	3.6
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	1.3	-	0.9	-	0.5	0.3
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	2.3	1.3	1.5	5.3	3.3	6.4	2.2
River Carpsucker	70.1	29.5	41.3	33.3	32.5	33.8	21.2	21.7	22.9	40.1
Black Bullhead	0.3	1.4	-	-	-	-	0.9	-	-	0.3
Channel Catfish	24.0	47.1	23.9	13.8	8.8	4.5	1.8	3.3	11.0	17.3
Flathead Catfish	-	-	2.2	3.4	-	-	1.8	2.6	6.9	1.9
White Bass	-	-	-	2.3	-	3.0	7.1	1.3	1.8	1.4
Green Sunfish	-	0.7	-	1.2	-	-	0.9	-	2.8	0.7
Bluegill Sunfish	0.5	0.7	-	5.8	1.3	5.8	-	0.7	4.1	1.8
O.-spotted Sunfish	-	-	-	-	-	3.0	-	-	-	0.1
Longear Sunfish	-	-	-	-	-	-	-	0.7	-	0.1
Largemouth Bass	-	-	-	2.3	-	-	-	-	-	0.1
White Crappie	-	-	-	3.4	6.3	1.5	2.7	0.7	3.7	1.6
Black Crappie	-	-	-	-	-	-	-	0.7	0.9	0.3
Sauger	-	-	-	-	-	-	-	-	0.5	0.1
Freshwater Drum	3.6	13.4	21.7	11.5	17.5	8.8	34.5	51.3	20.2	18.0
Total Fish	391.0	142.0	46.0	87.0	80.0	68.0	113.0	152.0	218.0	1297.0
Fish/1000 m (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Elec. Eft. (meters)	1325.0	1175.0	450.0	325.0	1250.0	1275.0	1000.0	900.0	500.0	8200.0

Table A4-22. Electrofishing seasonal summary for November through April 1980-81. Numerals indicate numbers of fish caught using this method.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	2.0	-	-	-	-	-	2.0
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	1.0	-	177.0	2.0	14.0	-	-	194.0
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	1.0	-	2.0	1.0	-	4.0
Common Carp	10.0	1.0	-	5.0	-	1.0	1.0	7.0	-	25.0
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	1.0	1.0	2.0	-	4.0	6.0	7.0	2.0	-	23.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-	-	-
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	4.0	-	2.0	1.0	-	7.0
Green Sunfish	-	-	-	1.0	-	-	-	-	-	1.0
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	1.0	-	10.0	-	9.0	-	-	20.0
Black Crappie	-	-	-	-	-	-	1.0	-	-	1.0
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	2.0	-	-	3.0	-	-	7.0	-	-	12.0
Total Fish	13.0	2.0	4.0	11.0	196.0	9.0	43.0	11.0	-	289.0
Fish/1000 m	32.5	3.8	13.3	22.0	224.0	10.6	41.0	21.2	-	57.6
Elec. Eft. (meters)	400.0	525.0	300.0	500.0	875.0	850.0	1050.0	520.0	-	5020.0

Table A4-23. Electrofishing seasonal summary for November through April 1980-81. Numerals indicate numbers of fish caught per 1000 meters of electrofishing effort.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	4.0	-	-	-	-	-	0.4
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	3.3	-	202.3	2.4	13.3	-	-	38.6
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	1.1	-	1.9	1.9	-	0.8
Common Carp	25.0	1.9	-	10.0	-	1.2	1.0	13.5	-	5.0
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	2.5	1.9	6.7	-	4.6	7.1	6.7	3.8	-	4.6
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-	-	-
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	4.6	-	1.9	1.9	-	1.4
Green Sunfish	-	-	-	2.0	-	-	-	-	-	0.2
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	3.3	-	11.4	-	8.6	-	-	4.0
Black Crappie	-	-	-	-	-	-	1.0	-	-	0.2
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	5.0	-	-	6.0	-	-	6.7	-	-	2.4
Total Fish	13.0	2.0	4.0	11.0	196.0	9.0	43.0	11.0	-	289.0
Fish/1000 m	32.5	3.8	13.3	22.0	224.0	10.6	41.0	21.2	-	57.6
Elec. Eft. (meters)	400.0	525.0	300.0	500.0	875.0	850.0	1050.0	520.0	-	5020.0

Table A4-24. Electrofishing seasonal summary for November through April 1980-81. The distribution of each species across sites is shown as a percentage of the total number of that species caught (per 1000 meters).

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		(%)
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	100.0	-	-	-	-	-	100.0
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	1.5	-	91.4	1.1	6.0	-	-	100.0
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	22.4	-	38.8	38.8	-	100.0
Common Carp	47.5	3.6	-	19.0	-	2.3	1.9	25.7	-	100.0
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	7.5	5.7	20.1	-	13.8	21.3	20.1	11.4	-	100.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-	-	-
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	54.8	-	22.6	22.6	-	100.0
Green Sunfish	-	-	-	100.0	-	-	-	-	-	100.0
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	14.2	-	48.9	-	36.9	-	-	100.0
Black Crappie	-	-	-	-	-	-	100.0	-	-	100.0
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	28.2	-	-	33.9	-	-	37.9	-	-	100.0
Total Fish	13.0	2.0	4.0	11.0	196.0	9.0	43.0	11.0	-	289.0
Fish/1000 m	8.8	1.0	3.6	6.0	60.8	2.9	11.1	5.8	-	100.0
Elec. Eft. (meters)	400.0	525.0	300.0	500.0	875.0	850.0	1050.0	520.0	-	5020.0

Table A4-25. Electrofishing seasonal summary for November through April 1980-81. Relative species composition at each site is shown as a percentage of all fish caught (per 1000 meters) at that site.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	18.2	-	-	-	-	-	0.7
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	24.8	-	90.3	22.6	32.4	-	-	67.0
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	0.5	-	4.6	9.0	-	1.4
Common Carp	76.9	50.0	-	45.5	-	11.3	2.4	63.7	-	8.7
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	7.7	50.0	50.0	-	2.1	67.0	16.3	17.9	-	8.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-	-	-
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	2.1	-	4.6	9.0	-	2.4
Green Sunfish	-	-	-	9.1	-	-	-	-	-	0.3
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	24.8	-	5.1	-	21.0	-	-	6.9
Black Crappie	-	-	-	-	-	-	2.4	-	-	0.3
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	15.4	-	-	27.3	-	-	16.3	-	-	4.2
Total Fish	13.0	2.0	4.0	11.0	196.0	9.0	43.0	11.0	-	289.0
Fish/1000 m (%)	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	-	100.0
Elec. Eft. (meters)	400.0	525.0	300.0	500.0	875.0	850.0	1050.0	520.0	-	5020.0

Table A4-26. Electrofishing summary for July 1979. Numerals indicate numbers of fish caught using this method.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	1.0	-	-	1.0	-	-	2.0
Shortnose Gar	-	-	-	1.0	-	-	1.0	3.0	-	5.0
Gizzard Shad	-	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	-	-	-	-	-
Common Carp	-	-	-	2.0	-	1.0	-	3.0	-	6.0
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	-	-	-	4.0	2.0	2.0	-	5.0	-	13.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	2.0	-	1.0	-	-	3.0
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-	-	-	-
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	1.0	-	-	-	1.0
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	4.0	2.0	-	6.0	7.0	-	19.0
Total Fish	-	-	-	12.0	6.0	4.0	9.0	18.0	-	49.0
Fish/1000 m	-	-	-	60.0	30.0	20.0	90.0	81.8	-	53.3
Elec. Eft. (meters)	-	-	-	200.0	200.0	200.0	100.0	220.0	-	920.0

Table A4-27. Electrofishing summary for August 1979. Numerals indicate numbers of fish caught using this method.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	-	-	-	-	-
Common Carp	-	-	-	-	-	-	-	-	2.0	2.0
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	-	-	-	-	-	-	-	-	7.0	7.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-	-	-
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-	-	2.0	2.0
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	-	-	-	-	-
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	-	-	2.0	2.0
Total Fish	-	-	-	-	-	-	-	-	13.0	13.0
Fish/1000 m	-	-	-	-	-	-	-	-	13.0	13.0
Elec. Eft. (meters)	-	-	-	-	-	-	-	-	1000.0	1000.0

Table A4-28. Electrofishing summary for October 1979. Numerals indicate numbers of fish caught using this method.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	-	11.0	-	11.0
Skipjack Herring	-	-	-	-	-	-	-	1.0	-	1.0
Goldeye	-	-	-	-	-	-	-	1.0	-	1.0
Common Carp	-	-	-	-	-	-	-	6.0	-	6.0
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	-	-	-	-	-	-	-	4.0	-	4.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-	-	-
Flathead Catfish	-	-	-	-	-	-	-	1.0	-	1.0
White Bass	-	-	-	-	-	-	-	-	-	-
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	-	-	-	-	-
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	2.0	-	2.0
Freshwater Drum	-	-	-	-	-	-	-	-	-	-
Total Fish	-	-	-	-	-	-	-	26.0	-	26.0
Fish/1000 m	-	-	-	-	-	-	-	23.6	-	23.6
Elec. Eft. (meters)	-	-	-	-	-	-	-	1100.0	-	1100.0

Table A4-29. Electrofishing summary for December 1979. Numerals indicate numbers of fish caught using this method.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	1.0	-	1.0
Gizzard Shad	-	-	-	-	-	17.0	-	8.0	-	25.0
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	1.0	-	-	-	1.0
Common Carp	-	-	-	-	-	-	-	5.0	-	5.0
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	-	-	-	-	-	-	-	2.0	-	2.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-	-	-
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-	-	-	-
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	-	-	-	-	-
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	-	-	-	-
Total Fish	-	-	-	-	-	18.0	-	16.0	-	34.0
Fish/1000 m	-	-	-	-	-	-	-	22.9	-	-
Elec. Eft. (meters)	-	-	-	-	-	-	-	700.0	-	-

Table A4-30. Electrofishing summary for March 1980. Numerals indicate numbers of fish caught using this method.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	-	-	-	-	-
Common Carp	10.0	-	-	5.0	-	1.0	-	-	-	16.0
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	1.0	-	-	-	-	-	1.0	-	-	2.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-	-	-
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-	-	-	-
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	-	-	-	-	-
Black Crappie	-	-	-	-	-	-	1.0	-	-	1.0
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	3.0	-	-	-	-	-	3.0
Total Fish	11.0	0.0	0.0	8.0	0.0	1.0	2.0	0.0	-	22.0
Fish/1000 m	110.0	0.0	0.0	53.3	0.0	5.0	10.0	0.0	-	19.4
Elec. Eft. (meters)	100.0	125.0	100.0	150.0	100.0	200.0	200.0	160.0	-	1135.0

Table A4-31. Electrofishing summary for March 1980. Numerals indicate numbers of fish caught per 1000 meters of electrofishing effort.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	-	-	-	-	-
Common Carp	100.0	-	-	33.3	-	5.0	-	-	-	14.1
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	10.0	-	-	-	-	-	5.0	-	-	1.8
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-	-	-
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-	-	-	-
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	-	-	-	-	-
Black Crappie	-	-	-	-	-	-	5.0	-	-	0.9
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	20.0	-	-	-	-	-	2.6
Total Fish	11.0	0.0	0.0	8.0	0.0	1.0	2.0	0.0	-	22.0
Fish/1000 m	110.0	0.0	0.0	53.3	0.0	5.0	10.0	0.0	-	19.4
Elec. Eft. (meters)	100.0	125.0	100.0	150.0	100.0	200.0	200.0	160.0	-	1135.0

