MELVIN PRICE LOCKS AND DAM

UPPER MISSISSIPPI RIVER BASIN
MISSISSIPPI RIVER MISSOURI AND ILLINOIS

PROGRESS REPORT 2007 - 2009

DESIGN MEMORANDUM NO. 24
AVOID AND MINIMIZE MEASURES

US Army Corps of Engineers
St. Louis District®

"Good engineering enhances the environment"

JULY 2010

Cover photo

St. Louis Harbor Chevron Construction. Three chevrons were designed and constructed in the fall of 2007 within the St. Louis Harbor of the Upper Mississippi River System between river miles 183 and 182. Island development in the shadow of the chevrons was seen the following summer when spring river levels fell. Post construction fish sampling is ongoing and is targeted for completion in Fall 2010.

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2007 - 2009 PROGRESS REPORT

MELVIN PRICE LOCKS AND DAM
MISSISSIPPI RIVER - MISSOURI AND ILLINOIS

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Table of Contents

Avoid and Minimize Environmental Impacts Program
St. Louis District - Mississippi Valley Division
2007-2009 Progress Report

Executive Summary

The St. Louis District agreed to establish an Avoid and Minimize Program (A&M) in 1992 to reduce possible environmental impacts of increased navigation traffic due to construction of a second lock at Melvin Price Locks and Dam. Expenditures in the program average around $826,000 a year. Full-scale implementation of the program began in 1996. Direction of the program is coordinated through the River Resource Action Team, which consists of state, federal and private partners in both natural resources and industry.

Several construction efforts funded through the Avoid and Minimize Program were made between 2007 and 2009. In 2007, the dike at river mile 75.5L was notched. This dike is located at Union Point/Wilson Landing just below the mouth of the Big Muddy River. In 2009, another dike just below this one was also notched at river mile 75.2L. Between 2007 and 2009, 15 multiple round point structures were built at river mile 257.2L, eight multiple round point structures were built at river mile 256.8L, and eighteen were built at river mile 255.7L, near and adjacent to Kelly Island. In 2008, adjacent to Carroll Island, two chevrons (river miles 270.5L and 269.3L) were constructed. Also adjacent to Carroll Island, 3 dikes were raised at river miles 269.7L, 268.9L, 268.6L. In 2008 construction took place at Jones Chute following recommendations from the 2004 Hydraulic Sediment Response Model (HSR). Thirteen hardpoints were built in the lower portion of the chute between river miles 95.8R and 96.5R and the closing structure at the lower end of the chute was notched. In addition, several banks in the chute and main channel border were revetted, two dikes were built and parts of three dikes were removed (see Jones Chute HSR model described below for more detail). Finally, in 2009, a W dike was built at river mile 221.0L between Squaw Island and Mason Island.

One biological monitoring report was submitted to the Corps from the Missouri Department of Conservation (MDC) in 2007. In 2001, the U.S. Army Corps of Engineers, St. Louis District issued a river regulating work plan for the Fort Chartres reach of the Middle Mississippi River (MMR, river miles 140.0 – 125.0). The plan detailed several dike extensions or modifications and the construction of new dikes, chevrons, and weirs at the Establishment Island complex (~river miles 134.0 – 128.0). The purpose of this work is to deepen the channel crossover and to provide additional width in the bend thereby reducing/eliminating dredging and providing a safe and dependable navigation channel. As part of the pre-project monitoring plan, fishes were sampled seasonally by MDC in the Establishment and Kaskaskia Islands complexes from fall 2002 through summer 2004 using seining, day-time electrofishing, and Missouri Trawling. Effort was duplicated at the Kaskaskia Island complex, using it as a “pseudo-control” to help explain observations and variation. The sampling reach for Kaskaskia Island was between RM’s 119.0 and 115.0.

The St. Louis District Corps is conducting a fisheries study for the St. Louis Harbor chevron dike project between river miles 181.5 and 183R. The study is comparing before and after fish communities in the St. Louis Harbor of the Upper Mississippi River System after the construction of three chevron dikes between the McKinley Bridge and the Merchant's Bridge. Pre-construction monitoring was done from September 2006 thru July 2007 and post-construction sampling was done from August 2008 thru October 2009. The research suggests that the chevron dikes increase habitat diversity, species abundance and total fish retrieved over a given time, known as catch per unit effort, as compared to the open river habitat.

In September 2007, a reconnaissance-level, pre-project fisheries study was initiated by the St. Louis Corps for the ecosystem benefits component of the Jones Chute (river miles 100.0 – 95.0) Hydraulic Sediment Response (HSR) model. Rockwood Island (river miles 103.0-101.0L) was sampled as a control area. Electrofishing was conducted and the species, with number captured, is listed in the table below. The study intended to use electrofishing and benthic trawling to look at changes in the fish community structure in Jones Chute as a result of HSR recommended modifications. A number of hardpoints, dike modifications (removal and notching), and revetment were added or changed in the chute during 2008.

A micro-model study was done in 2006 on the Upper and Lower Jones Chutes between river miles 100.0 and 95.0R in 2006 (Report dated 2007). This study was done for the purpose of evaluating environmental design alternatives for the development of side channel habitat. Currently these chutes are dry during low water periods. The goal of this study is to develop a way to increase the amount of flow through these chutes utilizing the existing stone dike structures in and around these waters (see Appendix H). Currently several dikes exist in the chutes with two of them acting as closing structures. The construction of the recommended alternative should increase flow through the chutes and improve habitat diversity without negatively affecting the navigation channel.

Avoid and Minimize
Environmental Impacts Program
St. Louis District - Mississippi Valley Division
2007-2009 Progress Report

In October 1992, the St. Louis District issued Design Memorandum No. 24, "Avoid and Minimize Measures, Melvin Price Locks and Dam, Upper Mississippi River - Missouri and Illinois." The document was developed as a commitment made in the 1988 Record of Decision attached to the Melvin Price Locks and Dam Environmental Impact Statement for the Second Lock. St. Louis District set aside funds from 1989 to 1995 to implement eight measures recommended by the study team. Implementations of measures in that part of the program were detailed in the 1995 Progress Report. In fiscal year 1996, O&M funds were received to begin full-scale implementation of recommended measures. The planning and implementation team consists of staff from the US Army Corps of Engineers, U.S. Fish and Wildlife Service (FWS), Illinois Department of Natural Resources (IDNR), Missouri Department of Conservation (MDOC), River Industry Action Committee (RIAC), and the Long Term Resource Monitoring Field Station (LTRM/MDOC) at Jackson, Missouri. Each group contributes staff time to plan and attend meetings and may collect data as part of an ongoing monitoring program. This team meets at least once a year, recently as members of the River Resources Action Team (RRAT), to discuss ongoing work and planned future work. Outside of these meetings the St. Louis District routinely corresponds with the team to coordinate monitoring and solicit ideas and input.

2007-2009 A&M Program Activities

A&M 1. 2007-2009 Construction. A&M funded

Several construction efforts funded through the Avoid and Minimize Program were made between 2007 and 2009. In 2007, the dike at river mile 75.5L was notched. This dike is located at Union Point/Wilson Landing just below the mouth of the Big Muddy River. In 2009, another dike just below this one was also notched at river mile 75.0L. Between 2007 and 2009, 15 multiple round point structures were built at river mile 257.2L, eight multiple round point structures were built at river mile 256.8L, and eighteen were built at river mile 255.7L, near and adjacent to Kelly Island. In 2008, adjacent to Carroll Island, two chevrons (river miles 270.5L and 269.3L) were constructed. Also adjacent to Carroll Island, 3 dikes were raised at river miles 269.7L, 268.9L, 268.6L. In 2008 construction took place at Jones Chute following recommendations from the 2004 Hydraulic Sediment Response Model (HSR). Thirteen hardpoints were built in the lower portion of the chute between river miles 95.8R and 96.5R and the closing structure at the lower end of the chute was notched. In addition, several banks in the chute and main channel border were revetted, two dikes were built and parts of tree dikes were removed (see Jones Chute HSR model described below for more detail). Finally, in 2009, a W dike was built at river mile 221.0L between Squaw Island and Mason Island.

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.**A&M 2. Biological Monitoring**

Establishment Island, Missouri Department of Conservation. In 2001, the U.S. Army Corps of Engineers, St. Louis District issued a river regulating work plan for the Fort Chartres reach of the

Middle Mississippi River (MMR, river miles (RM) 140.0 – 125.0). The plan detailed several dike extensions or modifications and the construction of new dikes, chevrons, and weirs at the Establishment Island complex (~RM 134.0 – 128.0). The purpose of this work is to deepen the channel crossover and to provide additional width in the bend.

Fishes were sampled seasonally in the Establishment and Kaskaskia Islands complexes from fall 2002 through summer 2004 using seining, day-time electrofishing, and Missouri Trawling. Effort was duplicated at the Kaskaskia Island complex, using it as a "pseudo-control" to help explain observations and variation. The sampling reach for Kaskaskia Island was between RM's 119.0 and 115.0.

Cyprinidae were numerically the most abundant family found in all three habitat strata. Clupeids, primarily gizzard shad, were the next most abundant group in all habitat strata except in crossover habitat in year 1 and in inside bend habitat in Establishment Island in year 1. Ictalurids, primarily channel catfish were numerically more abundant than gizzard shad in those habitats during those times. Acipenseridae (sturgeons) appeared to be proportionally more abundant in inside bend habitat and Moronidae (primarily white bass, *Morone chrysops*) seems to show some affinity for channel crossovers. Hiodonts (mooneye and goldeye, *Hiodon alosoides*) were proportionally more abundant in the second year in inside bend and crossover habitats. The side channel strata seem to be important for many species that do not frequent the crossovers and inside bend strata. For example, darters species and sauger *(Sander canadensis*, Percidae) and a host of miscellaneous families, such as Poeciliidae (primarily western mosquitofish, *Gambusia affinis*), Atherinidae (2 species of silversides), and members of the Cyprinidae that typically are not associated with large rivers in Missouri (such as pugnose minnow). Further analyses (ordination) will be needed to better explain the distribution and habitat use by fish species and guilds, but this does show that despite some environmental variation, there are some consistencies in species/habitat use between the island complexes, setting the stage for post-construction evaluation at Establishment Island.

St. Louis Harbor, St. Louis Corps. This study compares before and after fish communities in the St. Louis Harbor of the Upper Mississippi River System after the construction of three chevron dikes in the fall of 2007 between the McKinley Bridge and the Merchant's Bridge Three chevrons were designed and constructed in the fall of 2007 within the St. Louis Harbor (river miles 183 and 182). The research suggests that the chevron dikes increase habitat diversity, species abundance and total fish retrieved over a given time, known as catch per unit effort, as compared to the open river habitat.

One of the primary functions of chevron dikes is to improve navigation, but the shape and location of the chevron was designed to also improve environmental benefits. As navigation increased and other features, such as levees, were constructed, many backwater areas and unique habitats found throughout the Mississippi started to decrease. Determining the benefits of chevron dikes will be highly beneficial to the Corps in helping design future projects within the Upper Mississippi River System.

The primary objectives of the study are to 1) determine changes in fish communities due to construction of chevron dikes in the St. Louis Harbor as compared to pre-construction open river habitat and, 2) determine changes in habitat diversity as a result of construction of the chevron dikes in the St. Louis Harbor as compared to pre-construction open river habitat. Day electrofishing and benthic trawling were conducted along transects at the construction site and a downstream control area. Bathymetry surveys were also conducted to look at changes in bottom structure as a result of changes in flow and velocity.

Overall, the main channel chevron dikes have improved habitat diversity and diversified the current fish community Habitat diversity, species abundance, catch per unit effort and total number fish species have increased following the construction of the main channel chevrons

A&M 3. ***Hydraulic Sediment Response (HSR) Model Studies- Full reports of the following studies can be found on the St. Louis District's Centers of Expertise web site under Reports: http://www.mvs.usace.army.mil/arec/index.html***

Jones Chute, MRM 100.0-95.0 (Mary M. Miles et al. 2007)

The U.S. Army Corps of Engineers, St. Louis District initiated a study of the Upper Mississippi River between Miles 100.0 and 95.0, approximately ten miles downstream of Chester, Illinois. Funded as part of the Avoid and Minimize Program, the main purpose of the study was to evaluate environmental design alternatives in the Upper and Lower Jones Chutes for the development of side channel habitat, utilizing an existing dike field and island complex on the Mississippi River. In addition, a primary goal was to diversify aquatic habitat in the Upper and Lower Jones Chute by modifying present dike structures, developing new side channels and bar formations while maintaining the integrity of the navigation channel.

The Upper and Lower Jones Chutes can lose their connectivity with the main channel and become dry during low water periods. The main goal of the first phase of this study was to investigate alternatives to direct more flow through the two chutes in this section of the Mississippi River without causing negative effects to the navigation channel. Increased flow to the chutes will allow for more aquatic habitat diversity. Fish species thrive in slow, shallow channels, deep pools and around bar formations.

An alternative was recommended due to its ability to increase the depth of water in both the Upper and Lower Jones Chutes.

The recommended design includes the following:

- Notch Dike 98.4R 200 ft from the RDB to a depth of 0 ft LWRP. Raise remaining portions of Dike 98.4R to +18 ft LWRP.
- Construct a longitudinal closure structure from end of notch in Dike 98.4R to Liberty bar to +18 ft LWRP.
- Remove the portions of Dikes 97.5R and 97.0R that are contained within the Upper Jones Chute side channel.
- Construct a longitudinal closure structure between Liberty Bar and Jones Towhead to +18 ft LWRP with a 100 ft.- top width, v-notch on center to +5 ft LWRP invert.

- This closure structure will keep the flow entering Upper Jones Chute from exiting the side channel complex between Upper and Lower
- Notch closure structure 95.8R in the Lower Jones Chute channel. Notch will be 150 ft wide on center and to a depth of 0 ft LWRP.

Additional considerations to the above model design are the revetment of all bank lines inside both the Upper and Lower Jones Chutes. Revetment will also be needed along the upstream end of Liberty Bar extending to the closure structure between Liberty Bar and the notch in Dike 98.4R.

FY 2007-2009 A&M Program

St. Louis District Avoid and Minimize Program
Dollars Expended, 1996 - 2009

Fiscal Year	Total Expended
FY 1996	1,054,000
FY 1997	1,489,000
FY 1998	1,060,000
FY 1999	1,040,000
FY 2000	421,000
FY 2001	684,439
FY 2002	148,221
FY 2003	684,823
FY 2004	568,717
FY 2005	939,568
FY 2006	526,671
FY 2007	865,053
FY 2008	1,108,024
FY 2009	977,021
	11,566,537

TOTAL A&M PROGRAM
DOLLARS THROUGH FY 2009

Appendix A

The Effects of Existing and New Channel Realignment Structures on the Fish Communities of the Establishment Island Complex in the Middle Mississippi River: Results from Study Years 2002-2004 – Missouri Department of Conservation

Prepared for:
U.S. Army Corps of Engineers
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16 November 2007

PROGRESS REPORT: The Effects of Existing and New Channel Realignment Structures on the Fish Communities of the Establishment Island Complex in the Middle Mississippi River: Results from Study Years 2002-2004

Introduction

In 2001, the U.S. Army Corps of Engineers, St. Louis District issued a river regulating work plan for the Fort Chartres reach of the Middle Mississippi River (MMR, river miles (RM) 125.0 – 140.0; Appendix A). The plan detailed several dike extensions or modifications and the construction of new dikes, chevrons, and weirs at the Establishment Island complex (~RM 128.0 – 134.0). The purpose of this work is to deepen the channel crossover and to provide additional width in the bend. There have been 2 collisions and 18 groundings in this reach in the last 20 years (U.S. Coast Guard Database, Mary Miles, St. Louis COE, unpublished data; Edward Brauer, personal communication). Over 2.93 million cubic yards of material has been dredged and disposed on top of existing habitat from this reach in the last 12 years (Mike Rodgers, St. Louis COE, unpublished data; Edward Brauer, St. Louis COE, personal communication). That is equal to approximately 942 total barge loads of material or 79 barge loads of dredged material for each year of dredging.

Scientists have shown that bendways, channel crossovers, and inside bends may be important habitat for many obligate main channel fishes in the MMR. Channel crossovers are difficult to sample because they exist in or near the navigation channel in deep, swift water. The most effective gear to sample channel crossovers is a trawl (see Herzog et al., 2005). Trawling has primarily been conducted in the main channel border habitat stratum, thus channel crossovers and deep bendways have been poorly sampled using traditional fisheries techniques. Sixteen of thirty-six bends in the MMR contain weirs (known as Bendway Weirs; Davinroy, 1990), which were designed to widen the bend thereby reducing the need for dredging, improving safety and alleviating groundings and collisions, and minimizing the need for barges to flank through the bendway. Efforts have been made to document fish use and measure the effect of weirs on fish communities in bendways (see Keevin et al., 2002). Inside bend habitat, less channel crossovers and the navigation channel, has been sampled extensively by ORWFS scientists and others who have documented use by pallid sturgeon (*Scaphirhynchus albus*, see Hrabik et al., 2007), *Macrhybopsis* chubs (Herzog, 2004), and Ohio shrimp (*Macrobrachium ohione*, Barko and Hrabik, 2004), all listed species in Missouri (Missouri Department of Conservation, 2007). Pallid Sturgeon, a federally endangered species, has been collected in the Establishment Island complex and is a species of concern in the project area.

Although river training structures do provide habitat for fish species, Barko et al. (2004) suggested that some species may use the wing dike habitat as a substitute for inaccessible offshore areas with lower water velocities. There is concern from our partner agencies that fish species important to the ecology of the MMR as well as obligate main channel fishes that rely on inside bends and channel crossovers (see Galat and Zweimuller, 2001; Dettmers et al., 2001) would be adversely affected (reduced locally in number because of habitat modification) by the addition and modification of channel training structures in the Establishment Island complex.

The objectives of this 4-year study are to: 1) document the habitat and existing fish assemblage in the Establishment Island complex including the side channel, channel crossovers, and inside bend shoals and bars, 2) re-document the habitat and existing fish assemblage after completion of the channel regulating projects to detect changes, and 3) recommend mitigation measures in the Establishment Island complex, if necessary, and suggest policy measures for future work planned in other reaches. This report summarizes the biological results from sampling during the pre-construction period. Physical monitoring of the island complexes through bathymetry will be performed by the St. Louis District, Corps of Engineers. We only provide a descriptive analysis of the data at this point in time as trend information and cause and effect can not be determined until after the post-construction evaluation period.

Methods

Fishes were sampled seasonally in the Establishment and Kaskaskia Islands complexes from fall 2002 through summer 2004 using seining, day-time electrofishing, and Missouri Trawling (Herzog, et al., 2005). We duplicated our effort at the Kaskaskia Island complex, using it as a “pseudo-control” to help explain observations and variation. The sampling reach for Establishment Island was between RM 138.2 and 143.7 and the sampling reach for Kaskaskia Island was between RM 124.3 and 128.6 (Figure 1).

Sample sites were identified by 400 x 400 m grids indexed with Universal Transverse Mercator (UTM) coordinates and superimposed over each sampling area using ArcGIS (version 3.3) software. The grids were separated by inside bend, channel crossover, and side channel macrohabitats and then individually numbered. Sampling locations were randomly selected within each macrohabitat. Alternate sampling locations were also randomly chosen when selected sites could not be sampled or when additional sites were needed after detection of new species (see below). A Garmin GPSmap 168 Sounder/Global Positioning System with differential correction was used to locate sampling sites.

Macrohabitats were determined visually using a navigation map of the two areas and then verifying the delineations by field reconnaissance. Crossover (XO) areas are found where the channel thalweg moves from primarily one side of the channel to the other side. This usually occurs upstream and downstream of a bend in the river. We delineated sections of the river where crossovers occurred both above and below the island complexes for sampling. The inside bend (ISB) areas extend from where the crossover stratum ended at the top of the bend to where the crossover began at the bottom of the bend. Side channel (SC) strata included any secondary or tertiary channels lying landward of the islands (Figure 2).

For each sampling gear type, a minimum of 3 sites were selected within each of the 3 macrohabitats (i.e., bendway, crossover, and side channel) in each island complex. Therefore, 1 unit of effort per gear type was employed at one site in each macrohabitat for a minimum of 3 sites. If a new species was captured while sampling the third site, another site was selected for sampling. Additional sites were selected until no new species were captured. Each gear had its own set of randomly chosen site numbers in each macrohabitat. Only one gear type was used in each grid, but there was the possibility that a grid could be sampled again using another gear type.

Water physical parameters were measured near the center of each sampling site and included dissolved oxygen (mg/l), water temperature (ºC), specific conductance (µS/cm), Secchi disk transparency (cm), and average (estimated) water depth (m). Surface water velocity (measured 20 cm below the water surface in m/sec), bottom water velocity (measured 20 cm above the substrate in m/sec), turbidity (NTU), and pH were added during the second year to provide additional parameters to the water physical data set. Water physical parameters were measured using a Hydrolab® Minisonde™ (a multiprobe instrument). We used a Hydrolab® Surveyor 4™ Water Quality Data Display to visualize parameter readings and transfer data from the Hydrolab Minisonde. Water velocity measurements were taken with a Marsh-McBirney Flo-mate™ Model 2000 flow meter. Turbidity measurements were taken with a Hach 2100P portable turbidity meter. Qualitative appraisals of substrate composition, vegetation, and other proximate structures were also recorded as we measured water quality parameters.

Seining was used to collect small fishes in shallow areas. Seines were made of "Ace"-style nylon netting with a mesh size of 3 mm (1/8 inch). Seines were 10.7 m (35 ft) long and 1.8 m (6 ft) high, with a square bag measuring 0.9-m (3-ft) on each side located at the center of the net. A mudline was attached to the seine to skim over soft sediments, thereby reducing heavy sediment loads in the bag.

Seines were employed along shorelines in water not exceeding 1.2 m (4 ft) deep. Seining effort at a site was standardized at 5 minutes of net time in the water. A seine haul was completed slowly to ensure that the lead line remained in contact with the river bottom and that the float line remained on the surface of the water at all times. A single seine haul was usually about 30 seconds long, but varied based on the judgment of the crew leader. In areas where snags were anticipated, a third person patrolled the back of the seine, clearing the lead line as necessary to keep it in contact with the bottom substrate while attempting to minimize disturbance to fish in front of the seine. If the haul was interrupted by a snag, that in the judgment of the crew leader required an excessive amount of clearing time, the seine haul was terminated and a new haul was initiated in undisturbed water. Data from all hauls were combined into one unit of effort over the entire 5 minutes.

Standardized electrofishing was conducted according to LTRMP fish monitoring protocols (Gutreuter, et al., 1995) in aquatic areas where water depth ranged from approximately 0.5 – 3.0 m. Electrofishing effort was recorded in time (minutes) the generator was transferring electrical current into the water, regulated by a LTRMP control box. Stunned fish were collected using two persons equipped with 30-cm (12-inch) deep, 3-mm (1/8-inch) diameter mesh dip nets (Duraframe Electro-regular D) on 2.4-m (8-ft) fiberglass handles. Dip netters collected each fish as it appeared, regardless of size or species. Collected fish were placed in a holding tank until the run was terminated. Unusual species or specimens that were observed but not collected during the run were noted by the crew and reported in a comments section on the data sheet, however these observations are not entered into the data set for analysis.

