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THE LONG-TERM ILLINOIS RIVERS FISH POPULATION MONITORING PROGRAM 2014

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The Long-Term Illinois Rivers Fish Population Monitoring Program

F-101-R-26

Annual Report to the Illinois Department of Natural Resources

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DISCLAIMER

The findings, conclusions, and views expressed herein are those of the researchers and should not be considered as the official position of the United States Fish and Wildlife Service or the Illinois Department of Natural Resources.

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The Long-term Illinois Rivers Fish Population Monitoring Program (F-101-R) is supported by the Federal Aid in Sport Fish Restoration Act (P.L. 81-6814, Dingell-Johnson/Wallop-Breaux),with funds administered by the U.S. Fish and Wildlife Service and the Illinois Department of Natural Resources (IDNR). The Illinois Department of Natural Resources and Dr. Brian Anderson, Chief of the Illinois Natural History Survey (INHS), and INHS staff provided administrative support. Staff from the Illinois River Biological Station, National Great Rivers Research and Education Center, and INHS staff based at the University of Illinois Champaign-Urbana provided expertise and support for clerical, data entry, data verification, and field collections. This survey was originally conceived and initiated in 1957 by the late Dr. William C. Starrett.

EXECUTIVE SUMMARY

This report presents a summary of those data collected during segment 26 (2014-15) of the Long-term Illinois Rivers Fish Population Monitoring Program (LTEF), an annual survey executed by members of the Illinois Natural History Survey with funds administered by the U.S. Fish and Wildlife Service and the Illinois Department of Natural Resources. Sampling for the LTEF program was conducted on: six reaches of the Illinois River Waterway, six segments or pools of the Mississippi River, and navigable portions of the Iroquois and Kankakee Rives. In all segments of the LTEF program, all fish species collected were accurately identified, tallied, measured, and weighed. The catch rates of sportfish species were calculated as the number of individuals collected per hour ($CPUE_N \pm$ standard error). Structural indices [Proportional Size Distribution (PSD) and Relative Weight (W_r)] were also calculated for species of interest to regional managers. Catch rates and species richness varied greatly among all sampling locations and sampling periods. Emerald Shiners and Gizzard Shad comprised the majority of the individuals caught, and Silver Carp and Common Carp accounted for the greatest proportion of the biomass collected in most sampling areas of the survey. The analysis of $CPUE_N$ and PSD trends in sportfish populations sampled by the program may indicate inter-annual recruitment patterns in sportfish populations around the state. Both Shovelnose Sturgeon and Blue Catfish were the two species most commonly encountered in the gill net surveys.

Sportfish

Catch rates and sizes of popular sportfish species varied greatly among the rivers and reaches sampled during 2014. Channel Catfish was the most-abundantly collected sportfish species in all segments of our study. Collections of black bass species were greatest in the Upper Illinois Waterway. Catch rates of Black Crappie and White Crappie were very low among all reaches sampled during 2014. Gill-netting studies in the Mississippi River contributed important insights about the current structure of Shovelnose Sturgeon and Blue Catfish populations in that region. Our long-term datasets allow us to observe tremendous annual variations in the relative abundance and size distribution of many sportfish species, like White Bass. These observations should serve as a catalyst for future research investigating the effects environmental change and management policy on the health and sustainability of Illinois sportfishes. Although the factors controlling the annual variations in the relative abundances of fishes in Midwestern rivers may be difficult to measure, our ability to detect and possibly explain such changes is dependent upon the execution of well-designed fisheries surveys. The operation and maintenance of the LTEF program and the data it generates can contribute to more complex and nuanced understandings that can, in turn, aid in the development of more effective and sustainable management policies for sportfishes in the rivers of Illinois.

Invasive Species

Although the main focus of F-101-R programs are to conduct monitoring to improve our understanding of population dynamics, life histories, and habitat requirements of sportfish species, the programs sampling strategies may also be useful for documenting trends in the relative abundance of non-native species occupying Illinois large river ecosystems. However, we advise that researchers use caution when interpreting the data we collect on invasive species as our sampling protocols (e.g. restriction to main-channel habitats) may limit our probability of encountering the greatest densities of the species in some instances. Our monitoring and analyses suggest densities of Silver Carp are greatest in the Lower Illinois River but that body condition of Silver Carp in the Lower Illinois River has been much lower during the last 5-6 years than during the preceding years.

JOB ACCOMPLISHMENTS DEFINED BY F-101-R-26 WORK PLAN

Job 1: *Prepare electrofishing equipment and train staff*

Project workers maintained and repaired electrofishing and netting equipment as need throughout Project Segment 26. Full-time staff also trained seasonal staff members in the use of computerized data entry programs, electrofishing techniques, troubleshooting and repairing sampling gear, and statistical analysis of fisheries data.

Job 2: *Sample fish by AC electrofishing, pulsed-DC electrofishing, and netting on the Illinois and Mississippi Rivers*

Project workers completed all electrofishing and netting assignments in the Illinois, Iroquois, Kankakee, and Mississippi Rivers during Project Segment 26.

Job 3: *Update computer database*

All F-101-R Segment 26 (2014-15) project data were transferred to the project database and archived in fire-resistant file cabinets at the Illinois River Biological Station, Havana.

Job 4: *Analyze data*

Project staff used Segment 26 data to investigate trends in catch-per-unit effort and stock size indices to investigate spatial and temporal trends in fish populations. Those analyses are included in this report.

Job 5: *Presentation of results*

Project workers, Mark Fritts, Jason DeBoer, Ben Lubinski, and graduate students, Jerrod Parker and Edward Culver, presented the results of electrofishing sampling at professional meetings (Appendix XIX). Project workers also continued the composition of the annual project report. Additionally, one peered-reviewed manuscript produced using LTEF data was published during Project Segment 26:

Parker, J., J. Epifanio, A. Casper, and Y. Cao. 2015. The effects of improved water quality on fish assemblages in a heavily modified large river system. River Research and Applications 2015. DOI: 10.1002/rra.2917

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PREFACE

This report presents a summary of data collected during 2014 during segment 26 of Federal Aid project F-101-R, the Long-Term Illinois and Mississippi Rivers Fish Population Monitoring Program. The purpose of this document is to provide information on the large-scale trends in fish populations in Illinois' large river ecosystems. Although we gather data on many other fish species in the course of our sampling, this report is primarily focused on recreationally valued sportfishes in accordance with Goal 3 of the 2010-2015 Strategic Plan for the Conservation of Illinois Fisheries Resources. Some historical data will be included in this report to facilitate longer-term analyses when appropriate. Previous summaries of the long-term data set, begun in 1957, were given by Sparks and Starrett (1975), Sparks (1977), Sparks and Lerczak (1993), Lerczak and Sparks (1994), Lerczak *et al*. (1994), Koel and Sparks (1999), McClelland and Pegg (2004), McClelland and Sass (2010), and McClelland *et al.* (2012). The format used in this report is revised from previous annual reports on this project (Lerczak *et al*. 1993, 1994, 1995, and 1996; Koel et al. 1997 and 1998; Koel and Sparks 1999; Arnold *et al*. 2000; McClelland and Pegg 2001, 2002, 2003, 2004, 2005; McClelland and Cook 2006; McClelland and Sass 2007, 2008, 2009, 2010; Michaels, Tyszko, and McClelland 2011; Tyszko *et al*. 2012; Fritts *et al.* 2013; Fritts *et al*. 2014). The annual reports for project F-101-R will continue to build upon previously collected data. Fish common names used throughout this report follow Page *et al*. (2013). We have used English units of measure throughout the report. While this practice is generally discouraged in scientific writing, the use of the English measurement system is preferred by many public agencies in the United States, including the Illinois Department of Natural Resources. Throughout this report, we have frequently used many abbreviations. Here are the principle abbreviations and definitions:

RM: River Mile
AC: Alternating Current
DC: Direct Current
°F: Temperature expressed as degrees Fahrenheit
Hz: Hertz
W: Watts
µS: Microseimens
ppm: parts per million
in: inches
lb: Pounds

All data collected by F-101-R funded projects is maintained at the Illinois River Biological Station, Havana, IL and most components of project data can be provided upon request. All inquiries about the LTEF dataset should be directed to project staff on site (Telephone 309-543-6000; email mwfritts@illinois.edu, jadeboer@illinois.edu, or afcasper@illinois.edu).

CHAPTER 1
INTRODUCTION

The large rivers of Illinois have experienced dramatic changes that have been attributed to natural and anthropogenic forces during the previous century (Theiling 1998). These changes have dramatically altered the viability of our riverine ecosystems, and Illinois' fisheries managers are faced with the increasingly difficult task of maintaining the viability of these once-thriving riverine fisheries (Sparks and Starret 1975). The purpose of this Long-term Illinois Rivers Fish Monitoring Program (LTEF) is to provide Illinois' fisheries managers with rigorous and robust information and analyses about the status, trend, condition, and other critical qualities (such as management evaluations) of Illinois's large-river sportfisheries throughout the Illinois River, the Illinois portions of the Mississippi, Ohio, and Wabash rivers, and their tributaries.

Ultimately, the ability of managers, public policymakers, and stakeholders to protect and improve the quality and sustainability of Illinois' sportfish resources depends on accurate assessments of the state of the fisheries. In particular, we need to gain insight into how the fisheries respond to stressors and management actions. Unfortunately, many of the most critical fisheries responses are inherently out-of-synch or delayed in relation to the driving factor (e.g., because of the seasonal cycle of reproduction, fish productivity often requires a full year before it reflects the effects of a flood or a drought). Thus, long-term, large-scale ecological monitoring data are important for making inferences about temporal and spatial variations in the structure and function of ecosystems (Bolgrien *et al.* 2005; Dodds *et al.* 2013). These inferences can enhance the predictive understanding of natural resource managers, aiding them in the development and implementation of more effective resource stewardship policies at local and statewide scales. Standardized, continuous, high-quality fisheries monitoring surveys can therefore offer fisheries managers with critical insights that cannot be provided by other, shorter-term programs. A long-term record of consistent and scientifically robust monitoring, like that carried out by LTEF for over 50 years, is critical to providing insights for successful management.

The LTEF program follows respected, standardized protocols to collect fisheries data using boat-mounted electrofishing and netting gears throughout the largest rivers in Illinois (Figure 1.1). Data generated from these surveys have previously been used to document large-scale changes in the structure of riverine fish communities (Sparks and Starrett 1975, Pegg and McClelland 2004; McClelland *et al.* 2012), estimate the effects of flow alterations on riverine fish communities (Koel and Sparks 2002; Yang *et al.* 2008), investigate the evolving role of non-native species in Illinois' riverine ecosystems (Raibley *et al.* 1995; Irons *et al*. 2006; Irons *et al.* 2007; Sass *et al.* 2010; Irons *et al.* 2011; Liss *et al.* 2013; Liss *et al.* 2014; Lamer *et al.* 2014), and evaluate the efficiency of electrofishing gears for large river fisheries research (McClelland *et al.*2012; McClelland *et al.* 2013). Given this impressive legacy of scientific research, the LTEF program can continue to provide high-quality data for important assessments of riverine sportfish populations in relation to contemporary environmental perturbation such as climate shifts, on-going loss of side-channel and backwater habitat to sedimentation, unnatural water-level fluctuations from navigation, poor water quality, and river channel maintenance and dredging activities.

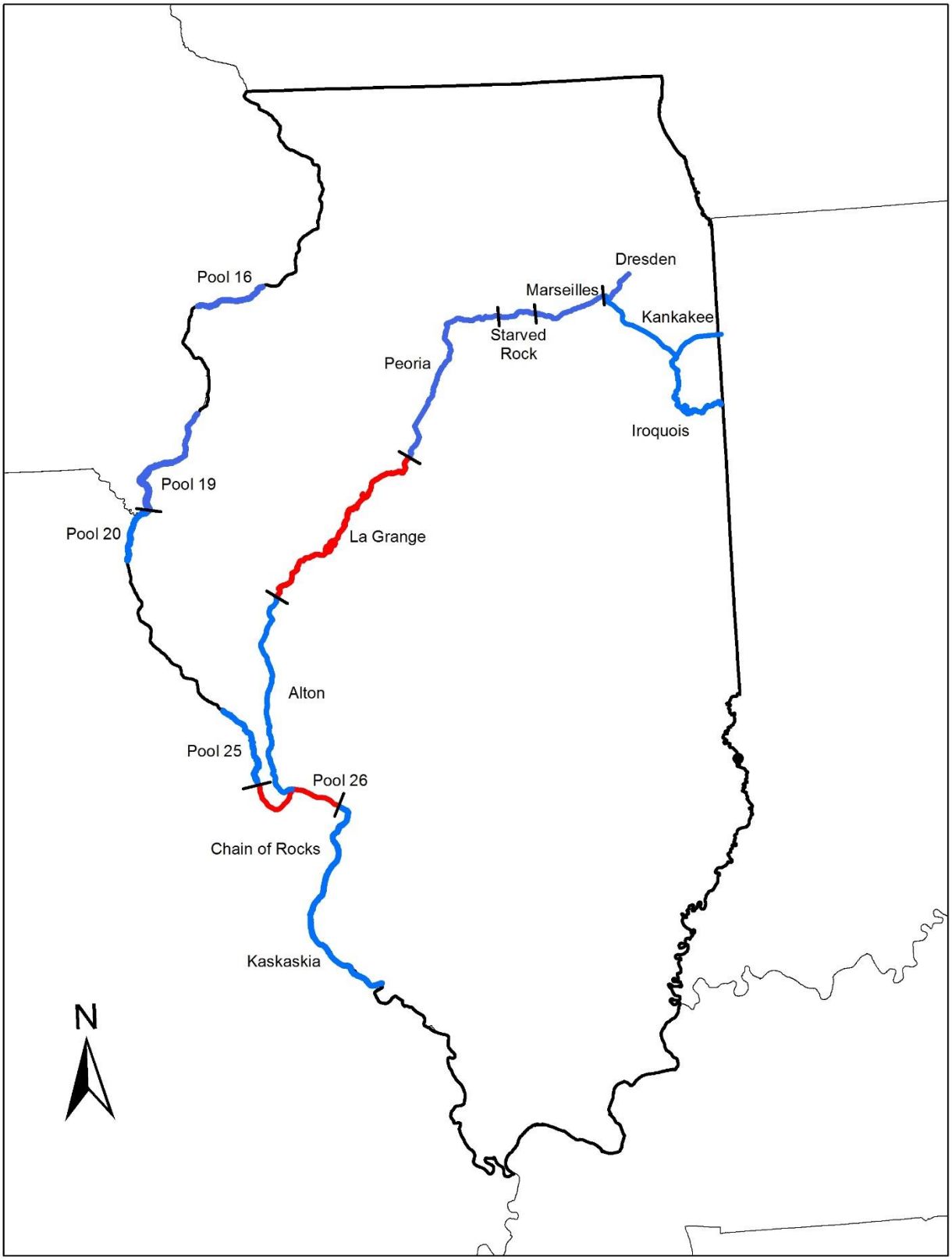

Figure 1.1. Map of the Illinois Waterway, and the Illinois portions of the Mississippi, Iroquois, and Kankakee Rivers illustrating areas sampled by the Long Term Illinois Rivers Fish Population Monitoring Program (colored in blue) during 2014. Areas currently sampled by the US Army Corps of Engineers Upper Mississippi River Restoration Environmental Management Program's (UMRR-EMP) Long Term Resource Monitoring Program component (LaGrange Reach, Illinois River and Pool 26, Mississippi River) are colored red.

CHAPTER 2
SPORTFISH ASSESSMENTS IN THE ILLINOIS RIVER

Section 2.1 - AC Electrofishing Collections

Sportfish populations were monitored at 28 fixed sites along the Illinois and Mississippi Rivers using boat-mounted three-phase AC electrofishing gear: two sites on the lower Des Plaines River, twenty-four sites on the Illinois River, and one site on the Mississippi River near the confluence of the Illinois River (Brickhouse Slough, sampled periodically since 1978; Figure 2.1). Sixteen fixed sites were located exclusively in side-channel habitats and the remaining sites were distributed among side-channel and main-channel border habitats (see Lerczak *et al.*, 1994 for detailed description of site selection). In previous years' sampling, a fixed site had been sampled at Lambie's Boat Harbor (Illinois River Mile 170.3). However, this sampling location was made inaccessible during 2013 and 2014 because of excessive siltation following floods during spring 2013. The fixed sampling location at Lambie's Boat Harbor was replaced in 2014 by an alternative location at the Peoria Islands, the newly constructed Habitat Restoration site completed by the US Army Corps of Engineers. However, the shallow water at the Peoria Islands site may preclude its permanent inclusion in our annual sampling if sediment accumulates there as well. During 2014 sampling, pervasive high water conditions caused us to exceed the stage height threshold established for this survey at 14 of the 28 sites sampled: 6 sites in Alton pool, 6 sites in LaGrange pool, and 2 sites in Peoria pool.

Fish populations were sampled by electrofishing from a 16-ft aluminum boat using a 3000-watt, three-phase AC generator. Sampling at each site typically lasted one hour. Stunned fish were gathered with a dip net [1/4-in mesh] and stored in an aerated livewell until sampling was completed. Fish were then identified to species, measured [total length (TL-mm) and weight (g)], inspected for externally visible abnormalities, and returned to the water.

Section 2.2 - Pulsed-DC Electrofishing Collections

Sportfish populations were monitored in 5 reaches of the Illinois Waterway using boat-mounted pulsed-DC electrofishing gear. Additionally, 6 segments or pools of the Mississippi River were sampled via the same methodology (see Appendix I). Sites were randomly selected using GIS layers of main channel border habitats in all study areas. The LaGrange Reach on the Illinois River and Pool 26 of the Mississippi River are currently monitored by the U.S. Army Corps of Engineers Upper Mississippi River Restoration Environmental Management Program's (UMRR-EMP) Long Term Resource Monitoring Program component (LTRMP, http://www.umesc.usgs.gov/ltrmp.html) and are, therefore, not included in F-101-R monitoring (Figure 1.1).

Electrofishing collections were conducted according to established LTRMP protocols for monitoring fish populations in large rivers as described by Gutreuter et al. (1995) during three sampling periods (15 June – 31 July, 1 August – 15 September, 16 September – 31 October). Boat-mounted pulsed-DC electrofishing was used to catch fish. A three-person crew consisting of a pilot and two dippers performed 15-minute electrofishing runs at a collection site. Power was supplied by a 5,000-W generator with voltage and amperage adjusted to achieve LTRMP standardized power goals using 60Hz and a 25% duty cycle (Gutreuter et al. 1995). Stunned fish were caught with a dip net of 1/8-in (0.3 cm) mesh and placed in an aerated livewell until sampling was completed. Fish were then identified to species, measured (TL and weight), and returned to the water. Non-carp cyprinids, darters, centrarchids < 2 in, and clupeids < 4 in were recorded and weighed as groups.

Section 2.3 - Ancillary Habitat Quality Measurements

Measurements for ancillary habitat-quality parameters (i.e., water temperature, dissolved oxygen, Secchi disk transparency, conductivity, surface velocity, water depth, and river stage) were recorded prior to each electrofishing run and net set. Stage height was recorded from a single U.S. Army Corps of Engineers

or U.S. Geological Survey (USGS) river gauge for each sampled reach for standardization (Table 2.1).

Section 2.4 - Statistical Analyses

For each site, the number of individual fish and total weight were tallied for each species in the field. The resulting catch data are summarized and reported by river segments. Data collected during multiple sampling periods were pooled for the calculation of catch statistics. Catch rates were quantified as the number of individuals collected per hour of electrofishing (expressed as $CPUE_N \pm$ standard error). In regions where the CPUE of sportfish species was greater than 1 fish/hr, proportional size distribution (PSD) scores (Neumann and Allen 2007) were calculated as an index of sportfish size structures. Condition [relative weight (*Wr*)] was calculated for Silver Carp (Irons *et al.* 2011) in those regions where captures exceeded 20 individuals. Recent research in the Wabash River indicates that 60-Hz pulsed-DC electrofishing is ineffective for sampling Flathead Catfish in riverine environments (Moody-Carpenter 2013). Therefore, Flathead Catfish were excluded from our analyses of catch rates and sportfish size structures.

Section 2.5 - 2014 Illinois River Ancillary Habitat Quality Data

Sampling using AC electrofishing gear was conducted in full daylight between 7:55 AM and 5:00 PM central standard time from 8 September to 6 October 2014. A complete record of the physical measurements recorded at each sampling location is included in Appendix II. Specific physical habitat values for AC electrofishing surveys (river stage height) exceeded expected ranges established by previous sampling surveys (Lerczak et al. 1994; Koel and Sparks 1999) because of an unusual and prolonged period of late summer flooding. Pulsed-DC electrofishing was conducted between 8:13 a.m. and 6:10 p.m. central standard time during the three sampling periods specified in Section 2.2. Physical measurements for ancillary water-quality parameters were collected at each site and are summarized in Table 2.1.

Table 2.1. Summary of ancillary water quality data collected during pulsed-DC electrofishing surveys on five reaches of the Illinois River during 2014. Values are expressed as the mean observed parameter value ± standard error.

Navigational Reaches	Total EF Effort (h)	EF Power Used (Watts)	Depth (ft)	Secchi Depth (in)	Water Temperature (°F)	DO (ppm)	Conductivity (µS)	Stage Height (ft)
Dresden (RM 271.5-286)	**2.25**	**5628.4 ± 251.0**	**3.9 ± 1.0**	**27.8 ± 1.4**	**74.3 ± 3.2**	**5.4 ± 0.3**	**872.1 ± 35.0**	**505.5 ± 0.0**
Time Period 1	0.75	6389.7 ± 76.7	4.5 ± 2.0	24.4 ± 2.6	78.9 ± 0.8	6.1 ± 0.4	961.7 ± 9.1	505.6 ± 0.0
Time Period 2	0.75	5166.0 ± 549.1	5.5 ± 2.0	31.2 ± 1.5	82.1 ± 1.3	5.2 ± 0.4	738.7 ± 13.8	505.5 ± 0.0
Time Period 3	0.75	5329.7 ± 86.8	1.8 ± 0.3	27.8 ± 1.4	62.0 ± 0.2	5.0 ± 0.5	916.0 ± 23.2	505.5 ± 0.0
Marseilles (RM 247-271.5)	**4.50**	**5157.8 ± 70.0**	**5.1 ± 0.4**	**18.2 ± 0.8**	**73.8 ± 2.1**	**7.0 ± 0.2**	**743.2 ± 15.9**	**8.0 ± 0.2**
Time Period 1	1.50	5462.8 ± 87.6	5.5 ± 0.6	17.6 ± 0.4	79.5 ± 0.2	7.0 ± 0.1	774.7 ± 11.0	7.6 ± 0.1
Time Period 2	1.50	5113.3 ± 77.9	4.8 ± 0.9	20.3 ± 1.9	80.1 ± 0.7	6.3 ± 0.1	661.5 ± 11.9	7.5 ± 0.1
Time Period 3	1.50	4897.3 ± 60.9	5.1 ± 0.4	16.5 ± 0.8	61.9 ± 0.4	7.8 ± 0.3	793.5 ± 16.3	8.9 ± 0.0
Starved Rock (RM 231-247)	**2.25**	**5041.3 ± 196.4**	**3.3 ± 0.7**	**16.4 ± 1.9**	**70.9 ± 3.7**	**7.8 ± 0.4**	**715.1 ± 28.9**	**460.0 ± 0.0**
Time Period 1	0.75	4736.3 ± 67.2	3.9 ± 0.7	11.0 ± 0.8	74.6 ± 0.2	7.0 ± 0.2	612.3 ± 9.8	460.0 ± 0.0
Time Period 2	0.75	5796.3 ± 83.2	3.2 ± 1.3	21.9 ± 1.3	81.4 ± 0.8	7.0 ± 0.4	803.3 ± 10.5	459.9 ± 0.0
Time Period 3	0.75	4591.3 ± 136.9	2.9 ± 1.7	16.1 ± 3.2	56.7 ± 0.7	9.3 ± 0.4	729.7 ± 23.1	*
Peoria (RM 158-231)	**11.25**	**5257.5 ± 103.4**	**3.7 ± 0.3**	**10.6 ± 0.5**	**73.4 ± 1.4**	**6.3 ± 0.1**	**745.4 ± 15.1**	**17.3 ± 0.3**
Time Period 1	3.75	5201.0 ± 109.0	4.4 ± 0.4	10.3 ± 0.7	77.3 ± 0.5	6.1 ± 0.2	708.6 ± 24.0	18.6 ± 0.6
Time Period 2	3.75	6019.1 ± 93.0	3.2 ± 0.5	10.6 ± 1.1	82.0 ± 0.7	6.0 ± 0.2	842.9 ± 16.7	16.0 ± 0.3
Time Period 3	3.75	4552.5 ± 55.0	3.5 ± 0.5	10.8 ± 0.9	61.0 ± 0.8	6.7 ± 0.2	684.7 ± 16.4	17.2 ± 0.1
Alton (RM 0-80)	**11.25**	**4791.9 ± 77.6**	**5.0 ± 0.4**	**7.9 ± 0.5**	**75.1 ± 1.2**	**5.8 ± 0.2**	**641.9 ± 11.5**	**25.4 ± 0.5**
Time Period 1	3.75	4932.5 ± 61.8	6.4 ± 0.8	9.1 ± 1.0	79.4 ± 0.4	6.1 ± 0.2	654.5 ± 12.3	29.0 ± 0.6
Time Period 2	3.75	5158.9 ± 125.7	4.2 ± 0.5	7.0 ± 0.5	80.9 ± 0.5	4.3 ± 0.3	677.7 ± 14.6	22.2 ± 0.3
Time Period 3	3.75	4284.3 ± 88.2	4.2 ± 0.6	7.7 ± 0.8	64.9 ± 1.5	7.0 ± 0.3	593.3 ± 24.7	25.0 ± 0.5

*The gage for Starved Rock reach was offline during Period 3 sampling during 2014.