Table A4-32. Electrofishing summary for April 1980. Numerals indicate numbers of fish caught using this method.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	2.0	-	-	-	-	-	2.0
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	1.0	-	176.0	2.0	14.0	-	-	193.0
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	-	-	1.0	-	1.0
Common Carp	-	-	-	-	-	-	-	1.0	-	1.0
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	-	-	2.0	-	2.0	-	5.0	-	-	9.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-	-	-
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	4.0	-	1.0	-	-	5.0
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	1.0	-	10.0	-	9.0	-	-	20.0
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	2.0	-	-	-	-	-	7.0	-	-	9.0
Total Fish	2.0	0.0	4.0	2.0	192.0	2.0	36.0	2.0	-	240.0
Fish/1000 m	6.7	0.0	20.0	10.0	960.0	10.0	360.0	12.5	-	153.8
Elec. Eft. (meters)	300.0	200.0	200.0	200.0	200.0	200.0	100.0	160.0	-	1560.0

Table A4-33. Electrofishing summary for April 1980. Numerals indicate numbers of fish caught per 1000 meters of electrofishing effort.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	10.0	-	-	-	-	-	1.3
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	5.0	-	880.0	10.0	140.0	-	-	123.7
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	-	-	6.3	-	0.6
Common Carp	-	-	-	-	-	-	-	6.3	-	0.6
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	-	-	10.0	-	10.0	-	50.0	-	-	5.8
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-	-	-
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	20.0	-	10.0	-	-	3.2
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	5.0	-	50.0	-	90.0	-	-	12.8
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	6.7	-	-	-	-	-	70.0	-	-	5.8
Total Fish	2.0	0.0	4.0	2.0	192.0	2.0	36.0	2.0	-	240.0
Fish/1000 m	6.7	0.0	20.0	10.0	960.0	10.0	360.0	12.5	-	153.8
Elec. Eft. (meters)	300.0	200.0	200.0	200.0	200.0	200.0	100.0	160.0	-	1560.0

Table A4-34. Electrofishing summary for May 1980. Numerals indicate numbers of fish caught using this method.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	1.0	-	-	-	-	-	-	-	-	1.0
Gizzard Shad	-	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	-	-	-	-	-
Common Carp	-	2.0	-	1.0	2.0	-	-	-	-	5.0
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	1.0	-	1.0
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	3.0	1.0	1.0	-	1.0	-	-	9.0	-	15.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	2.0	-	-	2.0	-	-	1.0	-	5.0
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
White Bass	1.0	-	-	-	-	1.0	-	-	-	2.0
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	4.0	-	-	-	-	-	4.0
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	1.0	-	-	-	1.0	-	1.0	-	-	3.0
Black Crappie	-	-	-	-	-	1.0	-	-	-	1.0
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	1.0	-	-	-	-	-	-	-	-	1.0
Total Fish	7.0	5.0	1.0	5.0	6.0	2.0	1.0	11.0	-	38.0
Fish/1000 m	35.0	25.0	16.7	25.0	30.0	4.0	5.0	55.0	-	21.6
Elec. Eft. (meters)	200.0	200.0	60.0	200.0	200.0	500.0	200.0	200.0	-	1760.0

Table A4-35. Electrofishing summary for May 1980. Numerals indicate numbers of fish caught per 1000 meters of electrofishing effort.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	5.0	-	-	-	-	-	-	-	-	0.6
Gizzard Shad	-	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	-	-	-	-	-
Common Carp	-	10.0	-	5.0	10.0	-	-	-	-	2.8
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	0.5	-	0.6
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	15.0	5.0	16.7	-	5.0	-	-	45.0	-	8.5
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	10.0	-	-	10.0	-	-	5.0	-	2.8
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
White Bass	5.0	-	-	-	-	2.0	-	-	-	1.1
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	20.0	-	-	-	-	-	2.3
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	5.0	-	-	-	5.0	-	5.0	-	-	1.7
Black Crappie	-	-	-	-	-	2.0	-	-	-	0.6
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	5.0	-	-	-	-	-	-	-	-	0.6
Total Fish	7.0	5.0	1.0	5.0	6.0	2.0	1.0	11.0	-	38.0
Fish/1000 m	35.0	25.0	16.7	25.0	30.0	4.0	5.0	55.0	-	21.6
Elec. Eft. (meters)	200.0	200.0	60.0	200.0	200.0	500.0	200.0	200.0	-	1760.0

Table A4-36. Electrofishing summary for June 1980. Numerals indicate numbers of fish caught using this method.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	1.0	1.0	-	-	-	-	2.0
Shortnose Gar	1.0	4.0	-	-	1.0	-	-	-	-	6.0
Gizzard Shad	-	36.0	-	1.0	6.0	-	16.0	9.0	-	68.0
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	1.0	-	-	-	-	-	1.0
Common Carp	7.0	1.0	1.0	2.0	1.0	-	3.0	1.0	-	16.0
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	5.0	22.0	-	4.0	7.0	-	6.0	-	-	44.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	3.0	-	-	-	-	-	-	2.0	-	5.0
Flathead Catfish	4.0	-	-	-	-	-	-	-	-	4.0
White Bass	1.0	1.0	-	-	-	-	-	-	-	2.0
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	1.0	-	-	-	-	-	1.0
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	-	2.0	-	-	2.0
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	1.0	-	1.0
Freshwater Drum	2.0	-	-	3.0	-	-	-	-	-	5.0
Total Fish	23.0	64.0	1.0	13.0	16.0	-	27.0	13.0	-	157.0
Fish/1000 m	57.5	128.0	5.0	65.0	80.0	-	135.0	65.0	-	82.6
Elec. Eft. (meters)	400.0	500.0	200.0	200.0	200.0	-	200.0	200.0	-	1900.0

Table A4-37. Electrofishing summary for June 1980. Numerals indicate numbers of fish caught per 100(meters of electrofishing effort.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	5.0	5.0	-	-	-	-	1.1
Shortnose Gar	2.5	8.0	-	-	5.0	-	-	-	-	3.2
Gizzard Shad	-	72.0	-	5.0	30.0	-	80.0	45.0	-	35.8
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	5.0	-	-	-	-	-	0.5
Common Carp	17.5	2.0	5.0	10.0	5.0	-	15.0	5.0	-	8.4
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	12.5	44.0	-	20.0	35.0	-	30.0	-	-	23.2
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	7.5	-	-	-	-	-	-	10.0	-	2.6
Flathead Catfish	10.0	-	-	-	-	-	-	-	-	2.1
White Bass	2.5	2.0	-	-	-	-	-	-	-	1.1
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	5.0	-	-	-	-	-	0.5
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	-	10.0	-	-	1.1
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	5.0	-	0.5
Freshwater Drum	5.0	-	-	15.0	-	-	-	-	-	2.6
Total Fish	23.0	64.0	1.0	13.0	16.0	-	27.0	13.0	-	157.0
Fish/1000 m	57.5	128.0	5.0	65.0	80.0	-	135.0	65.0	-	82.6
Elec. Eft. (meters)	400.0	500.0	200.0	200.0	200.0	-	200.0	200.0	-	1900.0

Table A4-38. Electrofishing summary for August 1980. Numerals indicate numbers of fish caught using this method.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	1.0	-	-	-	1.0
Shortnose Gar	-	-	-	-	-	1.0	-	1.0	1.0	3.0
Gizzard Shad	9.0	15.0	2.0	-	40.0	8.0	4.0	5.0	81.0	164.0
Skipjack Herring	-	-	-	-	-	-	-	-	1.0	1.0
Goldeye	-	-	-	-	-	-	1.0	-	2.0	3.0
Common Carp	3.0	5.0	5.0	4.0	-	-	2.0	8.0	19.0	46.0
Blue Sucker	1.0	-	-	-	-	-	-	-	-	1.0
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	1.0	1.0
Shorthead Redhorse	-	-	-	-	-	-	-	-	1.0	1.0
River Carpsucker	5.0	5.0	3.0	3.0	9.0	-	3.0	4.0	13.0	45.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	1.0	-	-	-	-	2.0	-	1.0	7.0	11.0
Flathead Catfish	-	2.0	2.0	2.0	-	-	-	-	11.0	17.0
White Bass	2.0	2.0	-	-	2.0	-	3.0	1.0	8.0	18.0
Green Sunfish	-	-	-	-	-	1.0	-	-	1.0	2.0
Bluegill Sunfish	-	-	-	-	1.0	1.0	-	-	1.0	3.0
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	3.0	3.0
White Crappie	-	-	-	2.0	1.0	-	-	1.0	4.0	8.0
Black Crappie	-	-	-	-	-	-	1.0	1.0	5.0	7.0
Sauger	-	-	-	-	-	-	-	2.0	4.0	6.0
Freshwater Drum	4.0	4.0	6.0	1.0	10.0	1.0	9.0	10.0	11.0	56.0
Total Fish	25.0	33.0	18.0	12.0	63.0	15.0	23.0	34.0	174.0	397.0
Fish/1000 m	62.5	66.0	90.0	60.0	157.5	21.4	41.8	61.8	101.2	76.1
Elec. Eft. (meters)	400.0	500.0	200.0	200.0	400.0	700.0	550.0	550.0	1720.0	5220.0

Table A4-39. Electrofishing summary for August 1980. Numerals indicate numbers of fish caught per 1000 meters of electrofishing effort.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	1.4	-	-	-	0.2
Shortnose Gar	-	-	-	-	-	1.4	-	1.8	0.6	0.6
Gizzard Shad	22.5	30.0	10.0	-	100.0	11.4	7.3	9.1	47.1	31.4
Skipjack Herring	-	-	-	-	-	-	-	-	0.6	0.2
Goldeye	-	-	-	-	-	-	1.8	-	1.2	0.6
Common Carp	7.5	10.0	25.0	20.0	-	-	3.6	14.5	11.0	8.8
Blue Sucker	2.5	-	-	-	-	-	-	-	-	0.2
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	0.6	0.2
Shorthead Redhorse	-	-	-	-	-	-	-	-	0.6	0.2
River Carpsucker	12.5	10.0	15.0	15.0	22.5	-	5.5	7.3	7.6	8.6
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	2.5	-	-	-	-	2.9	-	1.8	4.1	2.1
Flathead Catfish	-	4.0	10.0	10.0	-	-	-	-	6.4	3.3
White Bass	5.0	4.0	-	-	5.0	-	5.5	1.8	4.7	3.4
Green Sunfish	-	-	-	-	-	1.4	-	-	0.6	0.4
Bluegill Sunfish	-	-	-	-	2.5	1.4	-	-	0.6	0.6
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	1.7	0.6
White Crappie	-	-	-	10.0	2.5	-	-	1.8	2.3	1.5
Black Crappie	-	-	-	-	-	-	1.8	1.8	2.9	1.3
Sauger	-	-	-	-	-	-	-	3.6	2.3	1.1
Freshwater Drum	10.0	8.0	30.0	5.0	25.0	1.4	16.4	18.2	6.4	10.7
Total Fish	25.0	33.0	18.0	12.0	63.0	15.0	23.0	34.0	174.0	397.0
Fish/1000 m	62.5	66.0	90.0	60.0	157.5	21.4	41.8	61.8	101.2	76.1
Elec. Eft. (meters)	400.0	500.0	200.0	200.0	400.0	700.0	550.0	550.0	1720.0	5220.0