Before beginning an electrofishing run, the crew reviewed the description of the area to be sampled and the collection site boundaries. Surface conductivity and water temperature were measured and used to identify the proper settings to reach the desired electrical power goal of 3,000 W. A standard electrofishing run lasted 15 min and was typically ~200 m (656 ft) long and ~30 m (98 ft) wide. The pilot used a timer to measure the actual collection time. During the run, the pilot operated the boat at a speed and along a path (an in-and-out downstream motion) such that 15 min of effort allows maximum coverage of the sampling area (i.e., nearly 100% of the bankline is sampled). The pilot was free to modify the boat path to permit the most effective collection of fish. Undercut banks, submerged logs, and any other structure within the sampling area were shocked thoroughly until fish no longer surfaced. We did not use chase boats in our electrofishing surveys.

Trawling was used to capture small-bodied benthic fishes in areas where seining was not possible. We used the Missouri Trawl (16-foot trawl covered in small mesh) and methodology as described in Herzog et al. (2005) to sample small-bodied fishes, and a larger 7.62m (25-foot) trawl with 19.05 mm (.75 inch) bar mesh to capture larger fishes, also using the Herzog, et al. (2005) methodology. The standard unit of effort was 2 trawl hauls per site. One haul was conducted in water less than 3.0 m deep and the second haul was conducted in water greater than 3.0 m deep. Data from each haul was recorded separately and therefore not combined into the annotated list of species captured at a site.

Results and Discussion

There was no sampling effort completed in this study within the main channel/bendway weir habitats. These areas were not sampled because of the depth, turbulence, and underwater structures. These habitats represent a fairly large percentage of the total area within the Establishment Island and Kaskaskia Island complexes. Advances in bioacoustics and other sampling techniques may allow future sampling in these habitats.

Year One

The first year of sampling began in fall 2002 and was completed in summer of 2003. We sampled 148 sites in 3 strata at the Establishment Island complex (Table 1a, Figure 3a) and 162 sites in 3 strata at the Kaskaskia Island complex (Figure 4a). Sampling year 1 was characterized by low river stages (Figure 5). The low water limited day-time electrofishing and trawling in most of the side channel sites (Table 1a) because of access. Seining was most effective in side channels during year one compared to other gear. In year 1, we captured 38,583 fish; 16,292 fish at the Establishment Island complex and 21,661 fish at the Kaskaskia Island complex (Table 2). We collected 8 species (blue sucker, *Cycleptus elongatus*; mooneye, *Hiodon tergisus*; pugnose minnow, *Opsopoeodus emiliae*; river darter, *Percina shumardi*; sicklefin chub, *Macrhybopsis meeki*; sturgeon chub, *Macrhybopsis gelida*; silver chub, *Macrhybopsis storeriana*; and Mississippi silvery minnow, *Macrhybopsis nuchalis*) during Year 1 that were listed as endangered, threatened, or on the watch list in Missouri (Missouri Department of Conservation, 2007). We also collected a striped mullet (*Mugil cephalus*) in the Kaskaskia Island complex during the summer sample.

Sixty species comprising 16,292 individuals were collected in the first year at the Establishment Island complex. Cross over habitats produced the most species (50), followed by inside bends (41) and side channel habitats (40 species). Overall, emerald shiner (*Notropis atherinoides*) composed 42.4% of the catch followed by gizzard shad (*Dorosoma cepedianum*) and channel catfish *(Ictalurus punctatus*) at 14.5% and 10.5%, respectively (Table 3). In the inside bend stratum, emerald shiner composed 30.8%, followed by channel catfish, 23.9%, and gizzard shad, 19.6% of the total catch (Table 4a). In the side channel stratum, emerald shiner composed 46.9% of the catch followed by gizzard shad and channel shiner (*Notropis wickliffi*), 17.8% and 8.3%, respectively (Table 4b). In the crossover stratum emerald shiner composed 44.9% of the catch. gizzard shad and channel catfish followed at 9.4% and 8.4%, respectively (Table 4c).

Dissolved oxygen, water temperature, specific conductance, and Secchi transparency data from the Establishment Island complex are graphically displayed in Figures 6a and 6b. Water temperature ranged from 1.1 to 29.9 ºC and dissolved oxygen ranged from 5.4 to 17.2 mg/l. Dissolved oxygen measurements were lowest during the summer sample and highest during winter. Conductivity ranged from 432 to 673 µS/cm. The lowest conductivity occurred during the fall sample and the highest conductivity during winter. Secchi transparency ranged from 7 to 63 cm. The lowest readings were taken during the spring flood, and the highest readings were during winter.

Fifty-nine species comprising 21,661 individuals were collected in the first year at the Kaskaskia Island complex (Table 2). Inside bend habitat produced the most species (47), followed by side channel (44), and crossovers (43 species; Table 2). Overall, emerald shiner composed 30.4 % of the catch followed by gizzard shad and channel shiner at 22.1% and 9.8%, respectively (Table 5). Emerald shiner composed 29.4% of the inside bend stratum catch, while gizzard shad and channel catfish composed 16.7% and 14.2%, respectively, of the catch (Table 6a). In the side channel stratum, gizzard shad composed 35.3 % of the catch, while emerald shiner and red shiner (*Cyprinella lutrensis*) composed 23.2 % and 10.2 % of the catch, respectively (Table 6b). Emerald shiner composed 42.9 % of the catch in the cross over stratum, followed by channel shiner and gizzard shad at 9.9 % and 8.1 %, respectively (Table 6c).

Dissolved oxygen, water temperature, specific conductance, and Secchi transparency data from the Kaskaskia Island complex are graphically displayed in Figures 7a and 7b. Water temperature ranged from 1.8 to 32.2 ºC and dissolved oxygen levels ranged from 4.5 to 20 mg/l. The lowest and the highest dissolved oxygen levels both occurred during the summer sample, where side channels had unusually high readings and some crossover sites had low readings. Conductivity ranged from 413 to 756 µS/cm. The lowest conductivity occurred twice, during the fall and the winter sample, and the highest conductivity occurred during the summer sample. Secchi transparency ranged from 10 to 56 cm. The lowest readings occurred during summer and the highest readings occurred during winter.

Year Two

The second year of sampling began in fall 2003 and was completed in summer of 2004. We sampled at 157 sites in 3 strata at the Establishment Island complex and 143 sites in 3 strata at the Kaskaskia Island complex (Table 1b; Figures 3b and 4b). Sampling was affected by flood conditions during the spring samples (Figure 5). The high water conditions did not allow for effective seining in most areas sampled. Day-time electrofishing was also limited in success because of high turbidity (200 to 2100 NTU) during the spring sample. The high water did allow for trawling in side channels, which we had not been able to do in previous sampling episodes (Tables 1a and 1b). We captured 25,450 fish; 12,935 fish at Establishment Island and 12,515 fish at Kaskaskia Island. The total catch was down from the first year of sampling (Table 2). We collected 8 species (blue sucker, mooneye, pugnose minnow, river darter, sicklefin chub, sturgeon chub, silver chub, and Mississippi silvery minnow) during Year 2 that were listed as endangered, threatened, or on the Missouri watch list (Missouri Department of Conservation, 2007). During spring 2004, we also collected 4 larval sturgeon and 84 larval paddlefish (*Polyodon spathula*) from the Establishment Island complex and 6 larval sturgeon and 70 larval paddlefish from the Kaskaskia Island complex. The larval sturgeons were sent to Southern Illinois University-Carbondale for genetic identification to the species level.

Fifty-nine species comprising 12,935 individuals were collected in the second year at Establishment Island complex. Crossover habitats produced the most species (53), followed by side channel and inside bend habitats with 38 species each (Table 2). Emerald shiner comprised 29.9% of the catch followed by channel shiner and gizzard shad at 22.6% and 11.4%, respectively (Table 7). In the inside bend stratum, emerald shiner composed 37.2%, followed by gizzard shad, 28.1%, and shoal chub, 6.7% of the catch (Table 8a). In the side channel stratum, channel shiner composed 35.4% of the catch followed by emerald shiner and red shiner at 23% and 7.7%, respectively (Table 8b). Emerald shiner composed 40.7% of the catch in the crossover stratum and shoal chub and gizzard shad followed at 11.9% and 8.6%, respectively (Table 8c).

Dissolved oxygen, water temperature, specific conductance, Secchi transparency, pH, and turbidity data from the Establishment Island complex are graphically displayed in Figures 8a-8c. Water temperature ranged from 1.6 to 25.7 ºC and dissolved oxygen ranged from 4.8 to 20 mg/l. The lowest dissolved oxygen level occurred during the summer sample and the highest occurred during the winter sample. Conductivity ranged from 291 to 786 μS/cm. The lowest conductivity occurred during the fall sample and the highest during winter. Secchi transparency ranged from 3 to 63 cm. The lowest readings were taken during the spring flood and the highest readings were during winter. The pH values ranged from 7.0 to 8.87. The lowest readings occurred during winter and the highest during fall. Turbidity ranged from 16 to 2124 NTU. The lowest readings were taken in winter and the highest readings during spring.

Fifty-nine species comprising 12,515 individuals were collected in the second year at the Kaskaskia Island complex (Table 2). Crossover habitat produced the most species (45), followed by side channel (43), and inside bend habitat (35 species; Table 2). Overall, Emerald shiner composed 30.7 % of the catch followed by red Shiner and gizzard Shad 19.8% and 10.8%, respectively (Table 9). Emerald shiner composed 41.7% of the inside bend stratum catch followed by gizzard shad and shoal chub at 17.4% and 9.2%, respectively (Table 10a). In the side channel stratum, red shiner composed 29.5% of the catch, while emerald shiner and channel shiner composed 26.8% and 13.9% of the catch, respectively (Table 10b). Emerald shiner composed 33.7% of the catch in the crossover stratum, followed by gizzard shad at 10.4% and freshwater drum (*Aplodinotus grunniens*) 10.1% of the catch (Table 10c).

Dissolved oxygen, water temperature, specific conductance, Secchi transparency, pH, and turbidity data from the Kaskaskia Island complex are graphically displayed in Figures 9a-9c. Water temperature ranged from 1.1 to 28.5 ºC and dissolved oxygen levels ranged from 4.9 to 15.4 mg/l. The lowest dissolved oxygen readings were taken during spring and the highest levels occurred during the winter sample. Conductivity ranged from 348 to 772 μS/cm. The lowest conductivity occurred during the spring sample and the highest during the fall sample. Secchi transparency ranged from 1 to 64 cm. The lowest readings occurred during spring and the highest readings occurred during winter. The pH values ranged from 7.2 to 8.9. The lowest readings were taken during spring and the highest during summer. Turbidity ranged from 15 to 1418 NTU. The lowest readings were taken in the winter and the highest readings during spring.

Overall, sampling was completed to the best of our ability given environmental conditions. Low water in the winter and summer periods hampered our ability to use all gears in the three macrohabitat strata. Conversely, high river stages allowed access to all habitat strata, but some gear could not be fished effectively because of steep banks or flooded terrestrial vegetation (Tables 1a and 1b).

While we attempted to sample the island complexes as close to the same time periods each year, circumstances did not allow exact timing of samples. River stages between the two years were quite different, although we attempted to ameliorate these differences by sampling when river stages were similar between each year (Figure 5). For example, the winter 2003 sample was taken between days 40–50 when the river stages were between 6 and12 feet at Cape Girardeau, Mo gage. In winter 2004, the sample was taken between days 42–52 and river stages 8 and10 feet. Conversely, the spring sample and river stages were more much difficult to predict thus the 2003 sample was taken between days 148–158 with river stages between 18–24 feet, but during a falling river, and the 2004 sample was taken between days 148–159 with river stages between 23–33 feet, but during a rising river (note that flood stage at Cape Girardeau is 32 feet). Variation in environmental conditions, no matter how great the attempt to reduce sampling bias, will cause variation in the data that will be difficult to explain during analysis. This is why we caution that only 2 years of, in this project, pre-construction monitoring probably will not suffice to explain most variation in the dataset.

Such variation can be seen, for example, in Figures 6a, 7a, 8a, and 9a, depicting surface water temperature and dissolved oxygen, two important parameters affecting fish distribution, in both island complexes. Note the ranges in values between the island complexes and years. Kaskaskia Island shows more variation than Establishment Island, which poses no concern, but there seems to be a difference between years with the low water year having greater variability, especially in some macrohabitat types in certain seasons (for example, side channel stratum in the fall).

As expected with such environmental variation, the fish community can be reflective of the conditions. Table 11 gives the relative proportion of fish family groups by macrohabitat strata and year. Cyprinidae were numerically the most abundant family found in all three habitat strata. Clupeids, primarily gizzard shad, were the next most abundant group in all habitat strata except in crossover habitat in year 1 and in inside bend habitat in Establishment Island in year 1. Ictalurids, primarily channel catfish were numerically more abundant than gizzard shad in those habitats during those times. Acipenseridae (sturgeons) appeared to be proportionally more abundant in inside bend habitat and Moronidae (primarily white bass, *Morone chrysops*) seems to show some affinity for channel crossovers. Hiodonts (mooneye and goldeye, *Hiodon alosoides*) were proportionally more abundant in the second year in inside bend and crossover habitats. The side channel strata seem to be important for many species that do not frequent the crossovers and inside bend strata. For example, darters species and sauger *(Sander canadensis,* Percidae) and a host of miscellaneous families, such as Poeciliidae (primarily western mosquitofish, *Gambusia affinis*), Atherinidae (2 species of silversides), and members of the Cyprinidae that typically are not associated with large rivers in Missouri (such as pugnose minnow). Other analyses (ordination) will be needed to better explain the distribution and habitat use by fish species and guilds, but this does show that despite some environmental variation, there are some consistencies in species/habitat use between the island complexes, setting the stage for post-construction evaluation at Establishment Island.

Table 1a. Number of sites sampled from the Establishment and Kaskaskia Island complexes from fall 2002 through summer 2003 (year 1) by period, gear, and stratum.

Establishment Island Year 1

Period	Gear	Stratum	# sampled
1	D	ISB	3
1	D	SC	0
1	D	XO	4
1	ET	ISB	3
1	ET	SC	0
1	ET	XO	4
1	LT	ISB	3
1	LT	SC	0
1	LT	XO	3
1	S	ISB	3
1	S	SC	1
1	S	XO	3
			27
Period	Gear	Stratum	# sampled
2	D	ISB	2
2	D	SC	6
2	D	XO	4
2	ET	ISB	3
2	ET	SC	5
2	ET	XO	5
2	LT	ISB	5
2	LT	SC	3
2	LT	XO	3
2	S	ISB	3
2	S	SC	3
2	S	XO	3
			45
Period	Gear	Stratum	# sampled
3	D	ISB	3
3	D	SC	2
3	D	XO	6
3	ET	ISB	4
3	ET	SC	0
3	ET	XO	3
3	LT	ISB	3
3	LT	SC	0
3	LT	XO	3
3	S	ISB	4
3	S	SC	3
3	S	XO	5
			36
Period	Gear	Stratum	# sampled
4	D	ISB	3
4	D	SC	3
4	D	XO	4
4	ET	ISB	3
4	ET	SC	0
4	ET	XO	6
4	LT	ISB	3
4	LT	SC	0
4	LT	XO	5
4	S	ISB	4
4	S	SC	5
4	S	XO	4
			40
Total # of Sites Sampled			148

Kaskaskia Island Year1

Period	Gear	Stratum	# sampled
1	D	ISB	5
1	D	SC	0
1	D	XO	3
1	ET	ISB	3
1	ET	SC	0
1	ET	XO	4
1	LT	ISB	3
1	LT	SC	0
1	LT	XO	5
1	S	ISB	6
1	S	SC	1
1	S	XO	5
			35
Period	Gear	Stratum	# sampled
2	D	ISB	5
2	D	SC	5
2	D	XO	0
2	ET	ISB	6
2	ET	SC	3
2	ET	XO	0
2	LT	ISB	3
2	LT	SC	3
2	LT	XO	3
2	S	ISB	4
2	S	SC	4
2	S	XO	3
			39
Period	Gear	Stratum	# sampled
3	D	ISB	4
3	D	SC	0
3	D	XO	4
3	ET	ISB	3
3	ET	SC	0
3	ET	XO	3
3	LT	ISB	5
3	LT	SC	0
3	LT	XO	5
3	S	ISB	4
3	S	SC	6
3	S	XO	5
			39
Period	Gear	Stratum	# sampled
4	D	ISB	7
4	D	SC	5
4	D	XO	6
4	ET	ISB	4
4	ET	SC	0
4	ET	XO	5
4	LT	ISB	6
4	LT	SC	0
4	LT	XO	4
4	S	ISB	6
4	S	SC	3
4	S	XO	3
			49
Total # of Sites Sampled			162

Table 1b. Number of sites sampled from the Establishment and Kaskaskia Island complexes from fall 2003 through summer 2004 (year 2) by period, gear, and stratum.

Establishment Island Year 2

Period	Gear	Stratum	# sampled
1	D	ISB	4
1	D	SC	2
1	D	XO	6
1	ET	ISB	3
1	ET	SC	0
1	ET	XO	5
1	LT	ISB	3
1	LT	SC	0
1	LT	XO	4
1	S	ISB	3
1	S	SC	3
1	S	XO	3
			36
Period	Gear	Stratum	# sampled
2	D	ISB	6
2	D	SC	5
2	D	TRI	2
2	D	XO	5
2	ET	ISB	4
2	ET	SC	3
2	ET	XO	3
2	LT	ISB	3
2	LT	SC	3
2	LT	XO	1
2	S	ISB	3
2	S	SC	2
2	S	XO	3
			43
Period	Gear	Stratum	# sampled
3	D	ISB	6
3	D	SC	3
3	D	XO	5
3	ET	ISB	3
3	ET	SC	0
3	ET	XO	4
3	LT	ISB	3
3	LT	SC	0
3	LT	XO	4
3	S	ISB	5
3	S	SC	4
3	S	XO	3
			40
Period	Gear	Stratum	# sampled
4	D	ISB	6
4	D	SC	0
4	D	XO	5
4	ET	ISB	3
4	ET	SC	0
4	ET	XO	3
4	LT	ISB	3
4	LT	SC	0
4	LT	XO	4
4	S	ISB	4
4	S	SC	4
4	S	XO	6
			38
Total # of Sites Sampled			157

Kaskaskia Island Year2

Period	Gear	Stratum	# sampled
1	D	ISB	3
1	D	SC	0
1	D	XO	5
1	ET	ISB	3
1	ET	SC	0
1	ET	XO	3
1	LT	ISB	3
1	LT	SC	0
1	LT	XO	3
1	S	ISB	3
1	S	SC	4
1	S	XO	3
			30
Period	Gear	Stratum	# sampled
2	D	ISB	6
2	D	SC	9
2	D	XO	3
2	ET	ISB	5
2	ET	SC	3
2	ET	XO	2
2	LT	ISB	3
2	LT	SC	3
2	LT	XO	0
2	S	ISB	2
2	S	SC	3
2	S	XO	4
			43
Period	Gear	Stratum	# sampled
3	D	ISB	5
3	D	SC	0
3	D	XO	4
3	ET	ISB	3
3	ET	SC	0
3	ET	XO	3
3	LT	ISB	4
3	LT	SC	0
3	LT	XO	4
3	S	ISB	4
3	S	SC	3
3	S	XO	5
			35
Period	Gear	Stratum	# sampled
4	D	ISB	3
4	D	SC	0
4	D	XO	5
4	ET	ISB	4
4	ET	SC	0
4	ET	XO	4
4	LT	ISB	3
4	LT	SC	0
4	LT	XO	3
4	S	ISB	3
4	S	SC	4
4	S	XO	6
			35
Total # of Sites Sampled			143

Table 2. Number of species and fish captured by seining, trawling, and day-time electrofishing from the Establishment and Kaskaskia Island complexes by habitat strata from fall 2002 through summer 2004 (years 1 and 2).

Establishment Island Year 1

Stratum	Total Fish	Number of Species
ISB	3646	41
SC	5435	40
XO	7211	50
	16292	60

Kaskaskia Island Year 1

Stratum	Total Fish	Number of Species
ISB	7976	47
SC	8222	44
XO	5463	43
	21661	55

Establishment Island Year 2

Stratum	Total Fish	Number of Species
ISB	2422	38
SC	7425	38
XO	3088	53
	12935	59

Kaskaskia Island Year 2

Stratum	Total Fish	Number of Species
ISB	2252	35
SC	8138	43
XO	2155	45
	12515	57

ISB = Inside Bend
SC = Side Channel
XO = Crossover

Table 3. Fish species and total numbers captured by seining, trawling, and day-time electrofishing in the Establishment Island complex from fall 2002 through summer 2003 (year 1).

Establishment Island -Year 1

Common Name	Scientific Name	Total
Chestnut lamprey	*Ichthyomyzon castaneus*	2
Shovelnose sturgeon	*Scaphirhynchus platorynchus*	84
Unidentified sturgeon	*Scaphirhynchus* sp.	19
Paddlefish	*Polyodon spathula*	23
Shortnose gar	*Lepisosteus platostomus*	58
Goldeye	*Hiodon alosoides*	33
Mooneye	*Hiodon tergisus*	4
American eel	*Anguilla rostrata*	2
Skipjack herring	*Alosa chrysochloris*	51
Gizzard shad	*Dorosoma cepedianum*	2362
Threadfin shad	*Dorosoma petenense*	20
Central stoneroller	*Campostoma anomalum*	1
Grass carp	*Ctenopharyngodon idella*	3
Red shiner	*Cyprinella lutrensis*	479
Spotfin shiner	*Cyprinella spiloptera*	1
Common carp	*Cyprinus carpio*	580
Mississippi silvery minnow	*Hybognathus nuchalis*	26
Silver carp	*Hypophthalmichthys molitrix*	7
Bighead carp	*Hypophthalmichthys nobilis*	3
Shoal chub	*Macrhybopsis hyostoma*	570
Sturgeon chub	*Macrhybopsis gelida*	9
Sicklefin chub	*Macrhybopsis meeki*	3
Silver chub	*Macrhybopsis storeriana*	12
Emerald shiner	*Notropis atherinoides*	6917
River shiner	*Notropis blennius*	438
Silverband shiner	*Notropis shumardi*	179
Sand shiner	*Notropis stramineus*	10
Mimic shiner	*Notropis volucellus*	2
Channel shiner	*Notropis wickliffi*	1271
Pugnose minnow	*Opsopoeodus emiliae*	83
Bluntnose minnow	*Pimephales notatus*	4
Bullhead minnow	*Pimephales vigilax*	13
River carpsucker	*Carpiodes carpio*	290
Blue sucker	*Cycleptus elongatus*	16
Smallmouth buffalo	*Ictiobus bubalus*	20
Bigmouth buffalo	*Ictiobus cyprinellus*	19
Black buffalo	*Ictiobus niger*	28
Unidentified buffalo	*Ictiobus* sp.	21
Shorthead redhorse	*Moxostoma macrolepidotum*	6
Blue catfish	*Ictalurus furcatus*	157
Channel catfish	*Ictalurus punctatus*	1703
Stonecat	*Noturus flavus*	5
Freckled madtom	*Noturus nocturnus*	1
Flathead catfish	*Pylodictis olivaris*	88
Northern studfish	*Fundulus catenatus*	1
Western mosquitofish	*Gambusia affinis*	21
Brook silverside	*Labidesthes sicculus*	2

Table 3 (cont.)