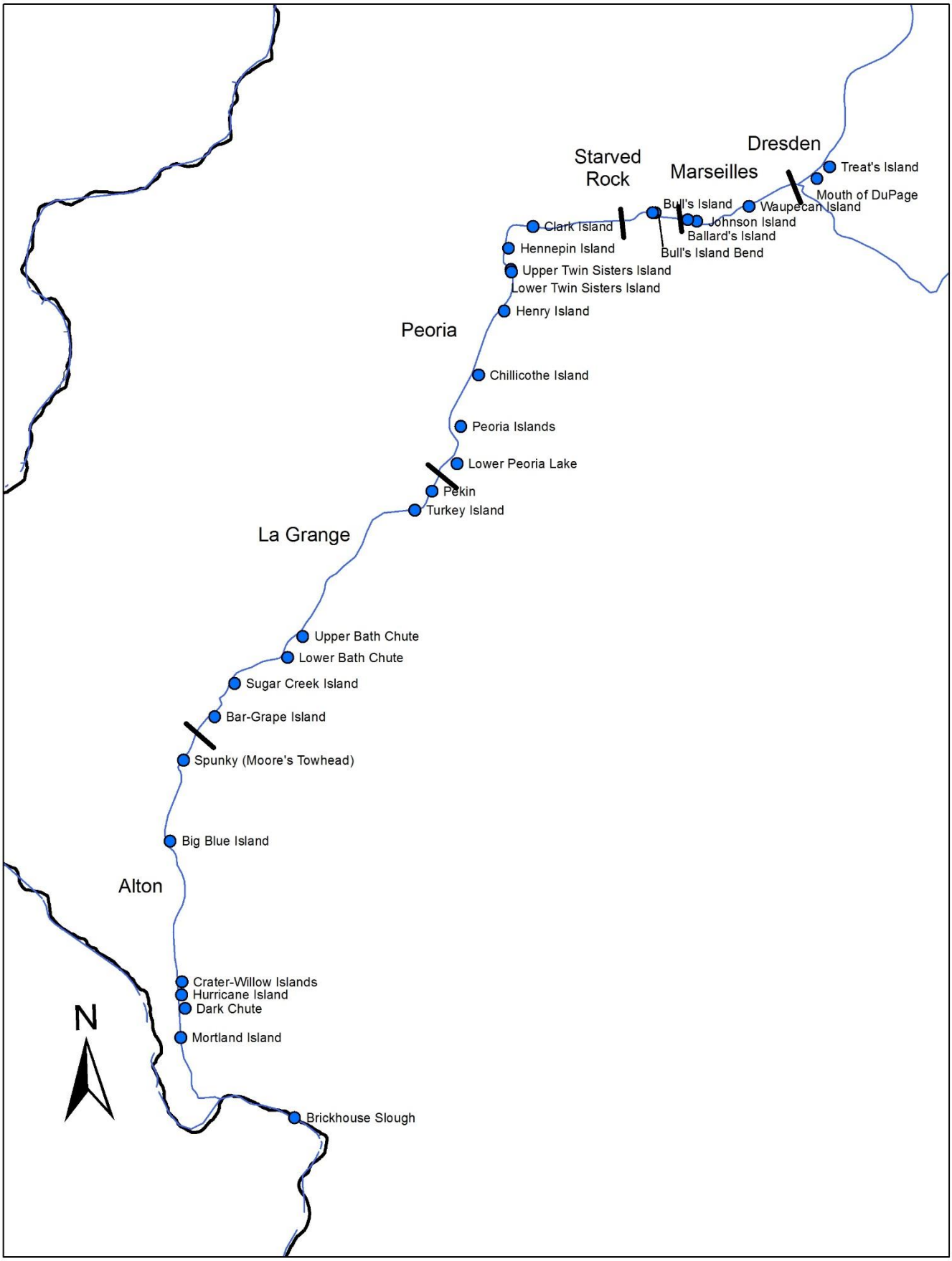

Figure 2.1. Map of the Illinois Waterway, and the fixed locations sampled by the Long Term Illinois Rivers Fish Population Monitoring Program (F-101-R) using AC electrofishing gear during 2014 (blue dots).

Section 2.6 - 2014 Upper Illinois River Electrofishing Catch Statistics

In the following section, we have drawn a distinction between those data collected above and below the Great Bend region of the Illinois River. Starrett (1971) suggested that the upper river is best characterized as a less-mature geologic landscape with a narrow valley and more swift currents generated by higher gradients; the lower river represents a much older, lower gradient, alluvial floodplain. Furthermore, Pegg and McClelland (2004) used advanced multivariate analyses of historic LTEF catch records to demonstrate that the fish communities observed in the upper and lower sections of the Illinois River were different. Therefore, sampling statistics developed for those data collected above the Starved Rock Lock and Dam (RM 231; RKM 371.8) will be presented separately from those results derived from the sampling below that structure. Fisheries data collected by LTRMP surveys in the LaGrange Reach in the Lower Illinois River have been included in CPUE calculations to increase the spatial continuity of the data used for the following analyses. These data are a product of the U.S. Army Corps of Engineers' Upper Mississippi River Restoration—Environmental Management Program, LTRMP element, as distributed by the U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin (www.umesc.usgs.gov/ltrmp.html).

We collected 1,924 fish representing 46 species and 3 hybrids from 12 families during 6.5 hours of AC electrofishing at 7 locations on the Upper Illinois and Lower Des Plains Rivers. Emerald Shiner was the most abundant species in our AC electrofishing collections (632 fish; 32.8% of total catch) followed by Bluegill (305; 15.9%), and Gizzard Shad (245; 12.7%). Silver Carp contributed the greatest biomass of fishes collected in the Upper Illinois and Lower Des Plaines Rivers (131.1 lb; 35.5% total collected biomass), followed by Largemouth Bass (70.6 lb; 19.1%), and Common Carp (33.3 lb; 9.0%). Comprehensive records of fish collections and biomass at each AC electrofishing site are included in Appendices III and IV.

We collected 2,696 fish representing 63 species and 4 hybrids from 13 families during 9 hours of pulsed-DC electrofishing at 36 sites on the Upper Illinois and Lower Des Plains Rivers. Emerald Shiner was the most abundant species in our pulsed-DC electrofishing collections (481 fish; 17.8% of total catch) followed by Gizzard Shad (395; 14.7%), and Spotfin Shiner (250; 9.3%). Smallmouth Buffalo contributed the greatest biomass of fishes collected in the pulsed-DC survey of this region (422.3 lb; 39.8% total collected biomass), followed by Common Carp (251.2 lb; 23.7%), and Silver Carp (105.4 lb; 9.9%). Comprehensive records of collections and biomass within each reach and sampling periods using pulsed-DC electrofishing gear are included in Appendices V and VI.

Threatened and Endangered Species

No fishes included on lists of threatened or endangered species in Illinois were collected during three-phase AC electrofishing surveys of the Upper Illinois River. Two Starhead Topminnow (Illinois Threatened) and eleven Banded Killifish (Illinois Threatened) were collected during pulsed-DC electrofishing collections in the Upper Illinois River (Appendix V). These fishes were identified in the field, and were not verified by INHS museum staff.

Bluegill

Catch rates of Bluegill in the Upper Illinois River during 2014 were nearly equal to those during 2013 (Figure 2.1). The PSD values calculated from 2014 captures indicates that the Bluegill population of the Upper Illinois River has been dominated by small young-of-year and juvenile individuals since 2006.

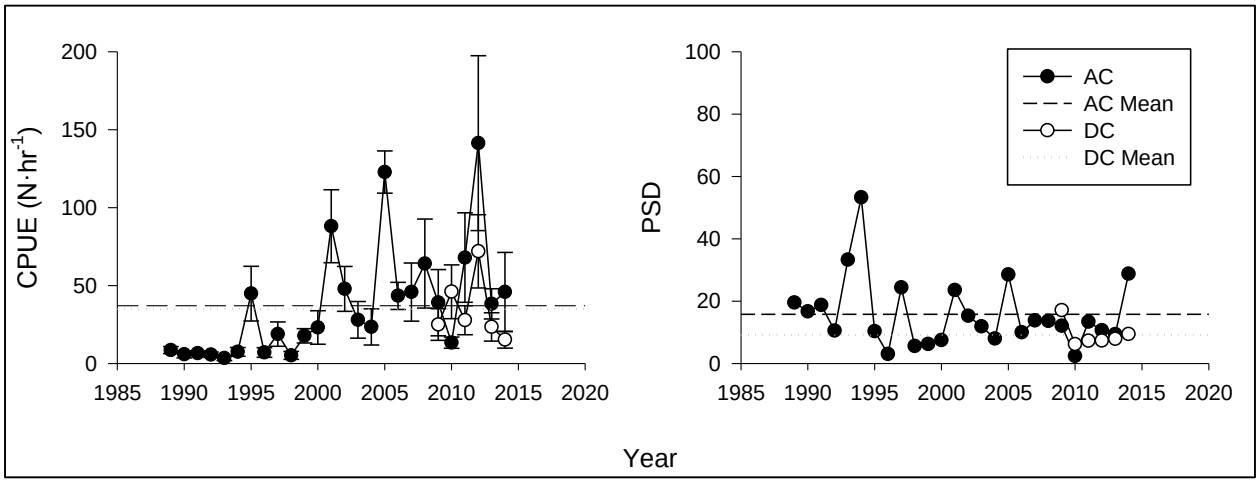

Figure 2.2. Catch per unit effort and proportional size distribution of Bluegill collected by AC and pulsed-DC electrofishing surveys in the Upper Illinois River. The dashed lines represent the long-term averages for each gear type used since F-101-R sampling initiated in 1989.

Channel Catfish

Catch rates of Channel Catfish in the Upper Illinois River during 2014 were higher than those observed in 2012, especially for DC surveys (Figure 2.2). However, it appears that the relative abundance of Channel Catfish is generally lower in the Upper Illinois River than in other study areas covered by LTEF sampling programs. The calculated PSD values suggest that Channel Catfish populations in the Upper Illinois River are dominated by larger, more mature individuals and that the production of smaller, juvenile and young-of-year individuals has been limited since 2010.

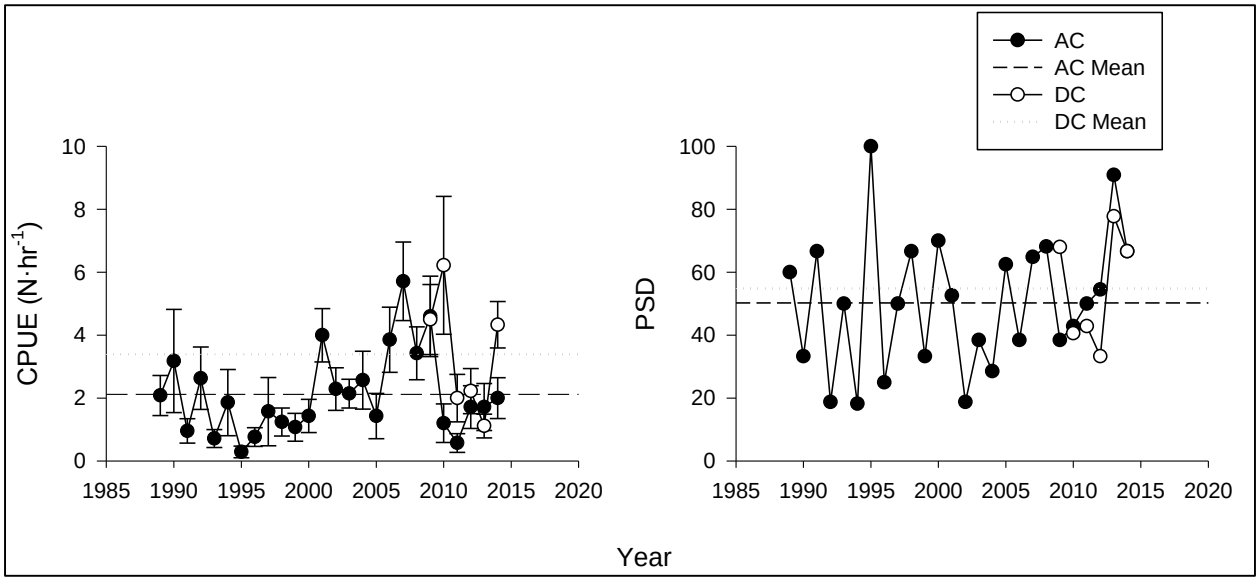

Figure 2.3. Catch per unit effort and proportional size distribution of Channel Catfish collected by AC and pulsed-DC electrofishing surveys in the Upper Illinois River. The dashed lines represent the long-term averages for each gear type used since F-101-R sampling initiated in 1989.

Largemouth Bass

Largemouth Bass CPUE in the Upper Illinois River during 2014 was higher than 2013, especially for AC surveys (Figure 2.3). The PSD value calculated during 2014 for AC surveys was well above long-term averages, though for DC surveys the PSD value was near average. However, inter-annual comparisons of structural index values may be complicated by the considerable variance observed among years.

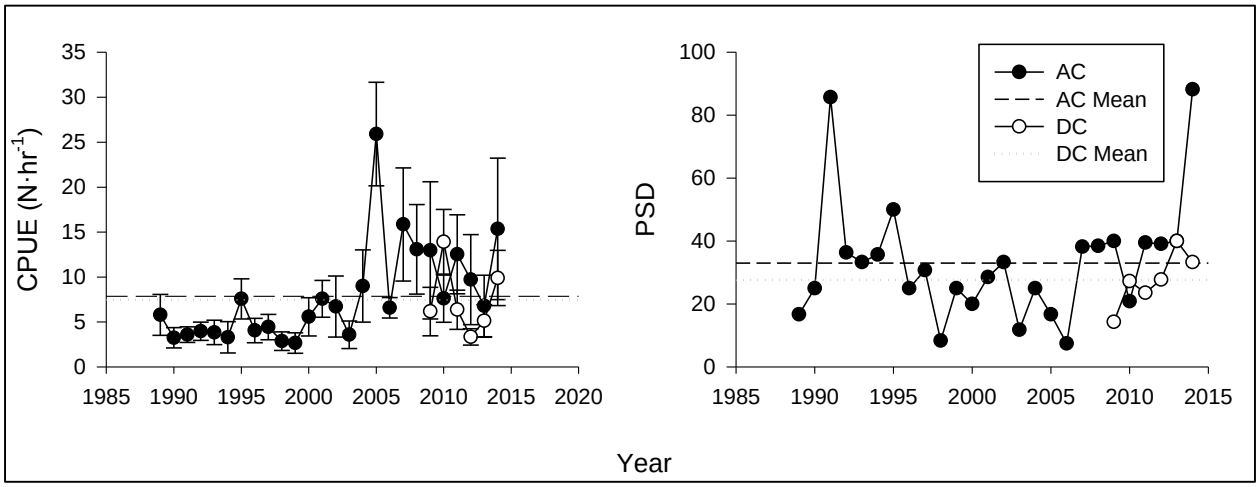

Figure 2.4. Catch per unit effort and proportional size distribution of Largemouth Bass collected by AC and pulsed-DC electrofishing surveys in the Upper Illinois River. The dashed lines represent the long-term averages for each gear type used since F-101-R sampling initiated in 1989.

Smallmouth Bass

Mean catch rates of Smallmouth Bass in the Upper Illinois River were above long-term averages during 2014; however, there was considerable variance among the catch rates among all sites sampled in the region (Figure 2.4). Additionally, the variability of catch rates and PSD values over time indicates that Smallmouth Bass recruitment trends in this region are sporadic compared with other sportfish species. It is unclear whether these trends are the result of random fluctuations in populations or, alternatively, some outcome of environmental variables controlling recruitment trends or catchability. Future study of the effects of abiotic and biotic environmental variables on the population dynamics of Smallmouth Bass is recommended.

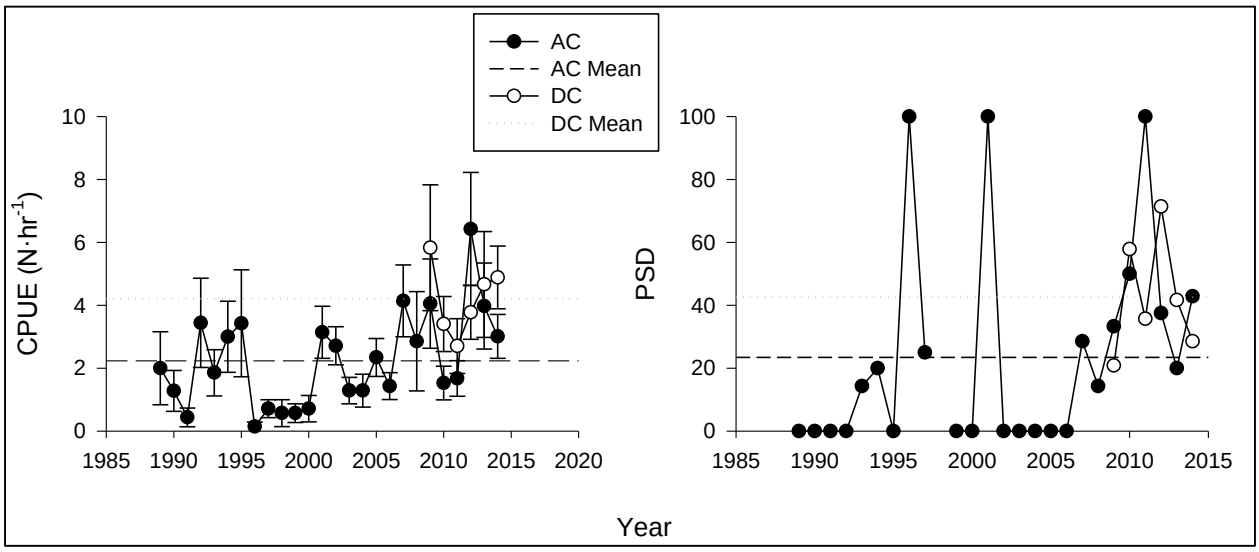

Figure 2.5. Catch per unit effort and proportional size distribution of Smallmouth Bass collected by AC and pulsed-DC electrofishing surveys in the Upper Illinois River. The dashed lines represent the long-term averages for each gear type used since F-101-R sampling initiated in 1989.

Section 2.7 - 2014 Lower Illinois River Electrofishing Catch Statistics

We collected 3,022 fish representing 54 species and 3 hybrids from 15 families during 20.1 hours of AC electrofishing at 20 locations on the Lower Illinois River and its confluence with the Mississippi River. Freshwater Drum was the most abundant species in our AC electrofishing collections (464 fish; 15.4% of total catch) followed by Silver Carp (395; 13.1%), and Bluegill (358; 11.8%). Silver Carp contributed the

greatest biomass of fishes collected in the Lower Illinois River and Confluence region (1100.7 lb; 23.9% total collected biomass), followed by Common Carp (755.5 lb; 16.4%), and Bigmouth Buffalo (178.4 lb; 3.9%). Comprehensive records of fish collections and biomass at each AC electrofishing site are included in Appendices III and IV.

We collected 8,210 fish representing 60 species and 2 hybrids from 14 families during 21.75 hours of pulsed-DC electrofishing at 89 sites on the Lower Illinois River. Gizzard Shad was the most abundant species in our pulsed-DC electrofishing collections (3,617 fish; 44.1% of total catch) followed by Emerald Shiner (1,613; 19.6%), and Silver Carp (521; 6.3%). Silver Carp contributed the greatest biomass of fishes collected in the pulsed-DC survey of the Lower Illinois River (1290.8 lb; 39.2% total collected biomass), followed by Common Carp (678.5 lb; 20.6%), and Channel Catfish (311.1 lb; 9.5%). Comprehensive records of collections and biomass within each navigational reach and sampling periods using pulsed-DC electrofishing gear are included in Appendices V and VI.

Threatened and Endangered Species

No fishes included on lists of threatened or endangered species in Illinois were collected during either three-phase AC or pulsed-DC electrofishing surveys of the Lower Illinois River.

Black and White Crappies

Although CPUE of Black and White Crappies is generally low in our DC electrofishing survey of the lower Illinois River, inter-annual catch rates in the AC electrofishing survey are more reliable and have demonstrated a substantial decline since 2010 (Figure 2.5). However, an analysis of long-term catch rates and PSD values may indicate a 2-3 year, cyclical pattern of recruitment; catch rates during 2014 were greater than those recorded during 2013 for both AC and DC surveys, although PSD values during 2014 were both markedly lower than during 2013, indicating the possibility of limited recruitment in recent years.

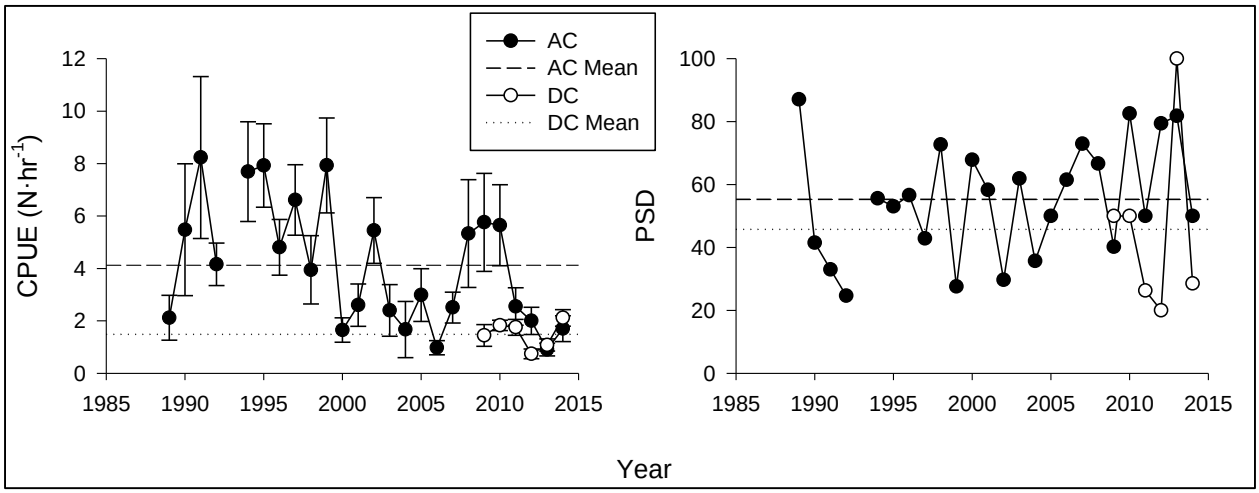

Figure 2.6. Catch per unit effort and proportional size distribution of Black and White Crappies collected by AC and pulsed-DC electrofishing surveys in the Lower Illinois River. The dashed lines represent the long-term averages for each gear type used since F-101-R sampling initiated in 1989.

Bluegill

Catch rates of Bluegill in the Lower Illinois River declined again during 2014 after having remained relatively high and stable from 2005 to 2012 (Figure 2.6). The pronounced difference in CPUE between AC and DC electrofishing gears has been consistent since DC sampling began in 2009 and may indicate that the gear and/or sampling design of the AC electrofishing survey is more effective for capturing Bluegill in this region. The low PSD values recorded since sampling began in 1989 are likely indicative of a population dominated by smaller or younger individuals, which may be an indication of a lack of recruitment to adult life-stages because of depauperate overwintering habitat or food limitation.

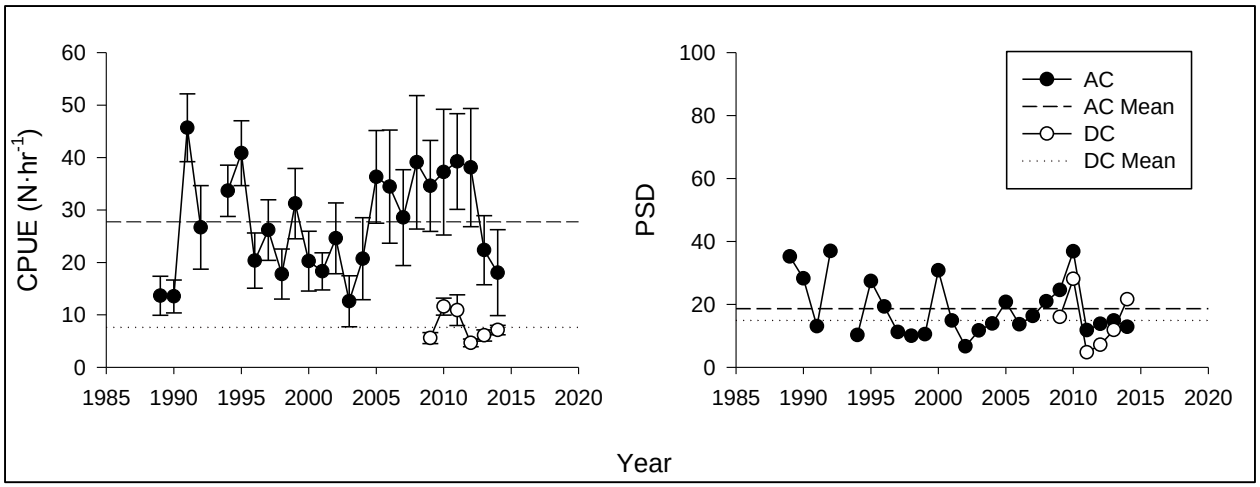

Figure 2.7. Catch per unit effort and proportional size distribution of Bluegill collected by AC and pulsed-DC electrofishing surveys in the Lower Illinois River. The dashed lines represent the long-term averages for each gear type used since F-101-R sampling initiated in 1989.

Channel Catfish

Catch rates of Channel Catfish in the Lower Illinois River increased for DC surveys, and decreased slightly for AC surveys (Figure 2.7). The PSD values observed in 2014 in this region indicate a population with a mix of large and small fish. Long-term trends in CPUE and PSD also suggest that Channel Catfish populations in the Lower Illinois River have maintained a balance among larger, mature fish and smaller recruits in recent years.

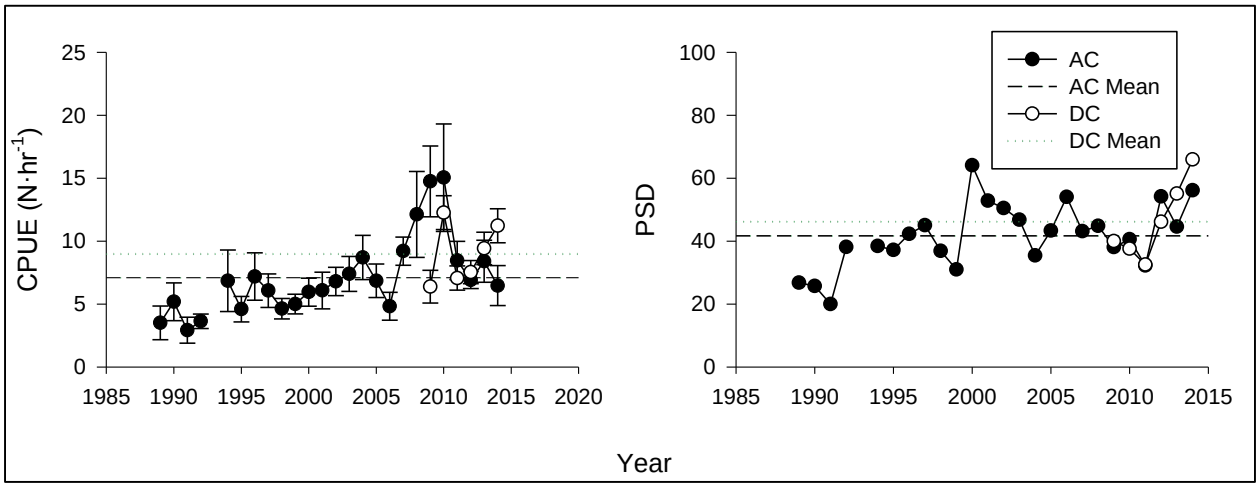

Figure 2.8. Catch per unit effort and proportional size distribution of Channel Catfish collected by AC and pulsed-DC electrofishing surveys in the Lower Illinois River. The dashed lines represent the long-term averages for each gear type used since F-101-R sampling initiated in 1989.