Table A4-40. Electrofishing summary for September 1980. Numerals indicate numbers of fish caught using this method.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	1.0	-	1.0
Gizzard Shad	6.0	3.0	2.0	3.0	38.0	32.0	30.0	13.0	-	127.0
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	1.0	-	-	-	-	-	-	-	-	1.0
Common Carp	8.6	6.0	1.0	1.0	-	-	-	2.0	-	18.0
Blue Sucker	-	1.0	-	-	-	-	-	-	-	1.0
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	1.0	-	-	-	-	-	-	1.0
River Carpsucker	11.0	6.0	8.0	12.0	3.0	-	1.0	11.0	-	52.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	3.0	-	1.0	-	-	-	-	-	-	4.0
Flathead Catfish	1.0	6.0	3.0	7.0	-	2.0	1.0	4.0	-	24.0
White Bass	-	3.0	-	-	1.0	3.0	1.0	5.0	-	13.0
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	1.0	-	-	-	-	-	-	1.0	-	2.0
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	1.0	-	1.0
Freshwater Drum	6.0	3.0	2.0	1.0	-	1.0	1.0	10.0	-	24.0
Total Fish	37.0	28.0	18.0	24.0	42.0	38.0	34.0	48.0	-	269.0
Fish/1000 m	87.1	50.9	102.9	87.3	120.0	108.6	68.0	120.0	-	88.9
Elec. Eft. (meters)	425.0	550.0	175.0	275.0	350.0	350.0	500.0	400.0	-	3025.0

Table A4-41. Electrofishing summary for September 1980. Numerals indicate numbers of fish caught per 1000 meters of electrofishing effort.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	2.5	-	0.3
Gizzard Shad	14.1	5.5	11.4	10.9	108.6	91.4	60.0	32.5	-	42.0
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	2.4	-	-	-	-	-	-	-	-	0.3
Common Carp	18.8	10.9	5.7	3.6	-	-	-	5.0	-	6.0
Blue Sucker	-	1.8	-	-	-	-	-	-	-	0.3
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	5.7	-	-	-	-	-	-	0.3
River Carpsucker	25.9	10.9	45.7	43.6	8.6	-	2.0	27.5	-	17.2
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	7.1	-	5.7	-	-	-	-	-	-	1.3
Flathead Catfish	2.4	10.9	17.1	25.5	-	5.7	2.0	10.0	-	7.9
White Bass	-	5.5	-	-	2.9	8.6	2.0	12.5	-	4.3
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	2.4	-	-	-	-	-	-	2.5	-	0.7
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	2.5	-	0.3
Freshwater Drum	14.1	5.5	11.4	3.6	-	2.9	2.0	25.0	-	7.9
Total Fish	37.0	28.0	18.0	24.0	42.0	38.0	34.0	48.0	-	269.0
Fish/1000 m	87.1	50.9	102.9	87.3	120.0	108.6	68.0	120.0	-	88.9
Elec. Eft. (meters)	425.0	550.0	175.0	275.0	350.0	350.0	500.0	400.0	-	3025.0

Table A4-42. Electrofishing summary for November 1980. Numerals indicate numbers of fish caught using this method.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	1.0	-	-	-	-	1.0
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	1.0	-	-	-	-	1.0
Common Carp	-	-	-	-	-	-	1.0	6.0	-	7.0
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	-	-	-	-	2.0	6.0	1.0	2.0	-	11.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-	-	-
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	1.0	1.0	-	2.0
Green Sunfish	-	-	-	1.0	-	-	-	-	-	1.0
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	-	-	-	-	-
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	-	-	-	-
Total Fish	-	-	-	1.0	4.0	6.0	3.0	9.0	-	23.0
Fish/1000 m	-	-	-	6.7	7.0	13.3	7.5	45.0	-	13.0
Elec. Eft. (meters)	-	-	-	150.0	575.0	450.0	400.0	200.0	-	1775.0

Table A4-43. Electrofishing summary for November 1980. Numerals indicate numbers of fish caught per 1000 meters of electrofishing effort.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	1.7	-	-	-	-	0.6
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	1.7	-	-	-	-	0.6
Common Carp	-	-	-	-	-	-	2.5	30.0	-	3.9
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	-	-	-	-	3.5	13.3	2.5	10.0	-	6.2
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-	-	-
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	2.5	5.0	-	1.1
Green Sunfish	-	-	-	6.7	-	-	-	-	-	0.6
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	-	-	-	-	-
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	-	-	-	-
Total Fish	-	-	-	1.0	4.0	6.0	3.0	9.0	-	23.0
Fish/1000 m	-	-	-	6.7	7.0	13.3	7.5	45.0	-	13.0
Elec. Eft. (meters)	-	-	-	150.0	575.0	450.0	400.0	200.0	-	1775.0

Table A4-44. Electrofishing summary for February 1981. Numerals indicate numbers of fish caught using this method.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	-	2.0	-	-	2.0
Common Carp	-	-	-	-	-	-	-	-	-	-
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	-	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-	-	-
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-	-	-	-
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	-	-	-	-	-
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	-	-	-	-
Total Fish	-	-	-	-	-	-	2.0	-	-	2.0
Fish/1000 m	-	-	-	-	-	-	5.7	-	-	5.7
Elec. Eft. (meters)	-	-	-	-	-	-	350.0	-	-	350.0

Table A4-45. Electrofishing summary for February 1981. Numerals indicate numbers of fish caught per 1000 meters of electrofishing effort.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	-	5.7	-	-	5.7
Common Carp	-	-	-	-	-	-	-	-	-	-
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	-	-	-	-	-	-	-	-	-	-
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-	-	-
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-	-	-	-
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	-	-	-	-	-
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	-	-	-	-
Total Fish	-	-	-	-	-	-	2.0	-	-	2.0
Fish/1000 m	-	-	-	-	-	-	5.7	-	-	5.7
Elec. Eft. (meters)	-	-	-	-	-	-	350.0	-	-	350.0

Table A4-46. Electrofishing summary for March 1981. Numerals indicate numbers of fish caught using this method.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	-	-	-	-	-
Common Carp	-	1.0	-	-	-	-	-	-	-	1.0
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	-	1.0	-	-	-	-	-	-	-	1.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-	-	-
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-	-	-	-
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	-	-	-	-	-
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	-	-	-	-
Total Fish	-	2.0	-	-	-	-	-	-	-	2.0
Fish/1000 m	-	10.0	-	-	-	-	-	-	-	10.0
Elec. Eft. (meters)	-	200.0	-	-	-	-	-	-	-	200.0

Table A4-47. Electrofishing summary for March 1981. Numerals indicate numbers of fish caught per 1000 meters of electrofishing effort.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	-	-	-	-
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	-	-	-	-	-
Common Carp	-	5.0	-	-	-	-	-	-	-	5.0
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	-	5.0	-	-	-	-	-	-	-	5.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-	-	-
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	-	-	-	-	-
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	-	-	-	-	-
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	-	-	-	-
Total Fish	-	2.0	-	-	-	-	-	-	-	2.0
Fish/1000 m	-	10.0	-	-	-	-	-	-	-	10.0
Elec. Eft. (meters)	-	200.0	-	-	-	-	-	-	-	200.0

Table A4-48. Electrofishing summary for April 1981. Numerals indicate numbers of fish caught using this method.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	13.0	6.0	-	19.0
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	-	-	1.0	-	1.0
Common Carp	-	-	-	-	-	-	2.0	4.0	-	6.0
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	1.0	-	-	1.0
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	1.0	1.0	-	2.0
River Carpsucker	-	-	-	-	-	-	17.0	27.0	-	44.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-	-	-
Flathead Catfish	-	-	-	-	-	-	1.0	2.0	-	3.0
White Bass	-	-	-	-	-	-	3.0	1.0	-	4.0
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-	1.0	-	1.0
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	1.0	-	1.0
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	-	-	1.0	-	1.0
Black Crappie	-	-	-	-	-	-	-	1.0	-	1.0
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	23.0	33.0	-	56.0
Total Fish	-	-	-	-	-	-	61.0	79.0	-	140.0
Fish/1000 m	-	-	-	-	-	-	305.0	395.0	-	35.0
Elec. Eft. (meters)	-	-	-	-	-	-	200.0	200.0	-	400.0

Table A4-49. Electrofishing summary for April 1981. Numerals indicate numbers of fish caught per 1000 meters of electrofishing effort.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	-	-	65.0	30.0	-	47.5
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	-	-	5.0	-	2.5
Common Carp	-	-	-	-	-	-	10.0	20.0	-	15.0
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	5.0	-	-	2.5
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	5.0	5.0	-	5.0
River Carpsucker	-	-	-	-	-	-	85.0	135.0	-	110.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	-	-	-	-	-	-	-	-	-
Flathead Catfish	-	-	-	-	-	-	5.0	-	-	-
White Bass	-	-	-	-	-	-	15.0	5.0	-	10.0
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-	5.0	-	2.5
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	5.0	-	2.5
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	-	-	-	5.0	-	2.5
Black Crappie	-	-	-	-	-	-	-	5.0	-	2.5
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	-	-	115.0	165.0	-	140.0
Total Fish	-	-	-	-	-	-	61.0	79.0	-	140.0
Fish/1000 m	-	-	-	-	-	-	305.0	395.0	-	350.0
Elec. Eft. (meters)	-	-	-	-	-	-	200.0	200.0	-	400.0

Table A4-50. Electrofishing summary for May 1981. Numerals indicate numbers of fish caught using this method.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	3.0	4.0	5.0	12.0	7.0	8.0	5.0	3.0	18.0	65.0
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	1.0	-	-	-	1.0	-	1.0	-	99.0	12.0
Common Carp	2.0	4.0	-	-	2.0	6.0	1.0	2.0	13.0	30.0
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	1.0	1.0
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	2.0	1.0	-	2.0	4.0	14.0	23.0
River Carpsucker	272.0	24.0	16.0	22.0	17.0	15.0	1.0	4.0	50.0	421.0
Black Bullhead	1.0	2.0	-	-	-	-	1.0	-	-	4.0
Channel Catfish	85.0	59.0	8.0	11.0	2.0	1.0	1.0	5.0	24.0	196.0
Flathead Catfish	-	-	1.0	3.0	-	-	1.0	1.0	15.0	21.0
White Bass	-	-	-	-	-	-	2.0	-	4.0	6.0
Green Sunfish	-	1.0	-	1.0	-	-	1.0	-	6.0	9.0
Bluegill Sunfish	2.0	1.0	-	3.0	-	1.0	-	-	9.0	16.0
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	2.0	-	-	-	-	-	2.0
White Crappie	-	-	-	2.0	-	-	-	-	8.0	10.0
Black Crappie	-	-	-	-	-	-	-	-	2.0	2.0
Sauger	-	-	-	-	-	-	-	-	1.0	1.0
Freshwater Drum	10.0	12.0	3.0	8.0	5.0	1.0	10.0	39.0	44.0	132.0
Total Fish	376.0	107.0	33.0	66.0	35.0	32.0	26.0	58.0	218.0	951.0
Fish/1000 m	626.7	267.5	165.0	440.0	100.0	91.4	74.3	165.7	436.0	292.6
Elec. Eft. (meters)	600.0	400.0	200.0	150.0	350.0	350.0	350.0	350.0	500.0	3250.0

Table A4-51. Electrofishing summary for May 1981. Numerals indicate numbers of fish caught per 1000 meters of electrofishing effort.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	5.0	10.0	25.0	80.0	20.0	22.9	14.3	8.6	36.0	20.0
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	1.7	-	-	-	2.9	-	2.9	-	18.0	3.7
Common Carp	3.3	10.0	-	-	5.7	17.1	2.9	5.7	26.0	9.2
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	2.0	0.3
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	13.3	2.9	-	5.7	11.4	28.0	7.1
River Carpsucker	453.3	60.0	80.0	146.7	48.6	42.9	2.9	11.4	100.0	129.5
Black Bullhead	1.7	5.0	-	-	-	-	2.9	-	-	1.2
Channel Catfish	141.7	147.5	40.0	73.3	5.7	2.9	2.9	14.3	48.0	60.3
Flathead Catfish	-	-	5.0	20.0	-	-	2.9	2.9	30.0	6.5
White Bass	-	-	-	-	-	-	5.7	-	8.0	1.8
Green Sunfish	-	2.5	-	6.7	-	-	2.9	-	12.0	2.8
Bluegill Sunfish	3.3	2.5	-	20.0	-	2.9	-	-	18.0	4.9
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	13.3	-	-	-	-	-	0.6
White Crappie	-	-	-	13.3	-	-	-	-	16.0	9.1
Black Crappie	-	-	-	-	-	-	-	-	4.0	0.6
Sauger	-	-	-	-	-	-	-	-	2.0	0.3
Freshwater Drum	16.7	30.0	15.0	53.3	14.3	2.9	28.6	111.4	88.0	40.6
Total Fish	376.0	107.0	33.0	66.0	35.0	32.0	26.0	58.0	218.0	951.0
Fish/1000 m	626.7	267.5	165.0	440.0	100.0	91.4	74.3	165.7	436.0	292.6
Elec. Eft. (meters)	600.0	400.0	200.0	150.0	350.0	350.0	350.0	350.0	500.0	3250.0