Establishment Island -Year 1

Common Name	Scientific Name	Total
Inland silverside	*Menidia beryllina*	4
White bass	*Morone chrysops*	171
White x striped bass	*M. chrysops x M.saxatilis*	2
Green sunfish	*Lepomis cyanellus*	2
Warmouth	*Lepomis gulosus*	1
Orangespotted sunfish	*Lepomis humilis*	2
Bluegill	*Lepomis macrochirus*	7
Spotted bass	*Micropterus punctulatus*	1
White crappie	*Pomoxis annularis*	4
Black crappie	*Pomoxis nigromaculatus*	1
Western sand darter	*Ammocrypta clara*	5
Logperch	*Percina caprodes*	3
River darter	*Percina shumardi*	2
Sauger	*Sander canadense*	6
Freshwater drum	*Aplodinotus grunniens*	426
Larval fish	Unidentified	7

Table 4a. Fish species and number captured by seining, trawling, and day-time electrofishing in Establishment Island inside bend macrohabitat (ISB) from fall 2002 through summer 2003 (year 1).

Establishment Island Inside Bend Habitat - Year 1

Stratum	Common Name	Scientific Name	Total
ISB	Bullhead minnow	*Pimephales vigilax*	1
ISB	Blue catfish	*Ictalurus furcatus*	20
ISB	Bluegill	*Lepomis macrochirus*	3
ISB	Blue sucker	*Cycleptus elongatus*	5
ISB	Common carp	*Cyprinus carpio*	9
ISB	Central stoneroller	*Campostoma anomalum*	1
ISB	Channel catfish	*Ictalurus punctatus*	872
ISB	Channel shiner	*Notropis wickliffi*	255
ISB	Emerald shiner	*Notropis atherinoides*	1126
ISB	Flathead catfish	*Pylodictis olivaris*	4
ISB	Freckled madtom	*Noturus nocturnus*	1
ISB	Freshwater drum	*Aplodinotus grunniens*	82
ISB	Goldeye	*Hiodon alosoides*	6
ISB	Gizzard shad	*Dorosoma cepedianum*	715
ISB	Logperch	*Percina caprodes*	2
ISB	Larval fish	Unidentified	5
ISB	Mimic shiner	*Notropis volucellus*	2
ISB	Mooneye	*Hiodon tergisus*	3
ISB	Western mosquitofish	*Gambusia affinis*	7
ISB	Orangespotted sunfish	*Lepomis humilis*	1
ISB	Paddlefish	*Polyodon spathula*	23
ISB	Pugnose minnow	*Opsopoeodus emiliae*	8
ISB	Red shiner	*Cyprinella lutrensis*	8
ISB	River darter	*Percina shumardi*	2
ISB	River carpsucker	*Carpiodes carpio*	105
ISB	River shiner	*Notropis blennius*	90
ISB	Silverband shiner	*Notropis shumardi*	5
ISB	Sicklefin chub	*Macrhybopsis meeki*	3
ISB	Sturgeon chub	*Macrhybopsis gelida*	7
ISB	Sauger	*Sander canadense*	1
ISB	Shorthead redhorse	*Moxostoma macrolepidotum*	1
ISB	Skipjack herring	*Alosa chrysochloris*	13
ISB	Shoal chub	*Macrhybopsis hyostoma*	128
ISB	Shortnose gar	*Lepisosteus platostomus*	6
ISB	Shovelnose sturgeon	*Scaphirhynchus platorynchus*	31
ISB	Sand shiner	*Notropis stramineus*	3
ISB	Stonecat	*Noturus flavus*	2
ISB	Silver chub	*Macrhybopsis storeriana*	5
ISB	Mississippi silvery minnow	*Hybognathus nuchalis*	10
ISB	Threadfin shad	*Dorosoma petenense*	7
ISB	Unidentified buffalo	*Ictiobus* sp.	6
ISB	Unidentified sturgeon	*Scaphirhynchus* sp.	11
ISB	White bass	*Morone chrysops*	48
ISB	White crappie	*Pomoxis annularis*	3

Table 4b. Fish species and number captured by seining, trawling, and day-time electrofishing in Establishment Island side channel macrohabitat (SC) from fall 2002 through summer 2003 (years 1).

Establishment Island Side Channel Habitat - Year 1

Stratum	Common Name	Scientific Name	Total
SC	Bighead carp	*Hypophthalmichthys nobilis*	1
SC	Bullhead minnow	*Pimephales vigilax*	6
SC	Black buffalo	*Ictiobus niger*	1
SC	Black crappie	*Pomoxis nigromaculatus*	1
SC	Blue catfish	*Ictalurus furcatus*	12
SC	Bluegill	*Lepomis macrochirus*	1
SC	Bigmouth buffalo	*Ictiobus cyprinellus*	1
SC	Bluntnose minnow	*Pimephales notatus*	2
SC	Blue sucker	*Cycleptus elongatus*	5
SC	Common carp	*Cyprinus carpio*	182
SC	Channel catfish	*Ictalurus punctatus*	222
SC	Channel shiner	*Notropis wickliffi*	454
SC	Emerald shiner	*Notropis atherinoides*	2550
SC	Flathead catfish	*Pylodictis olivaris*	3
SC	Freshwater drum	*Aplodinotus grunniens*	29
SC	Goldeye	*Hiodon alosoides*	2
SC	Green sunfish	*Lepomis cyanellus*	1
SC	Gizzard shad	*Dorosoma cepedianum*	969
SC	Larval fish	Unidentified	1
SC	Western mosquitofish	*Gambusia affinis*	6
SC	Northern studfish	*Fundulus catenatus*	1
SC	Orangespotted sunfish	*Lepomis humilis*	1
SC	Pugnose minnow	*Opsopoeodus emiliae*	71
SC	Red shiner	*Cyprinella lutrensis*	371
SC	River carpsucker	*Carpiodes carpio*	97
SC	River shiner	*Notropis blennius*	233
SC	Silverband shiner	*Notropis shumardi*	53
SC	Sauger	*Sander canadense*	4
SC	Skipjack herring	*Alosa chrysochloris*	1
SC	Shoal chub	*Macrhybopsis hyostoma*	51
SC	Smallmouth buffalo	*Ictiobus bubalus*	5
SC	Shortnose gar	*Lepisosteus platostomus*	24
SC	Shovelnose sturgeon	*Scaphirhynchus platorynchus*	1
SC	Sand shiner	*Notropis stramineus*	5
SC	Spotted bass	*Micropterus punctulatus*	1
SC	Silver chub	*Macrhybopsis storeriana*	1
SC	Silver carp	*Hypophthalmichthys molitrix*	2
SC	Mississippi silvery minnow	*Hybognathus nuchalis*	7
SC	Threadfin shad	*Dorosoma petenense*	11
SC	Unidentified buffalo	*Ictiobus* sp.	9
SC	Western sand darter	*Ammocrypta clara*	3
SC	White bass	*Morone chrysops*	34

Table 4c. Fish species and number captured by seining, trawling, and day-time electrofishing in Establishment Island crossover macrohabitat (XO) from fall 2002 through summer 2003 (year 1).

Establishment Island Crossover Habitat - Year 1

Stratum	Common Name	Scientific Name	Total
XO	American eel	*Anguilla rostrata*	2
XO	Bighead carp	*Hypophthalmichthys nobilis*	2
XO	Bullhead minnow	*Pimephales vigilax*	6
XO	Black buffalo	*Ictiobus niger*	27
XO	Brook silverside	*Labidesthes sicculus*	2
XO	Blue catfish	*Ictalurus furcatus*	125
XO	Bluegill	*Lepomis macrochirus*	4
XO	Bigmouth buffalo	*Ictiobus cyprinellus*	18
XO	Bluntnose minnow	*Pimephales notatus*	2
XO	Blue sucker	*Cycleptus elongatus*	6
XO	Common carp	*Cyprinus carpio*	389
XO	Channel catfish	*Ictalurus punctatus*	609
XO	Chestnut lamprey	*Ichthyomyzon castaneus*	2
XO	Channel shiner	*Notropis wickliffi*	562
XO	Emerald shiner	*Notropis atherinoides*	3241
XO	Flathead catfish	*Pylodictis olivaris*	81
XO	Freshwater drum	*Aplodinotus grunniens*	315
XO	Goldeye	*Hiodon alosoides*	25
XO	Green sunfish	*Lepomis cyanellus*	1
XO	Grass carp	*Ctenopharyngodon idella*	3
XO	Gizzard shad	*Dorosoma cepedianum*	678
XO	Inland silverside	*Menidia beryllina*	4
XO	Logperch	*Percina caprodes*	1
XO	Larval fish	Unidentified	1
XO	Mooneye	*Hiodon tergisus*	1
XO	Western mosquitofish	*Gambusia affinis*	8
XO	Pugnose minnow	*Opsopoeodus emiliae*	4
XO	Red shiner	*Cyprinella lutrensis*	100
XO	River carpsucker	*Carpiodes carpio*	88
XO	River shiner	*Notropis blennius*	115
XO	Silverband shiner	*Notropis shumardi*	121
XO	White x striped bass	*M. chrysops x M.saxatilis*	2
XO	Spotfin shiner	*Cyprinella spiloptera*	1
XO	Sturgeon chub	*Macrhybopsis gelida*	2
XO	Sauger	*Sander canadense*	1
XO	Shorthead redhorse	*Moxostoma macrolepidotum*	5
XO	Skipjack herring	*Alosa chrysochloris*	37
XO	Shoal chub	*Macrhybopsis hyostoma*	391
XO	Smallmouth buffalo	*Ictiobus bubalus*	15
XO	Shortnose gar	*Lepisosteus platostomus*	28
XO	Shovelnose sturgeon	*Scaphirhynchus platorynchus*	52
XO	Sand shiner	*Notropis stramineus*	2
XO	Stonecat	*Noturus flavus*	3
XO	Silver chub	*Macrhybopsis storeriana*	6
XO	Silver carp	*Hypophthalmichthys molitrix*	5
XO	Mississippi silvery minnow	*Hybognathus nuchalis*	9
XO	Threadfin shad	*Dorosoma petenense*	2

Table 4c (cont.)

Establishment Island Crossover Habitat - Year 1

XO	Unidentified buffalo	*Ictiobus* sp.	6
XO	Unidentified sturgeon	*Scaphirhynchus sp.*	8
XO	Warmouth	*Lepomis gulosus*	1
XO	Western sand darter	*Ammocrypta clara*	2
XO	White bass	*Morone chrysops*	89
XO	White crappie	*Pomoxis annularis*	1

Table 5. Fish species and total numbers captured by seining, trawling, and day-time electrofishing in the Kaskaskia Island complex from fall 2002 through summer 2003 (year 1).

Kaskaskia Island - Year 1

Common Name	Scientific Name	Total
Chestnut lamprey	*Ichthyomyzon castaneus*	2
Shovelnose sturgeon	*Scaphirhynchus platorynchus*	122
Unidentified sturgeon	*Scaphirhynchus* sp.	6
Shortnose gar	*Lepisosteus platostomus*	132
Goldeye	*Hiodon alosoides*	18
Mooneye	*Hiodon tergisus*	5
American eel	*Anguilla rostrata*	1
Skipjack herring	*Alosa chrysochloris*	22
Gizzard shad	*Dorosoma cepedianum*	4777
Threadfin shad	*Dorosoma petenense*	36
Grass carp	*Ctenopharyngodon idella*	7
Red shiner	*Cyprinella lutrensis*	1279
Common carp	*Cyprinus carpio*	496
Mississippi silvery minnow	*Hybognathus nuchalis*	17
Silver carp	*Hypophthalmichthys molitrix*	7
Bighead carp	*Hypophthalmichthys nobilis*	7
Shoal chub	*Macrhybopsis hyostoma*	1014
Sturgeon chub	*Macrhybopsis gelida*	2
Sicklefin chub	*Macrhybopsis meeki*	1
Silver chub	*Macrhybopsis storeriana*	32
Emerald shiner	*Notropis atherinoides*	6594
River shiner	*Notropis blennius*	268
Silverband shiner	*Notropis shumardi*	298
Sand shiner	*Notropis stramineus*	8
Channel shiner	*Notropis wickliffi*	2129
Pugnose minnow	*Opsopoeodus emiliae*	499
Bluntnose minnow	*Pimephales notatus*	15
Bullhead minnow	*Pimephales vigilax*	46
River carpsucker	*Carpiodes carpio*	198
Blue sucker	*Cycleptus elongatus*	22
Smallmouth buffalo	*Ictiobus bubalus*	11
Bigmouth buffalo	*Ictiobus cyprinellus*	62
Black buffalo	*Ictiobus niger*	25
Unidentified buffalo	*Ictiobus* sp.	41
Shorthead redhorse	*Moxostoma macrolepidotum*	5
Unidentified sucker	Unidentified *Catostomidae*	1
Blue catfish	*Ictalurus furcatus*	257
Channel catfish	*Ictalurus punctatus*	1699
Stonecat	*Noturus flavus*	1
Freckled madtom	*Noturus nocturnus*	4
Flathead catfish	*Pylodictis olivaris*	42
Blackstripe topminnow	*Fundulus notatus*	1
Western mosquitofish	*Gambusia affinis*	92
Brook silverside	*Labidesthes sicculus*	9
Inland silverside	*Menidia beryllina*	20
White bass	*Morone chrysops*	170
Yellow bass	*Morone mississippiensis*	1

Table 5 (cont.)

Kaskaskia Island - Year 1

Common Name	Scientific Name	Total
White x striped bass	*M. chrysops x M.saxatilis*	49
Green sunfish	*Lepomis cyanellus*	16
Orangespotted sunfish	*Lepomis humilis*	16
Bluegill	*Lepomis macrochirus*	49
Spotted bass	*Micropterus punctulatus*	2
Largemouth bass	*Micropterus salmoides*	2
White crappie	*Pomoxis annularis*	3
Logperch	*Percina caprodes*	2
River darter	*Percina shumardi*	5
Sauger	*Sander canadense*	36
Freshwater drum	*Aplodinotus grunniens*	968
Striped mullet	*Mugil cephalus*	1
Larval fish	Unidentified	11

Table 6a. Fish species and number captured by seining, trawling, and day-time electrofishing in Kaskaskia Island inside bend macrohabitat (ISB) from fall 2002 through summer 2003 (year 1).

Kaskaskia Island Inside Bend Habitat - Year 1

Stratum	Common Name	Scientific Name	Total
ISB	Bullhead minnow	*Pimephales vigilax*	3
ISB	Black buffalo	*Ictiobus niger*	7
ISB	Brook silverside	*Labidesthes sicculus*	3
ISB	Blue catfish	*Ictalurus furcatus*	138
ISB	Bluegill	*Lepomis macrochirus*	11
ISB	Bigmouth buffalo	*Ictiobus cyprinellus*	4
ISB	Bluntnose minnow	*Pimephales notatus*	5
ISB	Blue sucker	*Cycleptus elongatus*	6
ISB	Common carp	*Cyprinus carpio*	205
ISB	Channel catfish	*Ictalurus punctatus*	1129
ISB	Chestnut lamprey	*Ichthyomyzon castaneus*	1
ISB	Channel shiner	*Notropis wickliffi*	728
ISB	Emerald shiner	*Notropis atherinoides*	2344
ISB	Flathead catfish	*Pylodictis olivaris*	12
ISB	Freshwater drum	*Aplodinotus grunniens*	336
ISB	Goldeye	*Hiodon alosoides*	13
ISB	Green sunfish	*Lepomis cyanellus*	6
ISB	Grass carp	*Ctenopharyngodon idella*	5
ISB	Gizzard shad	*Dorosoma cepedianum*	1337
ISB	Inland silverside	*Menidia beryllina*	9
ISB	Logperch	*Percina caprodes*	1
ISB	Larval fish	Unidentified	7
ISB	Mooneye	*Hiodon tergisus*	3
ISB	Western mosquitofish	*Gambusia affinis*	2
ISB	Orangespotted sunfish	*Lepomis humilis*	1
ISB	Pugnose minnow	*Opsopoeodus emiliae*	65
ISB	Red shiner	*Cyprinella lutrensis*	228
ISB	River darter	*Percina shumardi*	3
ISB	River carpsucker	*Carpiodes carpio*	124
ISB	River shiner	*Notropis blennius*	174
ISB	Silverband shiner	*Notropis shumardi*	10
ISB	White x striped bass	*M. chrysops x M.saxatilis*	10
ISB	Sicklefin chub	*Macrhybopsis meeki*	1
ISB	Sturgeon chub	*Macrhybopsis gelida*	2
ISB	Sauger	*Sander canadense*	17
ISB	Shorthead redhorse	*Moxostoma macrolepidotum*	4
ISB	Skipjack herring	*Alosa chrysochloris*	6
ISB	Shoal chub	*Macrhybopsis hyostoma*	656
ISB	Smallmouth buffalo	*Ictiobus bubalus*	8
ISB	Shortnose gar	*Lepisosteus platostomus*	84
ISB	Shovelnose sturgeon	*Scaphirhynchus platorynchus*	111
ISB	Sand shiner	*Notropis stramineus*	5
ISB	Striped mullet	*Mugil cephalus*	1
ISB	Silver chub	*Macrhybopsis storeriana*	14
ISB	Silver carp	*Hypophthalmichthys molitrix*	2
ISB	Mississippi silvery minnow	*Hybognathus nuchalis*	6
ISB	Threadfin shad	*Dorosoma petenense*	7

Table 6a (cont.)

Kaskaskia Island Inside Bend Habitat - Year 1

Stratum	Common Name	Scientific Name	Total
ISB	Unidentified buffalo	*Ictiobus* sp.	34
ISB	Unidentified sturgeon	*Scaphirhynchus* sp.	5
ISB	White bass	*Morone chrysops*	82
ISB	Yellow bass	*Morone mississippiensis*	1

Table 6b. Fish species and number captured by seining, trawling, and day-time electrofishing in Kaskaskia Island side channel macrohabitat (SC) from fall 2002 through summer 2003 (year 1).

Kaskaskia Island Side Channel Habitat - Year 1

Stratum	Common Name	Scientific Name	Total
SC	Bighead carp	*Hypophthalmichthys nobilis*	7
SC	Bullhead minnow	*Pimephales vigilax*	42
SC	Black buffalo	*Ictiobus niger*	13
SC	Brook silverside	*Labidesthes sicculus*	2
SC	Blue catfish	*Ictalurus furcatus*	1
SC	Bluegill	*Lepomis macrochirus*	26
SC	Bigmouth buffalo	*Ictiobus cyprinellus*	55
SC	Bluntnose minnow	*Pimephales notatus*	8
SC	Blue sucker	*Cycleptus elongatus*	14
SC	Common carp	*Cyprinus carpio*	141
SC	Channel catfish	*Ictalurus punctatus*	128
SC	Channel shiner	*Notropis wickliffi*	756
SC	Emerald shiner	*Notropis atherinoides*	1907
SC	Freckled madtom	*Noturus nocturnus*	1
SC	Freshwater drum	*Aplodinotus grunniens*	239
SC	Green sunfish	*Lepomis cyanellus*	3
SC	Grass carp	*Ctenopharyngodon idella*	2
SC	Gizzard shad	*Dorosoma cepedianum*	2899
SC	Inland silverside	*Menidia beryllina*	9
SC	Largemouth bass	*Micropterus salmoides*	2
SC	Larval fish	Unidentified	4
SC	Western mosquitofish	*Gambusia affinis*	83
SC	Orangespotted sunfish	*Lepomis humilis*	14
SC	Pugnose minnow	*Opsopoeodus emiliae*	416
SC	Red shiner	*Cyprinella lutrensis*	837
SC	River darter	*Percina shumardi*	1
SC	River carpsucker	*Carpiodes carpio*	41
SC	River shiner	*Notropis blennius*	68
SC	Silverband shiner	*Notropis shumardi*	240
SC	White x striped bass	*M. chrysops x M.saxatilis*	6
SC	Sauger	*Sander canadense*	7
SC	Shorthead redhorse	*Moxostoma macrolepidotum*	1
SC	Skipjack herring	*Alosa chrysochloris*	6
SC	Shoal chub	*Macrhybopsis hyostoma*	141
SC	Smallmouth buffalo	*Ictiobus bubalus*	2
SC	Shortnose gar	*Lepisosteus platostomus*	36
SC	Shovelnose sturgeon	*Scaphirhynchus platorynchus*	3
SC	Sand shiner	*Notropis stramineus*	3
SC	Spotted bass	*Micropterus punctulatus*	2
SC	Silver chub	*Macrhybopsis storeriana*	7
SC	Silver carp	*Hypophthalmichthys molitrix*	5
SC	Mississippi silvery minnow	*Hybognathus nuchalis*	5
SC	Threadfin shad	*Dorosoma petenense*	7
SC	Unidentified sucker	*Unidentified Catostomidae*	1
SC	Unidentified sturgeon	*Scaphirhynchus* sp.	1
SC	White bass	*Morone chrysops*	27
SC	White crappie	*Pomoxis annularis*	3

Table 6c. Fish species and number captured by seining, trawling, and day-time electrofishing in Kaskaskia Island crossover macrohabitat (XO) from fall 2002 through summer 2003 (year 1).

Kaskaskia Island Crossover Habitat - Year 1

Stratum	Common Name	Scientific Name	Total
XO	American eel	*Anguilla rostrata*	1
XO	Bullhead minnow	*Pimephales vigilax*	1
XO	Black buffalo	*Ictiobus niger*	5
XO	Brook silverside	*Labidesthes sicculus*	4
XO	Blue catfish	*Ictalurus furcatus*	118
XO	Bluegill	*Lepomis macrochirus*	12
XO	Bigmouth buffalo	*Ictiobus cyprinellus*	3
XO	Bluntnose minnow	*Pimephales notatus*	2
XO	Blackstripe topminnow	*Fundulus notatus*	1
XO	Blue sucker	*Cycleptus elongatus*	2
XO	Common carp	*Cyprinus carpio*	150
XO	Channel catfish	*Ictalurus punctatus*	442
XO	Chestnut lamprey	*Ichthyomyzon castaneus*	1
XO	Channel shiner	*Notropis wickliffi*	645
XO	Emerald shiner	*Notropis atherinoides*	2343
XO	Flathead catfish	*Pylodictis olivaris*	30
XO	Freckled madtom	*Noturus nocturnus*	3
XO	Freshwater drum	*Aplodinotus grunniens*	393
XO	Goldeye	*Hiodon alosoides*	5
XO	Green sunfish	*Lepomis cyanellus*	7
XO	Gizzard shad	*Dorosoma cepedianum*	541
XO	Inland silverside	*Menidia beryllina*	2
XO	Logperch	*Percina caprodes*	1
XO	Mooneye	*Hiodon tergisus*	2
XO	Western mosquitofish	*Gambusia affinis*	7
XO	Orangespotted sunfish	*Lepomis humilis*	1
XO	Pugnose minnow	*Opsopoeodus emiliae*	18
XO	Red shiner	*Cyprinella lutrensis*	214
XO	River darter	*Percina shumardi*	1
XO	River carpsucker	*Carpiodes carpio*	33
XO	River shiner	*Notropis blennius*	26
XO	Silverband shiner	*Notropis shumardi*	48
XO	White x striped bass	*M. chrysops x M.saxatilis*	33
XO	Sauger	*Sander canadense*	12
XO	Skipjack herring	*Alosa chrysochloris*	10
XO	Shoal chub	*Macrhybopsis hyostoma*	217
XO	Smallmouth buffalo	*Ictiobus bubalus*	1
XO	Shortnose gar	*Lepisosteus platostomus*	12
XO	Shovelnose sturgeon	*Scaphirhynchus platorynchus*	8
XO	Stonecat	*Noturus flavus*	1
XO	Silver chub	*Macrhybopsis storeriana*	11
XO	Mississippi silvery minnow	*Hybognathus nuchalis*	6
XO	Threadfin shad	*Dorosoma petenense*	22
XO	Unidentified buffalo	*Ictiobus* sp.	7
XO	White bass	*Morone chrysops*	61

Table 7. Fish species and total numbers captured by seining, trawling, and day-time electrofishing in the Establishment Island complex from fall 2003 through summer 2004 (year 2).