Largemouth Bass

Catch rates of Largemouth Bass in the Lower Illinois River during 2014 continued the increase observed during 2013, with both AC and DC CPUEs near long-term averages (Figure 2.8). The decrease in PSD values calculated for both gears during 2014 indicate a recent influx of new recruits to the population.

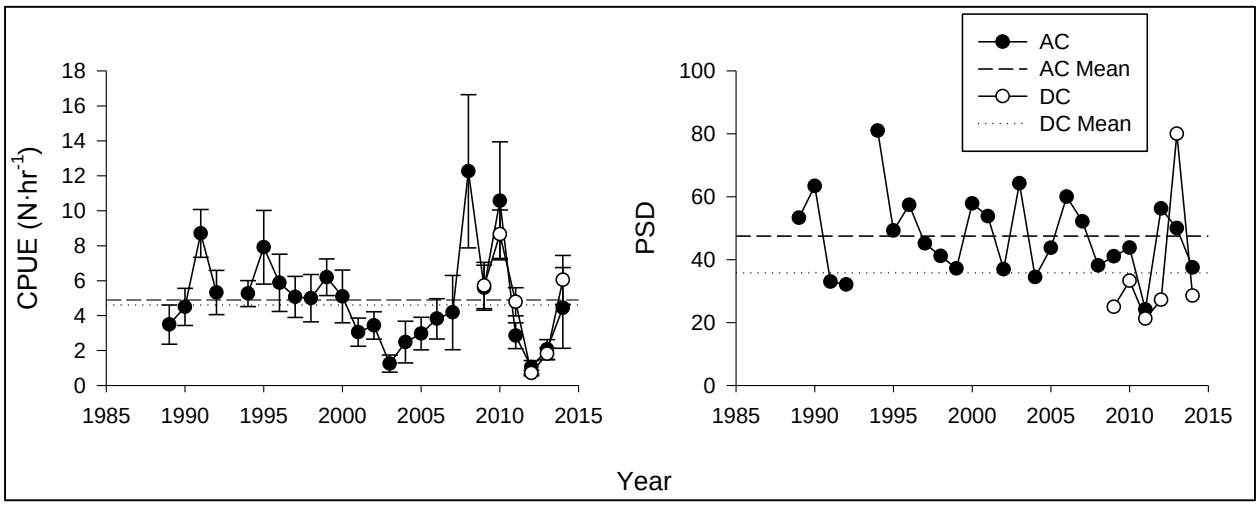

Figure 2.9. Catch per unit effort and proportional size distribution of Largemouth Bass collected by AC and pulsed-DC electrofishing surveys in the Lower Illinois River. The dashed lines represent the long-term averages for each gear type used since F-101-R sampling initiated in 1989.

White Bass

White Bass CPUE in the lower Illinois River during 2014 remained low for AC surveys, but was the highest on record for DC surveys (Figure 2.9). The disparity between the average PSD value of White Bass collected in the AC and DC electrofishing surveys may indicate that the gears demonstrate a size-selective bias, or habitat preference of different size classes of White Bass.

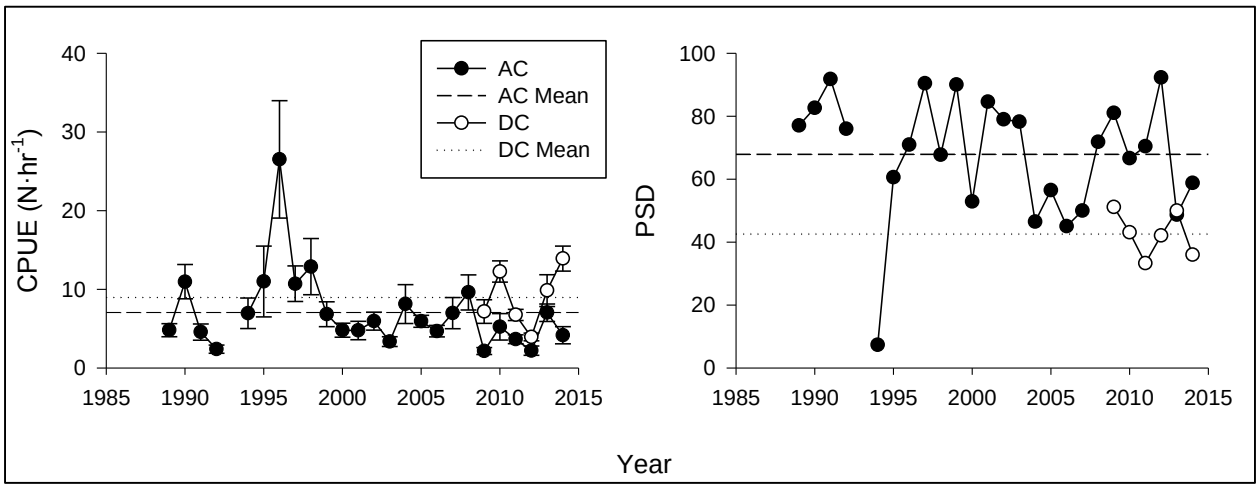

Figure 2.10. Catch per unit effort and proportional stock-density of White Bass collected by AC and pulsed-DC electrofishing surveys in the Lower Illinois River. The dashed lines represent the long-term averages for each gear type used since F-101-R sampling initiated in 1989.

Silver Carp

Silver Carp were first detected in F-101-R surveys during 2001 (Figure 2.10). Since then, CPUE has greatly increased to its highest level in 2007 then receded to current levels (~ 20 fish/h), though did take a marked increase for both gears during 2014. During that same time, the relative weight of Silver Carp in the Lower Illinois River has declined (Figure 2.10). Given both anecdotal and documented evidence of Silver Carp spawning activity during 2014, as well as a large increase in young-of-year Silver Carp captured during 2014, CPUE numbers could change dramatically during 2015.

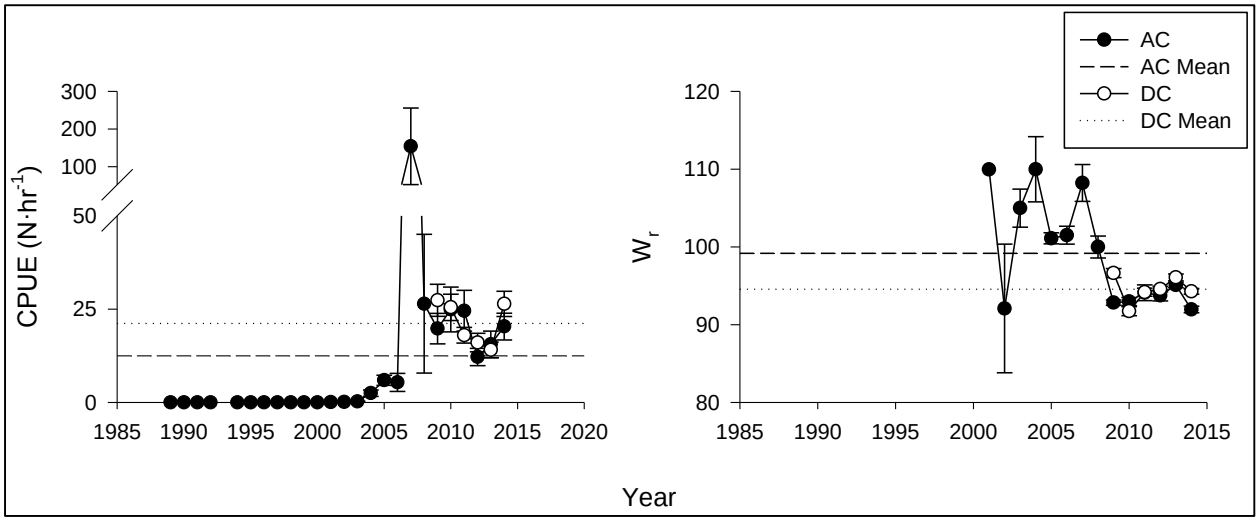

Figure 2.11. Catch per unit effort and condition (relative weight-W_r) of Silver Carp collected by AC and pulsed-DC electrofishing surveys in the Lower Illinois River. The dashed lines represent the long-term averages for each gear type used since F-101-R sampling initiated in 1989.

Section 2.8 - Additional research projects

Section 2.8.1 - Intersex condition in male Largemouth Bass from the Upper Illinois River

Intersex condition, the presence of both male and female characteristics in individuals of a normally gonochoristic species, has been documented in many watersheds among a diverse variety of fishes. Previous researchers indicated that a suite of endocrine disrupting chemicals are strongly associated with the occurrence of intersex. Although natural rates of intersex condition vary substantially in wild fishes, and the fundamental mechanisms for the development of intersex in individuals may be poorly understood, new studies in highly urbanized watersheds are important to our understanding of the management implications of this condition. Environmental reforms during the last 50 years have led to improved water quality in the Upper Illinois River Waterway (IRW) and the native fish community has responded favorably. However, emerging understandings of new threats—like intersex condition—pose new concerns. Our objective was to survey the severity of intersex in male Largemouth Bass in an area directly affected by surface runoff and wastewater effluents from the Chicago Metropolitan Area. Histological analysis indicated that testicular oocytes were present in 21 of 51 (41%) of Largemouth Bass (Figure 2.12). Oocyte numbers ranged from 1-25 among intersex individuals. These results are similar to those observed in similar studies of Largemouth Bass collected from impaired rivers in Pennsylvania (Blazer et al. 2012) and Georgia (Kellock et al. 2014). Our study offers the first survey of the severity of intersex in a population of Largemouth Bass in the upper Illinois River Waterway. This study of intersex condition may assist Illinois policymakers tasked with managing fisheries affected by reproductive impairment.

Section 2.8.2 - Factors affecting the growth of Largemouth Bass in the Upper Illinois River

Knowing how climate affects aquatic ecosystems is important for conservation and management of fish populations. We can use annual growth increments from fish otoliths to understand effects of environmental factors on individual fish growth. We collected Largemouth Bass using pulsed-DC

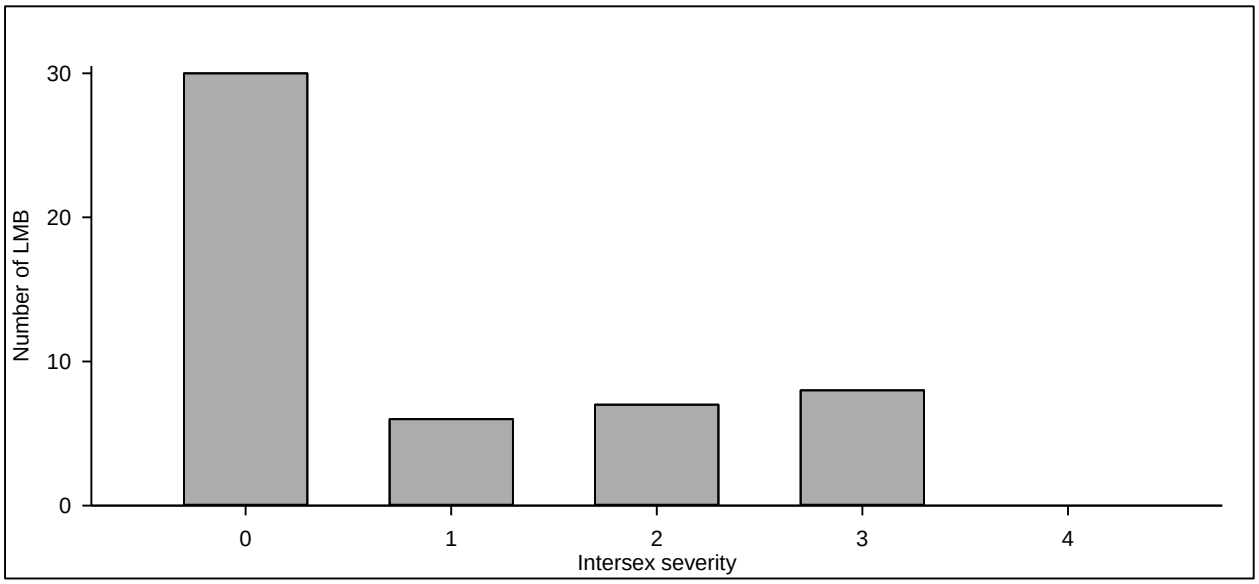

Figure 2.12. Number of male LMB at each level of intersex severity (from Kellock et al 2014). 0: no oocytes, 1: single oocyte, 2: multiple non-clustered oocytes, 3: clustering of 2-5 oocytes 4: multiple clusters of oocytes.

electrofishing in the Dresden Reach of the Upper Illinois River during Spring 2014, assigned ages to each fish, and back-calculated lengths-at-age from otolith growth increments. We modeled incremental growth as a function of age and several age-corrected environmental factors (e.g., river stage height, discharge, weather). Our environmental factors were auto-correlated, thus we only used a single environmental factor in each model, and used AIC_c (Hurvich and Tsai 1989) to rank our models (Table 2.2). Length increased

Table 2.2. The six environmental factors tested as individual models to understand variation in LMB growth. STGHT.MAX: maximum annual stage height, STGHT.MIN: minimum annual stage height, PRECIP: total annual precipitation, FLOW.MAX: maximum annual discharge, FLOW.MEAN: mean annual discharge, GDD: total annual growing degree days

Model	Intercept	LOG_AGE	STGHT.MAX	STGHT.MIN	PRECIP	FLOW.MAX	FLOW.MEAN	GDD	R^2	df	ΔAIC_c	AIC_c w
1	64.6	-95.3	0.24						0.79	4	0	0.59
2	67.5	-98.9		0.23					0.79	4	1	0.37
3	136.3	-184.4			0.005				0.79	4	6.1	0.03
4	149.6	-205.0				0.002			0.78	4	8.7	0.008
5	147.4	-198.1					0.01		0.78	4	11.3	0.002
6	136.9	-184.9						0.02	0.78	4	15	0
7	176.9	-236.3							0.77	3	17.5	0

with age and appeared to asymptote at age 6, whereas growth decreased with age. Age explained 77% of the variation in growth; however, each of the models containing age and an age-corrected environmental factor had a lower AIC_c than the age-only model. The two models containing maximum and minimum stage height had a combined AIC_c weight of 0.96. The parameter estimates for stage height were positive, indicating greater LMB growth occurred in years with greater stage height. We postulate greater stage height could allow for: (1) reconnection to seasonally isolated backwaters, which offer (a) greater access to energetically beneficial prey and (b) refugia from energetically expensive river flows, (2) increased availability of and access to flooded terrestrial habitat, and (3) inflow of floodplain nutrients into main-channel riverine habitats, which benefits Largemouth Bass that remain in the main channels.

Section 2.8.3 - Effects of body condition on fecundity of Largemouth Bass in the Upper Illinois River

Understanding the fecundity, or the reproductive potential, of a species is essential for the management of fisheries in riverine systems. The fecundity of female fishes can be significantly altered by physiological stress related to environmental disturbances. Accurate estimates of fecundity can help biologists determine the spawning biomass of commercially and recreationally-important fish species occupying highly-altered rivers. These data are especially significant for popular sport fish species, such as Largemouth Bass. Currently, there is a lack of fecundity data for fishes found throughout the Upper Mississippi River Watershed. This lack of information limits researcher's abilities to generate realistic stock-recruitment models for future management. For this study, twenty-three Largemouth Bass were collected from the Upper Illinois River. To calculate initial estimates of fecundity, we used the gravimetric method which involves manually counting weighed sub-samples of oocytes from the ovarian tissue and multiplying the result by the total ovarian mass; however, new computer-intensive methods developed for marine fishes are currently being tested by project workers and may reduce the need to manually count oocytes, thereby reducing the time and effort needed to determine accurate estimates of fecundity. The total fecundity values ranged from 32,012 to 320,586 with an average fecundity of 150,141.16 and a standard error of 6,178.14. Using simple linear regression, we compared age, total length, weight, condition factor, gonadosomatic index (GSI), and hepatosomatic index (HSI) for each female to the calculated fecundity. Total length, weight, and condition of female fish most significantly impacted fecundity indicating that larger, more robust fish are typically more fecund.

Section 2.8.4 – LTEF dataset analysis

Baselines are critical for evaluating changes. We are analyzing the LTEF database to document the profound recovery of sportfish since the initiation of the program. This analysis builds on previous research using the LTEF database, with a specific focus on sportfish populations. We are currently drafting a manuscript highlighting the dramatic recovery of sportfish, with the intent to submit the manuscript to the journal *BioScience*, a journal with a broad reach that includes policymakers.

The information value of samples depends on the precision with which they are collected. We analyzed a dataset of fish collected in the Kankakee River during the 1980s to analyze detection probability for fishes commonly found in the Illinois River watershed. We document the detection probability for 41 species by AC boat electrofishing and shoreline seining. Additionally, we analyzed how environmental covariates (water velocity, turbidity, water temperature, pH, dissolved oxygen, and conductivity) affect the detection probability of each species. Notably, most sportfish had high detection probabilities (e.g., smallmouth bass had a detection probability of ~0.95), whereas many non-game species had much lower detection probabilities. In addition to providing estimates of detection probability for species, we also provide data to allow other researchers to estimate how changes in environmental covariates affect detection probability. We are preparing this manuscript for submission to *North American Journal of Fisheries Management*.

CHAPTER 3
SPORTFISH ASSESSMENTS IN THE MISSISSIPPI RIVER

Section 3.1 - 2014 Mississippi River Ancillary Habitat Quality Data

Pulsed-DC electrofishing was conducted according to the methods described in Section 2.2 between 7:52 a.m. and 6:52 p.m. central standard time during the three sampling periods specified in Section 2.2. Physical measurements for ancillary water-quality parameters were collected at each site and are summarized in Table 3.1.

Table 3.1. Summary of ancillary water quality data collected during pulsed-DC electrofishing surveys on six sampling areas of the Mississippi River during 2014. Values are expressed as the mean observed parameter value ± standard error.

Navigational Reaches	Total EF Effort (h)	EF Power Used (Watts)	Depth (ft)	Secchi Depth (in)	Water Temperature (°F)	DO (ppm)	Conductivity (µS)	Stage Height (ft)
Pool 16 (RM 457-483)	**3.75**	**3781.2 ± 113.1**	**5.0 ± 0.5**	**12.9 ± 1.9**	**73.2 ± 1.7**	**6.5 ± 0.3**	**394.8 ± 20.5**	**12.5 ± 0.6**
Time Period 1	1.25	3950.0 ± 221.4	6.3 ± 0.7	5.7 ± 0.9	76.0 ± 0.3	4.8 ± 0.1	413.0 ± 47.0	15.8 ± 0.0
Time Period 2	1.25	3986.4 ± 76.3	4.0 ± 0.7	22.2 ± 0.6	79.0 ± 0.3	7.4 ± 0.3	439.2 ± 13.0	10.5 ± 0.0
Time Period 3	1.25	3313.8 ± 16.5	4.8 ± 0.9	10.9 ± 0.6	64.7 ± 0.6	7.3 ± 0.1	332.2 ± 22.2	11.1 ± 0.0
Pool 19 (RM 364.5-410.5)	**6.75**	**3844.5 ± 57.8**	**3.9 ± 0.4**	**12.8 ± 0.8**	**71.8 ± 2.2**	**8.6 ± 0.6**	**440.6 ± 7.0**	**526.6 ± 0.3**
Time Period 1	2.25	3891.0 ± 91.6	5.4 ± 0.7	10.5 ± 1.6	78.5 ± 0.4	5.3 ± 0.5	426.1 ± 20.0	528.4 ± 0.4
Time Period 2	2.25	4114.0 ± 33.6	2.4 ± 0.5	15.0 ± 1.0	80.9 ± 0.7	12.0 ± 0.5	450.9 ± 3.4	525.5 ± 0.0
Time Period 3	2.25	3528.4 ± 35.1	3.8 ± 0.7	12.9 ± 1.1	56.1 ± 0.5	8.4 ± 0.1	444.8 ± 4.5	526.0 ± 0.0
Pool 20 (RM 343-364.5)	**3.00**	**3998.0 ± 102.3**	**4.5 ± 0.7**	**13.0 ± 1.2**	**70.1 ± 3.2**	**8.2 ± 0.2**	**485.9 ± 11.0**	**7.7 ± 0.3**
Time Period 1	1.00	4256.0 ± 43.9	4.2 ± 2.1	15.5 ± 2.5	77.6 ± 0.3	7.7 ± 0.3	498.8 ± 2.4	8.7 ± 0.0
Time Period 2	1.00	4200.0 ± 47.7	5.4 ± 0.7	12.0 ± 2.3	77.5 ± 0.5	8.1 ± 0.5	492.0 ± 15.2	6.2 ± 0.0
Time Period 3	1.00	3538.0 ± 67.7	4.0 ± 0.4	11.5 ± 1.0	55.3 ± 0.2	8.8 ± 0.1	467.0 ± 30.0	8.1 ± 0.0
Pool 25 (RM 242-273.5)	**4.50**	**3818.6 ± 59.9**	**9.0 ± 0.9**	**9.6 ± 0.9**	**71.8 ± 2.1**	**8.5 ± 0.3**	**428.8 ± 8.9**	**38.1 ± 0.4**
Time Period 1	1.50	4036.7 ± 10.9	10.5 ± 1.7	7.8 ± 0.5	76.9 ± 0.1	7.3 ± 0.1	457.8 ± 2.7	40.3 ± 0.0
Time Period 2	1.50	3922.2 ± 61.4	9.0 ± 1.6	12.5 ± 2.4	78.3 ± 0.3	8.7 ± 0.8	434.3 ± 13.9	36.3 ± 0.2
Time Period 3	1.50	3496.8 ± 18.9	7.5 ± 1.1	8.5 ± 0.8	60.2 ± 2.2	9.5 ± 0.3	394.2 ± 14.1	37.7 ± 0.4
Chain of Rocks (RM 165.5-20	**5.25**	**3897.4 ± 94.2**	**11.6 ± 1.1**	**5.4 ± 0.7**	**72.5 ± 1.7**	**6.5 ± 0.2**	**447.7 ± 18.0**	**19.1 ± 1.8**
Time Period 1	1.75	4009.0 ± 133.2	12.7 ± 2.3	3.9 ± 0.7	78.8 ± 0.8	5.9 ± 0.1	443.9 ± 23.6	26.5 ± 1.6
Time Period 2	1.75	4032.7 ± 231.3	11.9 ± 1.8	6.4 ± 1.7	74.5 ± 2.2	6.1 ± 0.2	477.1 ± 46.0	16.2 ± 3.8
Time Period 3	1.75	3650.6 ± 47.9	10.2 ± 1.8	5.8 ± 1.2	64.2 ± 1.9	7.6 ± 0.4	422.1 ± 17.9	14.6 ± 1.4
Kaskaskia (RM 117-165.5)	**7.50**	**4165.3 ± 64.4**	**11.2 ± 0.9**	**6.8 ± 0.5**	**73.9 ± 1.7**	**7.1 ± 0.3**	**505.6 ± 10.4**	**17.9 ± 0.9**
Time Period 1	2.50	4213.6 ± 53.4	13.1 ± 1.9	7.8 ± 0.5	78.8 ± 0.3	6.8 ± 0.1	498.2 ± 11.3	22.5 ± 0.9
Time Period 2	2.50	4431.2 ± 107.3	9.5 ± 1.2	6.6 ± 1.3	81.5 ± 1.0	5.9 ± 0.4	528.2 ± 19.3	14.1 ± 1.0
Time Period 3	2.50	3851.1 ± 81.2	11.1 ± 1.3	6.0 ± 0.7	61.5 ± 0.8	8.5 ± 0.4	490.3 ± 21.4	17.0 ± 1.2

Section 3.2 - 2014 Upper Mississippi River Sampling Area Pulsed-DC Electrofishing Catch Statistics

The results in the following sections have been divided between those data collected in Pools 16, 19, and 20 (the Upper Mississippi River Sampling Area) and data collected in Pool 25, the Chain of Rocks Reach, and the Kaskaskia Reach (the Lower Mississippi River Sampling Area). We have made this distinction because of the geographic distance between the two sections. Fisheries data collected by LTRMP surveys in Pool 26 in the Lower Mississippi River Sampling Area have been included in CPUE calculations to increase the spatial continuity of the data used for the following analyses. These data are a product of the U.S. Army Corps of Engineers' Upper Mississippi River Restoration—Environmental Management Program, Long Term Resource Monitoring Program (LTRMP) element, as distributed by the U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin (www.umesc.usgs.gov/ltrmp.html).

We collected 6,928 fish representing 67 species and 3 hybrids from 13 families during 9.75 hours of pulsed-DC electrofishing at 39 sites in the Upper Mississippi River Sampling Area. Emerald Shiner was the

most abundant species in our catch (3,885 fish; 56.1% of total catch) followed by Spotfin Shiner (412; 5.9%), and Gizzard Shad (342; 4.9%). Common Carp represented the greatest proportion of the total collected biomass (1258.1 lb; 57.4% of total collected biomass) followed by Channel Catfish (244.7 lb; 11.2%), and River Carpsucker (116.67 lb; 5.3%). Comprehensive records of collections and biomass within each pool and sampling periods using pulsed-DC electrofishing gear are included in Appendices VII and VIII.

Threatened and Endangered Species

Four River Redhorse (Illinois Threatened), 4 Orangethroat Darter (Iowa Threatened), and one American Eel (Illinois Threatened) were sampled during pulsed-DC electrofishing surveys on the Upper Mississippi River Sampling Area (Appendix VII). These fishes were identified in the field, and were not verified by INHS museum staff.

Bluegill

Bluegill catch rates in the Upper Mississippi River Sampling Area during 2014 were slightly below the mean since 2009, though the Bluegill populations in this area appear to be relatively stable (Figure 3.1). The PSD value calculated during 2014 is the highest in our brief history in this area, indicating that we captured primarily large, mature fish during 2014.