Table A4-52. Electrofishing summary for June 1981. Numerals indicate numbers of fish caught using this method.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	6.0	9.0	4.0	3.0	3.0	-	25.0
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	-	-	-	-	-
Common Carp	-	-	-	-	2.0	4.0	1.0	2.0	-	9.0
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	1.0	-	-	-	-	1.0
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	1.0	3.0	-	-	4.0
River Carpsucker	2.0	17.0	3.0	7.0	7.0	7.0	6.0	2.0	-	51.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	9.0	6.0	3.0	1.0	4.0	2.0	1.0	-	-	26.0
Flathead Catfish	-	-	-	-	-	-	-	1.0	-	1.0
White Bass	-	-	-	2.0	-	1.0	3.0	1.0	-	7.0
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	2.0	1.0	3.0	-	-	-	6.0
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	1.0	1.0	-	3.0	-	-	5.0
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	4.0	7.0	7.0	2.0	8.0	4.0	6.0	6.0	-	44.0
Total Fish	15.0	30.0	13.0	21.0	33.0	26.0	26.0	15.0	-	179.0
Fish/1000 m	20.7	75.0	52.0	120.0	50.8	40.0	57.8	42.9	-	49.0
Elec. Eft. (meters)	725.0	400.0	250.0	175.0	650.0	650.0	450.0	350.0	-	3650.0

Table A4-53. Electrofishing summary for June 1981. Numerals indicate numbers of fish caught per 1000 meters of electrofishing effort.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	34.3	13.8	6.2	6.7	8.6	-	6.8
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	-	-	-	-	-
Common Carp	-	-	-	-	3.1	6.2	2.2	5.7	-	2.5
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	1.5	-	-	-	-	0.3
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	1.5	6.7	-	-	1.1
River Carpsucker	2.8	42.5	12.0	40.0	10.8	10.8	13.3	5.7	-	14.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	12.4	15.0	12.0	5.7	6.2	3.1	2.2	-	-	7.1
Flathead Catfish	-	-	-	-	-	-	-	2.9	-	0.3
White Bass	-	-	-	11.4	-	1.5	6.7	2.9	-	1.9
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	11.4	1.5	4.6	-	-	-	1.6
O.-spotted Sunfish	-	-	-	-	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	5.7	1.5	-	6.7	-	-	1.4
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	5.5	17.5	28.0	11.4	12.3	6.2	13.3	17.1	-	12.1
Total Fish	15.0	30.0	13.0	21.0	33.0	26.0	26.0	15.0	-	179.0
Fish/1000 m	20.7	75.0	52.0	120.0	50.8	40.0	57.8	42.9	-	49.0
Elec. Eft. (meters)	725.0	400.0	250.0	175.0	650.0	650.0	450.0	350.0	-	3650.0

Table A4-54. Electrofishing summary for July 1981. Numerals indicate numbers of fish caught using this method.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	1.0	-	-	2.0	1.0	-	-	-	4.0
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	2.0	2.0	-	-	-	4.0
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	-	-	-	-	-
Common Carp	-	1.0	-	-	-	1.0	-	-	-	2.0
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	-	1.0	-	-	2.0	1.0	-	-	-	4.0
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	2.0	-	-	1.0	-	-	-	-	3.0
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	1.0	-	-	-	1.0
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
O.-spotted Sunfish	-	-	-	-	-	2.0	-	-	-	2.0
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	4.0	1.0	-	-	-	5.0
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	1.0	1.0	-	-	-	2.0
Total Fish	-	5.0	-	-	12.0	10.0	-	-	-	27.0
Fish/1000 m	-	13.3	-	-	48.0	36.4	-	-	-	30.0
Elec. Eft. (meters)	-	375.0	-	-	250.0	275.0	-	-	-	900.0

Table A4-55. Electrofishing summary for July 1981. Numerals indicate numbers of fish caught per 1000 meters of electrofishing effort.

Species	Control		Dredge 1		Dredge 2		Dredge 3		Partial	Total
	1	2	A-B	D-E	A-B	D-E	A-B	D-E		
Shovelnose Sturgeon	-	-	-	-	-	-	-	-	-	-
Longnose Gar	-	2.7	-	-	8.0	3.6	-	-	-	4.4
Shortnose Gar	-	-	-	-	-	-	-	-	-	-
Gizzard Shad	-	-	-	-	8.0	7.3	-	-	-	4.4
Skipjack Herring	-	-	-	-	-	-	-	-	-	-
Goldeye	-	-	-	-	-	-	-	-	-	-
Common Carp	-	2.7	-	-	-	3.6	-	-	-	2.2
Blue Sucker	-	-	-	-	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Smallmouth Buffalo	-	-	-	-	-	-	-	-	-	-
Shorthead Redhorse	-	-	-	-	-	-	-	-	-	-
River Carpsucker	-	2.7	-	-	8.0	3.6	-	-	-	4.4
Black Bullhead	-	-	-	-	-	-	-	-	-	-
Channel Catfish	-	5.3	-	-	4.0	-	-	-	-	3.3
Flathead Catfish	-	-	-	-	-	-	-	-	-	-
White Bass	-	-	-	-	-	3.6	-	-	-	1.1
Green Sunfish	-	-	-	-	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-	-	-	-	-
O.-spotted Sunfish	-	-	-	-	-	7.3	-	-	-	2.2
Longear Sunfish	-	-	-	-	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-	-	-	-	-
White Crappie	-	-	-	-	16.0	3.6	-	-	-	5.6
Black Crappie	-	-	-	-	-	-	-	-	-	-
Sauger	-	-	-	-	-	-	-	-	-	-
Freshwater Drum	-	-	-	-	4.0	3.6	-	-	-	2.2
Total Fish	-	5.0	-	-	12.0	10.0	-	-	-	27.0
Fish/1000 m	-	13.3	-	-	48.0	36.4	-	-	-	30.0
Elec. Eft. (meters)	-	375.0	-	-	250.0	275.0	-	-	-	900.0

Table A4-56. Supplemental electrofishing summary for 1980 through 1981. Numerals indicate numbers of fish caught at additional or alternative sites in the vicinity of primary sampling areas.

Species	Control Supplemental	Dredge 1 Supplemental	Dredge 2 Supplemental	Dredge 3 Supplemental	Partial Supplemental	Total
Shovelnose Sturgeon	-	-	-	-	-	-
Longnose Gar	-	-	-	-	-	-
Shortnose Gar	-	-	-	-	-	-
Gizzard Shad	-	2.0	14.0	18.0	3.0	37.0
Skipjack Herring	-	-	-	-	1.0	1.0
Goldeye	-	-	-	-	1.0	1.0
Common Carp	12.0	5.0	1.0	-	6.0	24.0
Blue Sucker	-	-	-	-	-	-
Bigmouth Buffalo	-	-	-	-	-	-
Smallmouth Buffalo	-	-	7.0	-	-	7.0
Shorthead Redhorse	-	-	-	-	-	-
River Carpsucker	5.0	6.0	2.0	6.0	7.0	26.0
Black Bullhead	-	-	-	-	-	-
Channel Catfish	7.0	2.0	-	-	2.0	11.0
Flathead Catfish	1.0	-	-	-	-	1.0
White Bass	-	3.0	-	1.0	-	4.0
Green Sunfish	-	-	-	-	-	-
Bluegill Sunfish	-	-	-	-	-	-
O.-spotted Sunfish	-	-	-	-	-	-
Longear Sunfish	-	-	-	-	-	-
Largemouth Bass	-	-	-	-	-	-
White Crappie	2.0	11.0	1.0	4.0	-	18.0
Black Crappie	-	4.0	-	-	-	4.0
Sauger	-	-	-	-	-	-
Freshwater Drum	2.0	1.0	-	9.0	-	12.0
Total Fish	29.0	34.0	25.0	38.0	20.0	146.0

APPENDIX 5 -- FISH, SUBSTRATE AFFINITIES

Table A5-1, substrate affinities by species, 1979

Table A5-2, substrate affinities by species, 1980

Table A5-1. Substrate affinities of the 15 most common fish species in seining samples, lower Kansas River, 1979.

Total fish	Channel Catfish 570		Gizzard Shad 105		Freshwater Drum 115	
Silt	346	60.7%	67	63.8%	89	77.4%
Silt Sand	89	15.6%	18	17.1%	17	14.8%
Silt Rubble	6	1.1%	-	-	-	-
Sand	73	12.8%	11	10.5%	8	7.0%
Sand Gravel	7	1.2%	-	-	-	-
Gravel	29	5.1%	-	-	-	-
Gravel Rubble	12	2.1%	6	5.7%	1	0.9%
Rubble	8	1.4%	3	2.9%	-	-
Misc.	-	-	-	-	-	-

Fish per haul	Channel Catfish		Gizzard Shad		Freshwater Drum		# Hauls
Silt	7.7	28.5%	1.5	36.6%	2.0	60.6%	45
Silt Sand	5.6	20.7%	1.1	26.8%	1.1	33.3%	16
Silt Rubble	1.5	5.6%	-	-	-	-	4
Sand	1.3	4.8%	0.2	4.9%	0.1	3.0%	57
Sand Gravel	0.8	3.0%	-	-	-	-	9
Gravel	7.3	27.0%	-	-	-	-	4
Gravel Rubble	1.7	6.3%	0.9	22.0%	0.1	3.0%	7
Rubble	1.1	4.1%	0.4	9.8%	-	-	7
Misc.	-	-	-	-	-	-	3

Total fish	Silver Chub 80		Speckled Chub 74		Emerald Shiner 172	
Silt	70	87.5%	2	3.1%	24	14.0%
Silt Sand	1	1.3%	6	9.4%	105	61.0%
Silt Rubble	-	-	-	-	-	-
Sand	4	5.0%	28	43.8%	15	8.7%
Sand Gravel	5	6.3%	28	43.8%	-	-

Table A5-1. cont.

	Silver Chub		Speckled Chub		Emerald Shiner	
Gravel	-	-	-	-	-	-
Gravel Rubble	-	-	-	-	14	8.1%
Rubble	-	-	-	-	12	7.0%
Misc.	-	-	-	-	2	1.2%

Fish per haul	Silver Chub		Speckled Chub		Emerald Shiner		# Hauls
Silt	1.6	66.7%	0.04	0.9%	0.5	4.2%	45
Silt Sand	0.1	4.2%	0.4	9.9%	6.6	55.9%	16
Silt Rubble	-	-	-	-	-	-	4
Sand	0.1	4.2%	0.5	12.4%	0.3	2.5%	57
Sand Gravel	0.6	25.0%	3.1	76.4%	-	-	9
Gravel	-	-	-	-	-	-	4
Gravel Rubble	-	-	-	-	2.0	16.9%	7
Rubble	-	-	-	-	1.7	14.4%	7
Misc.	-	-	-	-	0.7	5.9%	3

Total fish	Red Shiner 8952		Sand Shiner 3391		Carpsuckers 1075	
Silt	3452	38.6%	1538	45.1%	580	54.0%
Silt Sand	308	3.4%	166	4.9%	75	7.0%
Silt Rubble	659	7.4%	42	1.2%	47	4.4%
Sand	2069	23.1%	1206	35.6%	340	31.6%
Sand Gravel	1542	17.2%	339	10.0%	23	2.1%
Gravel	208	2.3%	33	1.0%	-	-
Gravel Rubble	322	3.6%	23	0.7%	-	-
Rubble	94	1.1%	7	0.2%	4	0.4%
Misc.	298	3.3%	37	1.1%	6	0.6%

Table A5-1. cont.