Establishment Island Year-2

Common Name	Scientific Name	Total
Chestnut lamprey	*Ichthyomyzon castaneus*	3
Shovelnose sturgeon	*Scaphirhynchus platorynchus*	65
Unidentified sturgeon	*Scaphirhynchus* sp.	4
Paddlefish	*Polyodon spathula*	84
Longnose gar	*Lepisosteus osseus*	1
Shortnose gar	*Lepisosteus platostomus*	56
Goldeye	*Hiodon alosoides*	103
Mooneye	*Hiodon tergisus*	33
Skipjack herring	*Alosa chrysochloris*	53
Gizzard shad	*Dorosoma cepedianum*	1474
Threadfin shad	*Dorosoma petenense*	8
Grass carp	*Ctenopharyngodon idella*	1
Red shiner	*Cyprinella lutrensis*	718
Steelcolor shiner	*Cyprinella whipplei*	1
Common carp	*Cyprinus carpio*	328
Mississippi silvery minnow	*Hybognathus nuchalis*	8
Silver carp	*Hypophthalmichthys molitrix*	13
Bighead carp	*Hypophthalmichthys nobilis*	27
Bleeding shiner	*Luxilus zonatus*	1
Shoal chub	*Macrhybopsis hyostoma*	556
Sturgeon chub	*Macrhybopsis gelida*	2
Sicklefin chub	*Macrhybopsis meeki*	21
Silver chub	*Macrhybopsis storeriana*	5
Emerald shiner	*Notropis atherinoides*	3867
River shiner	*Notropis blennius*	156
Silverband shiner	*Notropis shumardi*	531
Sand shiner	*Notropis stramineus*	16
Channel shiner	*Notropis wickliffi*	2926
Pugnose minnow	*Opsopoeodus emiliae*	27
Bluntnose minnow	*Pimephales notatus*	29
Bullhead minnow	*Pimephales vigilax*	82
Creek chub	*Semotilus atromaculatus*	3
River carpsucker	*Carpiodes carpio*	190
Blue sucker	*Cycleptus elongatus*	7
Smallmouth buffalo	*Ictiobus bubalus*	18
Bigmouth buffalo	*Ictiobus cyprinellus*	6
Black buffalo	*Ictiobus niger*	13
Shorthead redhorse	*Moxostoma macrolepidotum*	1
Blue catfish	*Ictalurus furcatus*	43
Channel catfish	*Ictalurus punctatus*	448
Stonecat	*Noturus flavus*	25
Flathead catfish	*Pylodictis olivaris*	16
Rainbow smelt	*Osmerus mordax*	2
Northern studfish	*Fundulus catenatus*	1
Western mosquitofish	*Gambusia affinis*	471
Brook silverside	*Labidesthes sicculus*	4
Inland silverside	*Menidia beryllina*	16

White bass	*Morone chrysops*	83
Striped bass	*Morone saxatilis*	1
Green sunfish	*Lepomis cyanellus*	1
Orangespotted sunfish	*Lepomis humilis*	12
Bluegill	*Lepomis macrochirus*	96
Spotted bass	*Micropterus punctulatus*	3
Largemouth bass	*Micropterus salmoides*	2
White crappie	*Pomoxis annularis*	1
Black crappie	*Pomoxis nigromaculatus*	2
Logperch	*Percina caprodes*	3
River darter	*Percina shumardi*	1
Sauger	*Sander canadense*	3
Freshwater drum	*Aplodinotus grunniens*	264

Table 8a. Fish species and number captured by seining, trawling, and day-time electrofishing in Establishment Island inside bend macrohabitat (ISB) from fall 2003 through summer 2004 (year 2).

Establishment Island Inside Bend Habitat - Year 2

Stratum	Common Name	Scientific Name	Total
ISB	Bullhead minnow	*Pimephales vigilax*	2
ISB	Black buffalo	*Ictiobus niger*	4
ISB	Blue catfish	*Ictalurus furcatus*	16
ISB	Bluegill	*Lepomis macrochirus*	2
ISB	Blue sucker	*Cycleptus elongatus*	4
ISB	Common carp	*Cyprinus carpio*	54
ISB	Channel catfish	*Ictalurus punctatus*	151
ISB	Chestnut lamprey	*Ichthyomyzon castaneus*	2
ISB	Channel shiner	*Notropis wickliffi*	77
ISB	Emerald shiner	*Notropis atherinoides*	901
ISB	Flathead catfish	*Pylodictis olivaris*	2
ISB	Freshwater drum	*Aplodinotus grunniens*	67
ISB	Goldeye	*Hiodon alosoides*	56
ISB	Gizzard shad	*Dorosoma cepedianum*	680
ISB	Inland silverside	*Menidia beryllina*	13
ISB	Logperch	*Percina caprodes*	1
ISB	Largemouth bass	*Micropterus salmoides*	1
ISB	Mooneye	*Hiodon tergisus*	20
ISB	Paddlefish	*Polyodon spathula*	1
ISB	Rainbow smelt	*Osmerus mordax*	1
ISB	Red shiner	*Cyprinella lutrensis*	21
ISB	River carpsucker	*Carpiodes carpio*	53
ISB	River shiner	*Notropis blennius*	14
ISB	Silverband shiner	*Notropis shumardi*	3
ISB	Sicklefin chub	*Macrhybopsis meeki*	10
ISB	Sturgeon chub	*Macrhybopsis gelida*	1
ISB	Sauger	*Sander canadense*	2
ISB	Shorthead redhorse	*Moxostoma macrolepidotum*	1
ISB	Skipjack herring	*Alosa chrysochloris*	7
ISB	Shoal chub	*Macrhybopsis hyostoma*	155
ISB	Smallmouth buffalo	*Ictiobus bubalus*	6
ISB	Shortnose gar	*Lepisosteus platostomus*	14
ISB	Shovelnose sturgeon	*Scaphirhynchus platorynchus*	35
ISB	Stonecat	*Noturus flavus*	21
ISB	Silver chub	*Macrhybopsis storeriana*	3
ISB	Silver carp	*Hypophthalmichthys molitrix*	2
ISB	Mississippi silvery minnow	*Hybognathus nuchalis*	1
ISB	White bass	*Morone chrysops*	18

Table 8b. Fish species and number captured by seining, trawling, and day-time electrofishing in Establishment Island side channel macrohabitat (SC) from fall 2003 through summer 2004 (year 2).

Establishment Island Side Channel Habitat - Year 2

Stratum	Common Name	Scientific Name	Total
SC	Bighead carp	*Hypophthalmichthys nobilis*	27
SC	Bullhead minnow	*Pimephales vigilax*	79
SC	Black buffalo	*Ictiobus niger*	4
SC	Black crappie	*Pomoxis nigromaculatus*	1
SC	Brook silverside	*Labidesthes sicculus*	2
SC	Blue catfish	*Ictalurus furcatus*	3
SC	Bluegill	*Lepomis macrochirus*	75
SC	Bigmouth buffalo	*Ictiobus cyprinellus*	1
SC	Bluntnose minnow	*Pimephales notatus*	16
SC	Common carp	*Cyprinus carpio*	58
SC	Channel catfish	*Ictalurus punctatus*	175
SC	Chestnut lamprey	*Ichthyomyzon castaneus*	1
SC	Channel shiner	*Notropis wickliffi*	2628
SC	Emerald shiner	*Notropis atherinoides*	1710
SC	Flathead catfish	*Pylodictis olivaris*	4
SC	Freshwater drum	*Aplodinotus grunniens*	143
SC	Goldeye	*Hiodon alosoides*	3
SC	Gizzard shad	*Dorosoma cepedianum*	529
SC	Inland silverside	*Menidia beryllina*	3
SC	Longnose gar	*Lepisosteus osseus*	1
SC	Western mosquitofish	*Gambusia affinis*	468
SC	Orangespotted sunfish	*Lepomis humilis*	12
SC	Paddlefish	*Polyodon spathula*	14
SC	Pugnose minnow	*Opsopoeodus emiliae*	25
SC	Red shiner	*Cyprinella lutrensis*	573
SC	River carpsucker	*Carpiodes carpio*	110
SC	River shiner	*Notropis blennius*	79
SC	Silverband shiner	*Notropis shumardi*	516
SC	Skipjack herring	*Alosa chrysochloris*	36
SC	Shoal chub	*Macrhybopsis hyostoma*	35
SC	Smallmouth buffalo	*Ictiobus bubalus*	4
SC	Shortnose gar	*Lepisosteus platostomus*	14
SC	Shovelnose sturgeon	*Scaphirhynchus platorynchus*	3
SC	Sand shiner	*Notropis stramineus*	14
SC	Silver carp	*Hypophthalmichthys molitrix*	6
SC	Mississippi silvery minnow	*Hybognathus nuchalis*	2
SC	Threadfin shad	*Dorosoma petenense*	6
SC	White bass	*Morone chrysops*	45

Table 8c. Fish species and number captured by seining, trawling, and day-time electrofishing in Establishment Island crossover macrohabitat (XO) from fall 2003 through summer 2004 (year 2).

Establishment Island Crossover Habitat - Year 2

Stratum	Common Name	Scientific Name	Total
XO	Bleeding shiner	*Luxilus zonatus*	1
XO	Bullhead minnow	*Pimephales vigilax*	1
XO	Black buffalo	*Ictiobus niger*	5
XO	Black crappie	*Pomoxis nigromaculatus*	1
XO	Brook silverside	*Labidesthes sicculus*	2
XO	Blue catfish	*Ictalurus furcatus*	24
XO	Bluegill	*Lepomis macrochirus*	19
XO	Bigmouth buffalo	*Ictiobus cyprinellus*	5
XO	Bluntnose minnow	*Pimephales notatus*	13
XO	Blue sucker	*Cycleptus elongatus*	3
XO	Common carp	*Cyprinus carpio*	216
XO	Creek chub	*Semotilus atromaculatus*	3
XO	Channel catfish	*Ictalurus punctatus*	122
XO	Channel shiner	*Notropis wickliffi*	221
XO	Emerald shiner	*Notropis atherinoides*	1256
XO	Flathead catfish	*Pylodictis olivaris*	10
XO	Freshwater drum	*Aplodinotus grunniens*	54
XO	Goldeye	*Hiodon alosoides*	44
XO	Green sunfish	*Lepomis cyanellus*	1
XO	Grass carp	*Ctenopharyngodon idella*	1
XO	Gizzard shad	*Dorosoma cepedianum*	265
XO	Logperch	*Percina caprodes*	2
XO	Largemouth bass	*Micropterus salmoides*	1
XO	Mooneye	*Hiodon tergisus*	13
XO	Western mosquitofish	*Gambusia affinis*	3
XO	Northern studfish	*Fundulus catenatus*	1
XO	Paddlefish	*Polyodon spathula*	69
XO	Pugnose minnow	*Opsopoeodus emiliae*	2
XO	Rainbow smelt	*Osmerus mordax*	1
XO	Red shiner	*Cyprinella lutrensis*	124
XO	River darter	*Percina shumardi*	1
XO	River carpsucker	*Carpiodes carpio*	27
XO	River shiner	*Notropis blennius*	63
XO	Silverband shiner	*Notropis shumardi*	12
XO	Steelcolor shiner	*Cyprinella whipplei*	1
XO	Striped bass	*Morone saxatilis*	1
XO	Sicklefin chub	*Macrhybopsis meeki*	11
XO	Sturgeon chub	*Macrhybopsis gelida*	1
XO	Sauger	*Sander canadense*	1
XO	Skipjack herring	*Alosa chrysochloris*	10
XO	Shoal chub	*Macrhybopsis hyostoma*	366
XO	Smallmouth buffalo	*Ictiobus bubalus*	8
XO	Shortnose gar	*Lepisosteus platostomus*	28

XO	Shovelnose sturgeon	*Scaphirhynchus platorynchus*	27
XO	Sand shiner	*Notropis stramineus*	2
XO	Spotted bass	*Micropterus punctulatus*	3
XO	Stonecat	*Noturus flavus*	4
XO	Silver chub	*Macrhybopsis storeriana*	2
XO	Silver carp	*Hypophthalmichthys molitrix*	5
XO	Mississippi silvery minnow	*Hybognathus nuchalis*	5
XO	Threadfin shad	*Dorosoma petenense*	2
XO	Unidentified sturgeon	*Scaphirhynchus* sp.	4
XO	White bass	*Morone chrysops*	20
XO	White crappie	*Pomoxis annularis*	1

Table 9. Fish species and total numbers captured by seining, trawling, and day-time electrofishing in the Kaskaskia Island complex from fall 2003 through summer 2004 (year 2).

Kaskaskia Island Year - 2

Common Name	Scientific Name	Total
Shovelnose sturgeon	*Scaphirhynchus platorynchus*	65
Unidentified sturgeon	*Scaphirhynchus* sp.	7
Paddlefish	*Polyodon spathula*	71
Spotted gar	*Lepisosteus oculatus*	2
Longnose gar	*Lepisosteus osseus*	5
Shortnose gar	*Lepisosteus platostomus*	114
Goldeye	*Hiodon alosoides*	129
Mooneye	*Hiodon tergisus*	23
American eel	*Anguilla rostrata*	1
Skipjack herring	*Alosa chrysochloris*	3
Gizzard shad	*Dorosoma cepedianum*	1352
Threadfin shad	*Dorosoma petenense*	4
Largescale stoneroller	*Campostoma oligolepis*	3
Grass carp	*Ctenopharyngodon idella*	1
Red shiner	*Cyprinella lutrensis*	2477
Common carp	*Cyprinus carpio*	305
Mississippi silvery minnow	*Hybognathus nuchalis*	4
Silver carp	*Hypophthalmichthys molitrix*	51
Bighead carp	*Hypophthalmichthys nobilis*	14
Shoal chub	*Macrhybopsis hyostoma*	513
Sturgeon chub	*Macrhybopsis gelida*	5
Sicklefin chub	*Macrhybopsis meeki*	14
Silver chub	*Macrhybopsis storeriana*	14
Emerald shiner	*Notropis atherinoides*	3838
River shiner	*Notropis blennius*	166
Silverband shiner	*Notropis shumardi*	384
Sand shiner	*Notropis stramineus*	12
Channel shiner	*Notropis wickliffi*	1334
Pugnose minnow	*Opsopoeodus emiliae*	317
Bluntnose minnow	*Pimephales notatus*	2
Bullhead minnow	*Pimephales vigilax*	82
River carpsucker	*Carpiodes carpio*	82
Quillback	*Carpiodes cyprinus*	3
Blue sucker	*Cycleptus elongatus*	3
Smallmouth buffalo	*Ictiobus bubalus*	23
Bigmouth buffalo	*Ictiobus cyprinellus*	16
Black buffalo	*Ictiobus niger*	11
Unidentified buffalo	*Ictiobus* sp.	3
Shorthead redhorse	*Moxostoma macrolepidotum*	1

Blue catfish	*Ictalurus furcatus*	80
Channel catfish	*Ictalurus punctatus*	249
Stonecat	*Noturus flavus*	1
Freckled madtom	*Noturus nocturnus*	2
Flathead catfish	*Pylodictis olivaris*	32
Western mosquitofish	*Gambusia affinis*	194
Brook silverside	*Labidesthes sicculus*	1
Inland silverside	*Menidia beryllina*	14
White bass	*Morone chrysops*	50
Striped bass	*Morone saxatilis*	1
Green sunfish	*Lepomis cyanellus*	3
Orangespotted sunfish	*Lepomis humilis*	11
Bluegill	*Lepomis macrochirus*	45
Smallmouth bass	*Micropterus dolomieu*	1
Spotted bass	*Micropterus punctulatus*	1
Largemouth bass	*Micropterus salmoides*	1
Black crappie	*Pomoxis nigromaculatus*	2
Western sand darter	*Ammocrypta clara*	1
Logperch	*Percina caprodes*	1
Freshwater drum	*Aplodinotus grunniens*	371

Table 10a. Fish species and number captured by seining, trawling, and day-time electrofishing in Kaskaskia Island inside bend macrohabitat (ISB) from fall 2003 through summer 2004 (year 2).

Kaskaskia Island Inside Bend Habitat Year - 2

Stratum	Common Name	Scientific Name	Total
ISB	Bullhead minnow	*Pimephales vigilax*	1
ISB	Black buffalo	*Ictiobus niger*	5
ISB	Brook silverside	*Labidesthes sicculus*	1
ISB	Blue catfish	*Ictalurus furcatus*	31
ISB	Bigmouth buffalo	*Ictiobus cyprinellus*	2
ISB	Blue sucker	*Cycleptus elongatus*	2
ISB	Common carp	*Cyprinus carpio*	31
ISB	Channel catfish	*Ictalurus punctatus*	122
ISB	Channel shiner	*Notropis wickliffi*	106
ISB	Emerald shiner	*Notropis atherinoides*	940
ISB	Flathead catfish	*Pylodictis olivaris*	13
ISB	Freshwater drum	*Aplodinotus grunniens*	70
ISB	Goldeye	*Hiodon alosoides*	10
ISB	Gizzard shad	*Dorosoma cepedianum*	391
ISB	Inland silverside	*Menidia beryllina*	1
ISB	Longnose gar	*Lepisosteus osseus*	1
ISB	Mooneye	*Hiodon tergisus*	2
ISB	Paddlefish	*Polyodon spathula*	61
ISB	Pugnose minnow	*Opsopoeodus emiliae*	1
ISB	Quillback	*Carpiodes cyprinus*	2
ISB	Red shiner	*Cyprinella lutrensis*	27
ISB	River carpsucker	*Carpiodes carpio*	17
ISB	River shiner	*Notropis blennius*	77
ISB	Sicklefin chub	*Macrhybopsis meeki*	8
ISB	Sturgeon chub	*Macrhybopsis gelida*	5
ISB	Shoal chub	*Macrhybopsis hyostoma*	207
ISB	Smallmouth buffalo	*Ictiobus bubalus*	13
ISB	Shortnose gar	*Lepisosteus platostomus*	34
ISB	Shovelnose sturgeon	*Scaphirhynchus platorynchus*	51
ISB	Sand shiner	*Notropis stramineus*	2
ISB	Silver chub	*Macrhybopsis storeriana*	1
ISB	Silver carp	*Hypophthalmichthys molitrix*	2
ISB	Threadfin shad	*Dorosoma petenense*	1
ISB	Unidentified sturgeon	*Scaphirhynchus* sp.	5
ISB	Western sand darter	*Ammocrypta clara*	1
ISB	White bass	*Morone chrysops*	8

Table 10b. Fish species and number captured by seining, trawling, and day-time electrofishing in Kaskaskia Island side channel macrohabitat (SC) from fall 2003 through summer 2004 (year 2).

Kaskaskia Island Side Channel Habitat - Year 2

Stratum	Common Name	Scientific Name	Total
SC	Bighead carp	*Hypophthalmichthys nobilis*	13
SC	Bullhead minnow	*Pimephales vigilax*	79
SC	Black buffalo	*Ictiobus niger*	3
SC	Black crappie	*Pomoxis nigromaculatus*	2
SC	Blue catfish	*Ictalurus furcatus*	4
SC	Bluegill	*Lepomis macrochirus*	44
SC	Bigmouth buffalo	*Ictiobus cyprinellus*	10
SC	Bluntnose minnow	*Pimephales notatus*	2
SC	Common carp	*Cyprinus carpio*	70
SC	Channel catfish	*Ictalurus punctatus*	29
SC	Channel shiner	*Notropis wickliffi*	1129
SC	Emerald shiner	*Notropis atherinoides*	2181
SC	Flathead catfish	*Pylodictis olivaris*	3
SC	Freshwater drum	*Aplodinotus grunniens*	87
SC	Goldeye	*Hiodon alosoides*	28
SC	Green sunfish	*Lepomis cyanellus*	2
SC	Grass carp	*Ctenopharyngodon idella*	1
SC	Gizzard shad	*Dorosoma cepedianum*	740
SC	Inland silverside	*Menidia beryllina*	12
SC	Largemouth bass	*Micropterus salmoides*	1
SC	Longnose gar	*Lepisosteus osseus*	2
SC	Largescale stoneroller	*Campostoma oligolepis*	3
SC	Mooneye	*Hiodon tergisus*	13
SC	Western mosquitofish	*Gambusia affinis*	185
SC	Orangespotted sunfish	*Lepomis humilis*	11
SC	Paddlefish	*Polyodon spathula*	8
SC	Pugnose minnow	*Opsopoeodus emiliae*	277
SC	Quillback	*Carpiodes cyprinus*	1
SC	Red shiner	*Cyprinella lutrensis*	2397
SC	River carpsucker	*Carpiodes carpio*	52
SC	River shiner	*Notropis blennius*	66
SC	Silverband shiner	*Notropis shumardi*	381
SC	Shorthead redhorse	*Moxostoma macrolepidotum*	1
SC	Shoal chub	*Macrhybopsis hyostoma*	163
SC	Smallmouth buffalo	*Ictiobus bubalus*	5
SC	Shortnose gar	*Lepisosteus platostomus*	47
SC	Sand shiner	*Notropis stramineus*	9
SC	Spotted gar	*Lepisosteus oculatus*	1
SC	Silver chub	*Macrhybopsis storeriana*	6
SC	Silver carp	*Hypophthalmichthys molitrix*	48
SC	Mississippi silvery	*Hybognathus nuchalis*	4

	minnow		
SC	Threadfin shad	*Dorosoma petenense*	2
SC	Unidentified buffalo	*Ictiobus* sp.	3
SC	White bass	*Morone chrysops*	13

Table 10c. Fish species and number captured by seining, trawling, and day-time electrofishing in Kaskaskia Island crossover macrohabitat (XO) from fall 2003 through summer 2004 (year 2).