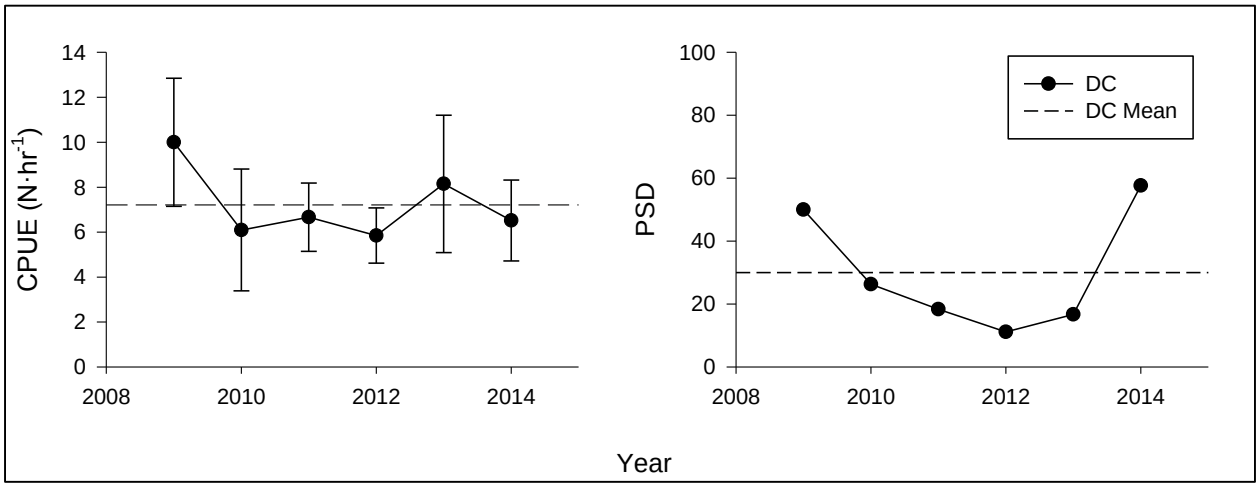

Figure 3.1. Catch per unit effort and proportional size distribution of Bluegill collected by pulsed-DC electrofishing surveys in the Upper Mississippi River Sampling Area. The dashed lines represent the long-term averages since F-101-R sampling initiated in 2009.

Channel Catfish

Catch rates of Channel Catfish rebounded slightly during 2014 from previous lows during 2012 and 2013, although PSD values remained high. These results likely indicate that the bulk of the sampled population is comprised of larger, mature fish.

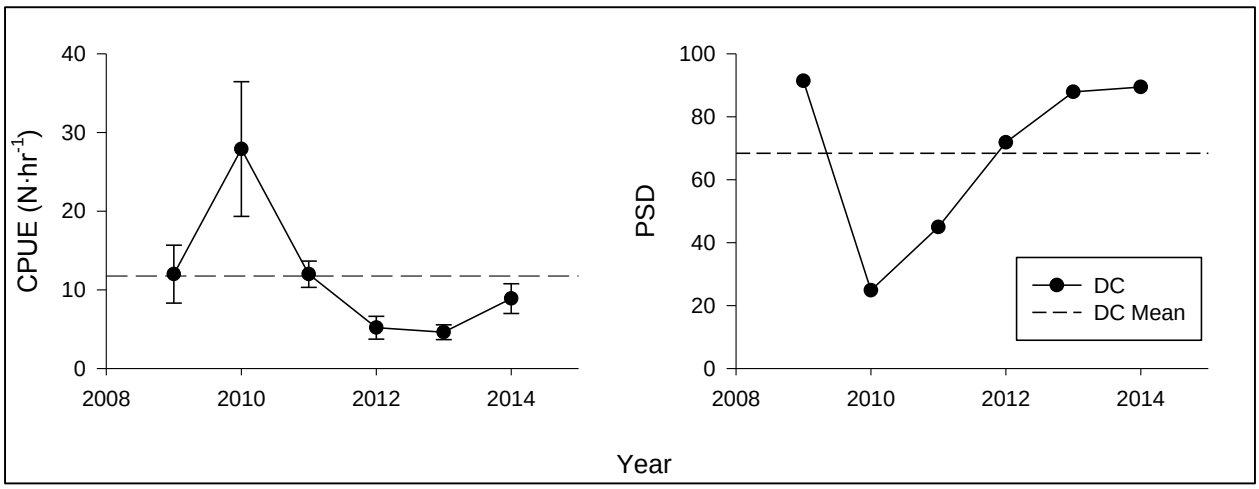

Figure 3.2. Catch per unit effort and proportional size distribution of Channel Catfish collected by pulsed-DC electrofishing surveys in the Upper Mississippi River Sampling Area. The dashed lines represent the long-term averages since F-101-R sampling initiated in 2009.

Largemouth Bass

Catch rates of Largemouth Bass in the Upper Mississippi River Sampling Area have been relatively steady since 2010, but increased markedly during 2014 (Figure 3.3). The five-year average PSD values indicate that the stock maintains a balance of larger, mature individuals and smaller, younger age groups.

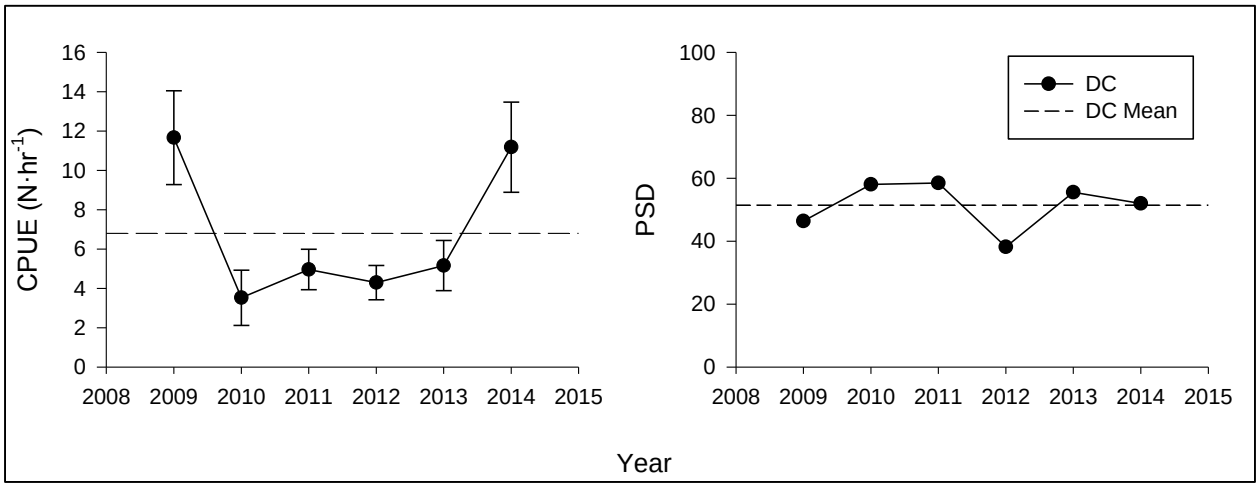

Figure 3.3. Catch per unit effort and proportional size distribution of Largemouth Bass collected by pulsed-DC electrofishing surveys in the Upper Mississippi River Sampling Area. The dashed lines represent the long-term averages since F-101-R sampling initiated in 2009.

Smallmouth Bass

Smallmouth Bass CPUE in the Upper Mississippi River Sampling Area during 2014 was slightly above the 6-year average (Figure 3.4). This increase in catch rates was accompanied by a decrease in PSD, likely indicating limited recruitment of smaller size classes during 2014.

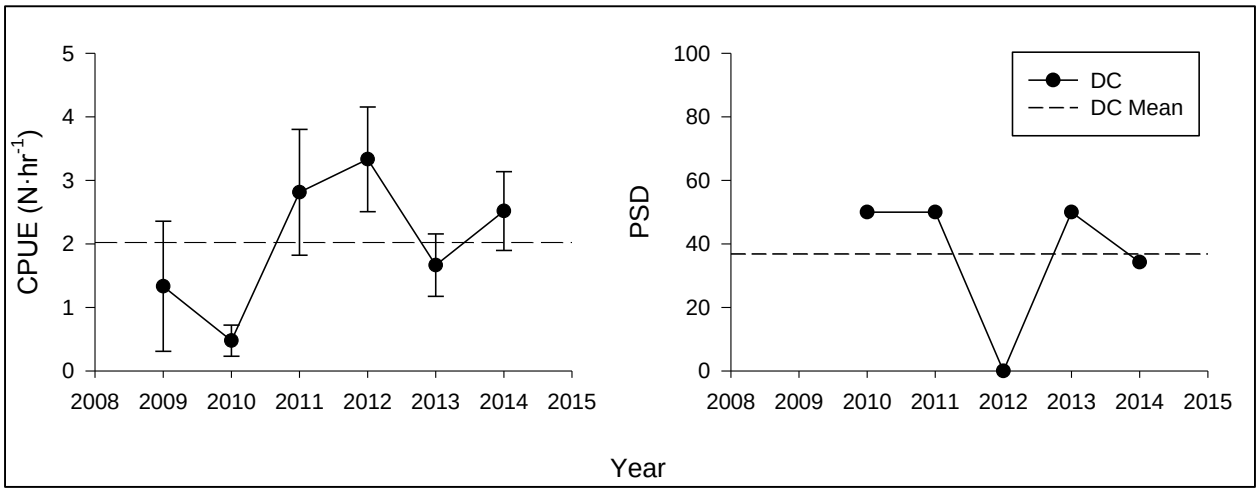

Figure 3.4. Catch per unit effort and proportional size distribution of Smallmouth Bass collected by pulsed-DC electrofishing surveys in the Upper Mississippi River Sampling Area. The dashed lines represent the long-term averages since F-101-R sampling initiated in 2009.

White Bass

Catch rates of White Bass in the Upper Mississippi River Sampling Area during 2014 were very similar to those observed during 2012 and 2013 (Figure 3.5). The observed increase in PSD values from 2012 to 2014 suggests that a greater proportion of larger, more mature individuals were encountered in our survey during 2014.

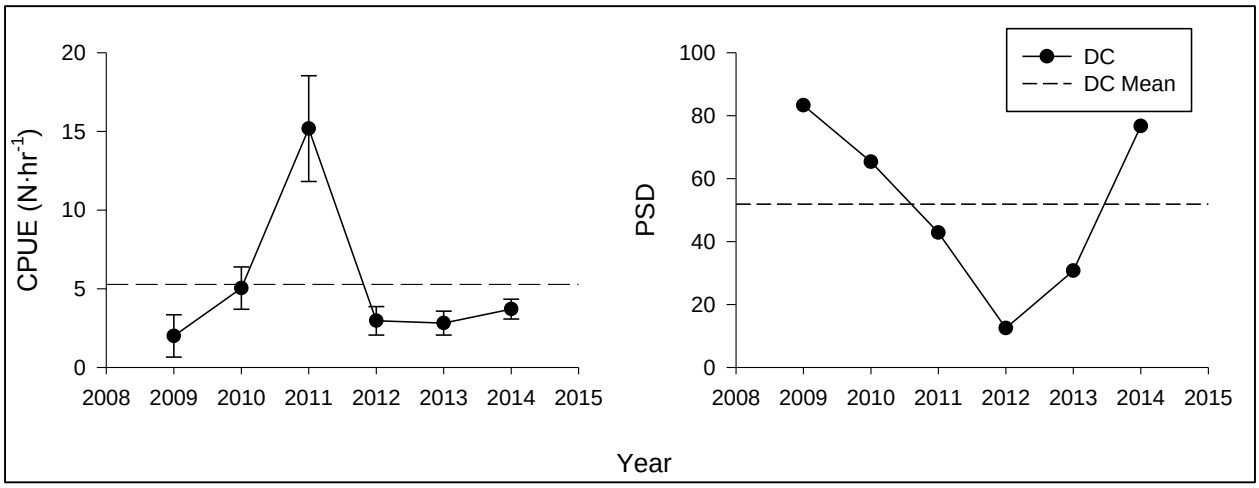

Figure 3.5. Catch per unit effort and proportional size distribution of White Bass collected by pulsed-DC electrofishing surveys in the Upper Mississippi River Sampling Area. The dashed lines represent the long-term averages since F-101-R sampling initiated in 2009.

Section 3.3 - 2012 Lower Mississippi River Sampling Area Pulsed-DC Electrofishing Catch Statistics

We collected 2,495 fish representing 50 species and 1 hybrid from 15 families during 12.75 hours of pulsed-DC electrofishing at 51 sites in the Lower Mississippi River Sampling Area. Emerald Shiner was the most abundant species in our catch (519 fish; 20.8% of total catch) followed by Common Carp (383; 15.4%), and Freshwater Drum (303; 12.1%). Common Carp represented the largest proportion of the total collected biomass (2,279.8 lb; 57.3% of total collected biomass) followed by Silver Carp (242.83 lb; 6.1%), and Smallmouth Buffalo (195.5 lb; 4.9%). Comprehensive records of collections and biomass within each pool or reach and within each sampling period using pulsed-DC electrofishing gear are included in Appendices VII and VIII.

Threatened and Endangered Species

No fishes included on lists of threatened or endangered species in Illinois or Missouri were collected

during electrofishing surveys of the Lower Mississippi River Sampling Area.

Bluegill

The catch rate of Bluegill in the Lower Mississippi River Sampling Area has decreased markedly since 2012 (Figure 3.6). Low PSD values indicate that the sampled population is dominated by small individuals, and similar values may indicate that annual production of year classes has been consistent since 2009.

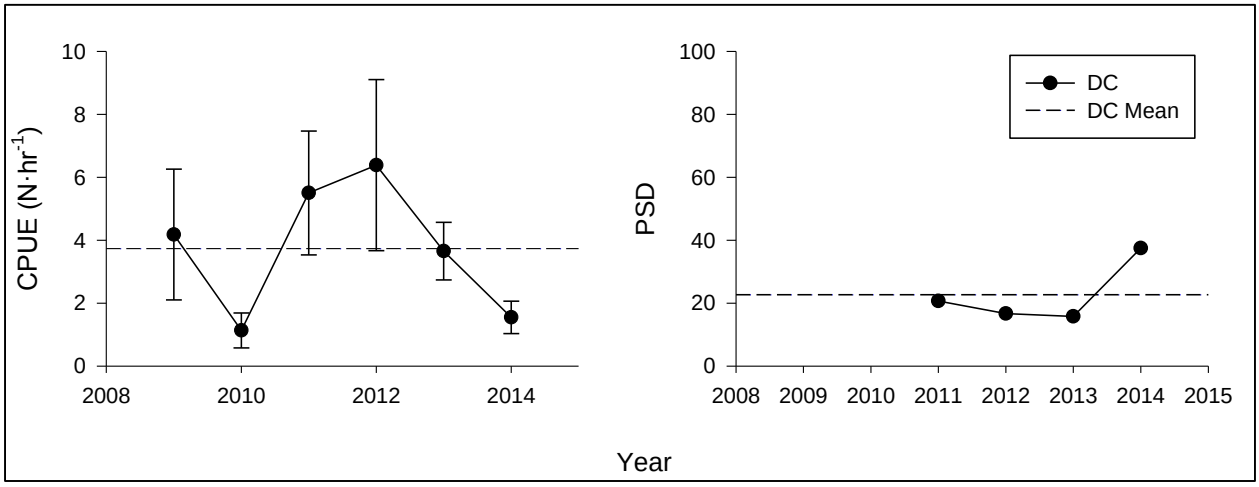

Figure 3.6. Catch per unit effort and proportional size distribution of Bluegill collected by pulsed-DC electrofishing surveys in the Lower Mississippi River Sampling Area. The dashed lines represent the long-term averages since F-101-R sampling initiated in 2009.

Channel Catfish

Catch rates of Channel Catfish in the Lower Mississippi River Sampling Area during 2014 rebounded slightly from 2013 (Figure 3.7). High and stable PSD values over the past five years indicate that the sampled population is largely composed of larger, mature individuals and that the catch of smaller size classes of Channel Catfish in this region has been relatively low.

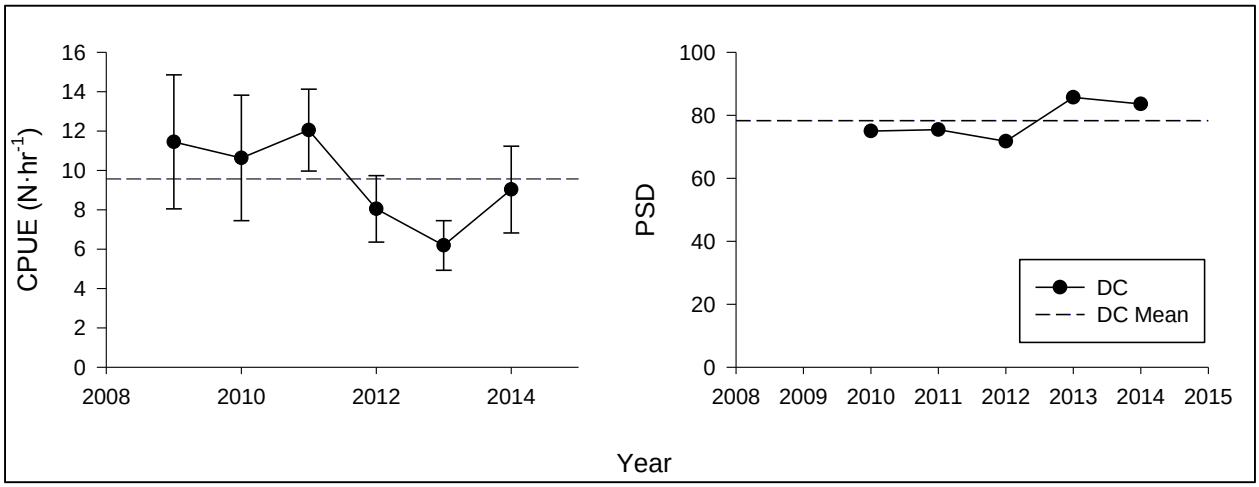

Figure 3.7. Catch per unit effort and proportional size distribution of Channel Catfish collected by pulsed-DC electrofishing surveys in the Lower Mississippi River Sampling Area. The dashed lines represent the long-term averages since F-101-R sampling initiated in 2009.

White Bass

White Bass CPUE in the Lower Mississippi River Sampling Area has remained relatively stable since 2010 (Figure 3.8). The high variation in annual PSD values calculated indicates recruitment of White Bass in the Lower Mississippi River sampling reaches may be cyclical or episodic.

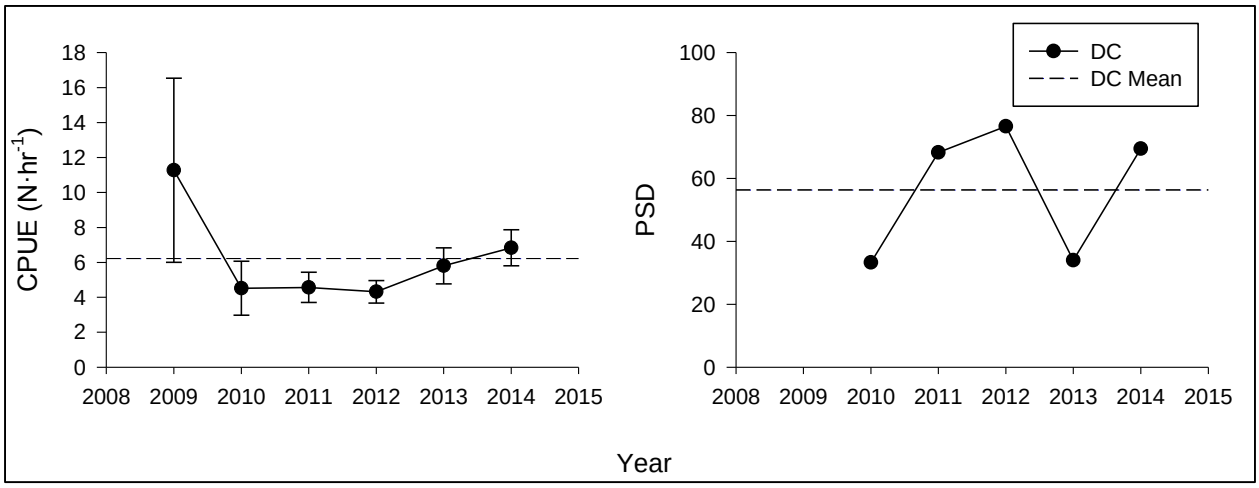

Figure 3.8. Catch per unit effort and proportional size distribution of White Bass collected by pulsed-DC electrofishing surveys in the Lower Mississippi River Reaches. The dashed lines represent the long-term averages since F-101-R sampling initiated in 2009.

Silver Carp

Catch rates of Silver Carp in the Lower Mississippi River Sampling Area during 2014 were the second-highest since sampling began in 2009 (Figure 3.9). The W_r calculated for 2014 also decreased, perhaps indicating an alarming influx of new recruits as in the Lower Illinois (Section 2.7).

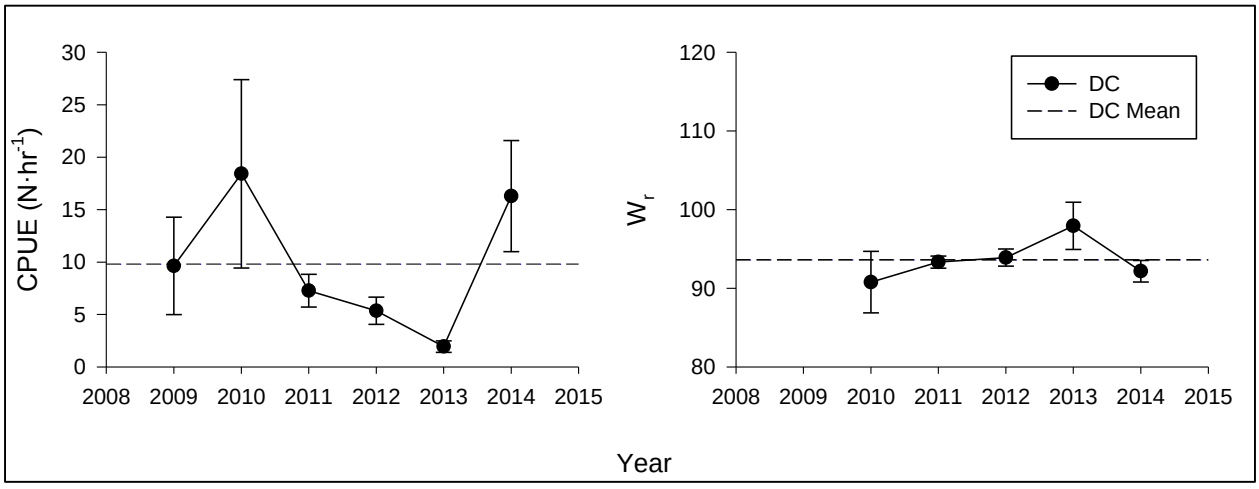

Figure 3.9. Catch per unit effort and condition (relative weight-W_r) of Silver Carp collected by pulsed-DC electrofishing survey in the Lower Mississippi River Sampling Area. The dashed lines represent the long-term averages for each gear type used since F-101-R sampling initiated in 2009.

Section 3.4 – 2014 Ancient Sportfish Assessment

Ancient sport fishes were sampled with gill nets in the Middle Mississippi River. Sites were randomly selected using GIS layers of wing dam habitats. Gill nets were fished in over-night sets (approximately 24-h soak time) when the surface water temperature was at or below 54.86°F as stated in the Pallid Sturgeon collection requirements (U.S. Fish and Wildlife Service 2005). Three different mesh sizes

of gill nets were used. The two- and three- inch square-mesh gill nets were 150 ft long, 10 ft deep, and were made of #10 monofilament. Five-inch square mesh size nets were 300 ft long, 24 ft deep, and were made of #8 monofilament. Sites were defined as areas containing three wing dams, and were randomly selected from all potential sites. At each site sampled, the three wing dams were fished with one of the three mesh size (2-in, 3-in, or 5-in) gill nets, such that all three mesh sizes were fished at each site. Ancillary habitat and water quality measurements (e.g. dissolved oxygen, current velocity, conductivity, etc.) were taken at each site. A section of the right pectoral fin ray was removed from a subset of Shovelnose Sturgeon that will be used for age and growth analysis.

Table 3.2. Ancillary habitat and water quality measurements measured during gill net collections on the Middle Mississippi River.

Total Effort (net-night)	Depth (ft)	Secchi Depth (cm)	Water Temp (°C)	DO (mg/L)	Conductivity (µS/cm)	Stage Height (ft)
66	25.6 ± 1.3	39.5 ± 2.0	4.9 ± 0.4	14.0 ± 0.2	603.3 ± 11.8	7.6 ± 0.4

During this segment, we quantified the number of potential sites (areas with three wing dams) within the Chain of Rocks and Kaskaskia reaches. We determined that the Chain of Rocks reach only had five potential sampling sites. As a result, we will no longer quantify our results by reach. Instead, we will quantify our results across both reaches and refer to these data as Middle Mississippi River data. In future segments, we will randomly select sampling sites across both of these reaches.

In segment 26, we collected 650 fish representing 26 species and 1 hybrid from 11 families during 66 net-days of gill net effort during the winter sampling season of 2013 and 2014. Aging structures were collected from 226 shovelnose sturgeon for use in an age and growth analysis. Three hundred and one fish were collected with 2-in mesh gill nets sampling random wing dam structures during 22 net-days of gill net effort. The most abundantly collected species was Shovelnose Sturgeon (152 fish, 50.5% of total catch), followed by Goldeye (53 fish, 17.6%), and then Gizzard Shad (17 fish, 5.7%). Shovelnose Sturgeon represented the largest proportion of the total collected biomass (265.4 lb; 120.4 kg; 48.7% of total collected biomass) followed by Goldeye (60.7 lb; 27.54 kg; 11.1%), and Longnose Gar (50.2 lb; 22.8 kg; 9.19%). One hundred and eighty three fish were collected with 3-in mesh gill nets sampling random wing dam structures during 22 net-days of gill net effort. The most abundantly collected species was Blue Catfish (62 fish, 33.9% of total catch), followed by Silver Carp (42 fish, 23.0%), and then Grass Carp (19 fish, 10.4%). Blue Catfish represented the largest proportion of the total collected biomass (426.7 lb; 193.5 kg; 40.5% of the total collected biomass) followed by Silver Carp (191.8 lb; 87.0 kg; 18.2%), and Grass Carp (185.6 lb; 84.2 kg; 17.6%). One hundred and sixty six fish were collected with 5-in mesh gill nets sampling random wing dam structures during 22 net-days of gill net effort. The most abundantly collected species was Shovelnose Sturgeon (65 fish, 39.2% of total catch), followed by Blue Catfish (58 fish, 34.9%), and then Paddlefish (20 fish, 12.1%). Blue Catfish represented the largest proportion of the total collected biomass (1387.2 lb; 629.226 kg; 62.4% of the total collected biomass) followed by Paddlefish (267.5 lb; 121.3 kg; 12.0%), and Grass Carp (176.2 lb; 79.9 kg, 7.9%).