Fish per haul	Red Shiner		Sand Shiner		Carpsuckers		# Hauls
Silt	76.7	11.3%	34.2	24.6%	12.9	31.8%	45
Silt Sand	19.3	2.8%	10.4	7.5%	4.7	11.6%	16
Silt Rubble	164.8	24.3%	10.5	7.6%	11.75	28.9%	4
Sand	36.3	5.3%	21.2	15.3%	6.0	14.8%	57
Sand Gravel	171.3	25.2%	37.7	27.1%	2.6	6.4%	9
Gravel	52.0	7.7%	8.3	6.0%	-	-	4
Gravel Rubble	46.0	6.8%	3.3	2.4%	-	-	7
Rubble	13.4	2.0%	1.0	0.7%	0.6	1.5%	7
Misc.	99.3	14.6%	12.3	8.9%	2.0	4.9%	3

Total fish	Bullhead minnow 29		Bluntnose minnow 63		Fathead Minnow 52	
Silt	6	20.7%	52	82.5%	32	61.5%
Silt Sand	5	17.2%	1	1.6%	1	1.9%
Silt Rubble	-	-	1	1.6%	1	1.9%
Sand	16	55.2%	8	12.7%	4	7.7%
Sand Gravel	-	-	-	-	13	25.0%
Gravel	-	-	-	-	-	-
Gravel Rubble	-	-	-	-	1	1.9%
Rubble	-	-	1	1.6%	-	-
Misc.	2	6.9%	-	-	-	-

Fish per haul	Bullhead minnow		Bluntnose minnow		Fathead minnow		# Hauls
Silt	0.13	9.4%	1.16	66.3%	0.71	26.6%	45
Silt Sand	0.31	22.3%	0.06	3.4%	0.06	2.2%	16
Silt Rubble	-	-	0.25	14.3%	0.25	9.4%	4
Sand	0.28	20.1%	0.14	8.0%	0.07	2.6%	57
Sand Gravel	-	-	-	-	1.44	53.9%	9
Gravel	-	-	-	-	-	-	4

Table A5-1. cont.

	Bullhead minnow		Bluntnose minnow		Fathead minnow		# Hauls
Gravel Rubble	-	-	-	-	0.14	5.2%	7
Rubble	-	-	0.14	8.0%	-	-	7
Misc.	0.67	48.2%	-	-	-	-	3

Total fish	White Bass 64		White Crappie 54		Bluegill 39	
Silt	48	75.0%	34	63.0%	27	69.2%
Silt Sand	3	4.7%	4	7.4%	10	25.6%
Silt Rubble	-	-	1	1.9%	-	-
Sand	12	18.8%	13	24.1%	1	2.6%
Sand Gravel	-	-	-	-	-	-
Gravel	-	-	1	1.9%	-	-
Gravel Rubble	-	-	-	-	-	-
Rubble	-	-	1	1.9%	1	2.6%
Misc.	1	1.6%	-	-	-	-

Fish per haul	White Bass		White Crappie		Bluegill		# Hauls
Silt	1.07	59.4%	0.76	40.4%	0.60	43.2%	45
Silt Sand	0.19	10.6%	0.25	13.3%	0.63	45.3%	16
Silt Rubble	-	-	0.25	13.3%	-	-	4
Sand	0.25	11.7%	0.23	12.2%	0.02	1.4%	57
Sand Gravel	-	-	-	-	-	-	9
Gravel	-	-	0.25	13.3%	-	-	4
Gravel Rubble	-	-	-	-	-	-	7
Rubble	-	-	0.14	7.4%	0.14	10.1%	7
Misc.	0.33	18.3%	-	-	-	-	3

Table A5-2. Substrate affinities of the 15 most common fish species in seining samples, lower Kansas River, 1980.

Total fish	Channel Catfish 194		Gizzard Shad 1423		Freshwater Drum 180	
Silt	120	61.8%	1081	76.0%	150	83.3%
Silt Sand	16	8.2%	208	14.6%	9	5.0%
Silt Rubble	8	4.1%	98	6.8%	18	10.0%
Sand	16	8.2%	19	1.3%	3	1.7%
Sand Gravel	-	-	-	-	-	-
Gravel	-	-	-	-	-	-
Gravel Rubble	-	-	-	-	-	-
Rubble	23	11.8%	17	1.2%	-	-
Misc.	11	5.7%	-	-	-	-

Fish per haul	Channel Catfish		Gizzard Shad		Freshwater Drum		# Hauls
Silt	1.0	23.8%	9.0	60.0%	1.2	69.3%	120
Silt Sand	0.2	4.8%	2.3	15.3%	0.1	5.8%	91
Silt Rubble	0.2	4.8%	2.2	14.7%	0.4	23.1%	44
Sand	0.2	4.8%	0.2	1.3%	0.03	1.7%	88
Sand Gravel	-	-	-	-	-	-	8
Gravel	-	-	-	-	-	-	0
Gravel Rubble	-	-	-	-	-	-	6
Rubble	1.8	42.8%	1.3	8.7%	-	-	13
Misc.	0.8	19.0%	-	-	-	-	14

Total fish	Silver Chub 219		Speckled Chub 55		Emerald Shiner 774	
Silt	198	90.4%	8	14.5%	205	26.5%
Silt Sand	16	7.3%	22	40.0%	226	29.2%
Silt Rubble	4	1.8%	1	1.8%	275	35.5%
Sand	1	0.5%	17	30.9%	29	3.7%
Sand Gravel	-	-	1	1.8%	5	0.6%

Table A5-2. cont.

	Silver Chub		Speckled Chub		Emerald Shiner	
Gravel	-	-	-	-	-	-
Gravel Rubble	-	-	2	3.6%	13	1.7%
Rubble	-	-	4	7.3%	-	-
Misc.	-	-	-	-	21	2.7%

Fish per haul	Silver Chub		Speckled Chub		Emerald Shiner		# Hauls
Silt	1.65	84.2%	0.1	8.2%	1.7	11.3%	120
Silt Sand	0.2	10.2%	0.2	16.4%	2.5	16.6%	91
Silt Rubble	0.1	5.1%	0.02	1.6%	6.25	41.5%	44
Sand	0.01	0.5%	0.2	16.4%	0.3	2.05%	88
Sand Gravel	-	-	0.1	8.2%	0.6	4.0%	8
Gravel	-	-	-	-	-	-	0
Gravel Rubble	-	-	0.3	24.6%	2.2	14.6%	6
Rubble	-	-	0.3	24.6%	-	-	13
Misc.	-	-	-	-	1.5	10.0%	14

Total fish	Red Shiner 37,193		Sand Shiner 9103		Carpsuckers 6475	
Silt	8331	22.4%	3405	37.4%	2744	42.4%
Silt Sand	15181	40.8%	2940	32.3%	2226	34.4%
Silt Rubble	4353	11.7%	391	4.3%	237	3.7%
Sand	7791	20.9%	1786	19.7%	974	15.0%
Sand Gravel	515	1.4%	166	1.8%	33	0.5%
Gravel	-	-	-	-	-	-
Gravel Rubble	88	0.2%	56	0.6%	-	-
Rubble	282	0.8%	63	0.7%	51	0.8%
Misc.	645	1.7%	296	3.3%	210	3.2%

Table A5-2. cont.

Fish per haul	Red Shiner		Sand Shiner		Carpsuckers		# Hauls
Silt	69.4	11.7%	28.4	19.4%	22.9	26.3%	120
Silt Sand	166.8	28.1%	32.3	21.1%	24.5	28.2%	91
Silt Rubble	121.7	20.5%	8.9	6.1%	5.4	6.2%	44
Sand	88.5	14.9%	20.3	13.9%	11.1	12.8%	88
Sand Gravel	64.4	10.8%	20.7	14.2%	4.1	4.7%	8
Gravel	-	-	-	-	-	-	0
Gravel Rubble	14.7	2.5%	9.6	6.6%	-	-	6
Rubble	21.7	3.7%	4.8	3.3%	3.9	4.5%	13
Misc.	46.1	7.8%	21.1	14.4%	15.0	17.3%	14

Total fish	Bullhead minnow 864		Bluntnose minnow 238		Fathead Minnow 41	
Silt	561	65.0%	185	77.7%	15	36.6%
Silt Sand	185	21.4%	26	10.9%	7	17.1%
Silt Rubble	52	6.0%	7	2.9%	-	-
Sand	53	6.1%	7	2.9%	9	22.0%
Sand Gravel	-	-	-	-	-	-
Gravel	-	-	-	-	-	-
Gravel Rubble	-	-	-	-	1	2.4%
Rubble	13	1.5%	7	2.9%	-	-
Misc.	-	-	-	-	4	9.8%

Fish per haul	Bullhead minnow		Bluntnose minnow		Fathead minnow		# Hauls
Silt	4.7	49.5%	1.5	55.5%	0.1	11.1%	120
Silt Sand	2.0	21.1%	0.3	11.1%	0.1	11.1%	91
Silt Rubble	1.2	12.6%	0.3	11.1%	0.1	11.1%	44
Sand	0.6	6.3%	0.1	3.7%	0.1	11.1%	88
Sand Gravel	-	-	-	-	-	-	8
Gravel	-	-	-	-	-	-	0

Table A5-2. cont.

	Bullhead minnow		Bluntnose minnow		Fathead minnow		# Hauls
Gravel Rubble	-	-	-	-	0.2	22.2%	6
Rubble	1.0	10.5%	0.5	18.5%	-	-	13
Misc.	-	-	-	-	0.3	33.3%	14

Total fish	White Bass 150		White Crappie 257		Bluegill 610	
Silt	108	72.0%	510	83.6%	123	47.9%
Silt Sand	23	15.3%	61	10.0%	15	5.8%
Silt Rubble	10	6.7%	20	3.3%	113	44.0%
Sand	8	5.3%	19	3.1%	-	-
Sand Gravel	1	0.7%	-	-	-	-
Gravel	-	-	-	-	-	-
Gravel Rubble	-	-	-	-	6	1.9%
Rubble	-	-	-	-	1	0.4%
Misc.	-	-	-	-	-	-

Fish per haul	White Bass		White Crappie		Bluegill		# Hauls
Silt	0.9	60.0%	4.2	76.4%	1.0	20.4%	120
Silt Sand	0.2	13.3%	0.7	12.7%	0.2	4.1%	91
Silt Rubble	0.2	13.3%	0.4	7.3%	2.6	53.1%	44
Sand	0.1	6.7%	0.2	3.6%	-	-	88
Sand Gravel	0.1	6.7%	-	-	-	-	8
Gravel	-	-	-	-	-	-	0
Gravel Rubble	-	-	-	-	1.0	20.4%	6
Rubble	-	-	-	-	0.1	2.0%	13
Misc.	-	-	-	-	-	-	14

APPENDIX 6 -- FISH, REPRODUCTIVE DATA

Table A6-1, gonadosomatic indexes and egg complements, by species and date of capture

Table A6-1. Summary of reproductive information for selected species in the lower Kansas River Gonado-somatic index (G.S.I.) equals Ovary Weight x 100/Total body Weight, except where specified.