Kaskaskia Island Crossover Habitat - Year 2

Stratum	Common Name	Scientific Name	Total
XO	American eel	*Anguilla rostrata*	1
XO	Bighead carp	*Hypophthalmichthys nobilis*	1
XO	Bullhead minnow	*Pimephales vigilax*	2
XO	Black buffalo	*Ictiobus niger*	3
XO	Blue catfish	*Ictalurus furcatus*	45
XO	Bluegill	*Lepomis macrochirus*	1
XO	Bigmouth buffalo	*Ictiobus cyprinellus*	4
XO	Blue sucker	*Cycleptus elongatus*	1
XO	Common carp	*Cyprinus carpio*	204
XO	Channel catfish	*Ictalurus punctatus*	98
XO	Channel shiner	*Notropis wickliffi*	99
XO	Emerald shiner	*Notropis atherinoides*	717
XO	Flathead catfish	*Pylodictis olivaris*	16
XO	Freckled madtom	*Noturus nocturnus*	2
XO	Freshwater drum	*Aplodinotus grunniens*	214
XO	Goldeye	*Hiodon alosoides*	91
XO	Green sunfish	*Lepomis cyanellus*	1
XO	Gizzard shad	*Dorosoma cepedianum*	221
XO	Inland silverside	*Menidia beryllina*	1
XO	Logperch	*Percina caprodes*	1
XO	Longnose gar	*Lepisosteus osseus*	2
XO	Mooneye	*Hiodon tergisus*	8
XO	Western mosquitofish	*Gambusia affinis*	9
XO	Paddlefish	*Polyodon spathula*	2
XO	Pugnose minnow	*Opsopoeodus emiliae*	39
XO	Red shiner	*Cyprinella lutrensis*	53
XO	River carpsucker	*Carpiodes carpio*	13
XO	River shiner	*Notropis blennius*	23
XO	Silverband shiner	*Notropis shumardi*	3
XO	Striped bass	*Morone saxatilis*	1
XO	Sicklefin chub	*Macrhybopsis meeki*	6
XO	Skipjack herring	*Alosa chrysochloris*	3
XO	Shoal chub	*Macrhybopsis hyostoma*	143
XO	Smallmouth buffalo	*Ictiobus bubalus*	5
XO	Smallmouth bass	*Micropterus dolomieu*	1
XO	Shortnose gar	*Lepisosteus platostomus*	33

XO	Shovelnose sturgeon	*Scaphirhynchus platorynchus*	14
XO	Sand shiner	*Notropis stramineus*	1
XO	Spotted bass	*Micropterus punctulatus*	1
XO	Stonecat	*Noturus flavus*	1
XO	Spotted gar	*Lepisosteus oculatus*	1
XO	Silver chub	*Macrhybopsis storeriana*	7
XO	Silver carp	*Hypophthalmichthys molitrix*	1
XO	Threadfin shad	*Dorosoma petenense*	1
XO	Unidentified sturgeon	*Scaphirhynchus* sp.	2
XO	White bass	*Morone chrysops*	29

Table 11. Relative proportion of the six most numerically abundant fish families in the Establishment and Kaskaskia Island complexes by macrohabitat strata collected from fall 2002 through summer 2004. Where HT=habitat type, ISB=inside bend stratum, SC=side channel stratum, XO=crossover stratum, ACI=Acipenseridae, CAT=Catostomidae, CEN=Centrarchidae, CLU=Clupeidae, CYP=Cyprinidae, HIO=Hiodontidae, ICT=Ictaluridae, MOR=Moronidae, PER=Percidae, POL=Polyodontidae, SCI=Sciaenidae, and OTR=other miscellaneous families.

HT	Location / Year	ACI	CAT	CEN	CLU	CYP	HIO	ICT	MOR	PER	POL	SCI	OTR
ISB	Establishment Island	0.012	0.032		0.202	0.453		0.247	0.013				
	YEAR ONE												
	Kaskaskia Island	0.015	0.049		0.169	0.533		0.16				0.042	
	Establishment Island		0.028		0.284	0.512	0.031	0.078				0.028	
	YEAR TWO												
	Kaskaskia Island	0.025			0.174	0.625		0.074			0.027	0.031	
SC	Establishment Island		0.022		0.18	0.734		0.044		0.006		0.005	
	YEAR ONE												
	Kaskaskia Island		0.015		0.354	0.558		0.016				0.029	0.011
	Establishment Island		0.017		0.077	0.777		0.025				0.019	0.064
	YEAR TWO												
	Kaskaskia Island		0.009	0.007	0.093	0.839						0.011	0.024
	Establishment Island		0.023		0.099	0.668		0.113	0.013			0.044	
	YEAR ONE												

X O	Kaskaskia Island		0.009		0.105	0.674		0.109	0.017			0.072	
	Establishment Island		0.016		0.09	0.747	0.018	0.052				0.017	
	YEAR TWO Kaskaskia Island				0.104	0.603	0.019	0.075	0.014			0.099	

Figure 1. Location map for Establishment and Kaskaskia Islands in the Middle Mississippi River.

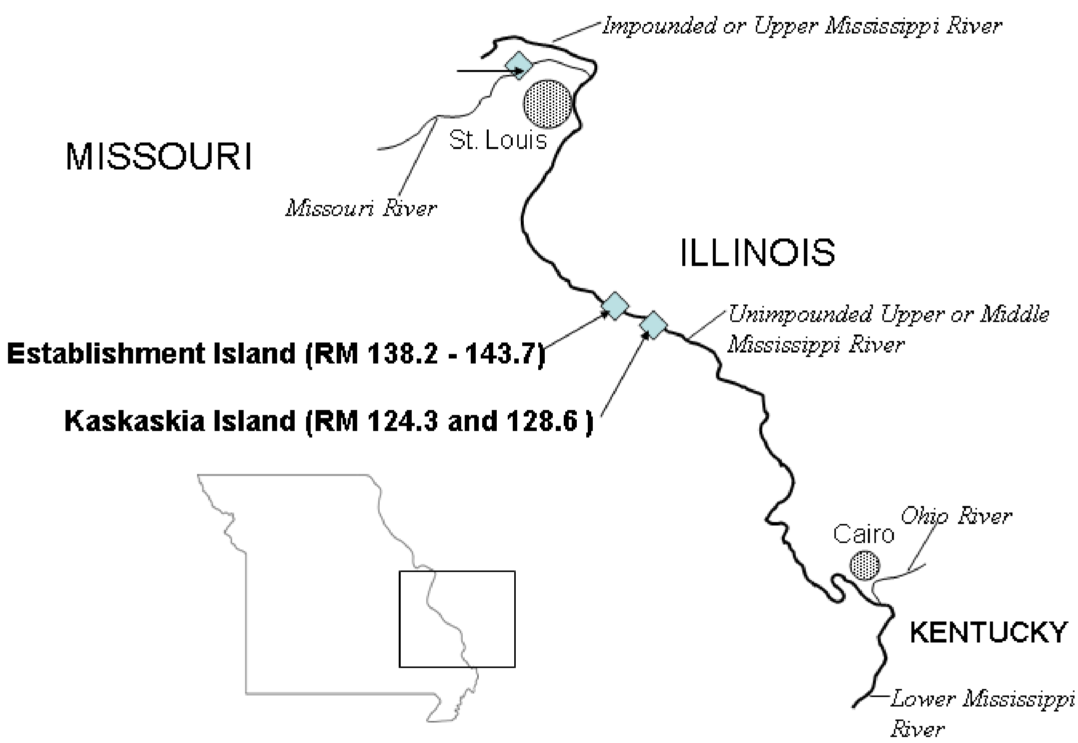


Figure 2. Generalized diagram depicting approximate boundaries for the three macrohabitat designations used in this study: channel crossover, inside bend, and side channel

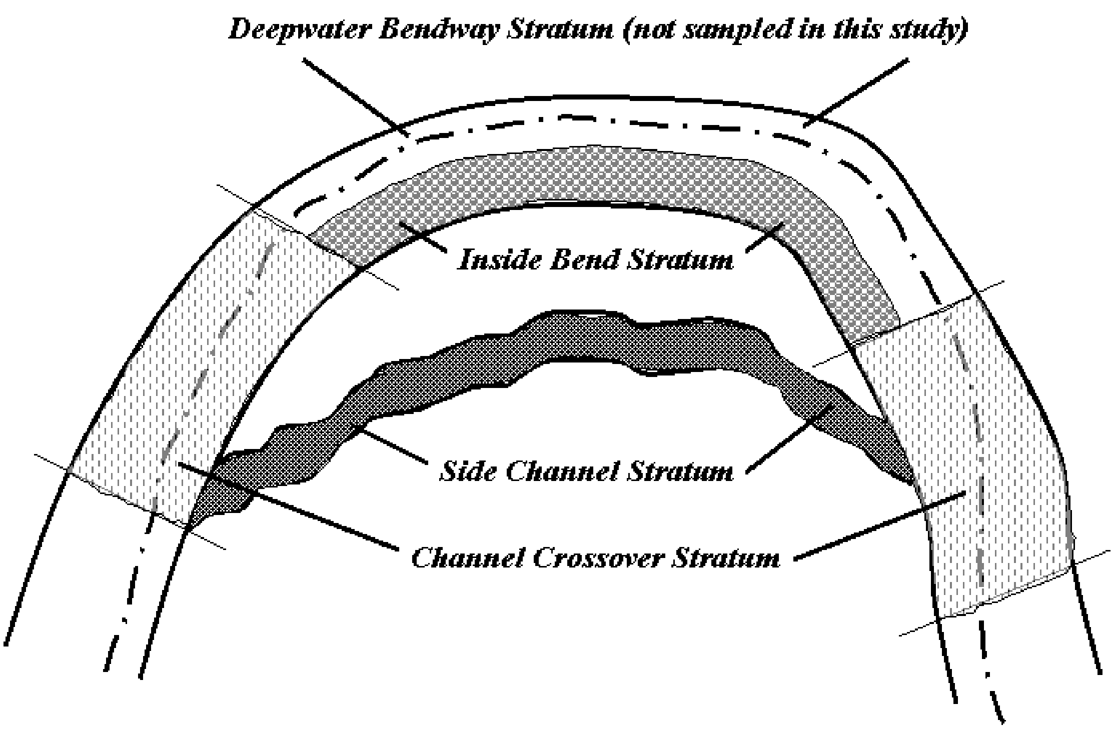


Figure 3a. Sampling sites in the Establishment Island complex (N=148) from fall 2002 through summer 2003 (year 1). Green, white, and yellow dots represent crossover, side channel, and inside bend macrohabitat sites, respectively.

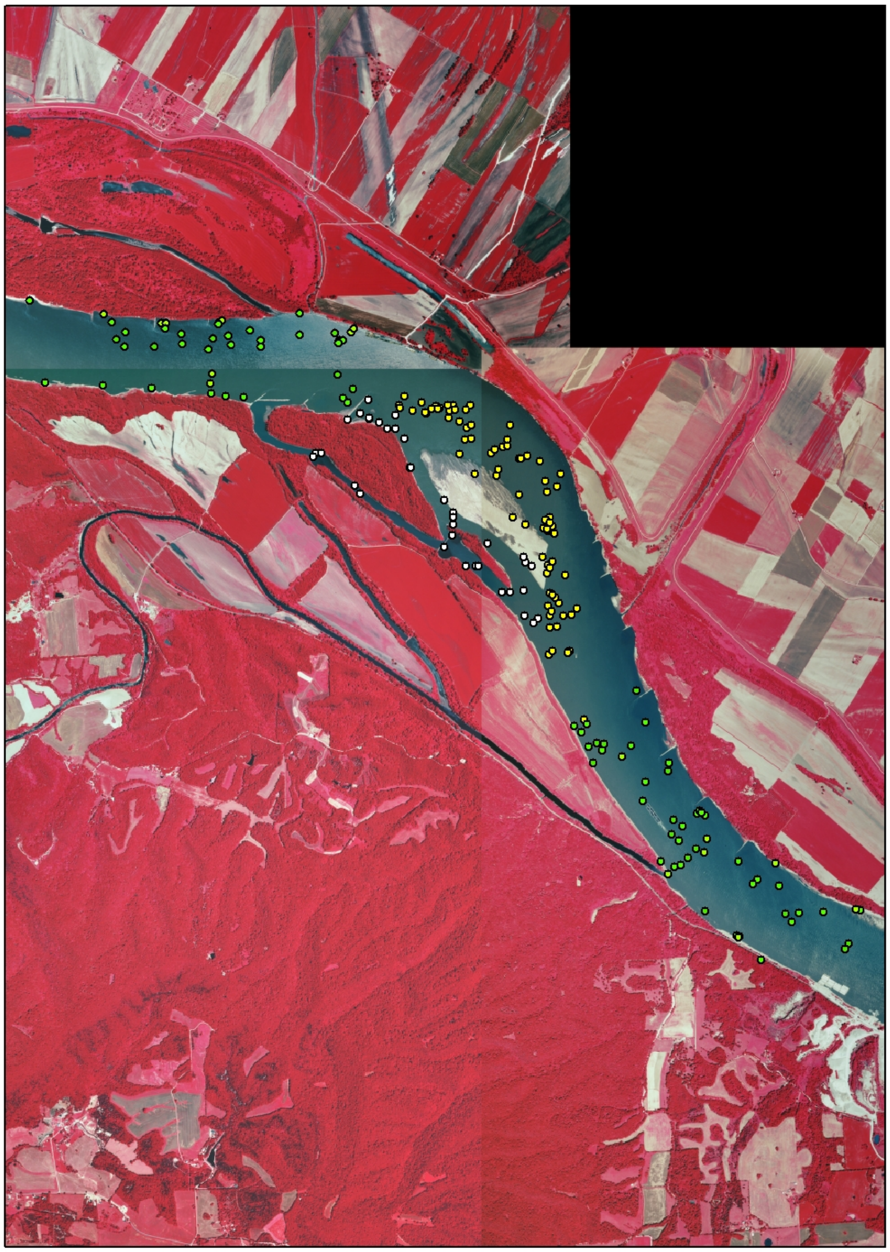


Figure 3b. Sampling sites in the Establishment Island complex (N=157) from fall 2003 through summer 2004 (year 2). Green, white, and yellow dots represent crossover, side channel, and inside bend macrohabitat sites, respectively.

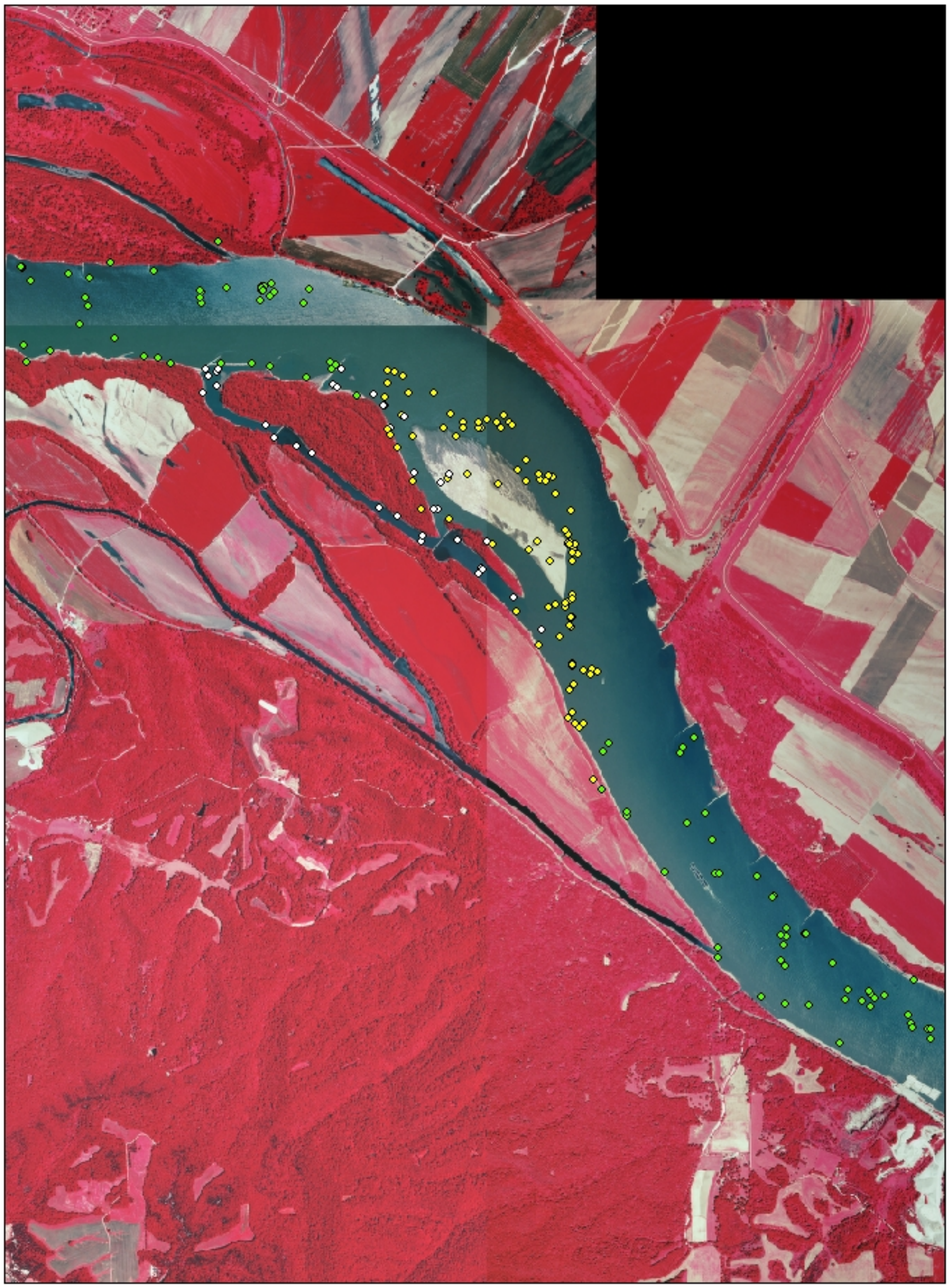
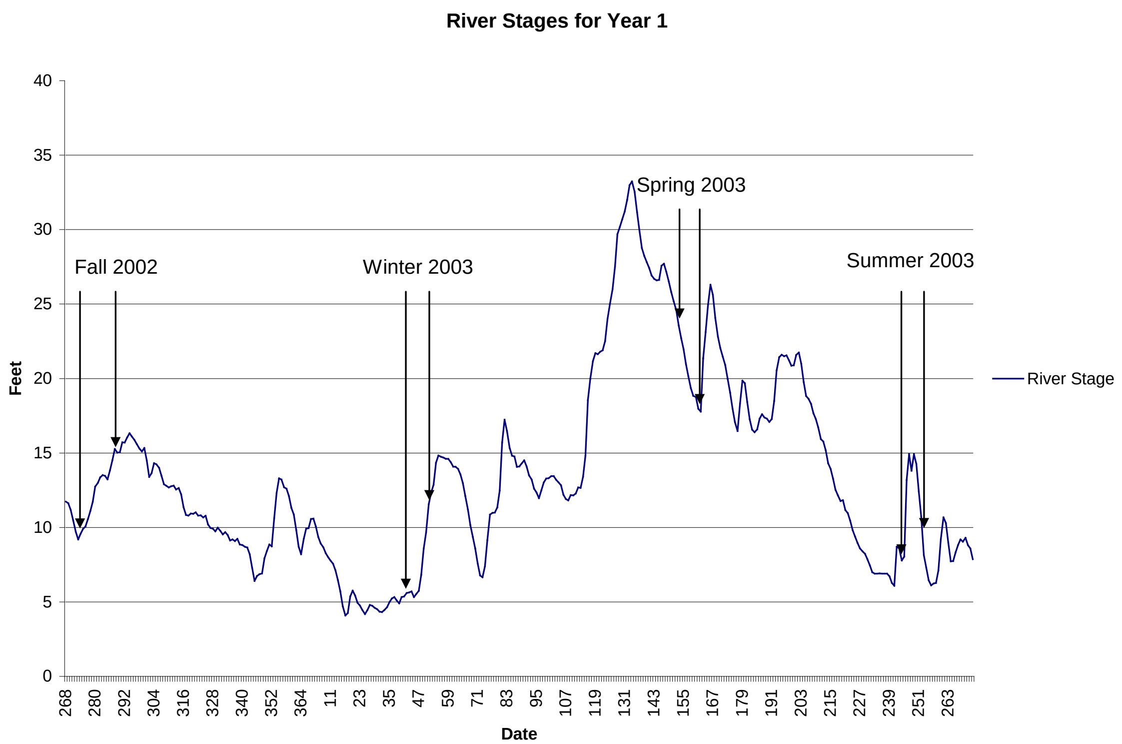
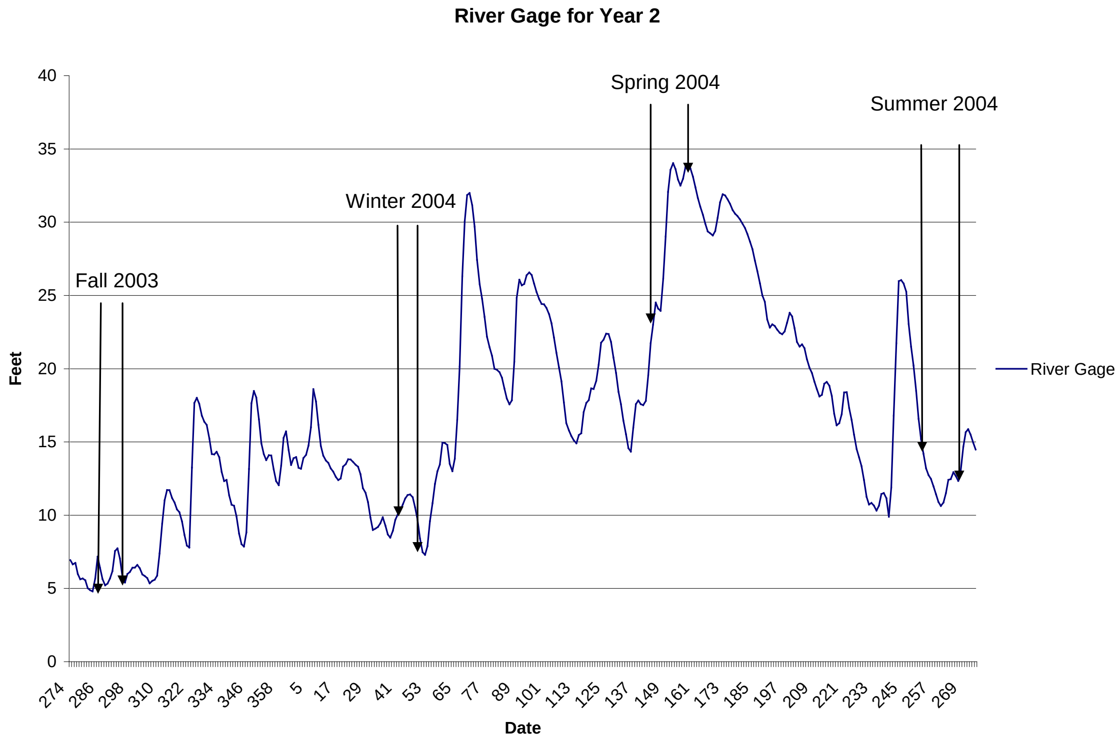


Figure 4a. Sampling sites in the Kaskaskia Island complex (N=162) from fall 2002 through summer 2003 (year 1). Green, white, and yellow dots represent crossover, side channel, and inside bend macrohabitat sites, respectively.

Figure 4b. Sampling sites in the Kaskaskia Island complex (N=143) from fall 2003 through summer 2004 (year 2 Green, white, and yellow dots represent crossover, side channel, and inside bend macrohabitat sites, respectively.