Analysis of the catch per net-night for the last two sampling seasons shows that Shovelnose Sturgeon captured in 2-in mesh gill nets was consistently the highest of the three mesh sizes (Figure 3.10).

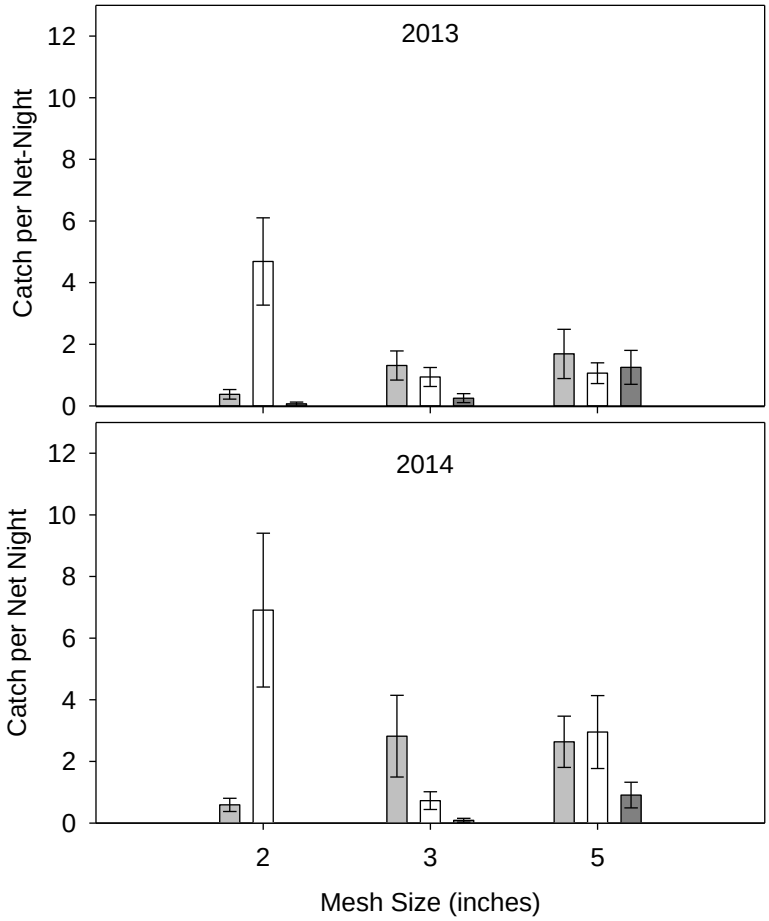

Figure 3.10. Mean catch per net-night of Shovelnose Sturgeon (white bars), Blue Catfish (light grey bars) and Paddlefish (dark grey bars) sampled in the Middle Mississippi River with 2-in, 3-in, and 5-in mesh gill nets from 2013 – 2014.

In the 2013 sampling season there were 48 net sets with 106 Shovelnose Sturgeon collected. In the 2014 sampling season there were 66 nets set, with 233 Shovelnose Sturgeon collected. In both 2013 and 2014, the catch per net night of Shovelnose Sturgeon in 3-in mesh nets was trivial relative to the 2-in mesh nets, and catch per net night of Shovelnose Sturgeon in the 5-in mesh nets was similar to, or greater than, the 3-in mesh nets.

Age analysis of pectoral fin rays from Shovelnose Sturgeon collected shows that the average age of fish collected was similar across the three sampling seasons (Figure 3.11). Ages of Shovelnose Sturgeon ranged between three and 22 years. The average age of Shovelnose Sturgeon collected during the 2012 sampling season was 12.6 ± 0.2 years. The average age of Shovelnose Sturgeon collected during the 2013 sampling season was 13.6 ± 0.4 years. The average age of Shovelnose Sturgeon collected from the 2014 sampling was 12.9 ± 0.2 years. The 3-in and 5-in mesh nets do not appear to be substantially altering the age distribution of Shovelnose Sturgeon collected, relative to the data from the 2-in mesh nets.

Conclusions and Sampling Modifications for Segment 27:

There is little evidence that continued sampling with 3-in mesh gill nets would expand the length or age distributions of the Shovelnose Sturgeon captured. As a result, we will no longer fish 3-in mesh gill nests in future segments. In segment 27, we will fish each site with one 2-in mesh gill net, and two 5-in mesh gill

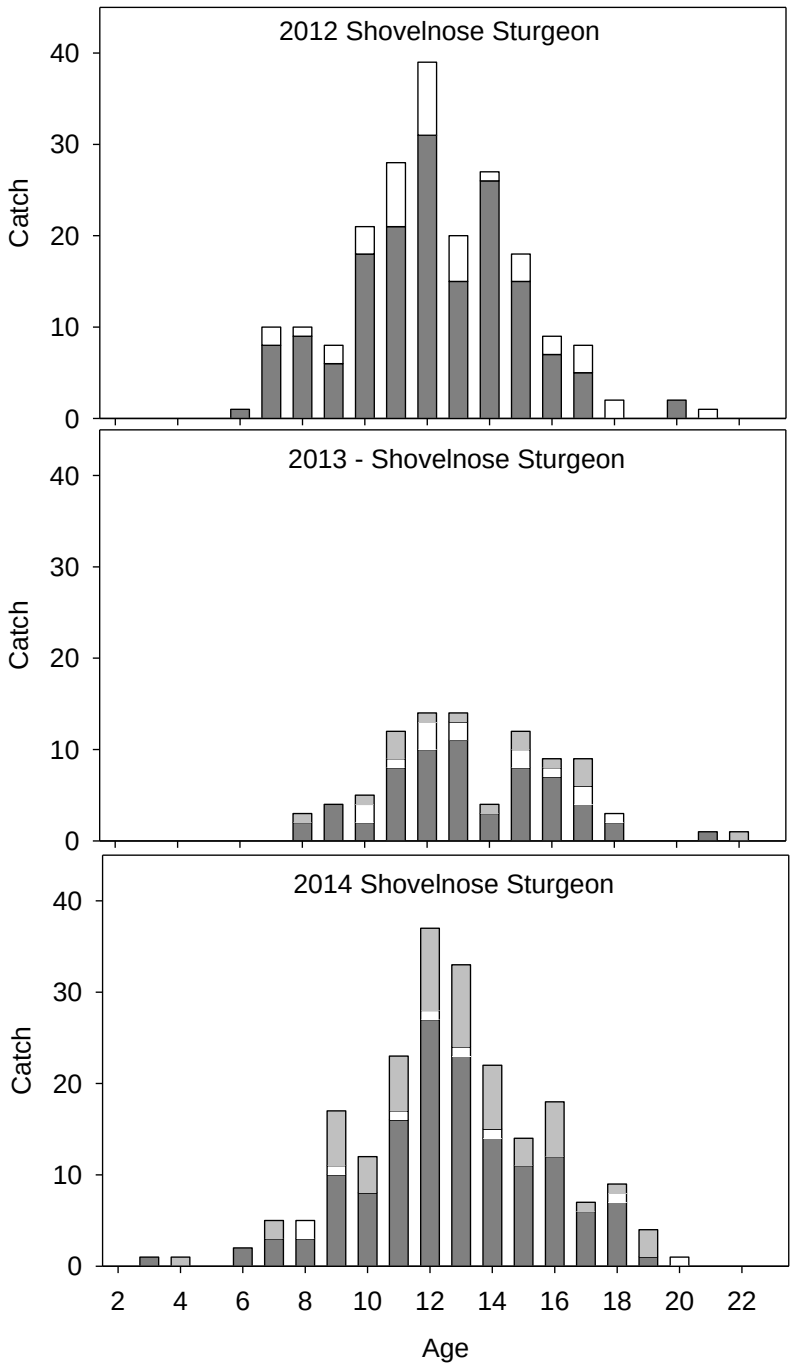

Figure 3.11. The age distribution (number captured by age) of Shovelnose Sturgeon sampled in the Middle Mississippi River from 2012-2014, with 2-in (dark grey bars), 3-in (white bars), and 5-in (light grey bars) mesh gill nets.

nets. This change should increase our capture rate of Blue Catfish and Paddlefish. Additionally, our sampling results will continue to be analyzed and reported as Middle Mississippi River catch and catch per net night (i.e., combined data from the Chain of Rocks and Kaskaskia reaches).

Section 3.5 - Assessment of Sportfish Harvest by Commercial Fishers in the Mississippi River

Tabulating catch data from all commercial fishing reports for 2013 has been completed. We have validated these data with QA/QC procedures and updated our commercial harvest data set with these data. The commercial harvest data set is being subdivided to allow analysis of harvest patterns at smaller spatial scales (i.e., river specific data). This work will continue into segment 27.

Section 3.6 – Erratum

Toward the end of the field season, the engine on the electrofishing boat used in East Alton broke down and we had to borrow other equipment to complete the work for this segment. Given the age of the hull on our electrofishing boat (over 25 years old), a decision was made to purchase a new electrofishing boat and engine. The DNR approved a transfer of unspent funds to allow for the purchase of a new electrofishing boat and engine. However, during the time that the University of Illinois was processing DNR approval letter and making the changes to the budget needed to complete the purchase, the vendor received orders from other customers with "cash in hand." By the time we were ready to place the order, the vendor was no longer able to complete construction of the new boat before the close of segment 26 (June 30, 2015). Therefore, the new electrofishing boat will have to be purchased during segment 27.

CHAPTER 4
SPORTFISH ASSESSMENTS ON THE IROQUOIS AND KANKAKEE RIVERS

Section 4.1 – 2014 Iroquois and Kankakee Rivers Ancillary Habitat Quality Data

The electrofishing surveys of the Iroquois and Kankakee Rivers, initiated in 2013, were continued during the 2014 season. All electrofishing was conducted at the fixed locations selected in 2013. These sites were selected using reach delineations defined by confluences of 2nd order streams with Iroquois and Kankakee main stems. A single site was chosen for each reach slightly upstream of these confluences. Not all sites could be sampled during all time periods due to logistics and equipment issues. It was not possible to sample the most upstream site on the Kankakee River, Site 25, during 2014. Site 25 was blocked from downstream access by a large log jam and from upstream access by sustained high water that prevented boat passage under State Line Bridge. However, the sustained high water did allow for access to sites not accessible to DC electrofishing during 2013. All 2014 Iroquois and Kankakee River sites (Figures 4.1 and 4.2) were sampled using standard boat mounted pulsed-DC electrofishing following the same protocols governing electrofishing on the larger rivers (Gutreuter et al. 1995).

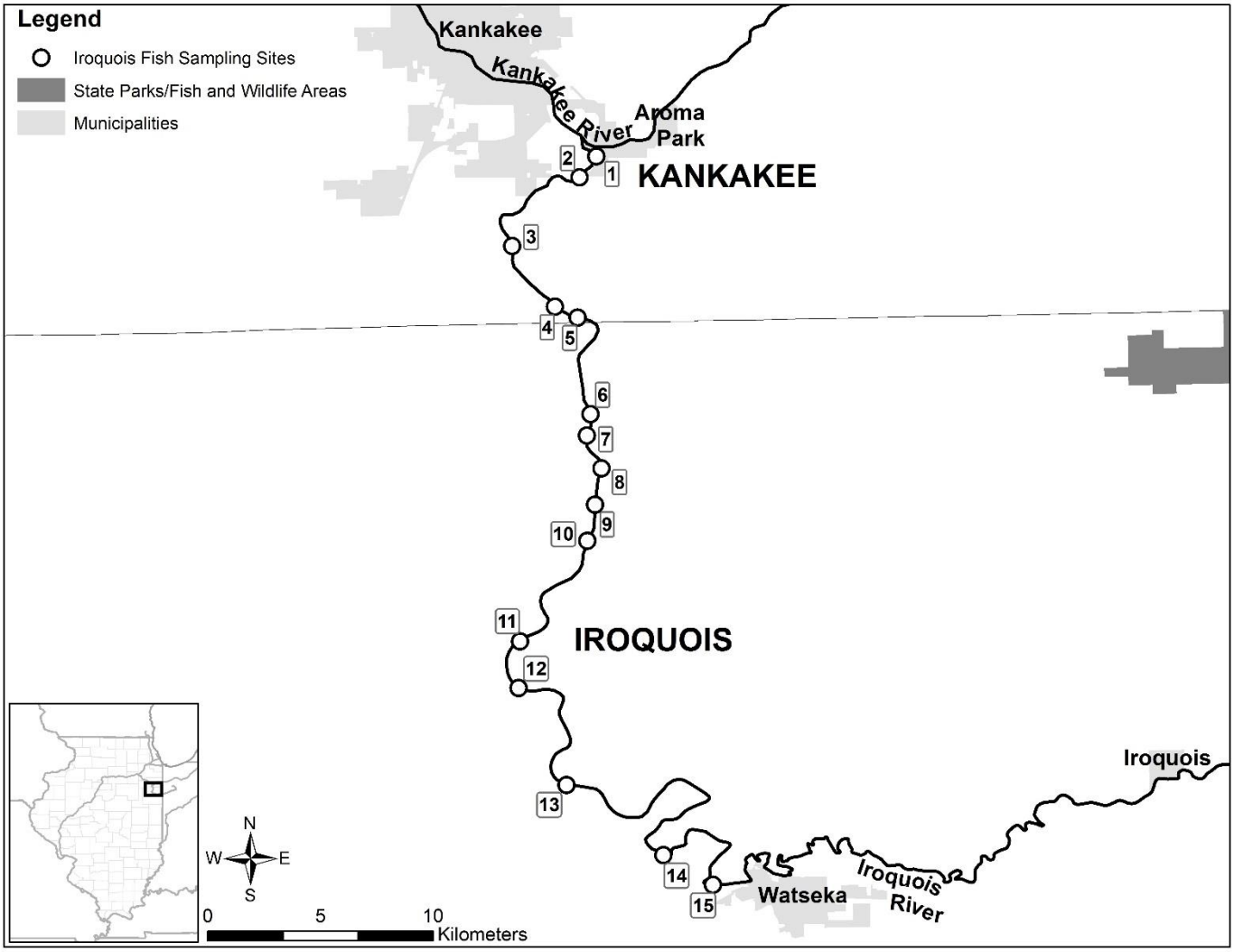

Figure 4.1. Map of the Iroquois River sites sampled by LTEF during 2014.

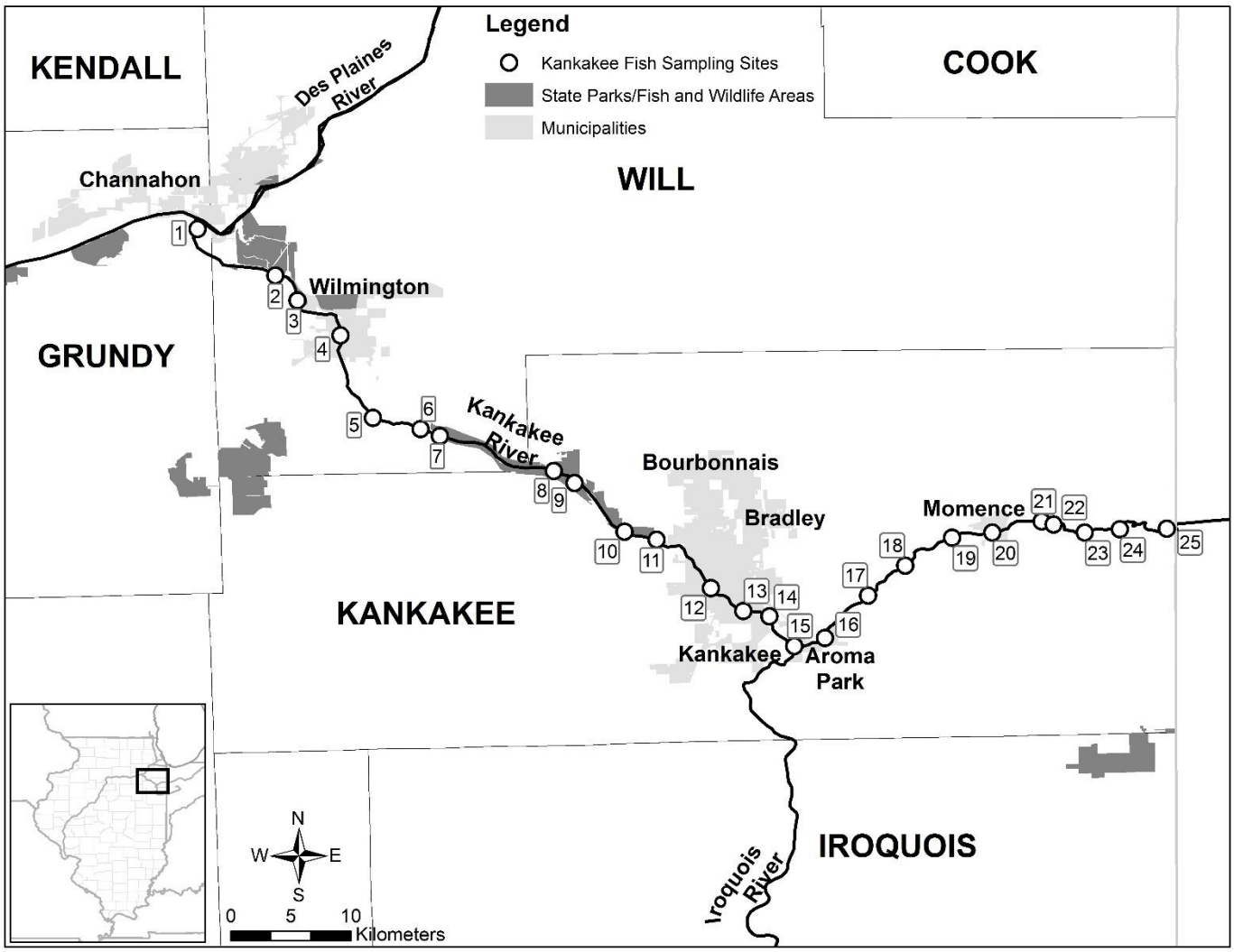

Figure 4.2. Map of the Kankakee River sites sampled by LTEF during 2014.

Two fish identification modifications were made in 2014 to improve accuracy. First, a code was instated for *Lepomis peltastes*, northern sunfish (NSF) based upon the 7th Edition (2013) of Common and Scientific Names of Fishes from the United States, Canada, and Mexico. This species was previously coded as *L. megalotis*, longear sunfish (LOS). This change resulted in no L. *megalotis* records for 2014. The second modification resulted from discussions with Illinois fish identification experts whom were confident *Cyprinella whipplei* (steelcolor shiner) were unlikely to be present in the Kankakee and Iroquois Rivers. Beginning in late time period 1 (7/14/2014) we undertook a more rigorous approach to the identification of *Cyprinella* species using pharyngeal teeth to help distinguish *C. spiloptera* (spotfin shiner), *C. lutrensis* (red shiner), and hybrids of the two species. This modification resulted in no *C. whipplei* recorded in time period 2 and 3, and a total of 93 red x spotfin hybrids.

Pulsed-DC electrofishing was conducted between 8:45 a.m. and 6:25 p.m. central standard time during the three time periods specified in Chapter 1. Physical measurements for ancillary water-quality parameters were collected at each site and are summarized in Table 4.1.

Table 4.1. Summary of ancillary water quality data collected during pulsed-DC electrofishing surveys of the Iroquois and Kankakee Rivers during 2014. Values are expressed as the mean observed parameter value ± standard error.

River	Total EF Effort (h)	DC EF Power Used (W)	Depth (ft)	Secchi Depth (in)	Water Temp (°C)	DO (mg/l)	Conductivity (µS/cm)	Stage Height (ft)
Iroquois	8.50	4288.2 ± 133.9	4.5 ± 0.3	12.1 ± 0.6	19.4 ± 0.8	6.6 ± 0.2	528.4 ± 14.9	6.9 ± 0.3
Time Period 1	3.75	4846.0 ± 206.1	4.5 ± 0.2	10.7 ± 0.7	22.7 ± 0.3	5.6 ± 0.2	582.3 ± 18.5	6.8 ± 0.4
Time Period 2	1.00	4200.0 ± 163.3	6.6 ± 0.5	12.6 ± 3.6	23.8 ± 0.4	-	503.5 ± 37.8	5.9 ± 1.1
Time Period 3	3.75	3754.0 ± 95.4	4.0 ± 0.5	13.2 ± 0.6	14.8 ± 0.5	7.6 ± 0.1	481.1 ± 19.6	7.4 ± 0.5
Kankakee	15.75	4367.8 ± 86.4	3.1 ± 0.2	25.8 ± 1.8	19.1 ± 0.6	7.9 ± 0.3	559.6 ± 9.4	2.5 ± 0.1
Time Period 1	5.75	4660.0 ± 111.2	3.5 ± 0.3	26.7 ± 3.7	21.9 ± 0.3	6.0 ± 0.3	596.2 ± 12.5	2.6 ± 0.1
Time Period 2	3.00	5141.2 ± 154.9	2.9 ± 0.4	23 ± 2.8	24.6 ± 0.5	-	617.5 ± 19.4	1.7 ± 0.2
Time Period 3	7.00	3796.4 ± 44	3.0 ± 0.2	26.2 ± 2.4	14.4 ± 0.4	9.2 ± 0.1	504.8 ± 9.0	2.8 ± 0.1

Section 4.2 – 2014 Iroquois River Electrofishing Catch Statistics

We collected 2,643 fishes representing 50 species from 10 families during 8.5 hours of pulsed-DC electrofishing at 34 sites on the Iroquois River. Spotfin shiner was the most abundant species (1,162 fish; 44% of total catch), followed by steelcolor shiner (218; 8%), orangespotted sunfish (162; 6%), and bullhead minnow (80; 3%). Common carp contributed the greatest biomass of fishes collected (383.8 lb; 28% of total collected biomass), followed by bigmouth buffalo (169.2 lb; 12%), black buffalo (163.9 lb; 12%), channel catfish (155.9 lb; 11%), and smallmouth buffalo (127.7 lb; 9%). Detailed records for the abundance and biomass of fish captured during each time period are included in Appendices XI and XII.

Threatened and Endangered Species

Five river redhorse (Illinois State Threatened) and three blackside darter (Federally Threatened) were collected during 2014 Iroquois River main stem sampling (Appendix XI).

Section 4.3 – 2014 Kankakee River Electrofishing Catch Statistics

We collected 7,028 fishes representing 68 species from 14 families during 14 hours of pulsed-DC electrofishing at 56 sites on the Kankakee River. Spotfin shiner was the most abundant species (1,933 fish; 27% of total catch), followed by shorthead redhorse (526; 7%), and smallmouth bass (418; 6%). Common carp contributed the greatest biomass of fishes collected (1,243.2 lb; 3% of total collected biomass), followed by channel catfish (665.8 lb; 14%), and golden redhorse (594.2 lb; 13%). Detailed records for the abundance and biomass of fish captured during each time period are included in Appendices XI and XII.

Threatened and Endangered Species

Five pallid shiner (Illinois State Endangered), 48 blacknose shiner (Illinois State Endangered), 24 river redhorse (Illinois State Threatened), and 15 blackside darter (Federally Threatened) were collected during 2014 Kankakee River main stem sampling (Appendix XI).

Sportfish

Although it is difficult to provide any robust assessment of the status of sportfish populations in these tributaries from only two years of data, catch rates of many popular sportfishes (i.e., Largemouth Bass and Smallmouth Bass, White Crappie and Black Crappie, Channel Catfish, and Walleye) were higher in the Kankakee and Iroquois Rivers than in other rivers we sampled during 2014. Additional research in these streams will be necessary to determine if these and other tributaries do, in fact, support or contribute to robust sportfish populations in Illinois largest watersheds (Pracheil et al. 2009; Pracheil et al. 2013).

Section 4.4 - Summary of Decigram-Accurate Weights in the Kankakee and Iroquois Rivers

Weighing small fish with one gram precision produces variable and often inaccurate results. A pilot study was initiated to weigh small fish with decigram precision. These results will be used to develop

length-weight regressions. Data from subsequent field seasons will be used to validate and increase the accuracy of regressions. Accurate estimates of biomass can be used to better depict structural changes within an assemblage due to the extreme size differences within and among species (Cohen, Jonsson & Carpenter 2003), the more stochastic nature of abundance (Minns, Kelso & Randall 1996), and evidence that biomass is more closely tied to ecosystem functioning (Carey & Wahl 2011). If these regressions prove robust, weights can be estimated for previous fish collections and allow for novel use of existing data, something not possible with batch weights. Moreover, weighing small fish in the field may be rendered unneccesary following regression validation (e.g. game fish 50-200mm), reducing time spent processing fish specimens.

During the 2014 field season 2,190 decigram precise weights were taken on fish ranging from 19 to 256mm within the Kankakee and Iroquois Rivers. The precise weights encompass 12 families, 51 species, and two hybrids (Appendix XIII). The mean weight for small fish was 10.93g. The smallest weight obtained was 0.09g and the largest weight was 137.53g.

CHAPTER 5
CONCLUSIONS

Fish monitoring conducted on the Illinois and Mississippi Rivers during 2014 was useful for describing the diversity and heterogeneity of fish communities in large Midwestern Rivers. Additional sampling in the Iroquois and Kankakee Rivers has also provided fresh insights into the unique structure of fish communities in major tributaries of Illinois' large rivers. Catch rates and species richness varied greatly among rivers, among reaches within each river, and among sampling periods. However, any analysis of annual variations in species richness or catch rates should consider the effects of abiotic and biotic factors known to affect the capture efficiency of a specific type of fishing gear (Yuccoz *et al.* 2001). Much of Illinois experienced substantial flooding during 2014 (NCDC 2014)—during Periods 1 and 3 of DC sampling, and all of AC sampling—and it is possible that the capture efficiency of our sampling gears was altered in some way by the unusual climatic conditions, such as extremely high/low water levels and subsequent changes in water velocity and water clarity. Nonetheless, we are confident that our current and future efforts to operate a wide-ranging, well-standardized fish monitoring survey of Illinois' largest river systems will contribute to a more comprehensive and nuanced understanding of the spatial and temporal dynamics of fish communities in our state. Although the capture efficiency of our gears may be highly variable among the different biological and environmental conditions encountered in our surveys, our observations of spatial and temporal changes in the relative abundance of some fish species in relation to both localized and large-scale environmental changes may comprise a substantial contribution to our collective intimations of the complexity of large river ecosystems (*sensu* Dodds *et al.* 2012). Inter-annual variations in the relative abundance of important forage species, like gizzard shad, or popular sportfish species, like Largemouth Bass and Channel Catfish, may be related to some combination of timely hydrologic events, broader aquatic community dynamics, and the implementation of fisheries and water-quality management directives. Our ability to effectively detect such changes is dependent upon the collection of fisheries data during additional years' sampling efforts. Our current and previous efforts are forming the basis for more comprehensive and robust analyses that will, hopefully, contribute to the development of more effective and sustainable management policies for the rivers of Illinois.