Number of females examined in parentheses ( ).

Date of Capture	Site	T.L.(mm.)	T.W.(gm.)	G.S.I	Est. Number of Eggs	Mean Egg Diameter
Gizzard Shad, *Dorosoma cepedianum* (18)						
3 May 1980	D3E	298	252.1	3.0	-	-
3 May 1980	D3E	310	261.5	6.3	-	-
3 May 1980	D3E	258	166.6	2.4	-	-
12 May 1981	P	354	558.4	7.2	157,070	0.57
23 Jun 1980	C2B	261	167.6	3.8	61,580	0.50
23 Jun 1980	C2B	312	304.2	1.0	-	-
5 Aug 1980	C2A	268	226.2	0 5	-	-
Goldeye, *Hiodon alosoides* (11)						
21 Feb 1981	D3A	366	608.4	10.7	20000	1.86
21 Feb 1981	D3A	352	422.2	7.0	9030	1.95
12 May 1981	P	362	458.9	0.5	spent	-
12 May 1981	P	337	444.9	0.6	-	-
12 May 1981	P	374	454.0	0 8	-	-
21 May 1981	C1B	281	262.2	0.5	-	-
23 Jun 1980	D1E	373	508.5	0.6	-	-
23 Nov 1980	D2A	377	612.2	9.6	24460	1.65
Common Carp, *Cyprinus carpio* (12)						
7 Mar 1980	C1B	592	2718.5	8.4	143100	-
7 Mar 1980	D1Pit	498	1879.6	6.7	164530	-
12 Apr 1980	C2B	555	2438.0	5.6	147980	1.12
12 Apr 1980	C2B	467	1620.8	14.0	234210	1.40
12 Apr 1980	C2B	565	2709.8	10.8	318300	1.28
12 Apr 1980	C2B	594	3518.5	8.9	399330	1.20
12 Apr 1980	C2B	509	2097.5	14.1	271610	1.40
12 Apr 1980	D1E	472	1598.1	16.5	217400	1.28
26 Jun 1980	D3D	228	167.1	1.1	-	-
5 Aug 1980	C2B	457	1711.6	6.6	84720	-
5 Aug 1980	C2B	479	2015.2	10.8	198300	-
5 Aug 1980	D1E	417	1083.1	0.6	-	-

Table A6-1. cont.

Date of Capture	Site	T.L.(mm.)	T.W.(gm.)	G.S.I	Est. Number of Eggs	Mean Egg Diameter
Emerald Shiner, Notropis atherinoides (4)						
			E.W.(gm.)[1]	G.S.I.[2]		
19 May 1981	C2A	71	2.9	0.19	-	0.85
20 May 1981	D3D	75	2.7	0.14	-	0.69
20 May 1981	D3D	67	2.1	0.20	-	0.79
20 May 1981	D3D	67	2.9	0.29	-	0.85

[1] - Eviscerated Weight

[2] - G.S.I. = Gonad weight x 100/Eviscerated weight

Red Shiner, Notropis lutrensis (5)						
			E.W.(gm.)[1]	G.S.I.[2]		
19 May 1981	D1D	64	3.1	5.2	-	-
19 May 1981	D1D	64	3.1	4.2	-	-
19 May 1981	D1D	67	3.4	14.1	-	0.87
20 May 1981	D3A	45	1.0	6.9	-	-

[1] - Eviscerated weight

[2] - G.S.I. = Gonad weight x 100/Eviscerated weight

Sand Shiner, Notropis stramineus (21)						
			E.W.(gm.)[1]	G.S.I.[2]		
19 May 1981	C2A	62	2.0	16.3	-	-
19 May 1981	C2A	55	1.4	21.8	-	-
19 May 1981	C2B	48	1.2	16.7	-	0.79
19 May 1981	C2B	48	1.1	26.9	-	0.84
19 May 1981	C2B	52	1.5	20.7	-	0.78
19 May 1981	C2B	43	-	-	-	0.82
19 May 1981	C2B	55	1.4	29.4	-	-
19 May 1981	C2B	46	0.7	17.8	564	-
19 May 1981	C2B	53	1.2	25.6	996	-
19 May 1981	C2B	52	1.1	21.9	622	-
19 May 1981	C2B	51	1.1	28.6	932	-

Table A6-1. cont.

Date of Capture	Site	T.L.(mm.)	T.W.(gm.)	G.S.I	Est. Number of Eggs	Mean Egg Diameter
Sand Shiner (cont.)						
19 May 1981	C2B	52	1.3	10.2	336	-
19 May 1981	C2B	53	1.3	26.1	1188	-
20 May 1981	D2A	63	2.6	19.9	-	-
20 May 1981	D3D	52	1.1	18.0	-	0.70
20 May 1981	D3D	39	0.6	12.5	-	0.70
20 May 1981	D3D	38	-	-	-	0.59
Smallmouth Buffalo, Ictiobus bubalus (1)						
11 Aug 1980	P	346	844.4	1.48	-	-
River Carpsucker, Carpiodes carpio (5)						
11 Apr 1980	D3Pit	466	1557.2	7.1	447500	0.89
19 May 1980	D1A	383	771.8	1.0	-	-
23 Jun 1980	D1E	441	1203.1	11.4	129530	0.98
5 Aug 1980	D1E	364	631.1	0.1	-	-
5 Aug 1980	D1E	385	830.8	0.1	-	-
Black Bullhead, Ictalurus melas (1)						
21 May 1981	C1A	165	63.1	1.50	2470	1.00
Channel Catfish, Ictalurus punctatus (42)						
7 Mar 1980	D2Pit	288	200.3	1.3	4310	1.04
2 May 1980	D2B	434	926.2	1.7	9970	2.08
12 May 1981	P	401	737.4	11.1	10,070	2.63
12 May 1981	P	403	721.9	6.7	10,700	1.98
12 May 1981	P	385	622.2	0.2	-	-
12 May 1981	P	355	458.7	0.1	-	-
12 May 1981	P	292	186.8	0.3	-	-
20 May 1980	D2A	395	667.4	7.1	9490	2.24

[1] - Eviscerated weight

[2] - G.S.I. = Gonad weight x 100/Eviscerated weight

Table A6-1. cont.

Date of Capture	Site	T.L.(mm.)	T.W.(gm.)	G.S.I	Est. Number of Eggs	Mean Egg Diameter
Channel Catfish (cont.)						
22 May 1981	D2Pit	247	152.8	0.1	-	-
18 Jun 1981	C1A	263	177.4	0.1	-	-
23 Jun 1980	C1A	287	201.4	0.4	-	-
23 Jun 1980	C1A	346	322.8	0.5	-	-
6 Aug 1980	D3E	293	258.3	0.1	-	-
23 Nov 1980	D2Pit	252	151.0	0.1	-	-
Flathead Catfish, *Pylodictis olivaris* (21)						
7 May 1981	D3A	325	422.9	0.2	-	-
12 May 1981	P	252	178.2	0.5	1100	1.15
12 May 1981	P	201	78.7	0.3	-	-
21 May 1981	D1E	324	407.1	0.2	-	-
21 May 1981	D1E	207	72.4	0.2	-	-
19 Jun 1981	D3E	1001	13166.0	7.9	46990	3.20
23 Jun 1980	C1B	239	137.9	0.3	-	-
5 Aug 1980	C2B	414	749.1	0.2	-	-
6 Sep 1980	C2A	283	262.0	0.2	-	-
6 Sep 1980	D1A	396	839.9	0.4	-	-
6 Sep 1980	D1E	402	812.7	0.2	-	-
23 Nov 1980	D2Pit	413	921.6	0.5	-	-
White Bass, *Morone chrysops* (19)						
7 May 1981	D3E	236	182.1	Male	mature/milt	-
22 May 1981	D3A	186	88.8	0.3	Spent	-
22 May 1981	D3A	277	316.0	0.6	Spent	-
22 May 1981	D3E	228	170.6	0.5	Spent	-
22 May 1981	D3E	229	168.0	0.5	Spent	-
22 May 1981	D3E	195	107.0	0.4	Spent	-
23 Jul 1981	D2E	317	496.0	0.3	-	-
6 Aug 1980	D3E	245	205.0	0.5	-	-
6 Sep 1980	D2B	203	152.2	0.3	-	-
22 Nov 1980	D3A	165	63.7	0.3	-	-
22 Nov 1980	D3E	285	306.6	1.6	-	-

Table A6-1. cont.

Date of Capture	Site	T.L.(mm.)	T.W.(gm.)	G.S.I	Est. Number of Eggs	Mean Egg Diameter
Largemouth Bass, *Micropterus salmoides* (3)						
21 May 1981	D1E	211	157.6	4.6	17040	0.83
11 Aug 1980	P	215	165.6	0.4	-	-
Green Sunfish, *Lepomis cyanellus* (3)						
12 May 1981	P	123	48.8	9.6	10650	0.87
12 May 1981	P	86	17.2	Male	mature/milt	-
19 May 1981	D1A	178	152.1	Male	mature/milt	-
21 May 1981	D1E	78	11.0	1.3	-	-
11 Aug 1980	P	83	12.1	10.2	4000	0.69
Bluegill, *Lepomis macrochirus* (5)						
19 May 1981	D1A	110	29.1	6.8	7200	0.79
21 May 1981	D1E	105	24.0	5.5	4100	0.78
22 May 1981	D2E	130	56.1	Male	mature/milt	-
18 Jun 1981	D1E	115	28.5	3.9	2620	0.79
19 Jun 1981	D2A	148	73.5	9.8	2160	0.91
White Crappie, *Pomoxis annularis* (25)						
21 Feb 1981	D2Pit	171	81.2	0.8	-	-
21 Feb 1981	D3Pit	171	72.7	0.2	-	-
8 Mar 1980	D2Pit	188	89.2	1.0	-	-
11 Apr 1980	D3A	196	100.3	0.9	-	-
11 Apr 1980	D3A	163	56.3	0.5	-	-
11 Apr 1980	D3A	162	42.5	0.3	-	-
12 Apr 1980	C1B	157	48.4	0.5	-	-
12 Apr 1980	D1E	156	40.9	0.6	-	-
12 Apr 1980	D1E	147	34.7	0.8	-	-
12 Apr 1980	D1E	126	21.9	1.1	-	-
12 Apr 1980	D1E	172	61.7	1.4	-	-
12 May 1981	P	196	96.4	1.4	-	-
12 May 1981	P	174	83.7	0.5	-	-

Table A6-1. cont.

Date of Capture	Site	T.L.(mm.)	T.W.(gm.)	G.S.I	Est. Number of Eggs	Mean Egg Diameter
White Crappie (cont.)						
12 May 1981	P	158	51.6	0.4	-	-
21 May 1981	D1E	127	27.2	3.7	-	-
21 May 1981	D1E	219	174.3	9.1	72,561	0.77
26 Jun 1980	D3A	176	73.7	0.6	-	-
11 Aug 1980	P	180	78.6	0.6	-	-
23 Aug 1980	D3Pit	195	118.3	0.4	-	-
23 Aug 1980	D3Pit	165	59.5	0.5	-	-
Black Crappie, *Pomoxis nigromaculatus*						
12 May 1981	P	192	113.9	2.0	-	-
11 Aug 1980	P	193	123.7	0.3	-	-
11 Aug 1980	P	157	60.2	0.5	-	-
11 Aug 1980	P	197	128.1	0.5	-	-
Sauger, *Stizostedion canadense* (2)						
26 Jun 1980	D3D	428	799.0	0.4	-	-
7 Sep 1980	D3E	374	476.4	0.4	-	-
Freshwater Drum, *Aplodinotus grunniens* (9)						
7 Mar 1980	D1D	364	653.8	0.6	-	-
23 Jun 1980	D1E	429	1125.9	0.6	-	-
23 Jun 1980	D1E	295	345.0	0.3	-	-
11 Aug 1980	P	389	889.8	0.3	-	-

APPENDIX 7 -- FISH, FOOD HABITS

Table A7-1, goldeye

Table A7-2, carp

Table A7-3, shorthead redhorse

Table A7-4, channel catfish

Table A7-5, flathead catfish

Table A7-6, white bass

Table A7-7, green sunfish

Table A7-8, bluegill

Table A7-9, largemouth bass

Table A7-10, white crappie

Table A7-11, black crappie

Table A7-12, sauger

Table A7-13, freshwater drum

Table A7-14, importance of various taxa as food for fishes

Table A7-1. Food items recorded from Goldeye (Hiodon alosoides) in the lower Kansas River.