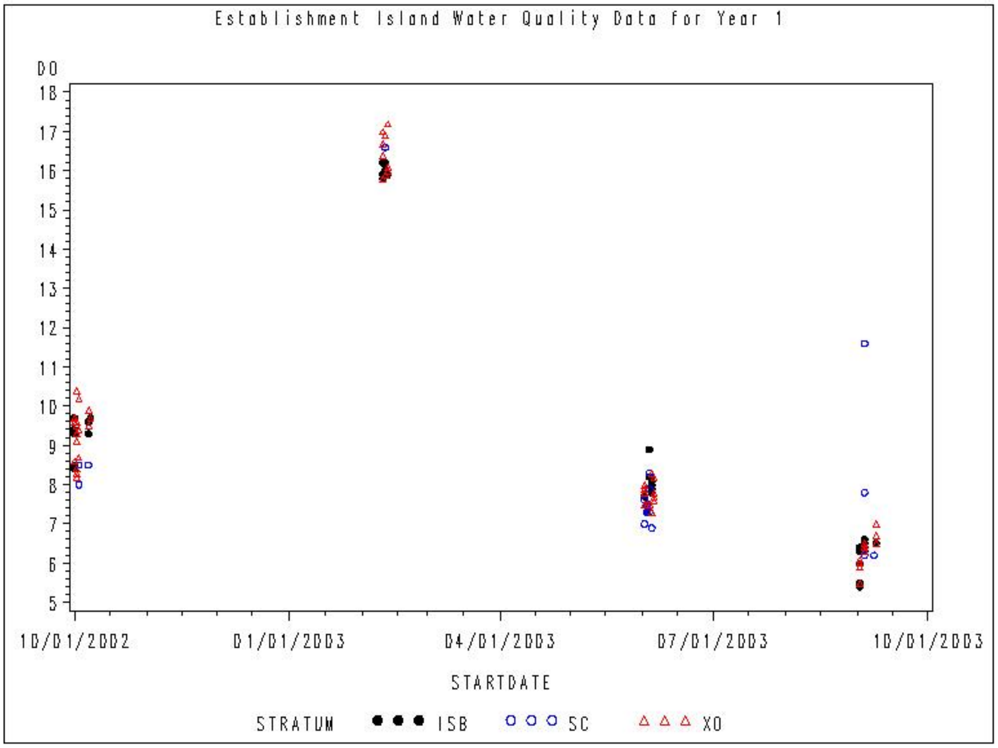
Figure 5. River stages from fall 2002 through summer 2004. River gage data taken from Cape Girardeau, Missouri.





River Gage for Year 2
Feet
Date
40
35
30
25
20
15
10
5
0
274
286
298
310
322
334
346
358
5
17
29
41
53
65
77
89
101
113
125
137
149
161
173
185
197
209
221
233
245
257
269
Fall 2003
Winter 2004
Spring 2004
Summer 2004
River Gage

Figure 6a. Ranges of dissolved oxygen and surface water temperature data taken from all macrohabitat strata in the Establishment Island complex from fall 2002 through summer 2003 (year 1).



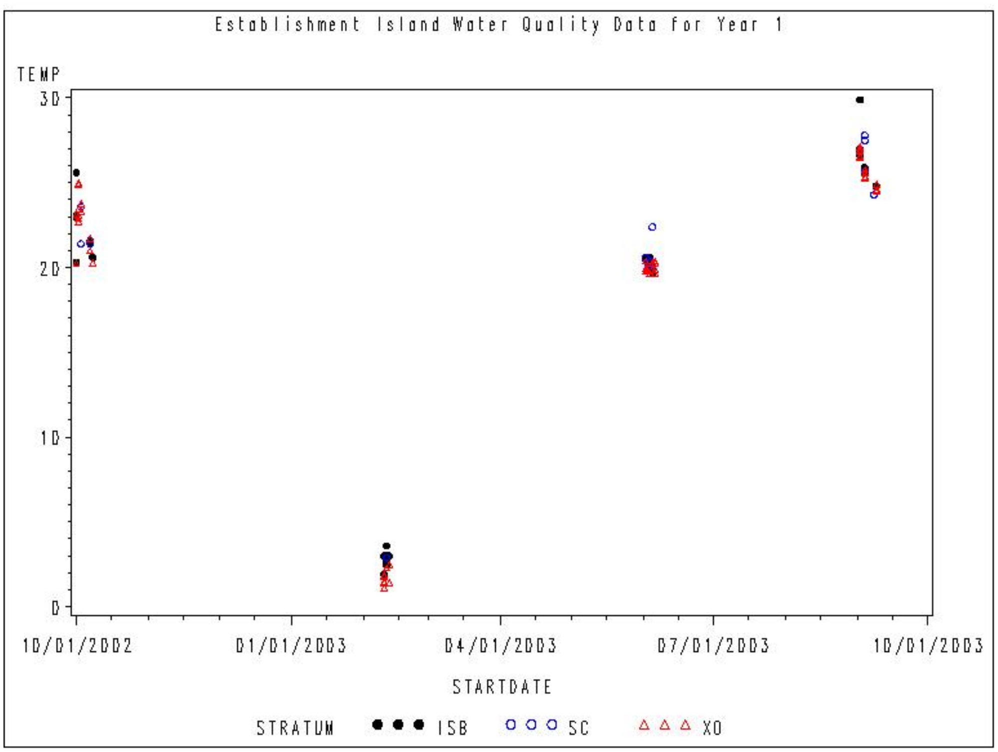
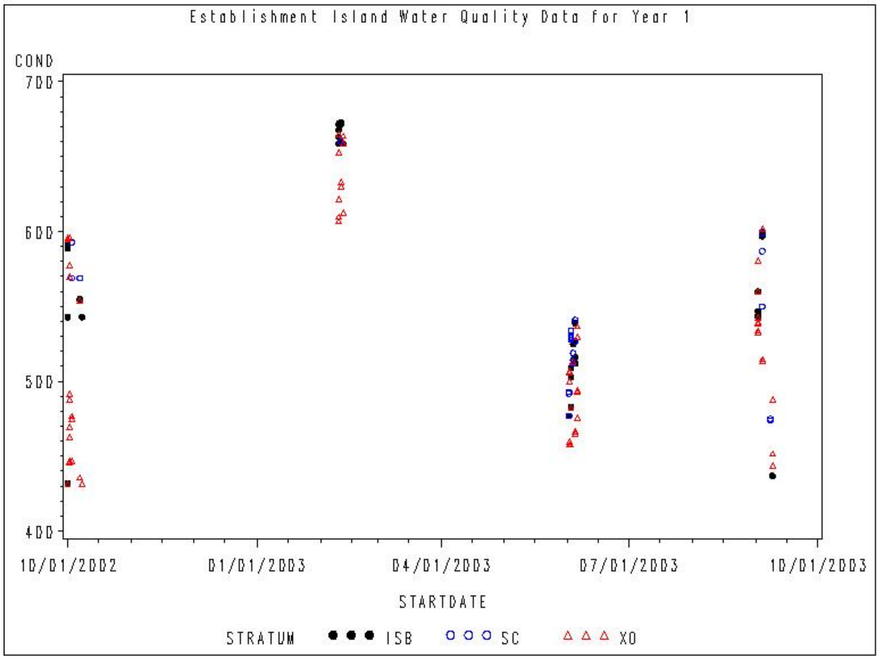


Figure 6b. Ranges of specific conductance and Secchi disk visibility data taken from all macrohabitat strata in the Establishment Island complex from fall 2002 through summer 2003 (year 1).



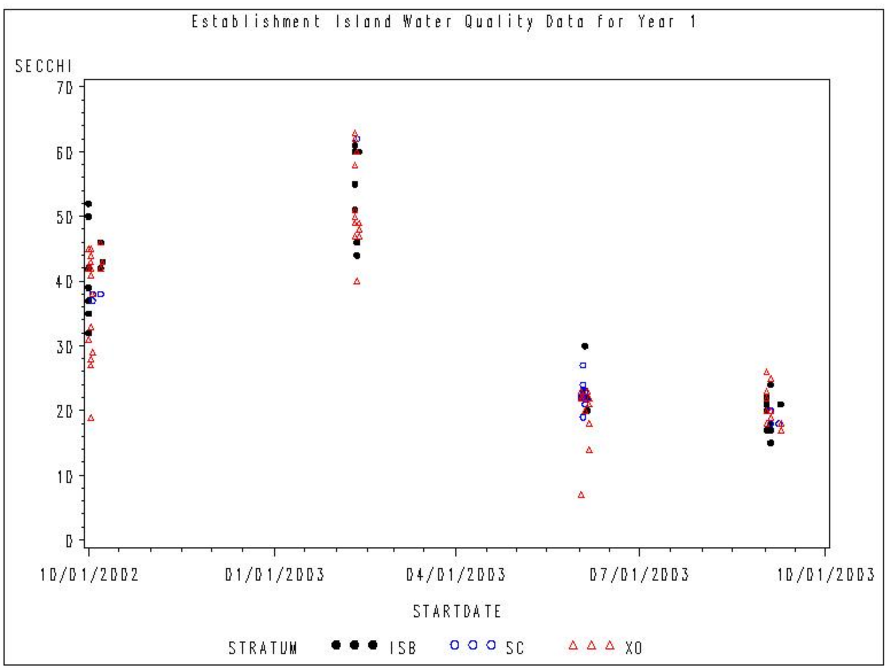
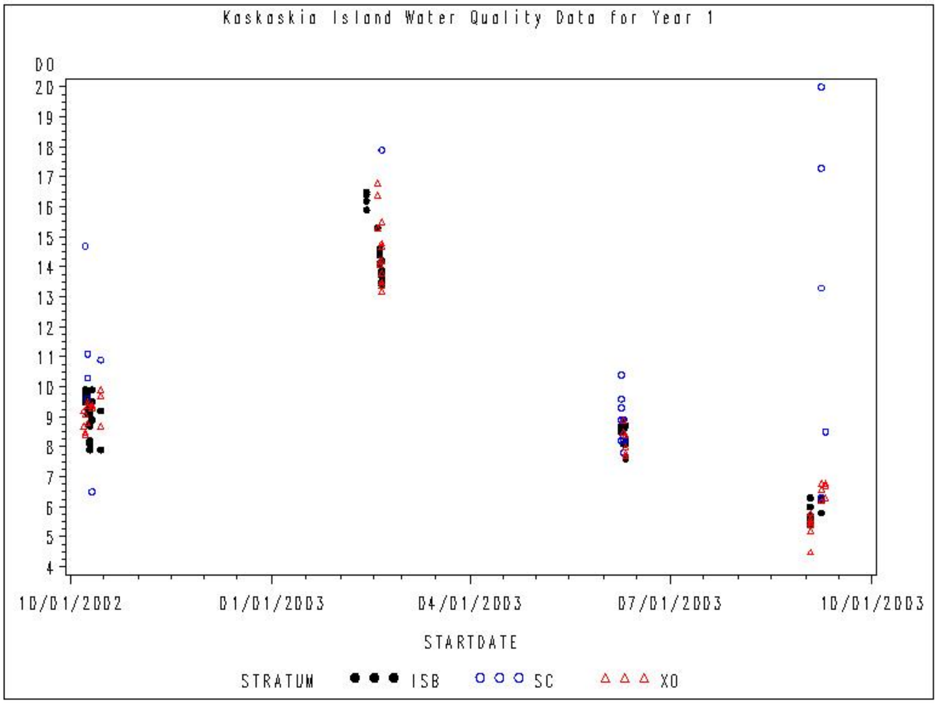


Figure 7a. Ranges of dissolved oxygen and surface water temperature data taken from all macrohabitat strata in the Kaskaskia Island complex from fall 2002 through summer 2003 (year 1).



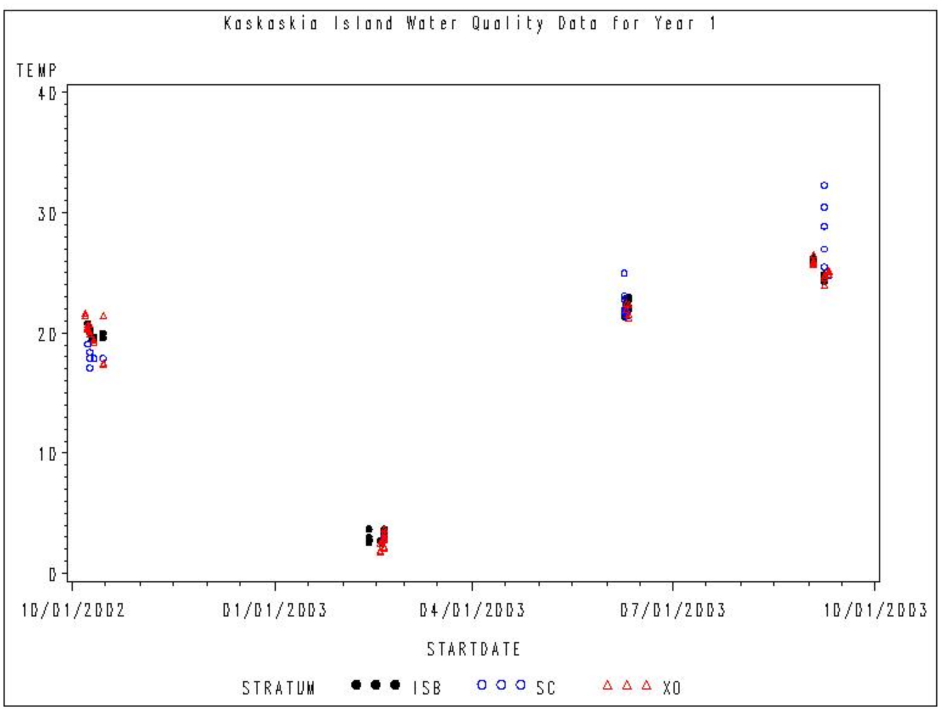
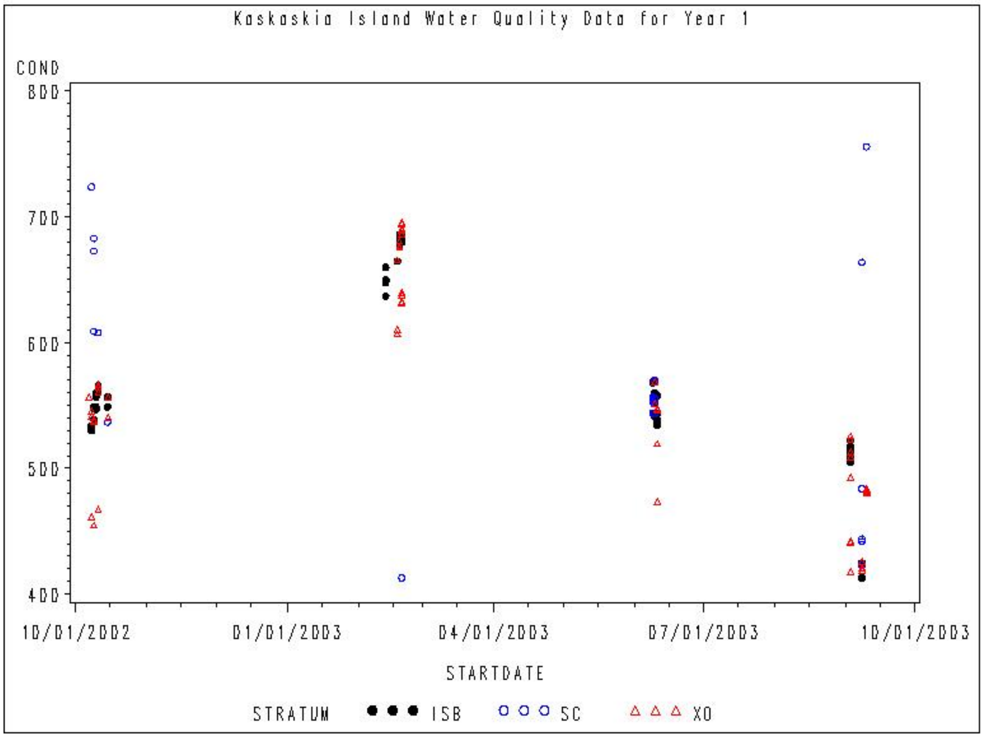


Figure 7b. Ranges of specific conductance and Secchi disk visibility data taken from all macrohabitat strata in the Kaskaskia Island complex from fall 2002 through summer 2003 (year 1).



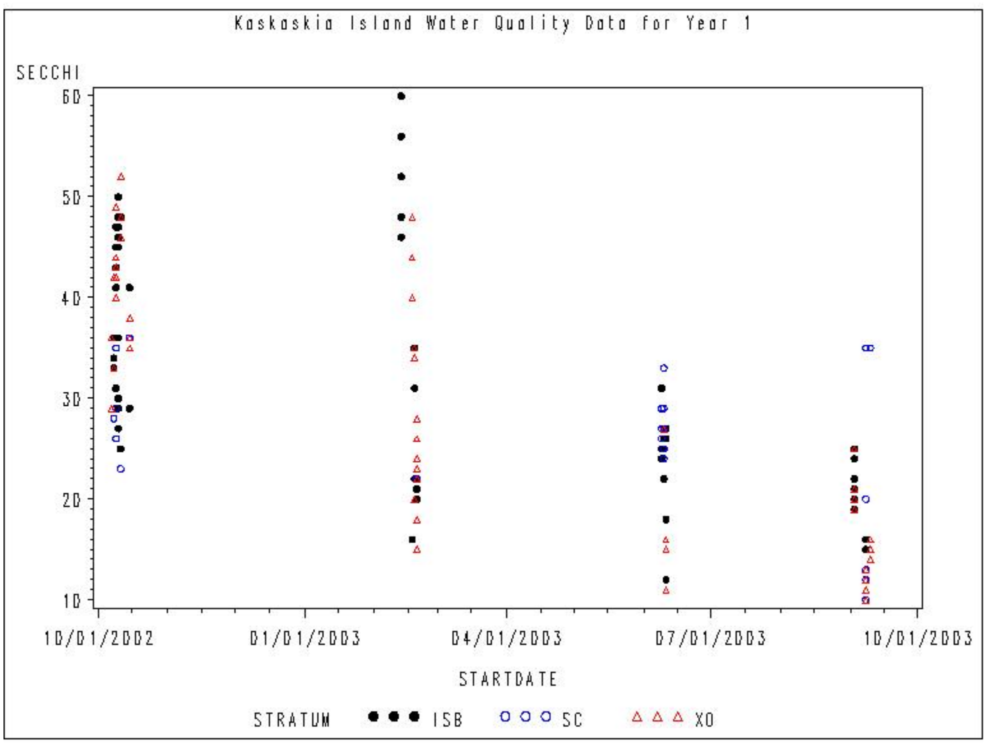
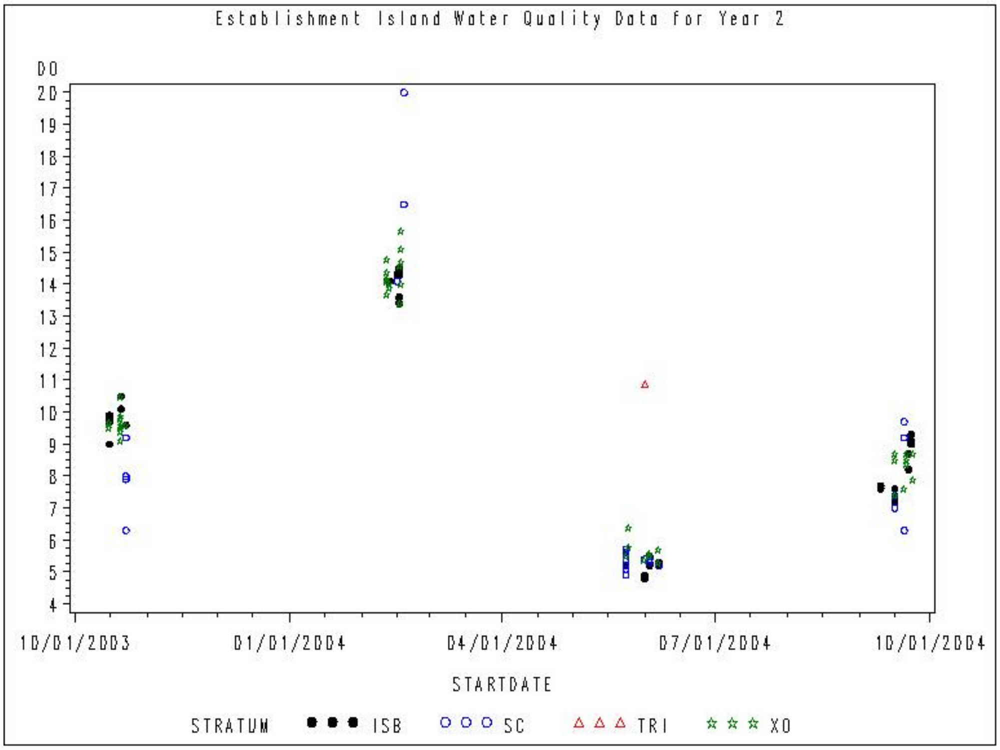


Figure 8a. Ranges of dissolved oxygen and surface water temperature data taken from all macrohabitat strata in the Establishment Island complex from fall 2003 through summer 2004 (year 2).