Sportfish

Catch rates and sizes of popular sportfish species varied greatly among the rivers and reaches sampled during 2014. Collections of black bass species were greatest in the Upper Illinois Waterway. Catch rates of Black Crappie and White Crappie were very low among all reaches sampled during 2014. Our observations of the tremendous annual variation observed in the relative abundance and size distribution of many sportfish species should serve as a catalyst for future research investigating the effects environmental change and management policy on the health and sustainability of Illinois sportfishes.

Invasive Species

Although the main focus of F-101-R programs are to conduct monitoring to improve our understanding of population dynamics, life histories, and habitat requirements of recreationally fished species, the programs sampling strategies may also be useful for documenting trends in the relative abundance of non-native species occupying Illinois large river ecosystems. However, we advise that researchers use caution when interpreting the data we collect on invasive species as our sampling protocols (i.e., restriction to main-channel habitats) may limit our probability of encountering the greatest densities of the species in some instances. Our monitoring and analyses indicate densities of Silver Carp are greatest in the Lower Illinois River and that body condition of Silver Carp was highest in the lower Mississippi River Sampling Areas. Directed sampling using netting gears in addition to electrofishing in backwater and side-channel habitats may be required to collect sufficient sample sizes of silver carp for inter-annual and spatial comparisons of body condition.

LITERATURE CITED

Arnold, J.L., T.M. Koel, and R.E. Sparks. 2000. The long-term Illinois River fish population monitoring program. Project F-101-R-11 Annual Report. Center for Aquatic Ecology Technical Report 00/05. Illinois Natural History Survey, Champaign. 36 pp.

Blazer, V. S., L.R. Iwanowicz, H. Henderson, P.M. Mazik, J.A. Jenkins, D.A. Alvarez, and J.A. Young. 2012. Reproductive endocrine disruption in smallmouth bass (Micropterus dolomieu) in the Potomac River basin: spatial and temporal comparisons of biological effects. *Environmental Monitoring and Assessment* 184:4309-4334.

Bolgrien, D.W., T.R. Arnold, E.W. Schweiger, J.R. Kelly. 2005. Contemplating the assessment of great river ecosystems. *Environmental Monitoring and Assessment* 103:5-20.

Burkhardt, R.W. and Gutreuter, S. 1995. Improving electrofishing catch consistency by standardizing power. *North American Journal of Fisheries Management* 15:375-381.

Carey, M.P. and Wahl, D.H. 2011. Determining the mechanism by which fish diversity influences production. *Oecologia,* **167,** 189-198.

Cohen, J.E., Jonsson, T. and Carpenter, S.R. 2003. Ecological community description using the food web, species abundance, and body size. *Proceedings of the National Academy of Sciences,* **100,** 1781-1786.

Dolan, C.R. and Miranda, L.E. 2004. Injury and mortality of warmwater fishes immobilized by electrofishing. *North American Journal of Fisheries Management* 24:118-127.

Dodds, W.K., C.T. Robinson, E.E. Gaiser, G.J.A. Hansen, H. Powell, J.M. Smith, N.B. Morse, S.L. Johnson, S.V. Gregory, T. Bell, T.K. Kratz, and W.H. McDowell. 2012. Surprises and insights from long-term aquatic data sets and experiments. *BioScience* 62(8):709-721.

Hurvich, C.M. and Tsai, C.-L. 1989. Regression and time series model selection in small samples. Biometrika 76: 297–307.

Kellock, K.A., B.E. Trushel, P.C. Ely, C.A. Jennings, and R.B. Bringolf. 2014. Survey of intersex Largemouth Bass from impoundments in Georgia USA. *Transactions of the American Fisheries Society* 143:565-572.

Kennedy, A.J., D.J. Daughtery, T.M. Sutton, B.E. Fisher. 2007. Population characteristics of Shovelnose Sturgeon in the upper Wabash River, Indiana. *North American Journal of Fisheries Management* 27: 52-62.

Koel, T.M., R.E. Sparks, K.D. Blodgett, and S.D. Whitney. 1997. The long-term Illinois River fish population monitoring program (F-101-R-8). Annual Report to the Illinois Department of Natural Resources. Aquatic Ecology Technical Report 97/14. Illinois Natural History Survey, Champaign. 35 pp.

Koel, T.M., R.E. Sparks, and K.D. Blodgett. 1998. The long-term Illinois River fish population monitoring program. Project F-108-R-9 Annual Report. Center for Aquatic Ecology Technical Report 98/8. Illinois Natural History Survey, Champaign. 35 pp.

Koel, T.M., and R.E. Sparks. 1999. The long-term Illinois River fish population monitoring program (F-101-R). Final Report to the Illinois Department of Natural Resources. Aquatic Ecology Technical Report 99/15. Illinois Natural History Survey, Champaign. 60 pp.

Irons, K.S., G.G Sass, M.A. McClelland, and T.M. O'Hara. 2011. Bigheaded carp invasion of the La Grange Reach of the Illinois River: Insights from the Long Term Resource Monitoring Program. Pages 31-50 *in* D.C. Chapman and M.H. Hoff, editors. *Invasive Asian carps in North America*. American Fisheries Society, Symposium 74, Bethesda, Maryland.

Lerczak, T.V., R.E. Sparks, and K.D. Blodgett. 1993. The long-term Illinois River fish population monitoring program (F-101-R). Annual Report to the Illinois Department of Conservation. Aquatic Ecology Technical Report 93/3. Illinois Natural History Survey, Champaign. 76 pp.

Lerczak, T.V. and R.E. Sparks. 1994. Fish populations in the Illinois River. Pages 239-241 *in* K.P. Pabich, editor. *The changing Illinois environment: critical trends, volume 3, ecological resources*. ILENR/RE-EA-95/05. Illinois Department of Energy and natural Resources, Springfield.

Lerczak, T.V., and R.E. Sparks, and K.D. Blodgett. 1994. The long-term Illinois River fish population monitoring program (F-101-R). Final Report to the Illinois Department of Conservation. Aquatic Ecology Technical Report 94/5. Illinois Natural History Survey, Champaign. 105 pp.

Lerczak, T.V., R.E. Sparks, and K.D. Blodgett. 1995. The long-term Illinois River fish population monitoring program (F-101-R-6). Annual Report to the Illinois Department of Conservation. Aquatic Ecology Technical Report 95/4. Illinois Natural History Survey, Champaign. 38 pp.

Lerczak, T.V., R.E. Sparks, and K.D. Blodgett. 1996. The long-term Illinois River fish population monitoring program (F-101-R-7). Annual Report to the Illinois Department of Natural Resources. Aquatic Ecology Technical Report 96/2. Illinois Natural History Survey, Champaign. 38 pp.

McClelland, M.A. and G.G. Sass. 2010. The long-term Illinois River fish population monitoring program. Project F-101-R-21 Annual Report to the Illinois Department of Natural Resources. Illinois Natural History Survey Technical Report 2010(28). University of Illinois, Institute of Natural Resource Sustainability, Illinois Natural History Survey, Champaign. 80 pp.

McClelland, M.A. and G.G. Sass. 2009. The long-term Illinois River fish population monitoring program. Project F-101-R-20 Annual Report to the Illinois Department of Natural Resources. Illinois Natural History Survey Technical Report 2009(7). University of Illinois, Institute of Natural Resource Sustainability, Illinois Natural History Survey, Champaign. 56 pp.

McClelland, M.A. and G.G. Sass. 2008. The long-term Illinois River fish population monitoring program. Project F-101-R-19 Annual Report to the Illinois Department of Natural Resources. Illinois Natural History Survey Technical Report 2008(10). Illinois Natural History Survey, Champaign. 57 pp.

McClelland, M.A. and G.G. Sass. 2007. The long-term Illinois River fish population monitoring program. Project F-101-R-18 Annual Report to the Illinois Department of Natural Resources. Illinois Natural History Survey Technical Report 2007(24). Illinois Natural History Survey, Champaign. 53 pp.

McClelland, M.A. and T.R. Cook. 2006. The long-term Illinois River fish population monitoring program. Project F-101-R-17 Annual Report to the Illinois Department of Natural Resources. Center for Aquatic Ecology Technical Report 06/3. Illinois Natural History Survey, Champaign. 54 pp.

McClelland, M.A. and M.A. Pegg. 2005. The long-term Illinois River fish population monitoring program. Project F-101-R-16 Annual Report to the Illinois Department of Natural Resources. Center for Aquatic Ecology Technical Report 05/8. Illinois Natural History Survey, Champaign. 50 pp.

McClelland, M.A. and M.A. Pegg. 2004. The long-term Illinois River fish population monitoring program. Project F-101-R-15 Final Report to the Illinois Department of Natural Resources. Center for Aquatic Ecology Technical Report 04/3. Illinois Natural History Survey, Champaign. 82 pp.

McClelland, M.A. and M.A. Pegg. 2003. The long-term Illinois River fish population monitoring program. Project F-101-R-14 Annual Report to the Illinois Department of Natural Resources. Center for Aquatic Ecology Technical Report 03/5. Illinois Natural History Survey, Champaign. 48 pp.

McClelland, M.A. and M.A. Pegg. 2002. The long-term Illinois River fish population monitoring program. Project F-101-R-13 Annual Report to the Illinois Department of Natural Resources. Center for Aquatic Ecology Technical Report 02/5. Illinois Natural History Survey, Champaign. 46 pp.

McClelland, M.A. and M.A. Pegg. 2001. The long-term Illinois River fish population monitoring program. Project F-101-R-12 Annual Report to the Illinois Department of Natural Resources. Center for Aquatic Ecology Technical Report 01/5. Illinois Natural History Survey, Champaign. 35 pp.

McClelland, M.A., G.G. Sass, T.R. Cook, K.S. Irons, N.M. Michaels, T.M. O'Hara, and C.S. Smith. 2012. The Long-term Illinois River Fish Population Monitoring Program. *Fisheries* 37(8):340-350.

McClelland, M.A., K.S. Irons, G.G. Sass, T.M. O'Hara, and T.R. Cook. 2013. A comparison of two electrofishing programmes used to monitor fish on the Illinois River, Illinois, USA. *River Research and Applications* 29: 125-133.

Michaels, N.N., S. Tyszko, M.A. McClelland, and G.G. Sass. 2011. The long-term Illinois, Mississippi, Ohio, and Wabash river fish population monitoring program. Project F-101-R-22 Annual Report to the Illinois Department of Natural Resources. Prairie Research Institute Technical Report 23. Illinois Natural History Survey, Champaign. 110 pp.

Minns, C.K., Kelso, J.R. & Randall, R.G. 1996. Detecting the response of fish to habitat alterations in freshwater ecosystems. *Canadian Journal of Fisheries and Aquatic Sciences,* **53,** 403-414.

Moody-Carpenter, C.J. 2013. Demographics of a commercially exploited population of flathead catfish (*Pylodictis olivaris*) in the Wabash River. Master's Thesis. Paper 1224.

National Climatic Data Center (NCDC). 2014. Record of climatological observations. http://www.ncdc.noaa.gov/temp-and-precip/drought/historical-palmers.php. Accessed May 5, 2014.

Neumann, R.M., and M.S. Allen. 2007. Size Structure. Pages 375-421 in C.S. Guy and M.L. Brown, editors. *Analysis and interpretation of freshwater fisheries data*. American Fisheries Society, Bethesda, Maryland.

Page, L.M., H. Espinosa-Pérez, L.T. Findley, C.R. Gilbert, R.N. Lea, N.E. Mandrak, R.L. Mayden, J.S. Nelson. 2013. *Common and scientific names of fishes from the United States, Canada, and Mexico, 7th edition*. American Fisheries Society, Special Publication 34, Bethesda, Maryland.

Pracheil, B.M., M.A. Pegg, and G. E. Mestl. 2009. Tributaries influence recruitment of fish in large rivers. Ecology of Freshwater Fish 18:603-609.

Pracheil, B.M., P.B. McIntyre, and J.D. Lyons. 2013. Enhancing conservation of large-river biodiversity by accounting for tributaries. Frontiers in Ecology and the Environment 11:124-128.

Reynolds, J.B. 1996. Electrofishing. Pages 221-253 in B.R. Murphy and D.W. Willis, editors, *Fisheries techniques*, 2nd edition. American Fisheries Society, Bethesda, Maryland.

Reynolds, J.B. and Holliman, F.M. 2000. Guidelines for assessment and reduction of electrofishing-induced injuries in trout and salmon. Pages 235-240 in D.Schill, editor, *Management in the new millennium: are we ready?* Proccedings of Wild Trout VII Symposium. Yellowstone National Park. October 1-4, 2000.

Snyder, D.E. 2003. Electrofishing and its harmful effects on fish. U.S. Geological Survey, Biological Resources Division Information and Technology Report USGS/BRD/ITR-2003–0002, U.S. Government Printing Office, Denver.

Sparks, R.E. 1977. Environmental inventory and assessment of navigation pools 24, 25, and 26, Upper Mississippi and lower Illinois Rivers: an electrofishing survey of the Illinois River, Special Report No. 5 Water Resources Center, University of Illinois, Urbana. 82 pp.

Sparks, R.E. and W.C. Starrett. 1975. An electrofishing survey of the Illinois River, 1959-1974. Illinois Natural History Survey Bulletin 31:317-380.

Sparks, R.E. and T.V. Lerczak. 1993. Recent trends in the Illinois River indicated by fish populations. Aquatic Ecology Technical Report 93/16. Illinois Natural History Survey, Champaign. 34 pp.

Theiling, C. 1999. The Illinois River. Chapter 14 in *Ecological status and trends of the Upper Mississippi River system 1998: a report of the Long Term Resource Monitoring Program*. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin. LTRMP 99-T001. 236 pp.

Tyszko, S.M., N.M. Michaels, B.J. Lubinski, T.W. Edison, J.E. Epifanio, J.H. Chick, Y. Cao, and G.G. Sass. 2012. The long-term Illinois, Mississippi, Ohio, and Wabash river fish population monitoring program. Project F-101-R-23 Annual Report to the Illinois Department of Natural Resources. Prairie Research Institute Technical Report 22. Illinois Natural History Survey, Champaign. 121 pp.

U.S. Fish and Wildlife Service. 2005. Biological procedures and protocol for collecting, tagging, sampling, holding, culture, transporting, and data recording for researchers and managers handling pallid sturgeon. Pallid Sturgeon Recovery Team Leader, U.S. Fish and Wildlife Service, 2900 4th Ave North, Suite 301 Billings, Montana.

Yuccoz, N.G., J.D. Nichols, and T. Boulinier. 2001. Monitoring of biological diversity in space and time. *Trends in Ecology and Evolution* 16(8): 446-453.

Appendix I. Reaches and pools sampled by LTEF pulsed-DC electrofishing surveys during 2014 with the upstream and downstream limits (RM), the number of sampling locations within each study area (N), and the locations of the USGS gauges used to record stage height in each study area are included in ascending (downstream to upstream) order.

River	Reach/Pool	Downstream	Upstream	N	Gage
Illinois	Alton	0.0	80.0	45	Florence, IL
	Peoria	158.0	231.0	44	Henry, IL
	Starved Rock	231.0	247.0	9	Ottawa, IL
	Marseilles	247.0	271.5	18	Morris, IL
Des Plaines	Dresden	271.5	286.0	9	Brandon Rd Lock and Dam
Kankakee				63	
Iroquois				34	
Mississippi	Kaskaskia Confluence	117.0	165.5	30	Chester, IL or Brickeys, MO
	Chain of Rocks	165.5	200.5	21	Saint Louis, MO
	Pool 25	242.0	273.5	18	Mosier Landing, IL
	Pool 20	343.0	364.5	12	Gregory Landing, MO
	Pool 19	364.5	410.5	27	Fort Madison, IA
	Pool 16	457.0	483.0	15	Fairport, IA

Appendix II. Station information and characteristics during AC electrofishing sampling during 2014. All stations, except where noted, are on the Illinois River and are listed in downstream-to-upstream order. Site miles are the average river mile and refer to Figure 2.1.

Sampling			River Mile	End time	Duration	Temp (°F)		DO		Secchi	Cond.	Vel.	Depth (ft)		Stage[b]
Order	Date	Name	mean[a]	(CST)	(min)	air	water	(ppm)	(%Sat.)	(in)	(µmhos)	(ft/s)	min	max	(ft)
Reach 26, Mississippi River															
19	30-Sep	Brickhouse Slough	205.1	11:45 AM	60	74.0	75.4	9.8	120.5%	9.1	340	0.0	2.0	6.5	
Alton Reach															
20	27-Sep	Mortland Island	18.8	2:55 PM	55	74.0	72.7	6.1	75.0%	8.3	672	1.0	1.0	12.5	5.3*
21	27-Sep	Dark Chute	25.0	5:00 PM	60	74.0	72.5	6.4	78.7%	7.9	649	0.9	1.5	8.6	5.2*
23	27-Sep	Hurricane Island	27.5	12:40 PM	60	70.0	71.8	6.1	72.1%	7.9	696	1.1	2.0	11.0	5.0*
22	27-Sep	Crater-Willow Island	30.0	10:39 AM	60	58.0	71.4	6.2	64.5%	9.4	696	1.0	1.5	9.5	5.0*
17	29-Sep	Big Blue Island	58.5	10:47 AM	60	69.0	70.9	6.5	76.1%	8.3	614	1.0	3.0	11.5	5.5*
18	29-Sep	Moore's Towhead	75.3	1:45 PM	60	78.0	72.3	6.7	85.6%	9.1	701	0.3	1.0	9.7	5.5*
La Grange Reach															
28	6-Oct	Grape-Bar Islands	86.4	12:35 PM	60	63.0	59.9	6.7	73.6%	5.5	604	1.5	4.0	12.5	12.3*
27	6-Oct	Sugar Creek Island	94.8	10:29 AM	60	48.0	60.4	6.9	63.5%	7.1	698	1.6	2.5	11.0	12.3*
26	3-Oct	Lower Bath Chute	107.1	10:39 AM	40	56.0	68.2	5.6	56.9%	9.1	685	0.9	2.5	10.0	6.7*
25	3-Oct	Upper Bath Chute	113.0	8:55 AM	60	52.0	69.4	6.1	59.1%	9.4	746	0.8	2.5	11.9	6.7*
24	2-Oct	Turkey Island	148.2	10:04 AM	39	66.0	70.9	6.6	74.9%	13.4	794	1.0	1.5	9.5	4.2*
16	26-Sep	Pekin	154.9	11:35 AM	60	60.0	71.1	7.4	78.7%	10.2	734	0.7	1.0	7.5	434.5*
Peoria Reach															
14	25-Sep	Lower Peoria Lake	163.6	10:50 AM	60	65.0	66.9	5.1	57.3%	8.7	704	0.0	1.0	3.5	11.8
15	25-Sep	Peoria Islands[c]	170.4	2:12 PM	60	75	72.32	7.1	88.1%	8.661	697	0.0	0.5	4.5	11.8
12	24-Sep	Chillicothe	180.9	10:00 AM	50	55.0	67.3	7.3	73.3%	10.6	731	1.0	1.5	9.7	15.0
13	24-Sep	Henry Island	193.9	1:05 PM	60	71.0	67.5	7.9	94.3%	13.8	745	1.1	1.0	10.5	15.0
11	23-Sep	Lower Twin Sister	202.8	1:18 PM	60	68.0	67.8	8.1	93.8%	17.7	745	1.1	1.0	9.5	15.4
10	23-Sep	Upper Twin Sister	203.4	11:17 AM	60	65.0	67.1	7.5	84.2%	18.1	746	0.9	1.0	7.5	15.4
9	22-Sep	Hennepin	207.9	2:40 PM	60	65.0	67.8	7.6	85.3%	16.9	746	1.2	1.0	8.5	15.7*
8	22-Sep	Clark Island	215.3	11:50 AM	60	56.0	67.3	7.9	80.3%	18.1	738	1.1	1.5	11.4	12.9*
Starved Rock Reach															
2	8-Sep	Bulls Island	240.7	2:09 PM	60	76.0	79.7	6.3	79.0%	17.7	748	0.1	1.0	5.7	459.5
1	8-Sep	Bulls Island Bend	241.4	12:08 PM	60	68.0	78.3	7.0	81.1%	19.3	743	1.0	1.5	9.4	459.5
Marseilles Reach															
4	18-Sep	Ballards Island	248.0	1:46 PM	60	65.0	68.4	7.4	83.1%	12.6	689	0.2	1.0	4.5	6.6
3	18-Sep	Johnson Island	249.8	12:03 PM	40	64.0	66.7	8.0	88.9%	13.4	636	1.0	1.5	6.5	6.6
5	18-Sep	Waupecan Island	260.7	4:35 PM	60	73.0	68.4	8.1	98.6%	13.4	692	1.0	1.5	8.5	6.6
Dresden Reach, Des Plains River															
6	19-Sep	Du Page River	277.3	9:15 AM	60	52.0	68.0	7.2	69.7%	36.6	921	0.1	1.5	8.5	505.1
7	19-Sep	Treats Island	279.9	11:40 AM	50	64.0	69.1	7.4	82.2%	28.3	915	0.2	0.5	4.0	505.1

[a]Refers to approximate average river mile electrofished at each site, 1957-2013.

[b]Feet above sea level or river stage (ft) at the U.S. Army Corps of Engineers river gage nearest to the sampling site.

[c]New site introduced to replace Lambie's Boat Harbor site (RM 170.6) that became inaccessable as a result of excessive sedimentation associated with 2013 flooding

*Sampling was conducted when river stage exceeded established low-water criteria

Appendix III. Numbers of each fish species collected using AC electrofishing at standardized locations in the Lower Illinois River (Alton and LaGrange Reaches, RM 0-158) during 2014.

		Mississippi R.	Lower Illinois River											
Family	River Mile	205.1	19.0	24.7	26.8	30.0	58.3	75.3	86.5	95.1	107.1	113.0	148.0	155.1
Species	Effort (min)	60	55	60	60	60	60	60	60	60	40	60	39	60
Atherinidae														
Brook Silverside					1					4				
Catastomidae														
Bigmouth Buffalo			4	1	2	3				3	1	3	1	1
Black Buffalo				1										
Golden Redhorse							1							1
Quillback												1		
River Carpsucker					1	1		4	1	3		1		3
Shorthead Redhorse			1	1			1	1				2	3	
Smallmouth Buffalo		4	2	6	4	4	3	6			1	5	4	
Centrarchidae														
Black Crappie				2						3		4		
Bluegill		4	2		2	1		2		4		4	3	
Green Sunfish		2											1	
Largemouth Bass		4		1	1					1		1		
Orangespotted Sunfish		4	9	3	3	2	2	4	1	4		12		
White Crappie								1		1				
Clupeidae														
Gizzard Shad		42	16	4	3	9	6	16		6	17			24
Skipjack Herring								5				2		4
Threadfin Shad								1		1	1			
Cyprinidae														
Bullhead Minnow		1	1	8	2	2	1	2	1	2	5	1	10	1
Common Carp			2	4		3	5	2	3	4	24	5	3	4
Common Carp x Goldfish		5												2
Emerald Shiner		3	15	5	6	7	13	17	14	19	17	5	23	5
Goldfish								2						
Grass Carp		11			1			1			1		1	
Red Shiner						1	3				2	1		
River Shiner		2	2				4			1			1	
Sand Shiner														2
Silver Carp		8	18	8	6	14	11	10	6	24	9	43	4	21
Silver Chub													3	1
Spotfin Shiner		2								1				
Spottail Shiner											1		4	
Esocidae														
Grass Pickerel								1						
Hiodontidae														
Goldeye										1				

Appendix III (continued). Numbers of each fish species collected using AC electrofishing at standardized locations in the Lower Illinois River (Alton and LaGrange Reaches, RM 0-158) during 2014.

		Lower Illinois River												
Family	River Mile	0.0	19.0	24.7	26.8	30.0	58.3	75.3	86.5	95.1	107.1	113.0	148.0	155.1
Species	Effort (min)	60	55	60	60	60	60	60	60	60	40	60	39	60
Ictaluridae														
Blue Catfish							1							
Channel Catfish		3	7	26	12	20	3	9	2	3	3	16	2	1
Flathead Catfish		1		1	2						4	2		
Yellow Bullhead							1						6	
Lepisosteidae														
Shortnose Gar				1										
Moronidae														
White Bass			5	17	14	3	4	13		2	1	3	1	2
Yellow Bass										1		1		
Percidae														
Johnny Darter						1								
Sauger									2				1	
Poeciliidae														
Western Mosquitofish			1		2						2			2
Sciaenidae														
Freshwater Drum		2	18	55	15	30	10	128	28	24	15	25	39	7
Total Individuals		98	103	144	77	101	69	225	58	112	104	137	110	81
Total species/hybrids		16/1	15/0	17/0	17/0	15/0	16/0	19/0	9/0	21/0	16/0	20/0	18/0	16/1

Appendix III (continued). Numbers of each fish species collected using AC electrofishing at standardized locations in the Lower Illinois River (Peoria Reach, RM 158-231) during 2014.

		Lower Illinois River							
Family	River Mile	163.4	166.0	180.6	193.8	202.8	203.3	207.7	215.3
Species	Effort (min)	60	60	50	60	60	60	60	60
Amiidae									
Bowfin						1		1	
Catastomidae									
Bigmouth Buffalo		19		3	1	2	5	8	
Golden Redhorse								1	
River Carpsucker		6	11			1	1		3
River Redhorse*					1				
Shorthead Redhorse		1			1	1	2		5
Smallmouth Buffalo		3		1	11	11	13	7	5
Centrarchidae									
Black Crappie		3	3			3	3	7	1
Bluegill		109	135	27	13	11	20	10	11
Bluegill x Green Sunfish		5	3						
Green Sunfish		33	6		3		1	1	
Largemouth Bass		34	34	4		1	2	9	
Longear Sunfish			1						
Northern Sunfish			1						
Orangespotted Sunfish		8	3	12	49	1		28	9
Smallmouth Bass		2	1		1			2	3
Warmouth			1						
White Crappie			3						
Clupeidae									
Gizzard Shad		35	54	14	42	6	3	32	4
skipjack Herring			2				2		
Threadfin Shad			1						
Cyprinidae									
Bighead Carp		1							
Bighead Carp x Silver Carp		1							
Bullhead Minnow		5	18	11	15	4	1	1	1
Common Carp		8	9	33	6	10	18	1	10
Common Carp x Goldfish		1	18						
Emerald Shiner				13	16	13	7	17	17
Golden Shiner		1							1
Goldfish			2	1					

Appendix III (continued). Numbers of each fish species collected using AC electrofishing at standardized locations in the Lower Illinois River (Peoria Reach, RM 158-231) during 2014.