Frequency of occurrence (5 most important by site, listed to best taxonomic category available). Food items are listed, followed by a percentage value of fish containing it. ( ) = Maximum number of one item in a stomach.

Number examined. 26 ; with food. 17 ; Control. 1 ; Dredge 1. 1 ; Dredge 2. 2 ; Dredge 3. 8 ; Partial. 5 .

Control	Dredge 1	Dredge 2	Dredge 3	Partial	All Sites
1. Hexagenia.....100	1. Coleoptera.....100	1. Corixidae.....100	1. Corixidae.....88	1. Hydropsychidae.....100	1. Hydropsychidae.....60 (882)
2.	2.	2. Coleoptera.....50	2. Hydropsychidae.....63	2. Potamyia.....60	2. Corixidae.....60 (139)
3.	3.	3. Coenagrionidae...50	3. Chironomidae.....63	3. Chironomidae.....60	3. Potamyia.....47 (87)
4.	4.	4. Orthoptera.....50	4. Potamyia.....50	4. Coleoptera.....40	4. Chironomidae.....47 (8)
5.	5.	5. Potamyia.....50	5. Pentagenia.....25	5. Hexagenia.....20	5. Coleoptera.....41 (8)

Additional items in order of frequency (all sites): Hexagenia, 18; Pentagenia, 11; Taenionema, 11; Coenagrionidae, 11; Baetis, 11; Orthoptera, 11; Simulium, 6; Ephemeridae, 6; Diptera, 6; Gomphus, 6; Araneida, 6; Hymenoptera, 6.

Table A7-2. Food items recorded from Common Carp (Cyprinus carpio) in the lower Kansas River.

Frequency of occurrence (5 most important by site, listed to best taxonomic category available). Food items are listed, followed by a percentage value of fish containing it. ( ) = Maximum number of one item in a stomach.

Number examined. 44 ; with food. 18 ; Control. 3 ; Dredge 1. 4 ; Dredge 2. 0 ; Dredge 3. 3 ; Partial. 8 .

Control	Dredge 1	Dredge 2	Dredge 3	Partial	All Sites
1. Detritus.....100	1. Detritus.....100	1.	1. Detritus.....100	1. Detritus.....100	1. Detritus.....89
2. Seeds.....67	2. Chironomidae....50	2.	2. Seeds.....67	2. Chironomidae.....25	2. Seeds.....67
3. Chironomidae....33	3. Seeds.....50	3.	3. Chironomidae.....33	3. Hydropsyche.....13	3. Chironomidae.....33 (50)
4. Hydropsyche.....33	4. Hydropsyche.....25	4.	4. Hydropsyche.....33	4. Gyrinidae.....13	4. Hydropsyche.....28 (100)
5. Oligochaeta.....33	5. Hymenoptera.....25	5.	5. Corixidae.....33	5. *Cestoda.....13	5. Hymenoptera.....11 (6)

Additional items in order of frequency (all sites): Oligochaeta, 6; Coleoptera, 6; Corixidae, 6; Gyrinidae, 6.

*Cestoda - 3 parasitic tapeworms attached to muscularis of stomach in one specimen.

Table A7-6. Food items recorded from White Bass (Morone chrysops) in the lower Kansas River.

Frequency of occurrence (5 most important by site, listed to best taxonomic category available). Food items are listed, followed by a percentage value of fish containing it. ( ) = Maximum number of one item in a stomach.

Number examined. 58 ; with food. 41 ; Control. 2 ; Dredge 1. 7 ; Dredge 2. 8 ; Dredge 3. 14 ; Partial. 10 .

Control	Dredge 1	Dredge 2	Dredge 3	Partial	All Sites*
1. Fish.....100	1. Fish.....71	1. Corixidae.....63	1. Corixidae.....57	1. Corixidae.....36	1. Corixidae.....51 (697)
2. Corixidae.....50	2. Corixidae.....29	2. Fish.....38	2. Fish.....50	2. Fish.....29	2. *Fish.....51 (7)
3.	3. Hexagenia.....29	3. Hydropsychidae...13	3. Potamyia.....14	3. Hydropsychidae.....29	3. Hydropsychidae.....17 (6)
4.	4. Hydropsychidae..14	4. Daphnia.....13	4. Hydropsychidae.....7	4. Chironomidae.....14	4. Potamyia.....7 (23)
5.	5. Seeds.....14	5. Copepoda.....13	5. Chironomidae.....7	5. Lepidoptera.....14	5. Chironomidae.....7 (7)

Additional items in order of frequency (all sites): Detritus, 5; Lepidoptera, 5; Hexagenia, 5; Baetis, 2 (77); Pentagenia, 2; Simulium, 2; Daphnia, 2; Copepoda, 2; Seeds, 2.

*Fish: Notropis lutrensis, 10; Notropis atherinoides, 2; Pimephales notatus, 2; Carpiodes sp. 2; Ictalurus punctatus, 2; Pomoxis annularis, 2; Unidentified, 37.

Table A7-5. Food items recorded from Flathead (Pylodictis olivaris) in the lower Kansas River.

Frequency of occurrence (5 most important by site, listed to best taxonomic category available). Food items are listed, followed by a percentage value of fish containing it. ( ) = Maximum number of one item in a stomach.

Number examined. 71 ; with food. 39 ; Control. 8 ; Dredge 1. 10 ; Dredge 2. 4 ; Dredge 3. 8 ; Partial. 9 .

Control	Dredge 1	Dredge 2	Dredge 3	Partial	All Sites	
1. Fish.....50	1. Fish.....60	1. Fish.....100	1. Fish.....63	1. Hydropsychidae.....67	1. *Fish.....62	(8)
2. Hydropsychidae..25	2. Hydropsychidae..30	2.	2. Hydropsychidae.....25	2. Fish.....56	2. Hydropsychidae.....33	(5)
3. Isonychia.....25	3. Potamyia.....20	3.	3. Chironomidae.....13	3. Chironomidae.....33	3. Chironomidae.....13	(103)
4. Stenonema.....25	4. Orconectes.....20	4.	4. Orconectes.....13	4. Heptageniidae.....33	4. Potamyia.....10	(9)
5. Potamyia.....13	5. Chironomidae....10	5.	5. Potamyia, 13	5. Argulus.....11	5. Orconectes.....10	(2)

Additional items in order of frequency (all sites): Stenonema, 8(9); Isonychia, 5(26); Coenogrionidae, 5; Araneida, 3; Argulus, 3; Heptageniidae, 3; Baetis, 3(24).

*Fish: Unidentified, 26; Ictalurus punctatus, 26; Carpiodes sp., 10; Aplodinotus grunniens, 8; Notropis sp., 8; Notropis atherinoides, 3; Ictalurus melas, 3; Lepomis cyanellus, 3.

Table A7-4. Food items recorded from Channel Catfish (Ictalurus punctatus) in the lower Kansas River.

Frequency of occurrence (5 most important by site, listed to best taxonomic category available). Food items are listed, followed by a percentage value of fish containing it. ( ) = Maximum number of one item in a stomach.

Number examined. 130; with food. 68 ; Control. 12 ; Dredge 1. 12 ; Dredge 2. 24 ; Dredge 3. 13 ; Partial. 7 .

Control	Dredge 1	Dredge 2	Dredge 3	Partial	All Sites
1. Chironomidae....58	1. Chironomidae....58	1. Chironomidae.....92	1. Chironomidae.....77	1. Chironomidae.....100	1. Chironomidae.....81 (571)
2. Hydropsychidae..42	2. Tipulidae.....33	2. Potamyia.....67	2. Potamyia.....62	2. Bryozoa.....100	2. Potamyia.....44 (172)
3. Hexagenia.....25	3. Potamyia.....25	3. Hydropsychidae...58	3. Hydropsychidae.....46	3. Potamyia.....14	3. Hydropsychidae.....38 (64)
4. Cicadidae.....25	4. Simulium.....17	4. Hexagenia.....42	4. Bryozoa.....23	4. Heleidae.....14	4. Hexagenia.....21 (52)
5. Potamyia.....17	5. Nematomorpha....17	5. Corixidae.....33	5. Heleidae.....15	5. Corixidae.....14	5. Corixidae.....19 (5)

Additional items in order of frequency (all sites): Bryozoa, 16; Misc. terrestrial insects, 13; Heleidae, 13; Pentagenia, 12; Coenagrionidae, 12; Simulium, 10; Tipulidae, 10; Orthoptera, 10; Stenonema, 7, Cicadidae, 6; Araneida, 6; Nematomorpha, 6; *Fish, 4; Lepidoptera, 4; Coleoptera, 4; Elmidae, 4; Caenis, 4; Mulberries, 4; Corydalus, 4; Orconectes, 3; Diplopoda, 3; Chilopoda, 3; Isonychia, 3; Odonata, 3; Heptagenia, 3; Hymenoptera, 3; Gomphus, 3; Coleoptera, 3; Oligochaeta, 2; Isopoda, 2; Dytiscidae, 2; Nectopsyche, 2; Isoperla, 2; Neoperla, 2; Perlesta, 2; Gastropoda, 2; Diptera 2; Tabanidae, 2; Baetis, 2; Phalangida, 2; Leptoceridae 2; Homoeoneuria, 2; Acroneuria, 2; Muscidae, 2.

*Fish: Notropis stramineus, 2; Notropis sp., 2.

Table A7-3. Food items recorded from Shorthead Redhorse (*Moxostoma macrolepidotum*) in the lower Kansas River.

Frequency of occurrence (5 most important by site, listed to best taxonomic category available). Food items are listed, followed by a percentage value of fish containing it. ( ) = Maximum number of one item in a stomach.

Number examined. 17 ; with food. 6 ; Control. 0 ; Dredge 1. 2 ; Dredge 2. 1 ; Dredge 3. 0 ; Partial. 3 .

Control	Dredge 1	Dredge 2	Dredge 3	Partial	All Sites	
1.	1. Chironomidae...100	1. Chironomidae....100	1.	1. Chironomidae.....100	1. Chironomidae.....100	(35)
2.	2. *Hydropsyche*.....50	2.	2.	2. Detritus.....100	2. Periphyton.....50	
3.	3. Nematoda.....50	3.	3.	3. *Potamyia*.....33	3. *Hydropsyche*.....33	(2)
4.	4.	4.	4.	4. *Hydropsyche*.....33	4. *Potamyia*.....17	(3)
5.	5.	5.	5.	5. Ephemeroptera.....33	5. Ephemeroptera.....17	(3)

Additional items in order of frequency (all sites): Nematoda, 17.

Table A7-8. Food items recorded from Bluegill (*Lepomis macrochirus*) in the lower Kansas River.

Frequency of occurrence (5 most important by site, listed to best taxonomic category available). Food items are listed, followed by a percentage value of fish containing it. ( ) = Maximum number of one item in a stomach.

Number examined. 28 ; with food. 14 ; Control. 1 ; Dredge 1. 6 ; Dredge 2. 1 ; Dredge 3. 2 ; Partial. 4 .