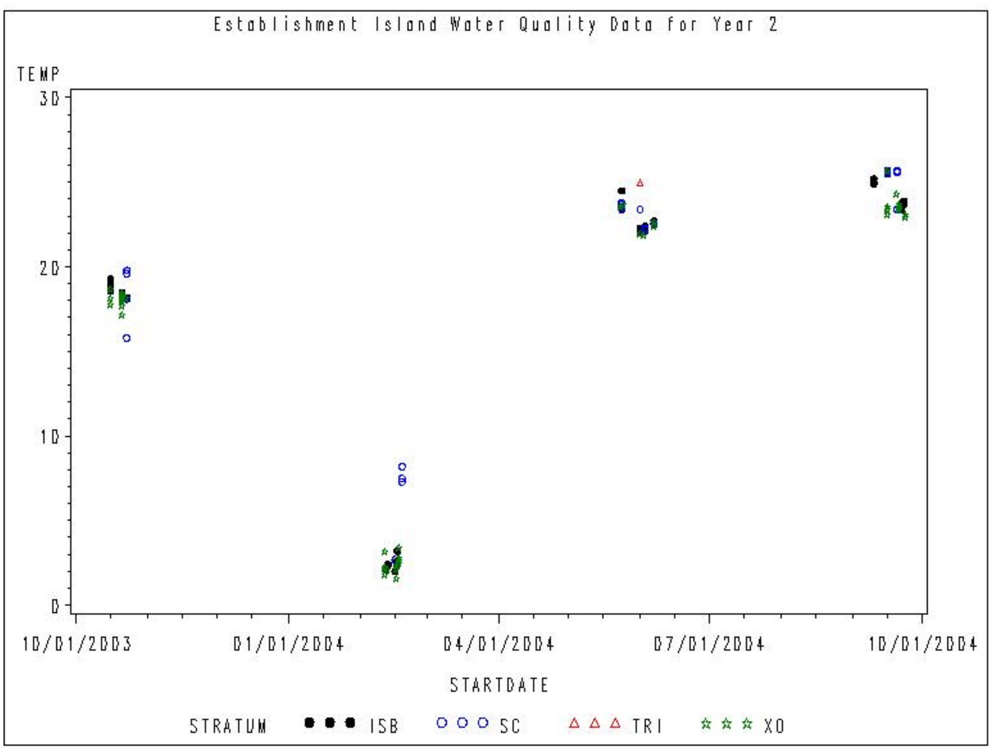
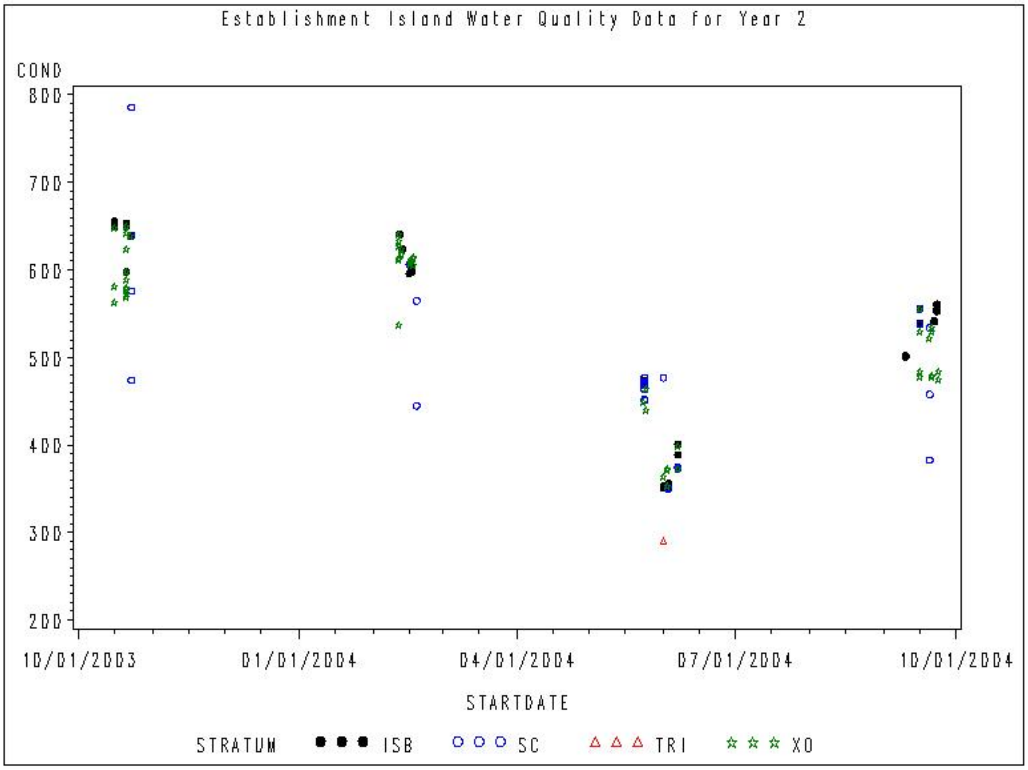


Figure 8b. Ranges of specific conductance and Secchi disk visibility data taken from all macrohabitat strata in the Establishment Island complex from fall 2003 through summer 2004 (year 2).



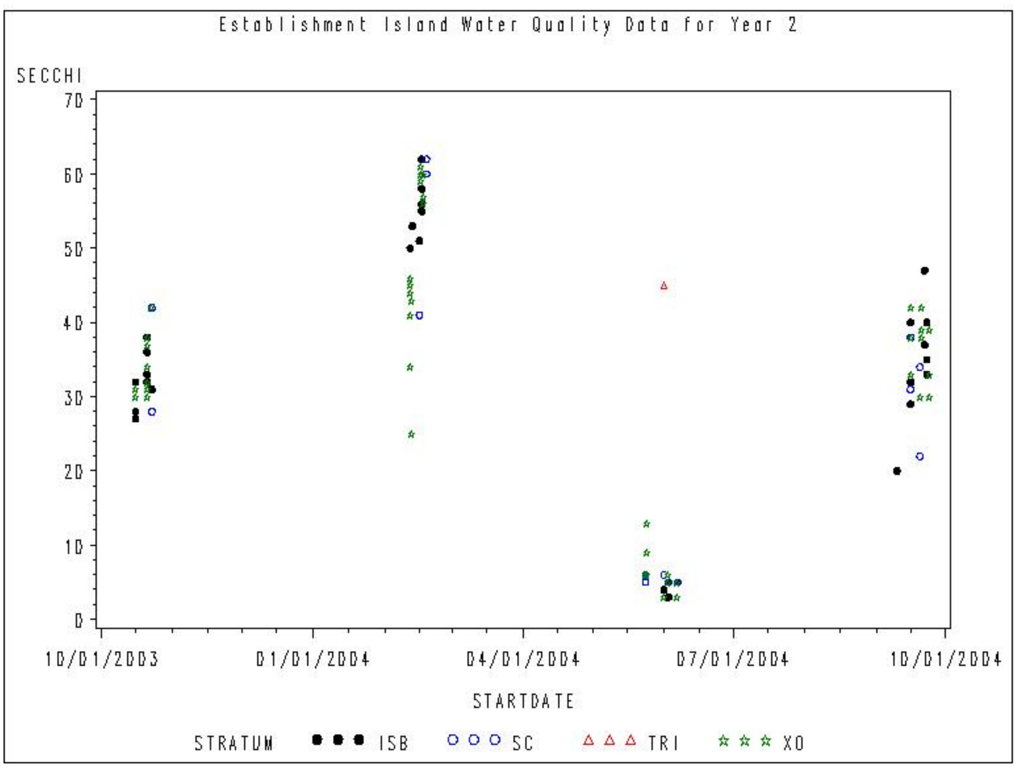
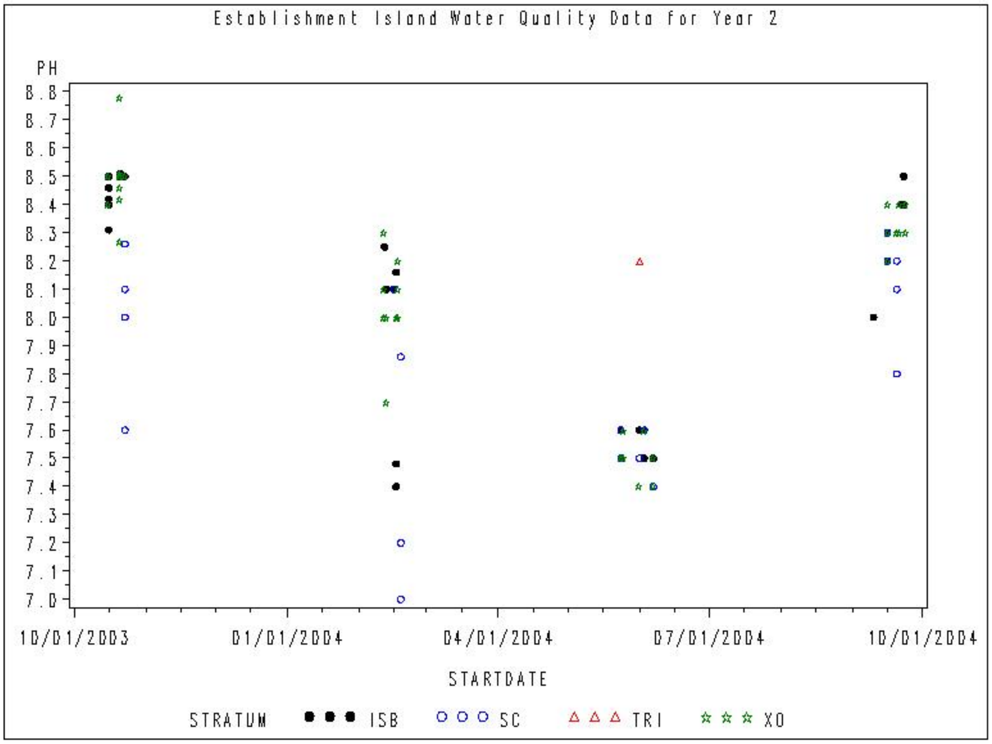


Figure 8c. Ranges of pH and turbidity data taken from all macrohabitat strata in the Establishment Island complex from fall 2003 through summer 2004 (year 2).



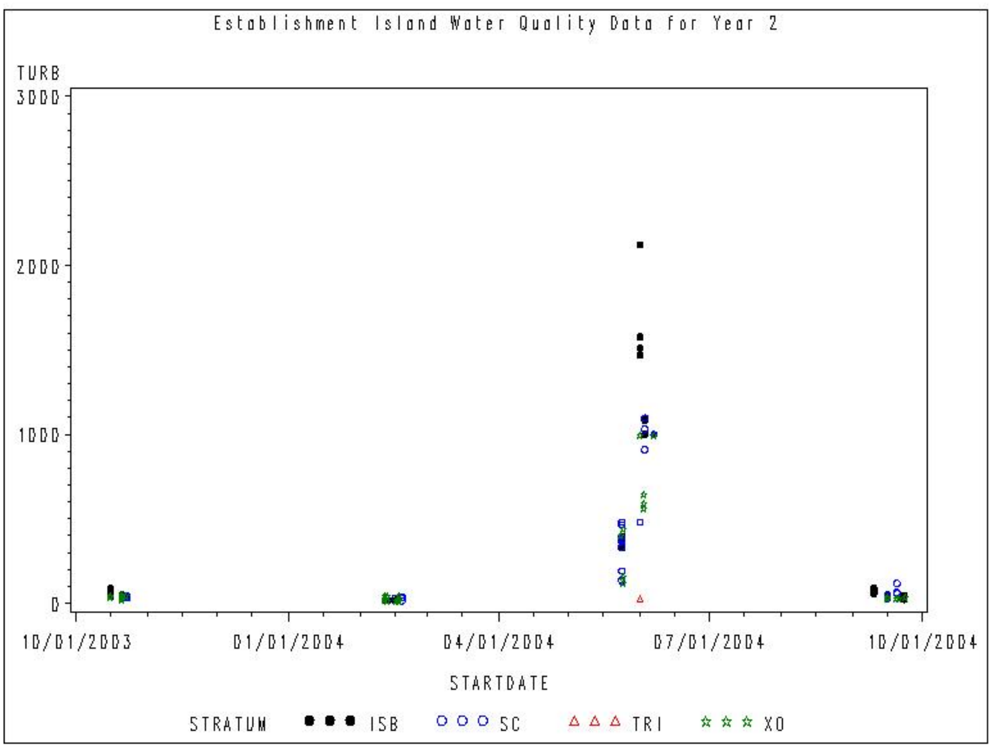
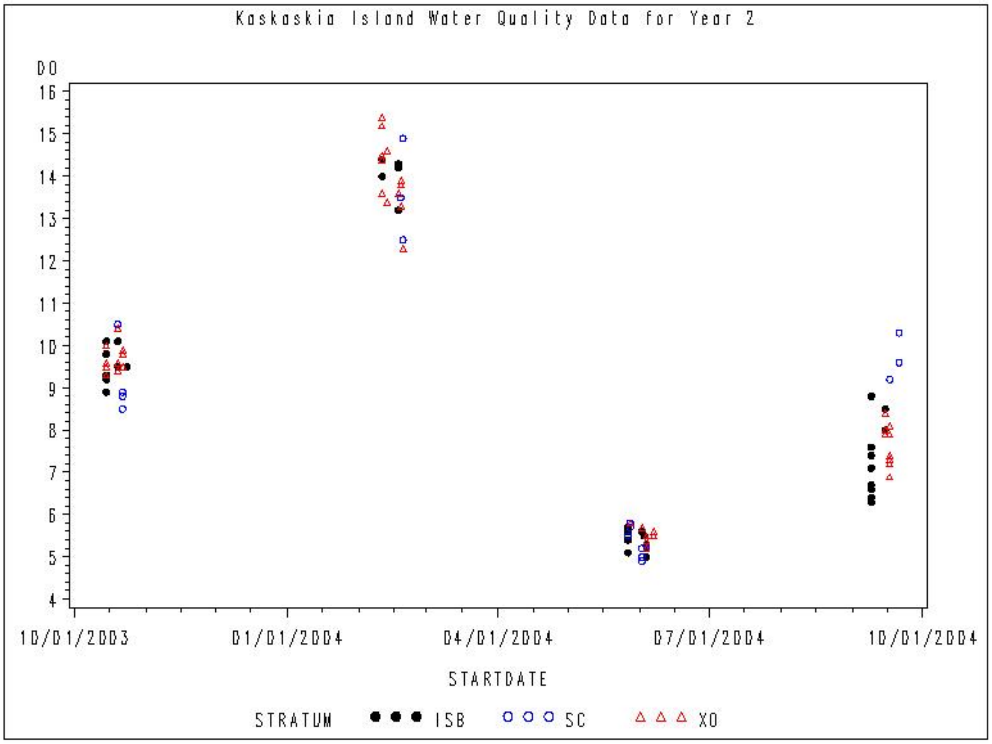


Figure 9a. Ranges of dissolved oxygen and surface water temperature data taken from all macrohabitat strata in the Kaskaskia Island complex from fall 2003 through summer 2004 (year 2).



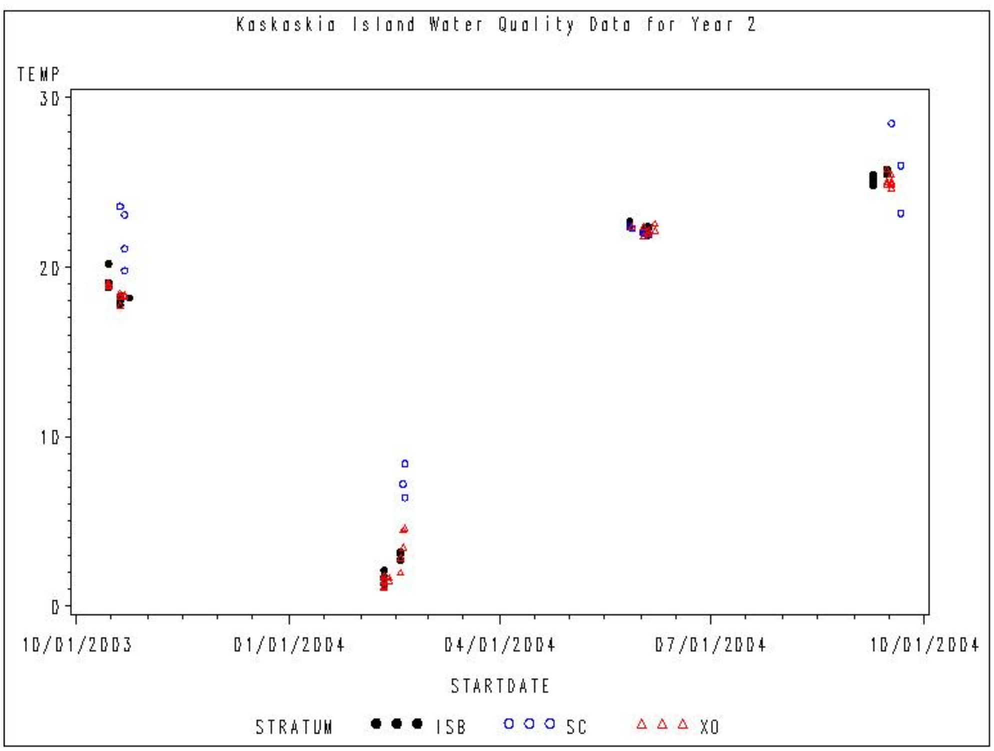
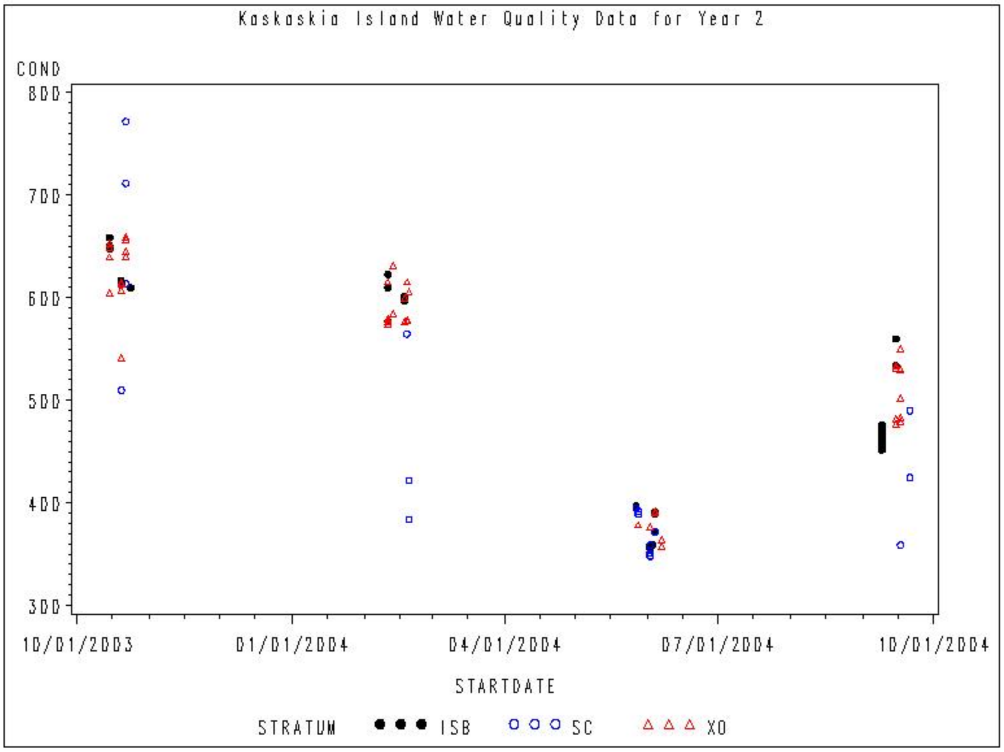


Figure 9b. Ranges of specific conductance and Secchi disk visibility data taken from all macrohabitat strata in the Kaskaskia Island complex from fall 2003 through summer 2004 (year 2).



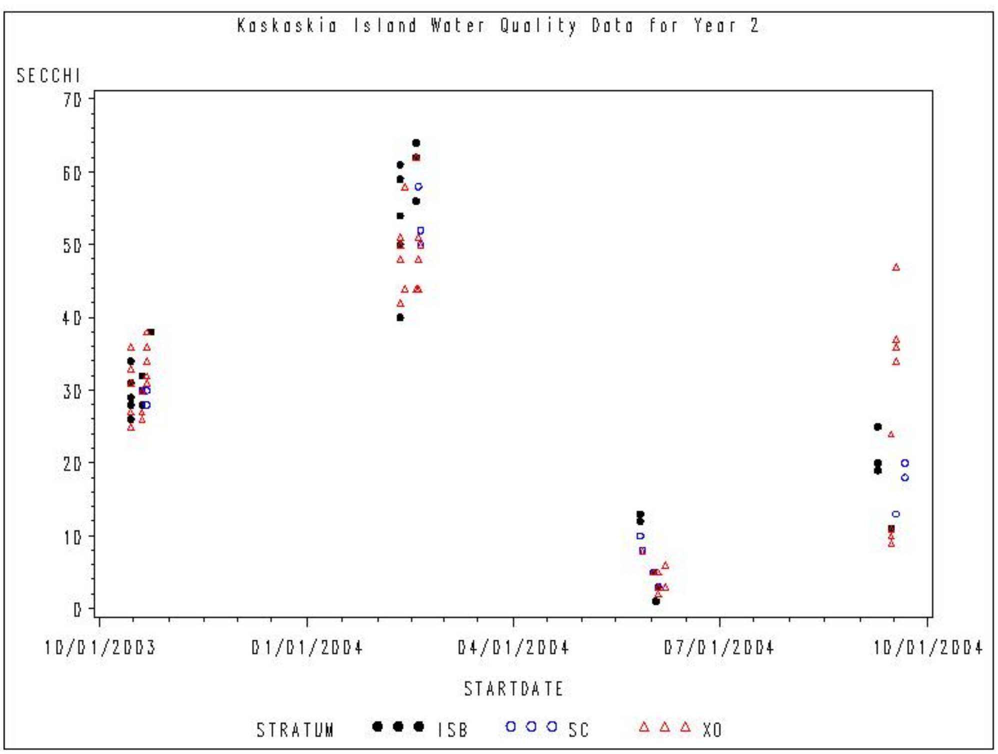
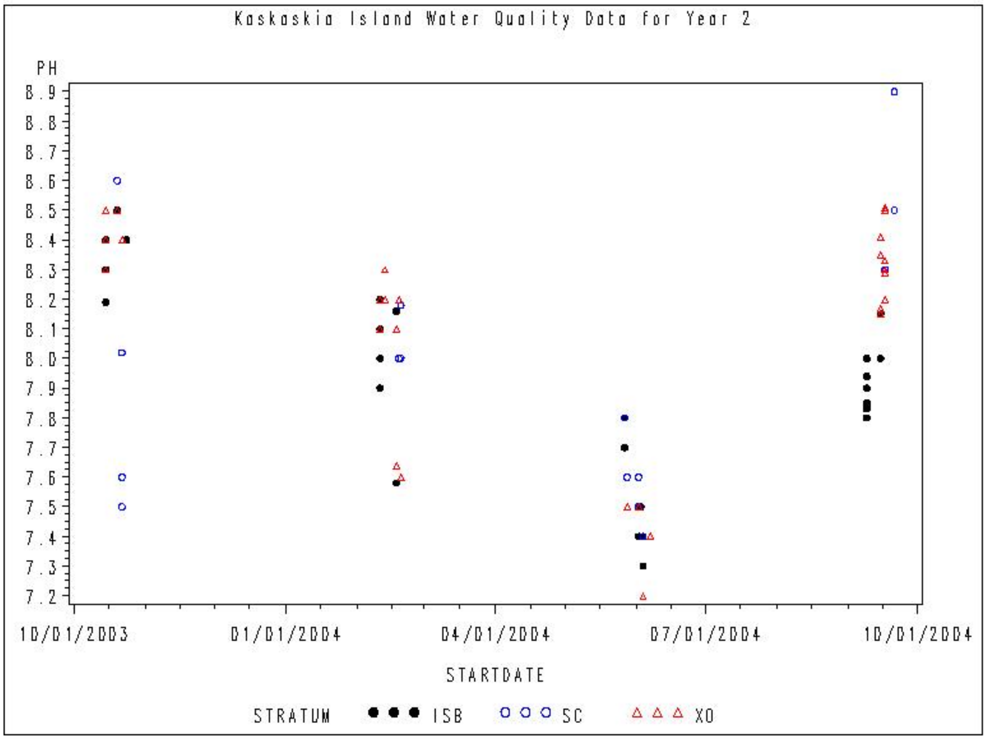
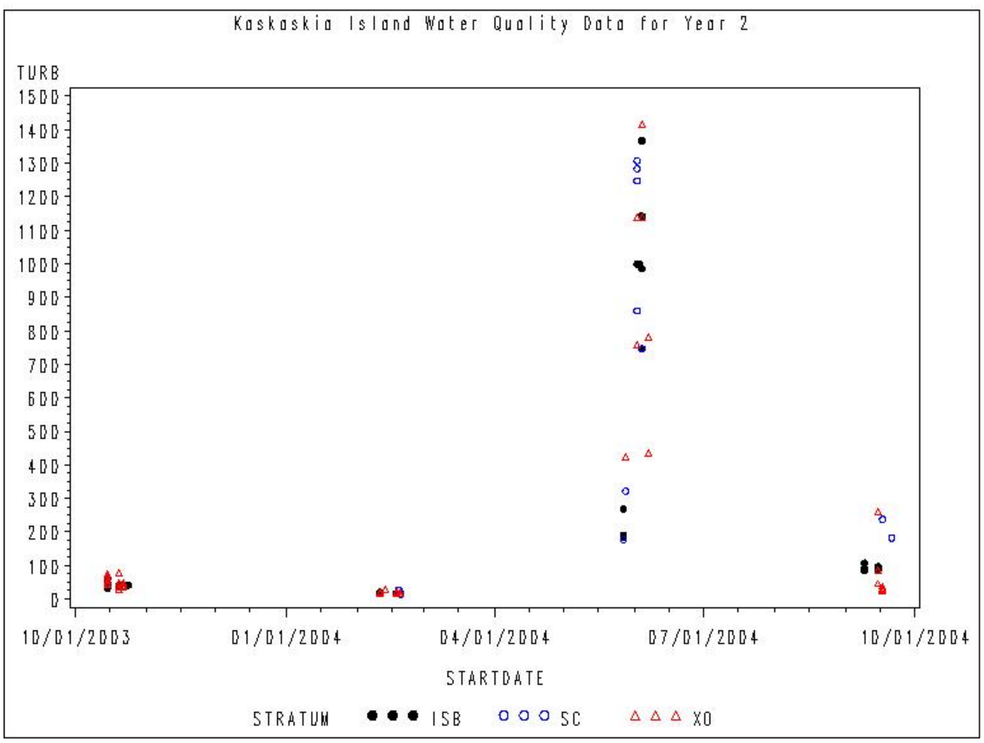