		Lower Illinois River							
Family	River Mile	163.4	166.0	180.6	193.8	202.8	203.3	207.7	215.3
Species	Effort (min)	60	60	50	60	60	60	60	60
Cyprinidae (continued)									
Grass Carp				1	1	4	1		
River Shiner				20	2	2			
Sand Shiner									1
Silver Carp		22	12	58	38	21	36	23	3
Silver Chub			8						
Spotfin Shiner								4	10
Spottail Shiner			1					1	
Suckermouth Minnow				1					
Unidentified juvenile Cyprinid							1		
Gobiidae									
Round Goby		1		1					
Ictaluridae									
Channel Catfish		10	2	1		3		3	3
Flathead Catfish				2				1	
Lepisosteidae									
Shortnose Gar						3			
Moronidae									
White Bass		2	1	3	3	6			1
Percidae									
Logperch						1		3	
Sauger		4	5				2	5	
Poeciliidae									
Western Mosquitofish					1				
Sciaenidae									
Freshwater Drum		24	20	6	6	5	5	1	1
Total individuals		338	355	212	210	110	123	166	89
Total species/hybrids		21/3	24/2	19/0	18/0	21/0	17/0	22/0	18/0

Appendix III (continued). Numbers of each fish species collected using AC electrofishing at standardized locations in the Upper Illinois River (Starved Rock, Marseilles, and Dresden Reaches, RM 231-280) during 2014.

		Upper Illinois River						
Family	River Mile	240.8	241.5	248.0	249.6	260.6	277.4	279.8
Species	Effort (min)	60	60	60	40	60	60	50
Atherinidae								
Brook Silverside				1			5	
Catastomidae								
Golden Redhorse		1	2	2		5	1	
Highfin Carpsucker		2	8					
Quillback			1					
River Carpsucker			5	4	1	6		
Shorthead Redhorse			2	1		1		
Silver Redhorse			1					
Smallmouth Buffalo		1	4	2		3		
White Sucker								4
Centrarchidae								
Black Crappie						1	2	
Bluegill		8	6	25	3	7	183	73
Bluegill x Green Sunfish							4	1
Green Sunfish		5	5	7	1	2	17	9
Largemouth Bass		2		14	1	4	56	25
Northern Sunfish			2	2		1		3
Orangespotted Sunfish						2		
Pumpkinseed							14	15
Redear Sunfish							49	
Rock Bass							9	1
Smallmouth Bass		1	2	6	3	1	3	3
Unidentified Sunfish Hybrid							1	
Clupeidae								
Gizzard Shad		38	64	105	14	5	19	
Skipjack Herring			1					
Threadfin Shad				2			8	
Cyprinidae								
Bluntnose Minnow		15	10	4	1	4	36	27
Bullhead Minnow		18	8	22	4			
Central Stoneroller								1
Common Carp		1	1	1		2	5	
Common Carp x Goldfish							6	3
Emerald Shiner		300	281	10	12	22	7	
Golden Shiner							2	
Goldfish							69	2

Appendix III (continued). Numbers of each fish species collected using AC electrofishing at standardized locations in the Upper Illinois River (Starved Rock, Marseilles, and Dresden Reaches, RM 231-280) during 2014.

		Upper Illinois River						
Family	River Mile	240.8	241.5	248.0	249.6	260.6	277.4	279.8
Species	Effort (min)	60	60	60	40	60	60	50
Cyprinidae (continued)								
Red Shiner			1					
River Shiner					4			
Sand Shiner		4	2					1
Silver Carp		1				22		
Silverband Shiner*			1					
Spotfin Shiner		8	13	17	13	6		
Spottail Shiner		1		6	2		6	
Unidentified juvenile Cyprinid					3			
Esocidae								
Northern Pike						1		
Fundulidae								
Banded Killifish					3			
Blackstripe Topminnow						1		
Gobiidae								
Round Goby			2	2	2			
Ictaluridae								
Channel Catfish		2	4	1		4	3	
Yellow Bullhead				1			2	
Moronidae								
White Bass			2	1				
Percidae								
Logperch							2	1
Sauger			1					
Sciaenidae								
Freshwater Drum					4	2		
Total individuals		408	429	236	71	102	509	169
Total species/hybrids		17/0	25/0	22/0	15/0	21/0	21/3	13/2

*These specimens were *not* vouchered by INHS museum staff

Appendix IV. Biomass (lb) of each fish species collected using AC electrofishing at standardized locations in the Lower Illinois River (Alton and LaGrange Reaches, RM 0-158) during 2014. Species comprising <0.01 lb total biomass were not included in this table.

		Mississippi	Lower Illinois River											
Family	River Mile	205.1	19.0	24.7	26.8	30.0	58.3	75.3	86.5	95.1	107.1	113.0	148.0	155.1
species	Effort (min)	60	55	60	60	60	60	60	60	60	40	60	39	60
Atherinidae														
Brook Silverside										0.01				
Catastomidae														
Bigmouth Buffalo			8.48	0.81	4.72	10.60				11.72	8.76	9.89	2.65	0.02
Black Buffalo				0.41										
Golden Redhorse							0.26							0.02
Quillback												0.51		
River Carpsucker					0.17	0.07		0.92	0.75	2.03		0.62		0.79
Shorthead Redhorse			0.73	0.36			0.47	0.37				1.83	1.88	
Smallmouth Buffalo		0.76	0.51	2.86	2.11	3.47	1.33	2.96			0.51	4.06	6.79	
Centrarchidae														
Black Crappie				0.49						1.06		1.56		
Bluegill		0.10	0.02		0.00	0.00		0.06		0.24		0.21	0.02	
Green Sunfish		0.02											0.02	
Largemouth Bass		0.40		0.61	0.60					0.05		0.00		
Orangespotted Sunfish		0.04	0.03	0.01	0.03	0.01	0.01	0.01	0.01	0.01		0.07		
White Crappie								0.04		0.03				
Clupeidae														
Gizzard Shad		2.50	0.68	0.12	0.09	0.20	0.37	0.76		0.21	0.65			1.06
Skipjack Herring								0.20				0.10		0.09
Cyprinidae														
Bullhead Minnow				0.02				0.01				0.01	0.02	
Common Carp			4.47	11.19		9.82	25.51	10.52	20.33	12.17	103.91	19.05	9.85	3.56
Common Carp x Goldfish		0.62												0.17
Emerald Shiner		0.01	0.03	0.01	0.02	0.02	0.06	0.07	0.07	0.08	0.03	0.02	0.11	0.02
Goldfish								0.10						
Grass Carp		0.01			6.53			0.01			6.66		12.79	
Red Shiner							0.07							
River Shiner							0.05			0.01				
Silver Carp		4.52	56.17	28.55	19.22	29.73	40.15	7.21	26.01	79.45	29.67	178.07	13.30	15.32
Silver Chub													0.06	0.08
Spottail Shiner													0.02	
Esocidae														
Grass Pickerel								0.02						
Hiodontidae														
Goldeye										0.43				

Appendix IV. Biomass (lb) of each fish species collected using AC electrofishing at standardized locations in the Lower Illinois River (Alton and LaGrange Reaches, RM 0-158) during 2014. Species comprising <0.01 lb total biomass were not included in this table.

		Mississippi	Lower Illinois River											
Family	River Mile	205.1	19.0	24.7	26.8	30.0	58.3	75.3	86.5	95.1	107.1	113.0	148.0	155.1
species	Effort (min)	60	55	60	60	60	60	60	60	60	40	60	39	60
Ictaluridae														
Blue Catfish							0.26							
Channel Catfish		2.16	3.64	28.34	13.39	19.58	3.29	3.05	3.73	10.09	4.59	28.47	1.77	0.59
Flathead Catfish		1.44		1.70	1.08						42.57	2.20		
Lepisosteidae														
Shortnose Gar				1.63										
Moronidae														
White Bass			3.25	8.29	4.88	1.01	1.12	2.20		0.58	0.06	1.18	0.64	0.24
Percidae														
Johnny Darter														
Sauger									0.44				0.13	
Sciaenidae														
Freshwater Drum		3.12	2.11	8.17	0.91	6.39	0.43	7.41	3.98	3.75	4.31	6.10	4.39	1.20
Total fish biomass/site		280.8	154.1	178.3	140.6	170.9	191.7	171.2	201.8	277.0	348.8	427.0	241.4	238.3

Appendix IV (continued). Biomass (lb) of each fish species collected using AC electrofishing at standardized locations in the Lower Illinois River (Peoria Reach, RM 158-231) during 2014. Species comprising <0.01 lb total biomass were not included in this table.

		Lower Illinois River							
Family	River Mile	163.4	166.0	180.6	193.8	202.8	203.3	207.7	215.3
species	Effort (h)	60	60	50	60	60	60	60	60
Amiidae									
Bowfin						4.94		5.33	
Catastomidae									
Bigmouth Buffalo		54.68		8.34	2.57	6.90	21.63	26.66	
Golden Redhorse								0.30	
River Carpsucker		13.55	3.12			0.22	0.99		3.39
River Redhorse					0.01				
Shorthead Redhorse		0.03			0.04	1.21	0.83		1.46
Smallmouth Buffalo		12.47		3.02	20.64	27.68	19.42	10.25	6.16
Centrarchidae									
Black Crappie		1.00	0.27			1.52	1.54	3.30	0.17
Bluegill		4.54	1.97	0.10	0.15	0.27	0.42	0.19	0.11
Bluegill x Green Sunfish		0.26	0.50						
Green Sunfish		1.93	0.67		0.03		0.01	0.01	
Largemouth Bass		14.90	3.32	0.12		0.58	1.32	6.82	
Longear Sunfish			0.09						
Northern Sunfish			0.04						
Orangespotted Sunfish		0.07	0.01	0.04	0.29	0.01		0.17	0.06
Smallmouth Bass		0.05	0.02		0.08			0.07	0.91
Warmouth			0.08						
White Crappie			0.68						
Clupeidae									
Gizzard Shad		0.97	1.06	0.35	1.36	0.12	0.13	1.45	0.53
Skipjack Herring			0.11						
Cyprinidae									
Bighead Carp		2.60							
Bighead Carp x Silver Carp		1.15							
Bullhead Minnow			0.05	0.02	0.02				
Common Carp		46.86	13.04	233.31	36.05	63.97	85.05	2.74	44.08
Common Carp x Goldfish		0.34	1.85						
Emerald Shiner				0.05	0.07	0.06	0.02	0.09	0.1
Golden Shiner		0.04							0.01
Goldfish			0.15	0.03					
Grass Carp				5.95	8.76	23.57	5.95		
River Shiner				0.03					

Appendix IV (continued). Biomass (lb) of each fish species collected using AC electrofishing at standardized locations in the Lower Illinois River (Peoria Reach, RM 158-231) during 2014. Species comprising <0.01 lb total biomass were not included in this table.

		Lower Illinois River							
Family	River Mile	163.4	166.0	180.6	193.8	202.8	203.3	207.7	215.3
species	Effort (h)	60	60	50	60	60	60	60	60
Cyprinidae (continued)									
Silver Carp		63.95	10.1	160.6	98.84	61.18	100.3	67.94	10.46
Silver Chub			0.05						
Spotfin Shiner								0.01	0.02
Spottail Shiner			0.01					0.01	
Gobiidae									
Round Goby		0.01							
Ictaluridae									
Channel Catfish		17.24	6.57	2.99		10.6		10.38	6.31
Flathead Catfish				0.88				0.77	
Lepisosteidae									
Shortnose Gar						5.86			
Moronidae									
White Bass		1.38	0.07	1.28	1.08	2.39			0.11
Percidae									
Logperch						0.01		0.02	
Sauger		0.38	0.79				0.6	0.78	
Sciaenidae									
Freshwater Drum		30.37	0.74	3.3	5.39	4.77	0.88	0.23	0.04
Total fish biomass/site		268.8	45.4	420.4	175.4	215.9	239.1	137.5	73.9

Appendix IV (continued). Biomass (lb) of each fish species collected using AC electrofishing at standardized locations in the Upper Illinois River (Starved Rock, Marseilles, and Dresden Reaches, RM 231-280) during 2014. Species comprising <0.1% of relative biomass were not included in table.

		Upper Illinois River						
Family	Mile	240.8	241.5	248.0	249.6	260.6	277.4	279.8
species	Effort	0.50	1.00	1.00	0.70	1.00	1.00	1.00
Atherinidae								
Brook Silverside							0.01	
Catastomidae								
Golden Redhorse		0.14	0.91	0.86		3.13	0.02	
Highfin Carpsucker		1.23	5.76					
Quillback			0.75					
River Carpsucker			4.48	7.45	2.05	9.30		
Shorthead Redhorse			1.48	0.68		1.17		
Silver Redhorse			3.12					
Smallmouth Buffalo		2.13	7.42	2.93		6.86		
White Sucker								0.00
Centrarchidae								
Black Crappie						0.01	0.11	
Bluegill		0.06	0.16	1.03	0.30	0.65	11.73	1.48
Bluegill x Green Sunfish							0.89	0.22
Green Sunfish		0.24	0.07	0.11		0.03	0.71	0.17
Largemouth Bass		0.01		2.68	0.01	1.27	61.69	4.91
Northern Sunfish			0.03	0.05		0.01		0.07
Orangespotted Sunfish						0.02		
Pumpkinseed							0.43	0.21
Redear Sunfish							0.50	
Rock Bass							1.54	0.01
Smallmouth Bass		0.47	0.10	2.06	0.07	0.01	0.62	0.91
Unidentified Sunfish Hybrid							0.20	
Clupeidae								
Gizzard Shad		1.35	2.53	5.56	0.39	0.21	0.82	
Skipjack Herring			0.11					
Threadfin Shad				0.02			0.07	
Cyprinidae								
Bluntnose Minnow		0.04	0.03	0.02		0.01	0.20	0.10
Bullhead Minnow		0.07	0.03	0.08	0.02			
Central Stoneroller								0.01
Common Carp		5.19	2.78	5.49		8.49	11.39	
Common Carp x Goldfish							0.44	0.13
Emerald Shiner		0.98	0.90	0.04	0.06	0.10	0.06	

Appendix IV (continued). Biomass (lb) of each fish species collected using AC electrofishing at standardized locations in the Upper Illinois River (Starved Rock, Marseilles, and Dresden Reaches, RM 231-280) during 2014. Species comprising <0.01 lb total biomass were not included in this table.

		Upper Illinois River						
Family	Mile	240.8	241.5	248.0	249.6	260.6	277.4	279.8
species	Effort	0.50	1.00	1.00	0.70	1.00	1.00	1.00
Cyprinidae (continued)								
Golden Shiner							0.02	
Goldfish							3.07	0.06
Sand Shiner		0.01						
Silver Carp		4.07				127.01		
Spotfin Shiner		0.07	0.04	0.06	0.06	0.03		
Spottail Shiner		0.01		0.04	0.02		0.05	
Esocidae								
Northern Pike						0.40		
Fundulidae								
Banded Killifish					0.02			
Gobiidae								
Round Goby			0.01	0.01	0.03			
Ictaluridae								
Channel Catfish		2.06	4.06	1.61		8.91	8.14	
Yellow Bullhead							0.72	
Moronidae								
White Bass			0.63	0.35				
Percidae								
Logperch							0.02	0.02
Sauger			0.42					
Sciaenidae								
Freshwater Drum					0.23	1.33		
Total fish biomass/site		18.1	35.8	31.1	3.3	169.0	103.5	8.3

Appendix V. Numbers of each fish species collected during 2014 using pulsed-DC electrofishing in five reaches of the Illinois River.

		Upper Illinois River									Lower Illinois River					
	Reach	Dresden			Marseilles			Starved Rock			Peoria			Alton		
Family	Effort/time period (h)	0.75			1.5			0.75			3.50			3.75		
species	Time period	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Amiidae																
Bowfin											1	1	1			2
Atherinopsidae																
Brook Silverside			1	1	2		1					1		1	12	1
Catostomidae																
Bigmouth Buffalo											2	4	2	1	1	2
Black Buffalo														10	2	4
Golden Redhorse		1		4	4	5	11	1				3	3		1	
Highfin Carpsucker						3	1									
Northern Hogsucker						1										
Quillback					1	3							1			
River Carpsucker			1		3	9	6	6		3	5	7	33	14	5	7
Shorthead Redhorse					1	1	3					1	1	5	3	3
Silver Redhorse							3					1				
Smallmouth Buffalo		3	3	2	10	21	87	26	3	16	12	41	44	24	24	33
Unidentified juvenile *Ictiobus*														1		
Unidentified juvenile Catostomid					3	2					21	5				
White Sucker				5												
Centrarchidae																
Black Crappie						1	1					4		2	11	4
Bluegill		9	67	8	9	27	12	2	2	1	4	23	30	5	26	10
Bluegill x Green Sunfish		1	1			1	1									
Bluegill x Orange Spotted Sunfish*			6													
Green Sunfish		2	12	5	9	10	2			2		7	1		11	1
Largemouth Bass		10	37	21	3	36				1	1	23	13	3	20	3
Nothern Sunfish				4												
Orange Spotted Sunfish			1			1	1					24	5		17	10
Pumpkinseed		1														
Redear Sunfish							1									
Rock Bass							1	1								
Smallmouth Bass		1			9	14	14	4		2	1	7	2			
Unidentified Sunfish hybrid		1	1	1	1											
White Crappie															1	
Clupeidae																
Gizzard Shad		150	49			111	26	2	9	48	24	578	188	363	1993	471
Skipjack Herring						3	2				8	53	10	11	12	9
Threadfin Shad				2		28	1				2	20			6	1
Unidentified juvenile Clupeid					1											
Cyprinidae																
Bighead Carp											1	1		2		
Bighead Carp x Silver Carp											2					
Bluntnose Minnow		17	59	100	9	13	5	3				4				
Bullhead Minnow			5	2	19	30	16	4		43	2	25	43	3	9	7
Central Stoneroller						2										
Channel Shiner						4								1	1	
Common Carp		10	15	2	1	13	17	4		1	24	18	31	61	25	29
Common Carp x Goldfish		1	5		1		1					9	1			

Appendix V (continued). Numbers of each fish species collected during 2014 using pulsed-DC electrofishing in five reaches of the Illinois River.

		Upper Illinois River									Lower Illinois River					
	Reach	Dresden			Marseilles			Starved Rock			Peoria			Alton		
Family	Effort/time period (h)	0.75			1.5			0.75			3.50			3.75		
species	Time period	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Cyprinidae (Cont.)																
Creek Chub					1	4										
Emerald Shiner			8	3	3	163	151	15	55	83	115	988	201	75	156	78
Fathead Minnow							1			1						
Golden Shiner				8								1	1	2		
Goldfish		2	7									4	6			
Grass Carp							1	2	1	4	2	4	1	1	1	1
Mimic Shiner*												6				
Red Shiner			7								4		5	12		
Redfin Shiner						1										
River Shiner					43	1	18	31		1	20		13		3	
Sand Shiner		1			2	29	8	5	5	3		5	8			
Silver Carp					1	1	1	1	10	6	36	231	86	36	106	26
Silver Chub													2	1	4	7
Silverband Shiner*												1			1	
Spotfin Shiner					101	63	32	14	14	26	18	7	1	2	10	
Spottail Shiner		14	3	10	15	74	9		1	2	1	22	14			
Suckermouth Minnow														1		
Unidentified juvenile Cyprinid				1						1	12				1	
Unidentified juvenile *Hypophthalmichthys*														2		1
Esocidae																
Grass Pickerel					4			1								
Fundulidae																
Banded Killifish*				1			5			5						
Blackstripe Topminnow			4				1									
Starhead Topminnow*			1			1										
Gobiidae																
Round Goby			1	1		1										
Hiodontidae																
Goldeye														3		3
Mooneye												1		3		
Ictaluridae																
Blue Catfish														1		
Channel Catfish		1			9	9	12	4	1	3	14	13	29	27	54	90
Flathead Catfish						1					1	6		8	6	3
Yellow Bullhead			1	5								1				
Lepisosteidae																
Longnose Gar					1			1				2	2	5	1	4
Shortnose Gar								3	1			1	4	35	17	23
Moronidae																
White Bass							3	1		2	15	24	36	25	33	130
White Perch											1					
Yellow Bass							5					1	5		3	7

Appendix V (continued). Numbers of each fish species collected during 2014 using pulsed-DC electrofishing in five reaches of the Illinois River.

		Upper Illinois River									Lower Illinois River					
	Reach	Dresden			Marseilles			Starved Rock			Peoria			Alton		
Family	Effort/time period (h)	0.75			1.5			0.75			3.50			3.75		
species	Time period	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Percidae																
Johnny Darter					1											
Logperch			3	7	4	31	4				1	17	4			
Sauger							3				2	11	17	2	1	14
Slenderhead Darter						11										
Walleye							1				1	1	2			
Yellow Perch				1												
Poeciliidae																
Western Mosquitofish												1				
Sciaenidae																
Freshwater Drum				2	1	3	13	3	2		9	17	64	42	50	312
Total specimens collected		225	298	196	272	732	481	134	104	254	362	2225	910	790	2627	1296
Total species/hybrids		14/2	20/3	21/0	26/1	36/1	37/2	22/0	12/0	20/0	29/1	44/1	36/1	33/1	34/0	30/0

*These specimens were *not* vouchered by INHS museum staff

Appendix VI. Biomass (lb) of each fish species collected during 2014 using pulsed DC electrofishing in five reaches of the Illinois River. Species comprising <0.01 lb total biomass were not included in this table.

		Upper Illinois River									Lower Illinois River					
	Reach	Dresden			Marseilles			Starved Rock			Peoria			Alton		
Family	Effort/time period (h)	0.75			1.5			0.75			3.50			3.75		
species	Time period	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Amiidae																
Bowfin											4.33	0.32	6.25			5.45
Atherinopsidae																
Brook Silverside															0.02	
Catostomidae																
Bigmouth Buffalo											4.78	10.88	5.53	2.25	0.07	0.18
Black Buffalo														27.26	2.42	10.80
Golden Redhorse		1.69		4.54	1.85	2.11	7.16	0.50				0.89	1.38		0.23	
Highfin Carpsucker						1.25	0.94									
Quillback					1.06	1.31							0.19			
River Carpsucker			1.84		4.67	10.49	9.79	8.56		5.15	0.80	5.33	38.45	10.85	3.28	1.72
Shorthead Redhorse					0.18	0.01	3.13					0.01	0.01	5.82	0.04	2.05
Silver Redhorse							6.84									
Smallmouth Buffalo		11.49	17.77	5.29	22.91	49.97	226.06	47.64	7.23	33.92	24.38	114.81	110.62	23.78	10.46	11.50
Unidentified juvenile Catostomid						0.02					0.02	0.02				
White Sucker				0.38												
Centrarchidae																
Black Crappie						0.47	1.19					0.43		0.18	3.04	1.11
Bluegill		0.73	1.53	0.38	0.25	1.15	1.24	0.19	0.03		0.60	0.93	2.16	0.63	0.43	0.49
Bluegill x Green Sunfish		0.02	0.02				0.11									
Bluegill x Orange Spotted Sunfish			0.08													
Green Sunfish		0.06	0.34	0.04	0.40	0.22	0.01			0.03		0.03	0.02		0.07	0.01
Largemouth Bass		1.83	4.28	0.48	1.47	1.23				0.02	0.11	3.32	1.48	0.39	1.50	2.38
Nothern sunfish				0.12												
Orange Spotted Sunfish			0.01			0.01						0.14	0.02		0.06	0.06
Pumpkinseed		0.10														
Rock Bass								0.10								
Smallmouth Bass		0.10			2.14	2.96	3.19	1.84		0.11		0.71	1.77			
Unidentified Sunfish hybrid					0.03											
White Crappie															0.32	
Clupeidae																
Gizzard Shad		1.38	1.32			3.26	1.18	0.03	0.32	2.72	1.03	7.49	11.75	6.95	25.62	36.79
Skipjack Herring						0.27	0.24				0.01	2.33	0.81	0.07	0.38	0.56
Threadfin Shad				0.02		0.49	0.02				0.04	0.05			0.06	0.02
Cyprinidae																
Bighead Carp											7.64	2.13		17.95		
Bighead Carp x Silver Carp											8.13					
Bluntnose Minnow		0.02	0.20	0.45	0.04	0.03		0.01				0.01				
Bullhead Minnow			0.01		0.10	0.13	0.08	0.02		0.08		0.05	0.09	0.01	0.02	0.02
Central Stoneroller						0.02										
Channel Shiner						0.01										
Common Carp		46.98	14.33	10.16	4.25	60.96	88.09	21.46		4.93	110.19	73.24	164.82	205.31	36.90	88.03
Common Carp x Goldfish		3.39	0.35		0.02		2.79					0.73	0.01			
Creek Chub						0.02										
Emerald Shiner			0.04	0.01	0.02	0.63	0.95	0.06	0.15	0.40	0.43	2.24	0.73	0.25	0.33	0.35
Golden Shiner				0.11								0.02	0.02			

Appendix VI (continued). Biomass (lb) of each fish species collected during 2014 using pulsed DC electrofishing in five reaches of the Illinois River. Species comprising <0.01 lb total biomass were not included in this table.