Control	Dredge 1	Dredge 2	Dredge 3	Partial	All Sites
1. Chironomidae...100	1. Chironomidae....33	1. Chironomidae....100	1. Chironomidae.....100	1. Chironomidae.....100	1. Chironomidae.....71 (162)
2. *Potamyia*.....100	2. *Hydropsyche*.....33	2. Coenagrionidae..100	2. Hydropsychidae.....50	2. Hydropsychidae.....25	2. Hydropsychidae.....29 (11)
3. Corixidae.....100	3. Corixidae.....33	3.	3. Corixidae.....50	3.	3. Corixidae.....29 (3)
4.	4. *Gomphus*.....33	4.	4.	4.	4. *Gomphus*.....14 (5)
5.	5. Gastropoda.....33	5.	5.	5.	5. Gastropoda.....14 (1)

Additional items in order of frequency (all sites): Diplopoda, 14; *Potamyia*, 14; Coenagrionidae, 7; *Stenonema*, 7; *Hexagenia*, 7; Tipulidae, 7; *Perlesta*, 7; *Isonychia*, 7; Acarina, 7; Chilopoda, 7; Heleidae, 7.

Table A7-7. Food items recorded from Green Sunfish (Lepomis cyanellus) in the lower Kansas River.

Frequency of occurrence (5 most important by site, listed to best taxonomic category available). Food items are listed, followed by a percentage value of fish containing it. ( ) = Maximum number of one item in a stomach.

Number examined. 12 ; with food. 7 ; Control. 0 ; Dredge 1. 3 ; Dredge 2. 0 ; Dredge 3. 1 ; Partial. 3 .

Control	Dredge 1	Dredge 2	Dredge 3	Partial	All Sites
1.	1. Fish.....33	1.	1. Chironomidae.....100	1. Chironomidae.....67	1. Chironomidae.....43 (61)
2.	2. Diptera.....33	2.	2. Corixidae.....100	2. Corixidae.....67	2. Corixidae.....43 (5)
3.	3. Nematomorpha....33	3.	3.	3. Potamyia.....33	3. Potamyia.....14
4.	4. Lepidoptera.....33	4.	4.	4. Insecta (Terr.).....33	4. Diptera.....14
5.	5. Acarina.....33	5.	5.	5.	5. *Fish.....14

Additional items in order of frequency (all sites): Nematomorpha, 14; Lepidoptera, 14, Acarina, 14; Diplopoda, 14; Gastropoda, 14; Insecta (Terr.), 14.

*Fish: Notropis sp., 14.

Table A7-9. Food items recorded from Largemouth Bass (Micropterus salmoides) in the lower Kansas River.

Frequency of occurrence (5 most important by site, listed to best taxonomic category available). Food items are listed, followed by a percentage value of fish containing it. ( ) = Maximum number of one item in a stomach.

Number examined. 5 ; with food. 4 ; Control. 0 ; Dredge 1. 2 ; Dredge 2. 0 ; Dredge 3. 0 ; Partial. 2 .

Control	Dredge 1	Dredge 2	Dredge 3	Partial	All Sites	
1.	1. Fish.....100	1.	1.	1. Fish.....50	1. *Fish.....75	(2)
2.	2.	2.	2.	2. Corixidae.....50	2. Corixidae.....25	(2)
3.	3.	3.	3.	3.	3.	
4.	4.	4.	4.	4.	4.	
5.	5.	5.	5.	5.	5.	

*Fish: Notropis atherinoides, 25; Notropis lutrensis, 25; Unidentified Fish, 50.

Table A7-10. Food items recorded from White Crappie (Pomoxis annularis) in the lower Kansas River.

Frequency of occurrence (5 most important by site, listed to best taxonomic category available). Food items are listed, followed by a percentage value of fish containing it. ( ) = Maximum number of one item in a stomach.

Number examined. 59 ; with food. 51 ; Control. 8 ; Dredge 1. 11 ; Dredge 2. 10 ; Dredge 3. 13 ; Partial. 9 .

Control	Dredge 1	Dredge 2	Dredge 3	Partial	All Sites
1. Hydropsychidae..75	1. Fish.....82	1. Fish.....60	1. Corixidae.....85	1. Corixidae.....100	1. *Fish.....61 (35)
2. Fish.....63	2. Hydropsychidae..55	2. Corixidae.....40	2. Hydropsychidae.....62	2. Chironomidae.....78	2. Corixidae.....61 (15)
3. Corixidae.....25	3. Corixidae.....46	3. Hydropsychidae...30	3. Fish.....54	3. Hydropsychidae.....56	3. Hydropsychidae.....55 (39)
4. Chironomidae....13	4. Chironomidae....27	4. Chironomidae.....30	4. Chironomidae.....23	4. Fish.....44	4. Chironomidae.....33 (17)
5. Diptera.....13	5. Ephemeroptera...27	5. Hexagenia.....10	5. Hexagenia.....15	5. Potamyia.....22	5. Hexagenia.....12 (2)

Additional items in order of frequency (all sites): Trichoptera, 6; Ephemeroptera, 6; Heptagenia, 4; Potamyia, 4; Isoperla, 2; Seeds, 2; Hemiptera, 2; Tipulidae, 2; Orthoptera, 2; Diptera, 2; Orconectes, 2.

*Fish: Notropis lutrensis, 20; Notropis stramineus, 2; Notropis sp., 10; Lepomis sp., 2; Aplodinotus grunniens, 2; Unidentified, 39.

Table A7-14. Relative importance of major taxa of aquatic invertebrates and fish in the diet of selected fishes in the lower Kansas river.
+ = Considered important diet component
- = Present in diet, but of minor importance

		[INVERTEBRATES														][FISH			]
		O. Oligochaeta	O. Decapoda	O. Coleoptera	O. Diptera	O. Ephemeroptera	O. Hemiptera	O. Megaloptera	O. Odonata	O. Plecoptera	O. Trichoptera	C. Gastropoda	C. Pelecypoda	P. Nematoda	P. Menatomorpha	O. Clupeiformes	O. Cypriniformes	O. Siluriformes	O. Perciformes
Shovelnose Sturgeon				-	+	-	+		-	-	+								
Longnose Gar						-										-	+	-	-
Shortnose Gar			+	+		-		-								-	+	-	-
Gizzard Shad																			
Skipjack Herring																	+		
Goldeye				-	+	-	+		-		+								
Common Carp		-		-	+						+								
Emerald Shiner		-			+		+		-		-								
River Shiner					+						-								
Red Shiner				+	+	-		-											
Sand Shiner				-	+				-		-								
Blue Sucker	(I)																		
Bigmouth Buffalo	(I)																		
Smallmouth Buffalo					+	+					-								
Shorthead Redhorse					+	-					+			-					
River Carpsucker																			
Black Bullhead																	+		
Channel Catfish		-	-	-	+	+	+	-	+	-	+	-			-		-		
Flathead Catfish			+		+	+			-		+						+	+	-
Stonecat					+						+								
White Bass					+	+	+				+						+	-	-
Green Sunfish					+	-	+				-	-	-		-		-		
Bluegill Sunfish					+	-	+		+	-	+	-							
O.-spotted Sunfish	(I)																		
Longear Sunfish	(I)																		
Largemouth Bass							+										+		
White Crappie			-		+	-	+			-	+						+		-
Black Crappie				-	+	-	+				+						-		
Sauger																	+		-
Freshwater Drum		-	-		+	+	-				+	-					-		

I = Insufficient Data

Table A7-13. Food items recorded from Freshwater Drum (Aplodinotus grunniens) in the lower Kansas River.

Frequency of occurrence (5 most important by site, listed to best taxonomic category available). Food items are listed, followed by a percentage value of fish containing it. ( ) = Maxmium number of one item in a stomach.

Number examined. 55 ; with food. 31 ; Control. 8 ; Dredge 1. 7 ; Dredge 2. 3 ; Dredge 3. 8 ; Partial. 5 .

Control	Dredge 1	Dredge 2	Dredge 3	Partial	All Sites
1. Chironomidae....50	1. Chironomidae....43	1. Corixidae.....100	1. Chironomidae.....75	1. Chironomidae.....80	1. Chironomidae.....61 (159)
2. Hydropsychidae..50	2. Hydropsychidae..29	2. Chironomidae.....67	2. Hydropsychidae.....50	2. Heptageniidae.....40	2. Hydropsychidae.....42 (112)
3. Fish.....50	3. Fish.....29	3. Hydropsychidae...67	3. Hexagenia.....25	3. Hydropsychidae.....20	3. *Fish.....23 (3)
4. Heptageniidae...25	4. Hexagenia.....29	4. Fish.....33	4. Baetis.....25	4. Hexagenia.....20	4. Baetis.....19 (5)
5. Hexagenia.....13	5. Baetis.....14	5. Baetis.....33	5. Corixidae.....13	5. Baetis.....20	5. Hexagenia.....19 (2)

Additional items in order of frequency (all sites): Corixidae, 16; Heptageniidae, 13; Potamyia, 10; Stenonema, 7; Leptoceridae, 7; Oligochaeta, 7; Ceratopogonidae, 3; Trichoptera, 3; Orconectes, 3; Isonychia, 3; Gastropoda, 3.

*Fish: Carpoides sp., 7; Notropis lutrensis, 3; Notropis stramineus, 3; Pimephales vigilax, 3; Unidentified, 10.

Table A7-11. Food items recorded from Black Crappie (*Pomoxis nigromaculatus*) in the lower Kansas River.

Frequency of occurrence (5 most important by site, listed to best taxonomic category available). Food items are listed, followed by a percentage value of fish containing it. ( ) = Maximum number of one item in a stomach.

Number examined. 14 ; with food. 7 ; Control. 0 ; Dredge 1. 2 ; Dredge 2. 0 ; Dredge 3. 1 ; Partial. 4 .

Control	Dredge 1	Dredge 2	Dredge 3	Partial	All Sites
1.	1. *Hexagenia*.....100	1.	1. Fish.....100	1. *Hydropsyche*.....100	1. Corixidae.....57 (37)
2.	2.	2.	2. Corixidae.....100	2. Corixidae.....75	2. *Hydropsyche*.....57 (17)
3.	3.	3.	3.	3. Chironomidae.....50	3. *Fish.....29 (10)
4.	4.	4.	4.	4. Elmidae.....25	4. Chironomidae.....29 (4)
5.	5.	5.	5.	5. Fish.....25	5. *Hexagenia*.....29 (4)

Additional items in order of frequency (all sites): Elmidae, 14; Coleoptera, 14; Hymenoptera, 14.

*Fish: *Notropis* sp. 14; *Notropis stramineus*, 14; *Carpiodes* sp., 14.

Table A7-12. Food items recorded from Sauger (Stizostedion canadense) in the lower Kansas River.

Frequency of occurrence (5 most important by site, listed to best taxonomic category available). Food items are listed, followed by a percentage value of fish containing it. ( ) = Maximum number of one item in a stomach.

Number examined. 9 ; with food. 6 ; Control. 0 ; Dredge 1. 0 ; Dredge 2. 0 ; Dredge 3. 3 ; Partial. 3 .

Control	Dredge 1	Dredge 2	Dredge 3	Partial	All Sites*	
1.	1.	1.	1. Carpiodes sp.....33	1. Aplodinotus grunniens...33	1. Carpiodes sp.....33	(1)
2.	2.	2.	2. Cyprinus carpio.....33	2. Carpiodes sp.....33	2. Notropis lutrensis.....17	(4)
3.	3.	3.	3. Notropis lutrensis..33	3. Lepomis sp.....33	3. Lepomis sp.....17	(2)
4.	4.	4.	4.	4.	4. Cyprinus carpio.....17	(1)
5.	5.	5.	5.	5.	5. Aplodinotus grunniens..17	(1)

*Specimens examined entirely piscivorous.