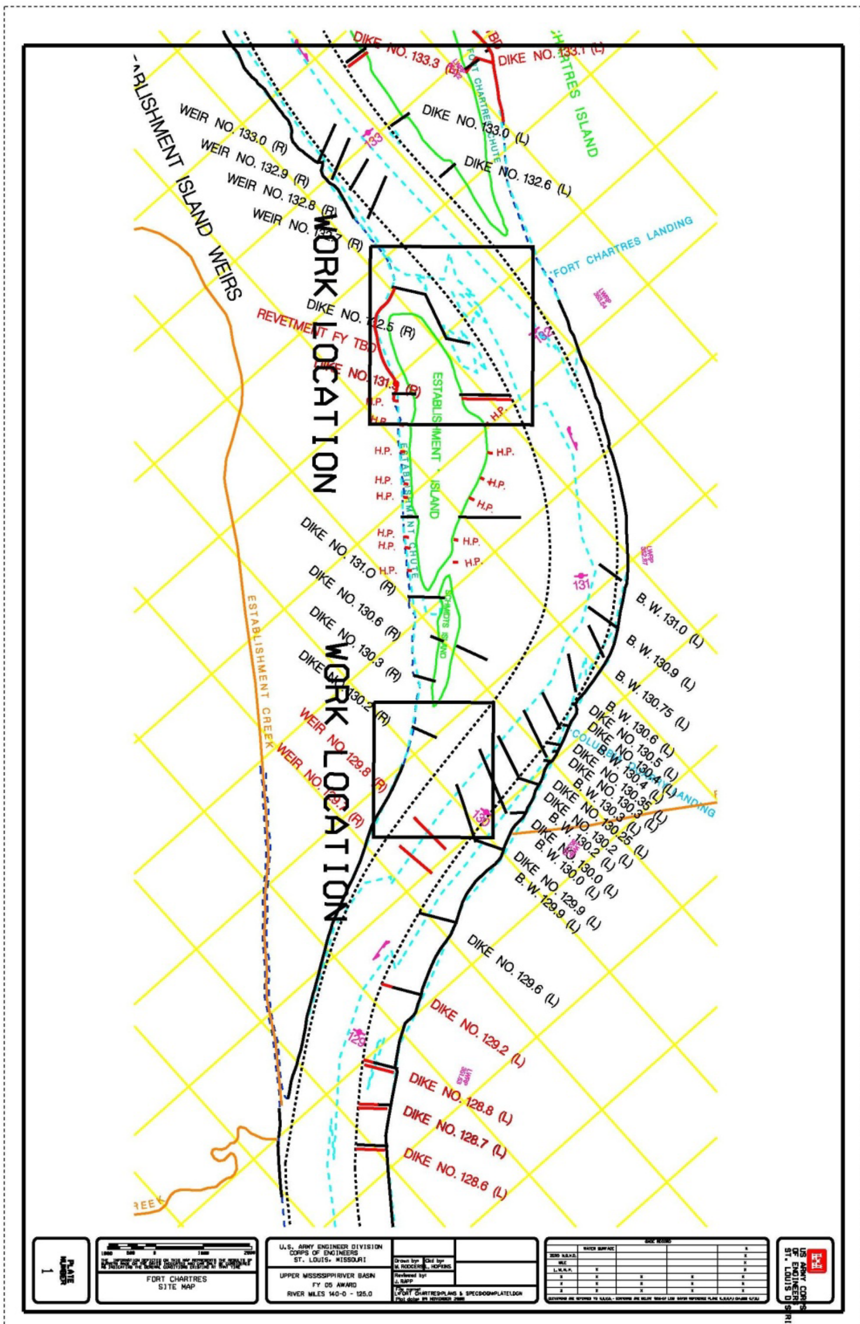
Figure 9c. Ranges of pH and turbidity data taken from all macrohabitat strata in the Kaskaskia Island complex from fall 2003 through summer 2004 (year 2).





Appendix A

Original work plan for the Fort Chartres reach of the Middle Mississippi River (MMR, river miles (RM) 125.0 – 140.0)



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Appendix D

Progress Report: Evaluation of Fish Communities and Habitat Diversity Following Chevron Dike Construction in the St. Louis Harbor of the Upper Mississippi River 2004 - 2009

Progress Report: Evaluation of Fish Communities and Habitat Diversity Following Chevron Dike Construction in the St. Louis Harbor of the Upper Mississippi River 2004 - 2009

Prepared for:
U.S. Army Corps of Engineers
St. Louis District

Prepared by:
U.S. Army Corp of Engineers
St. Louis District

August 2010

Progress Report: Evaluation of Fish Communities and Habitat Diversity Following Chevron Dike Construction in the St. Louis Harbor of the Upper Mississippi River 2004 - 2009

Abstract

This study compares before and after fish communities in the St. Louis Harbor of the Upper Mississippi River System after the construction of three chevron dikes between the McKinley Bridge and the Merchant's Bridge. The research suggests that the chevron dikes increase habitat diversity, species abundance and total fish retrieved over a given time, known as catch per unit effort, as compared to the open river habitat.

Introduction

Throughout the Upper Mississippi River system, like many large rivers, there has been an overall decrease in habitat diversity (Johnson and Jennings 1998). As navigation has increased, the need for a single, deep, main channel with little interference emerged. To achieve this, the United States Army Corps of Engineers (USACE) was tasked with constructing and maintaining a 9-foot deep navigation channel at all times. Several types of water control structures such as dams and dikes were constructed to maintain this channel. The majority of these structures were designed to control water flow to deepen the navigation channel and reduce dredging without environmental consideration. A newer style dike, known as a chevron dike, is currently being constructed where applicable. A chevron dike is a U-shaped dike either in the main channel or along the bankline.

One of the primary functions of chevron dikes is to improve navigation, but the shape and location of the chevron was designed to also improve environmental benefits. As navigation increased and other features, such as levees, were constructed, many backwater areas and unique habitats found throughout the Mississippi started to decrease (Johnson and Jennings 1998). Determining the benefits of chevron dikes will be highly beneficial to the Army Corps of Engineers to help design future projects within the Upper Mississippi River System.

Objectives

1) Determine changes in fish communities due to construction of chevron dikes in the St. Louis Harbor as compared to pre-construction open river habitat.
2) Determine changes in habitat diversity as a result of construction of the chevron dikes in the St. Louis Harbor as compared to pre-construction open river habitat.

Hypotheses

1) Fish species abundance and catch per unit effort will increase following construction of chevron dikes in the St. Louis Harbor.

2) Habitat diversity will increase as compared to the pre-construction open river habitat found in the St. Louis Harbor.

Methods

Site Location

Three chevrons were designed and constructed in the fall of 2007 within the St. Louis Harbor of the Upper Mississippi River System between river miles 183 and 182.

Sampling Location

Each chevron and sampling procedure used the same three specific transects. One to the east side, known as the Illinois transect, one to the west side, known as the Missouri transect and one directly down the center of the chevron. For electrofishing, an additional sampling area was added. The additional site differed slightly for pre- and post-construction monitoring. For pre-construction monitoring, a 5-minute randomized pattern of electrofishing was conducted between the Illinois transect and the Missouri transect. This covered the area where the chevron dike would be built. For post-construction monitoring, electrofishing was conducted along the rock structure on the outside and inside of each chevron dike.

Sampling Dates

- Chevron Construction: Aug. 07 through Nov. 07
- Pre-Construction Monitoring: Sept. 06, Nov. 06, Mar. 07, Jun. 07, Jul. 07
- Post-Construction Monitoring: Aug. 08, Nov. 08, Jul. 09, Oct. 09

Day Electrofishing

- Electrofishing allows for collection of smaller open water and top water fish species.
- 2 dip-netters on forward deck.
- A portable 230-volt generator with 3500-watt capacity and 60-Hz frequency to power the electrofishing equipment.
- Temperature and conductivity ratings are used to control the appropriate power setting on the electrofishing box.
- 12-volt direct current is supplied to the booms to create ample current.
- 2 booms connect to the forward deck.
- Each boom contains a ring of 12 electrodes approximately 40cm long sheathed by a 15cm long stainless steel tube.
- Several "dropper" electrodes at the bow of the boat to act as cathodes and anodes.

Bottom Trawling

- Trawling is designed to collect benthic fishes. All trawl transects were run in areas where no known mussel beds exist to reduce any ecological damage.
- Modified two-seam slingshot balloon trawl net, known as a Missouri trawl
- Standard two-seam 19.05 mm mesh net body
- Body covered in 4.76 mm mesh net cover
- Foot rope is 16 feet in length with a 4.76 mm diameter chain attached
- 50ft towlines used to adequately reach the river floor
- Reverse direction trawling used to increase safety with smaller boat in large river (Herzog 2004)
- The standard haul is 375m long and lasts approximately 6 minutes (Gutreuter et al. 1995).
- The standard haul length and time was reduced to prevent overlap between transects.
- Reduced to an average of 215m and last approximately 2 ½ minutes

Bathymetry

Variability in the river bottom creates habitat diversity for aquatic organisms. River bottom variability was measured through bathymetry surveys via the Army Corps of Engineers Motor Vessel (M/V) Simpson. The M/V Simpson is equipped with multibeam sonar and GPS for retrieving bathymetry data. Transects were run to include all three chevrons and as much of the control area as possible. All data was input into ArcGIS over all three chevrons to determine any changes in habitat diversity. The bathymetric surveys of the area were compared to the Low Water Reference Plane (LWRP).

Results

Fish Communities

Figures 3 below depicts the percent abundance of all fish species captured for pre- and post-construction monitoring. A general increase can be noted in the total fish species caught and differences in overall abundance of each species.

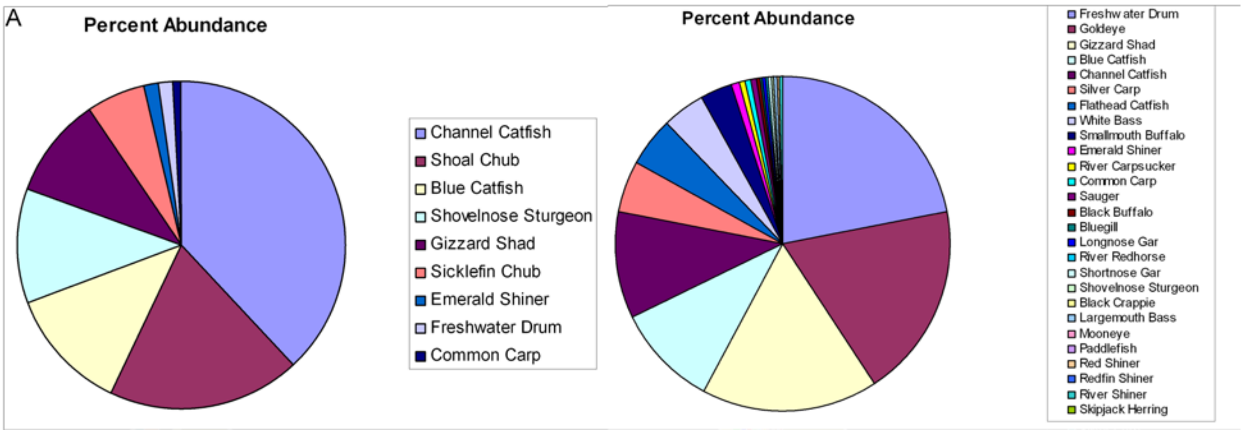

Figure 3. Percent abundance of all fish species captured during (A) pre-construction and (B) post-construction.

Another method for analyzing fish populations is the catch per unit effort. As catch per unit effort increases, more fish are caught in less time. Figure 4 displays the average increase in catch per unit effort for combined gear type and separate (trawl and electrofish) for post-construction.

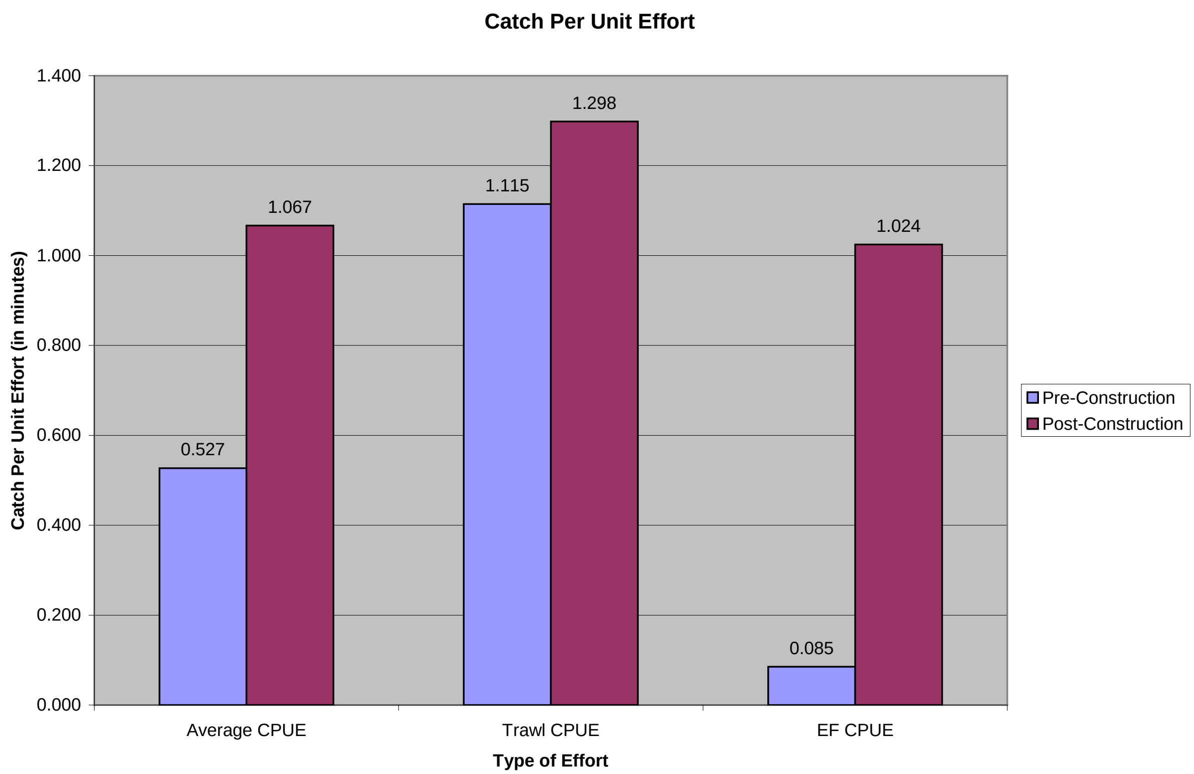

Figure 4. Average catch per unit effort for combined and separate gear types, including trawling, and electrofishing data for pre- and post-construction monitoring.

Bathymetric data was used to analyze habitat diversity. A clear change has occurred from the initial survey to the current survey. Shallow water and deep water have shifted throughout the area and new areas of shallow water and deep water have formed. Figures 5 depicts the changes in the river bed from the creation and destruction of islands and shallow water habitat and the creation of deep holes behind the chevron dikes.

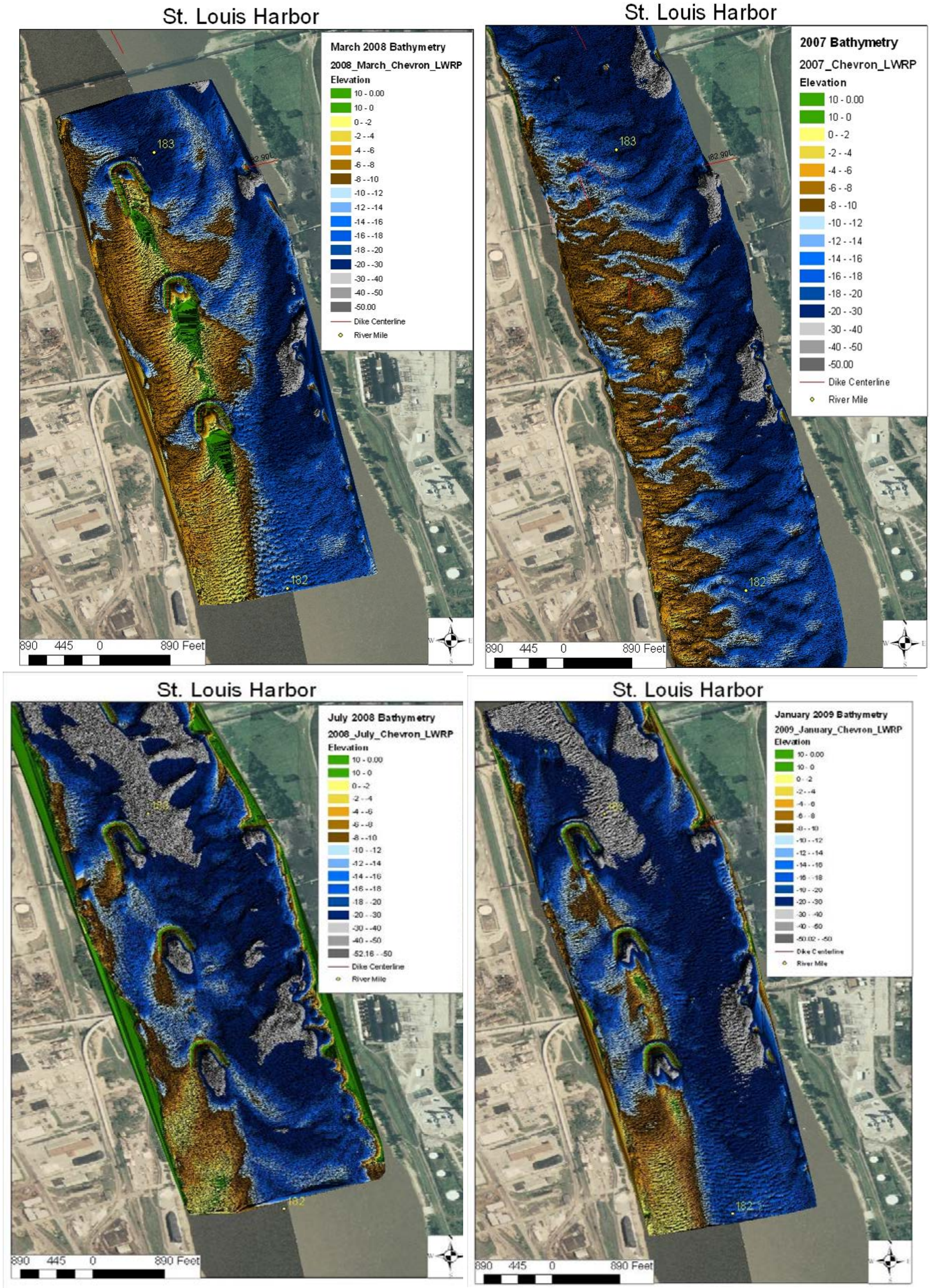

Figure 5. Bathymetric changes 2007 - 2009

Discussion and Conclusions

Overall, the main channel chevron dikes have improved habitat diversity and diversified the current fish community. In the Upper Mississippi River system, there are currently over 125 fish species. Nearly ¼ of these species have been caught in association with the St. Louis Harbor chevrons, as compared to the 9 species in the control site and pre-construction samples. The Mississippi River is likely to continue to experience loss of backwater habitats. The main channel chevron dikes provide evidence that backwater habitat can be created in the main channel of the open river. The chevron dikes appear to be innovative alternatives to traditional stub dikes, balancing the need for navigational structures and providing ecosystem benefits. The advantages include shallow, swift flowing water on the west side (benthic chub habitat); deep, pool-like water flows directly behind the chevron dikes; and sandbar islands behind the pools created by the chevrons, in addition to a deeper thalweg for navigation. Habitat diversity, species abundance, catch per unit effort and total number fish species have increased following the construction of the main channel chevrons in the St. Louis Harbor of the Upper Mississippi River. In conclusion, the chevron dikes constructed in the main channel of the open river have created improved environmental benefits to fish communities and habitat diversity that could be used to aid the USACE in planning future projects in the Upper Mississippi River System.

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Appendix D

Preliminary Fisheries Evaluation
Pre-Construction Monitoring for the
Jones Chute Side Channel Restoration Project

Preliminary Fisheries Evaluation
Pre-Construction Monitoring for the
Jones Chute Side Channel Restoration Project

Prepared for:
U.S. Army Corps of Engineers
St. Louis District

Prepared by:
U.S. Army Corp of Engineers
St. Louis District

August 2010

Pre-Construction Monitoring for the Jones Chute Side Channel Restoration Project

In September 2007, a reconnaissance-level, pre-project fisheries study was initiated by the St. Louis Corps District for the ecosystem benefits component of the Jones Chute (river miles 100.0 – 95.0) Hydraulic Sediment Response (HSR) model. Rockwood Island (river miles 103.0-101.0L) was sampled as a control area. Electrofishing was conducted and the species, with number captured, is listed in the table below. The study intended to use electrofishing and benthic trawling to look at changes in the fish community structure in Jones Chute as a result of HSR recommended modifications. A number of hardpoints, dike modifications (removal and notching), and revetment were added or changed in the chute during 2008.

The 2007sampling was left unfinished due to inclement weather and the study since that time has been postponed until further notice.

Rockwood Island – North bank and sandbar north of Island Point		Rockwood Island – West bank	Jones Chute – at entrance RM 96.6R
CPUE = 15 minutes		30 minutes	20 minutes
Species	**No. Captured**	**No. Captured**	**No. Captured**
Shortnose Gar	2	18	1
Goldeye	3	3	
Skipjack		1	
Gizzard Shad	13	18	13
Red Shiner	7		
Common Carp	1	14	3
Emerald Shiner	5	8	
River Carpsucker	1	9	
Bigmouth Buffalo		2	1
Black Buffalo	1		
Blue Catfish	1		3
Channel Catfish	4	6	3
Flathead Catfish	2	3	1
White Bass	2	2	
Warmouth			1
White Crappie			1
Sauger	1		
Freshwater Drum	6	6	5