		Upper Illinois River									Lower Illinois River					
	Reach	Dresden			Marseilles			Starved Rock			Peoria			Alton		
Family	Effort/time period (h)	0.75			1.5			0.75			3.50			3.75		
species	Time period	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Cyprinidae (continued)																
Goldfish		0.04	0.29									0.14	0.54			
Grass Carp								11.57	5.26	27.06	11.49	20.70	6.36	5.77		0.01
Mimic Shiner												0.02				
Red Shiner			0.06								0.03			0.06		
River Shiner					0.13		0.02	0.07			0.02		0.03			
Sand Shiner						0.08	0.02	0.02	0.02			0.01	0.02			
Silver Carp					6.53	5.76	6.09	2.72	58.30	25.99	113.34	650.79	262.79	106.96	103.06	53.81
Silver Chub													0.04	0.01	0.08	0.15
Silverband Shiner												0.01			0.01	
Spotfin Shiner					0.63	0.25	0.08	0.06	0.04	0.05	0.08	0.03	0.01	0.01	0.00	
Spottail Shiner		0.03	0.02	0.12	0.05	0.36	0.10		0.00	0.02	0.01	0.11	0.12			
Unidentified juvenile *Hypophthalmichthys*																0.01
Esocidae																
Grass Pickerel					0.07			0.09								
Fundulidae																
Banded Killifish				0.01			0.01			0.04						
Blackstripe Topminnow							0.01									
Gobiidae																
Round Goby			0.01	0.01		0.01										
Hiodontidae																
Goldeye														1.32		0.22
Mooneye												0.15		1.11		
Ictaluridae																
Blue Catfish														0.94		
Channel Catfish		2.76			15.72	9.69	29.68	3.51	4.38	5.67	46.82	19.74	70.83	30.56	42.36	100.74
Flathead Catfish						3.03					1.33	6.97		6.98	6.03	2.24
Yellow Bullhead				0.81								0.02				
Lepisosteidae																
Longnose Gar								1.11				0.15	1.33	2.54	0.28	1.08
Shortnose Gar								4.32	1.21			1.76	5.42	36.58	20.46	18.61
Moronidae																
White Bass							1.90	1.08		0.82	4.72	5.88	13.18	12.92	3.40	36.24
White Perch											0.17					
Yellow Bass							0.24					0.01	0.16		0.32	1.90
Percidae																
Logperch			0.03	0.09	0.01	0.20	0.05					0.10	0.03			
Sauger							0.42				1.39	1.29	5.39	0.36	0.08	4.10
Slenderhead Darter						0.02										
Walleye							0.24					0.11	1.14			
Yellow Perch				0.05												
Sciaenidae																
Freshwater Drum				5.63	0.00	4.29	12.08	2.00	0.04		5.40	9.07	48.14	17.61	12.40	57.10
Total Biomass (lb)/Reach/Time Period		70.6	42.5	28.7	62.5	160.7	404.0	107.0	77.0	107.0	347.3	943.2	761.6	525.4	273.7	437.7

Appendix VII. Numbers of each fish species collected during 2014 using pulsed-DC electrofishing in three upper pools of the Mississippi River.

		Upper Mississippi River Pools								
	Pool/Reach	Pool 16			Pool 19			Pool 20		
Family	Effort/time period (h)	1.25			2.25			1.00		
species	Time period	1	2	3	1	2	3	1	2	3
Amiidae										
Bowfin							1			1
Anguillidae										
American Eel									1	
Atherinopsidae										
Brook Silverside			1	4		1	1		1	
Catostomidae										
Bigmouth Buffalo		1			2	1	1			1
Black Buffalo							2			
Blue Sucker								1		
Golden Redhorse				1			4			
Highfin Carpsucker			3	1						
Quillback					1			1		4
River Carpsucker		1	1	8	7	1	1	7	6	46
River Redhorse			2						1	1
Shorthead Redhorse			1	7	2					1
Silver Redhorse		1								
Smallmouth Buffalo			2	2	4	8	1	2	5	
Unidentified juvenile Catostomid				3	34	2		1		
Centrarchidae										
Black Crappie			4		4		3			
Bluegill			15	7	2	28	35	1		
Bluegill x Green Sunfish					1					
Green Sunfish			2	1	2	14	1			
Largemouth Bass			24	7	9	54	57			
Orange Spotted Sunfish			5		17	1	53			
Smallmouth Bass			1	12	5	1	11	3		1
Unidentified Sunfish hybrid					3				1	
White Crappie						1	18			
Clupeidae										
Gizzard Shad			102	90	10	17	79	7	17	20
Skipjack Herring									1	
Cyprinidae										
Bighead Carp										2
Bluntnose Minnow					1		1	1		
Bullhead Minnow			10	73	12	4	4		1	2
Channel Shiner			26		168	3		1		
Common Carp			8	8	27	18	96	4	5	5
Common Carp x Goldfish					2	2	11			
Emerald Shiner		220	496	312	760	147	983	299	316	352

Appendix VII (continued). Numbers of each fish species collected during 2014 using pulsed-DC electrofishing in three upper pools of the Mississippi River.

		Upper Mississippi River Pools								
	Pool/Reach	Pool 16			Pool 19			Pool 20		
Family	Effort/time period (h)	1.25			2.25			1.00		
species	Time period	1	2	3	1		3	1	2	3
Cyprinidae (continued)										
Fathead Minnow					1					
Goldfish							2			
Grass Carp									2	2
Mississippi Silvery Minnow			18	28			10			1
Red Shiner			3		8	3				
Redfin Shiner									1	
River Shiner		12	80	137	28	4	33	8		19
Sand Shiner		1	1			7	8	11	8	9
Silver Carp								4	1	2
Silver Chub				19	85	1	4	1	2	6
Silverband Shiner			1			1				
Spotfin Shiner		7	105	56	202	23	10	6	3	
Spottail Shiner			17	11	3		1			
Suckermouth Minnow			1							
Unidentified juvenile Cyprinid			34	38		1	19		7	
Esocidae										
Northern Pike				1						
Hiodontidae										
Goldeye								2		
Mooneye		1	1		4					
Ictaluridae										
Channel Catfish		1	2	33	29	18	30	3	2	2
Flathead Catfish		1	3	1	9	2	1	12	6	1
Slender Madtom						1				
Tadpole Madtom				1		1				
Yellow Bullhead						1				
Lepisosteidae										
Longnose Gar			1		3			2	2	
Shortnose Gar				1	2	1				
Moronidae										
White Bass		6	3	9	10	3	6	5	3	5
Percidae										
Fantail Darter						1				
Johnny Darter			6	3						
Logperch			8	2		1				
Mud Darter				1	1					
Orangethroat Darter			2			2				
Rainbow Darter				1						
Sauger				8	3					

Appendix VII (continued). Numbers of each fish species collected during 2014 using pulsed-DC electrofishing in three upper pools of the Mississippi River.

		Upper Mississippi River Pools								
	Pool/Reach	Pool 16			Pool 19			Pool 20		
Family	Effort/time period (h)	1.25			2.25			1.00		
species	Time period	1	2	3	1	2	3	1	2	3
Percidae (continued)										
Slenderhead Darter				1		1				
Walleye				6			1			
Yellow Perch			1		2	9	2			
Sciaenidae										
Freshwater Drum			45	76	22	11	11	1	4	29
Total specimens collected		252	1035	969	1485	395	1501	383	396	512
Total species/hybrids		11/0	35/0	33/0	33/2	34/1	32/1	22/0	21/0	22/0

*These specimens were not vouchered by INHS museum staff

Appendix VIII. Biomass (lb) of each fish species collected during 2014 using pulsed-DC electrofishing in three upper pools of the Mississippi River. Species comprising <0.01 lb total biomass were not included in this table.

		Upper Mississippi River Pools								
	Pool/Reach	Pool 16			Pool 19			Pool 20		
Family	Effort/time period (h)	1.25			2.25			1.00		
species	Time period	1	2	3	1	2	3	1	2	3
Amiidae										
Bowfin							6.77			3.64
Anguillidae										
American Eel									1.79	
Atherinopsidae										
Brook Silverside				0.01						
Catostomidae										
Bigmouth Buffalo		3.06			9.57	0.46	0.09			10.29
Black Buffalo							9.25			
Blue Sucker								2.53		
Golden Redhorse				1.10			0.17			
Highfin Carpsucker			1.14	0.67						
Quillback					0.36			0.19		0.77
River Carpsucker		2.65	1.01	17.78	7.76	0.10		5.52	9.36	72.49
River Redhorse			3.22						0.93	2.43
Shorthead Redhorse			0.01	7.37	0.21					0.27
Silver Redhorse		5.43								
Smallmouth Buffalo			3.89	6.86	8.58	4.49	0.05	7.66	29.84	
Unidentified juvenile Catostomid				0.08	0.52	0.06				
Centrarchidae										
Black Crappie			2.00		0.02		0.09			
Bluegill			0.08	1.38	0.34	0.49	2.89	0.00		
Bluegill x Green Sunfish					0.08					
Green Sunfish			0.01	0.00	0.17	0.26	0.20			
Largemouth Bass			0.78	1.90	3.26	4.92	22.82			
Orange Spotted Sunfish			0.05		0.18	0.01	0.71			
Smallmouth Bass			0.54	4.87	2.47	0.32	7.33	2.24		0.06
Spotted Bass							0.02			
Unidentified Sunfish hybrid					0.02					
White Crappie						0.01	1.50			
Clupeidae										
Gizzard Shad			6.48	7.67	0.16	1.00	2.25	0.05	0.10	2.84
Skipjack Herring									0.77	
Cyprinidae										
Bighead Carp										24.47
Bullhead Minnow			0.03	0.20	0.04	0.01	0.02		0.00	0.00
Channel Shiner			0.06		0.42	0.01				
Common Carp			60.27	68.64	208.05	87.02	732.19	25.10	36.16	40.62
Common Carp x Goldfish					7.13	4.06	28.66			
Emerald Shiner		0.65	2.29	0.75	2.07	0.62	1.05	1.33	1.3	0.45

Appendix VIII (continued). Biomass (lb) of each fish species collected during 2014 using pulsed-DC electrofishing in three upper pools of the Mississippi River. Species comprising <0.01 lb total biomass were not included in this table.

		Upper Mississippi River Pools								
	Pool/Reach	Pool 16			Pool 19			Pool 20		
Family	Effort/time period (h)	1.25			2.25			1.00		
species	Time period	1	2	3	1	2	3	1	2	3
Cyprinidae (continued)										
Goldfish							2.06			
Grass Carp									23.59	21.28
Mississippi Silvery Minnow			0.08	0.14			0.11			0.01
Red Shiner			0.02		0.04	0.01				
River Shiner		0.05	0.52	0.47	0.09	0.01	0.03	0.02		0.12
Sand Shiner						0.02	0.01	0.03	0.02	0.01
Silver Carp								23.47	4.32	13.56
Silver Chub				0.11	0.39	0.01	0.05		0.03	0.04
Spotfin Shiner		0.03	0.46	0.19	1.13	0.09	0.04	0.03	0.01	
Spottail Shiner			0.09	0.07			0.01			
Suckermouth Minnow			0.01							
Unidentified juvenile Cyprinid			0.00	0.01		0.00	0.00		0.01	
Esocidae										
Northern Pike				2						
Hiodontidae										
Goldeye								0.55		
Mooneye		0.11	0.02		0.02					
Ictaluridae										
Channel Catfish		0.04	1.47	41.08	65.04	31.89	90.77	4.71	2.32	7.35
Flathead Catfish		0.02	2.78	0.43	17.76	0.50	0.21	9.72	5.24	2.00
Slender Madtom						0.01				
Yellow Bullhead						0.01				
Lepisosteidae										
Longnose Gar			3.26		0.08			2.58	2.72	
Shortnose Gar				1.67	3.96	2.45				
Moronidae										
White Bass		3.97	1.88	7.41	3.86	0.04	4.47	4.44	0.86	3.08
Percidae										
Johnny Darter			0.01	0.01						
Logperch			0.14	0.03		0.01				
Sauger				0.98	0.26					
Slenderhead Darter						0.01				
Walleye				0.67			0.13			
Yellow Perch			0.02		0.51	0.58	0.35			
Sciaenidae										
Freshwater Drum			13.68	1.48	17.61	24.41	20.94	0.06	0.02	16.11
Total Biomass (lb)/Reach/Time Period		16.0	106.3	176.1	362.2	163.9	935.2	90.2	119.4	221.9

Appendix IX. Numbers of each fish species collected during 2014 using pulsed-DC electrofishing in three lower pools/reaches of the Mississippi River.

		Lower Mississippi River Pools/Reaches								
	Pool/Reach	Pool 25			Chain of Rocks Reach			Kaskaskia Reach		
Family	Effort/time period (h)	1.5			1.75			2.50		
species	Time period	1	2	3	1	2	3	1	2	3
Amiidae										
Bowfin		1						1		
Anguillidae										
American Eel			1		1					
Atherinopsidae										
Brook Silverside			1							
Catostomidae										
Bigmouth Buffalo		3		1	2	2	4	4		1
Black Buffalo		3	2	1		1		2		5
Blue Sucker		1					3		1	
River Carpsucker		6		3	6	2	6	31	1	14
Shorthead Redhorse		2	1				1	1	1	1
Smallmouth Buffalo		12	8	7	9	4	7	19	8	7
Centrarchidae										
Black Crappie		2		4						
Bluegill		5	1	1		2				
Green Sunfish		5	4	2		1	1			
Largemouth Bass						2				
Orange Spotted Sunfish		10	1	1			6	1		
Smallmouth Bass		3		1						
Spotted Bass									2	
White Crappie				2					1	
Clupeidae										
Gizzard Shad		1	39	10		41	12	10	60	16
Skipjack Herring								1	3	
Cyprinidae										
Bighead Carp								1		
Bluntnose Minnow			1							
Bullhead Minnow		5		2	1		1	1		
Channel Shiner		41	1			3		1	1	1
Common Carp		67	70	39	14	11	61	27	34	60
Emerald Shiner		79	65	53	1	168	24	53	40	36
Golden Shiner			1							
Grass Carp		1		1		2	8	4	3	
Mimic Shiner			1							
Mississippi Silvery Minnow				1						
Red Shiner		3		1	2	3		12		
River Shiner		42		3	2		1	1		
Silver Carp		10	3	5	2	12	6	106	11	5
Silver Chub		2	1		1			1		

Appendix IX (continued). Numbers of each fish species collected during 2014 using pulsed-DC electrofishing in three lower pools/reaches of the Mississippi River.

		Lower Mississippi River Pools/Reaches								
	Pool/Reach	Pool 25			Chain of Rocks Reach			Kaskaskia Reach		
Family	Effort/time period (h)	1.50			1.75			2.50		
species	Time period	1	2	3	1	2	3	1	2	3
Cyprinidae (continued)										
Spotfin Shiner		18	9	5	2	9	1	9		4
Suckermouth Minnow		1								
Unidentified juvenile Cyprinid				4						
Unidentified juvenile Hypophthalmichthys						1		1	1	
Esocidae										
Northern Pike				1						
Hiodontidae										
Goldeye		1			3	8	4	13	2	7
Mooneye			2	3	1	1				
Ictaluridae										
Blue Catfish							3	1	2	1
Channel Catfish		16	30	11	3	4	3	6	10	5
Flathead Catfish		8	18	5	3	18	2	4	1	1
Freckled Madtom										2
Lepisosteidae										
Longnose Gar		10		3	7	14	5	2	7	5
Shortnose Gar		36	7	6	16	6	5	6	17	11
Unidentified Gar spp.					1					
Moronidae										
Striped Bass x White Bass				1	2		1			1
White Bass		11	12	11	2	24	5	5	4	2
Percidae										
Sauger		1	1	1		1		2	2	
Walleye				1					1	
Petromyzontidae										
Chestnut Lamprey							1			
Sciaenidae										
Freshwater Drum		52	40	76	5	10	60	9	12	39
Total specimens collected		458	320	266	86	350	231	335	225	224
Total species/hybrids		32/0	25/0	30/1	22/1	24/0	24/1	29/0	23/0	20/1

Appendix X. Biomass (lb) of each fish species collected during 2014 using pulsed-DC electrofishing in three lower pools/reaches of the Mississippi River. Species comprising <0.01 lb total biomass were not included in this table.

		Lower Mississippi River Pools/Reaches								
	Pool/Reach	Pool 25			Chain of Rocks Reach			Kaskaskia Reach		
Family	Effort/time period (h)	1.5			1.75			2.50		
species	Time period	1	2	3	1	2	3	1	2	3
Amiidae										
Bowfin		8.48						4.53		
Anguillidae										
American Eel			1.32		0.71					
Catostomidae										
Bigmouth Buffalo		13.34		2.84	6.45	5.46	17.22	19.89		7.36
Black Buffalo		9.78	16.45	9.24		10.68		7.44		26.29
Blue Sucker		8.57					6.44		2.26	
River Carpsucker		4.47		4.67	6.46	3.40	7.07	74.58	2.62	36.05
Shorthead Redhorse		2.91	2.13				0.03	1.41	1.62	1.30
Smallmouth Buffalo		14.69	6.89	7.54	26.16	7.97	26.59	61.94	25.89	17.82
Centrarchidae										
Black Crappie		0.75		1.85						
Bluegill		1.20	0.23	0.04		0.10				
Green Sunfish		0.05	0.05	0.01		0.01	0.01			
Largemouth Bass						0.03				
Orange Spotted Sunfish		0.09	0.02	0.01			0.04			
Smallmouth Bass		2.42		1.78						
Spotted Bass									0.06	
White Crappie				0.73					0.43	
Clupeidae										
Gizzard Shad		0.10	2.86	1.08		0.72	2.01	2.02	4.20	3.97
Skipjack Herring								0.01	0.27	
Cyprinidae										
Bullhead Minnow		0.02		0.01						
Channel Shiner		0.09				0.01				
Common Carp		367.82	357.38	223.14	92.77	79.00	463.27	172.28	173.05	351.13
Emerald Shiner		0.17	0.19	0.14	0.00	0.34	0.05	0.10	0.07	0.10
Golden Shiner			0.01							
Grass Carp		9.11		7.80		26.02	98.59	9.27	34.13	
Mississippi Silvery Minnow				0.01						
Red Shiner		0.03				0.01		0.06		
River Shiner		0.13		0.01	0.02			0.01		
Silver Carp		62.57	9.65	32.06	2.63	36.23	15.06	40.37	20.88	23.37
Silver Chub					0.02			0.04		
Spotfin Shiner		0.07	0.03	0.01		0.02		0.03		0.01

Appendix X (continued). Biomass (lb) of each fish species collected during 2014 using pulsed-DC electrofishing in three lower pools/reaches of the Mississippi River. Species comprising <0.01 lb total biomass were not included in this table.

		Lower Mississippi River Pools/ Reaches								
	Pool/Reach	Pool 25			Chain of Rocks Reach			Kaskaskia Reach		
Family	Effort/time period (h)	1.50			1.75			2.50		
species	Time period	1	2	3	1	2	3	1	2	3
Esocidae										
Northern Pike				2.56						
Hiodontidae										
Goldeye		0.01			0.10	0.46	0.26	1.14	0.05	0.64
Mooneye			0.21	0.25	0.06	0.10				
Ictaluridae										
Blue Catfish							19.49	3.60	8.97	0.42
Channel Catfish		27.38	47.47	17.57	3.25	5.01	0.03	12.39	18.88	3.58
Flathead Catfish		7.28	14.83	6.88	4.61	9.15	0.51	1.36	0.67	11.42
Freckled Madtom										0.05
Lepisosteidae										
Longnose Gar		14.93		3.96	10.22	28.39	4.15	3.00	12.43	5.29
Shortnose Gar		33.76	11.32	5.37	35.28	8.77	8.46	7.78	24.33	17.75
Unidentified Gar spp.					0.01					
Moronidae										
Striped Bass x White Bass				8.10	2.60		5.30			3.23
White Bass		4.26	7.35	5.10	0.37	6.26	1.50	2.50	1.72	1.10
Percidae										
Sauger		0.03	0.35	0.37		0.38		2.05	1.76	
Walleye				5.02					0.05	
Petromyzontidae										
Chestnut Lamprey							0.03			
Sciaenidae										
Freshwater Drum		39.43	46.63	35.90	2.90	2.74	23.60	6.17	5.73	24.11
Total Biomass (lb)/Reach/Time Period		633.9	525.3	384.0	194.6	231.2	699.7	433.9	340.1	535.0

Appendix XI. Numbers of each species collected using pulsed DC electrofishing in the Iroquois and Kankakee River in 2014.

		Iroquois			Kankakee		
	Gear	Pulsed-DC			Pulsed-DC		
Family	Total Effort (h)	3.75	1.00	3.75	5.75	2.50	6.00
Species	Time Period	1	2	3	1	2	3
Amiidae							
Bowfin					1	1	4
Anguillidae							
American Eel							1
Atherinopsidae							
Brook Silverside		4	18	12	2	9	9
Catostomidae							
Bigmouth Buffalo		11	14	13	3	3	6
Black Buffalo		6		17	8	2	10
Black Redhorse		1			16	11	23
Golden Redhorse		5	1	22	107	25	225
Highfin Carpsucker					1		
Northern Hogsucker		2			8	6	32
Quillback		4		39	10	8	63
River Carpsucker					6		3
River Redhorse		2		3	5	4	15
Shorthead Redhorse		10	2	38	127	34	365
Silver Redhorse		3	1	12	31	5	34
Smallmouth Buffalo		9		14	15	3	26
Spotted Sucker			3	2	3	1	12
White Sucker							1
Centrarchidae							
Black Crappie			1	6	21	3	16
Bluegill		1	6	8	38	18	40
Green Sunfish		2		8	6	9	15
Largemouth Bass			2	3	22	24	28
Longear Sunfish x Green Sunfish						1	
Nothern sunfish		36	6	9	162	52	60
Orange Spotted Sunfish		117	17	28	8	3	10
Pumpkinseed							2
Rock Bass		2		5	78	27	46
Smallmouth Bass		15		43	125	91	202
Sunfish spp.		1	1		1	5	3
Unidentified Sunfish hybrid				1	1		
Warmouth					1		
White Crappie		4	3	7	3		
Clupeidae							
Gizzard Shad			4	69	39	19	70
Threadfin Shad					3		
Cyprinidae							
Blacknose Shiner					43	5	
Bluntnose Minnow		32	2	10	110	42	149
Bullhead Minnow		23	5	52	37	8	71
Central Stoneroller						3	3
Channel Shiner					1		
Common Carp		25	4	27	64	20	81
Common Carp x Goldfish							2
Emerald Shiner		6	1	1	10		6
Ghost Shiner		4			4		
Golden Shiner					1	1	
Hornyhead Chub		1			2	2	2
Largescale Stoneroller		1					
Mimic Shiner		9	2	21	169	83	152
Pallid Shiner					4	1	
Red Shiner		27	1	7		7	5
Red shiner x Spotfin shiner hybrid		4	10	19		38	22
Redfin Shiner		4	1	1	1		
River Shiner					3		
Roseyface Shiner				7	18	12	42

Appendix XI (continued). Numbers of each species collected using pulsed DC electrofishing in the Iroquois and Kankakee River in 2014.

		Iroquois			Kankakee		
	Gear	Pulsed-DC			Pulsed-DC		
Family	Total Effort (h)	3.75	1.00	3.75	5.75	2.50	6.00
Species	Time Period	1	2	3	1	2	3
Steelcolor Shiner		218			121		
Striped Shiner				1		16	3
Suckermouth Minnow			1				
Unidentified Cyprinid		30	14	27	16	7	79
Esocidae							
Grass Pickerel		12	5	6	11	5	6
Northern Pike					15	6	15
Fundulidae							
Blackstripe Topminnow			2	3	4		2
Ictaluridae							
Channel Catfish		15		57	59	16	141
Flathead Catfish		9	2	3	7	3	6
Yellow Bullhead		2				1	
Lepisosteidae							
Longnose Gar					28	10	9
Moronidae							
White Perch							2
Yellow Bass		1		2			
Percidae							
Banded Darter				1	8	16	12
Blackside Darter		1	1	1	3	5	7
Darter spp.					1		
Johnny Darter		2	3	12	50	39	64
Logperch			1	3	18	61	6
Rainbow Darter					1		1
Slenderhead Darter		1			6	19	1
Walleye		5	3	17	16	4	22
Yellow Perch						1	
Sciaenidae							
Freshwater Drum					10	1	29
Total Specimens Collected		1535	203	905	2694	1309	3025
Total Species/Hybrids		1531/4	193/10	885/20	2693/1	1270/39	3001/24

Appendix XII. Biomass (lb) of each species collected using pulsed DC electrofishing in the Iroquois and Kankakee Rivers in 2014. Species comprising <0.01 lb total biomass were not included in this table.

		Iroquois			Kankakee		
	Gear	Pulsed-DC			Pulsed-DC		
Family	Total Effort (h)	3.75	1.00	3.75	5.75	2.50	6.00
Species	Time Period	1	2	3	1	2	3
Amiidae							
Bowfin					0.12	3.91	24.50
Anguillidae							
American Eel							0.72
Catostomidae							
Bigmouth Buffalo		18.10	80.17	70.97	13.98	16.68	34.14
Black Buffalo		23.57		140.31	45.73	21.09	71.86
Black Redhorse		7.05			29.09	12.22	33.99
Golden Redhorse		8.18	1.04	26.63	155.54	38.71	399.94
Highfin Carpsucker					0.26		
Northern Hogsucker		0.69			12.67	10.45	31.01
Quillback		6.10		84.81	22.14	17.45	127.22
River Carpsucker					15.23		7.50
River Redhorse		11.32		18.56	25.00	25.49	74.94
Shorthead Redhorse		0.27		17.83	105.78	36.89	370.79
Silver Redhorse		6.13	2.93	18.16	84.86	11.57	102.27
Smallmouth Buffalo		43.60		84.07	73.66	16.09	109.91
Spotted Sucker			0.02	0.14	0.03	0.01	4.36
White Sucker							0.83
Centrarchidae							
Black Crappie				2.94	3.57	0.02	2.68
Bluegill		0.02	0.33	0.11	3.94	0.92	2.30
Green Sunfish		0.08		0.09	0.24	0.19	0.25
Largemouth Bass			0.05	0.04	7.16	1.80	8.69
Nothern sunfish		1.47	0.06	0.22	5.78	1.88	2.04
Orange Spotted Sunfish		1.18	0.21	0.39	0.20	0.03	0.16
Pumpkinseed							0.03
Rock Bass		0.35		1.40	9.41	3.66	8.44
Smallmouth Bass		10.29		47.41	75.54	49.86	153.09
Warmouth					0.01		
White Crappie		1.63	1.63	4.15	0.38		
Clupeidae							
Gizzard Shad			0.07	4.70	0.49	1.21	7.56
Cyprinidae							
Bluntnose Minnow		0.01			0.15	0.06	0.04
Bullhead Minnow		0.05		0.01	0.06	0.03	0.06
Central Stoneroller						0.01	0.01
Common Carp		165.24	19.81	198.78	406.38	146.11	690.68
Emerald Shiner		0.04		0.02	0.01		0.03
Hornyhead Chub						0.04	0.07
Largescale Stoneroller		0.01					
Mimic Shiner							0.02
Red Shiner		0.23	0.01			0.01	0.01
Roseyface Shiner							0.02
Sand Shiner					0.02		0.09
Spotfin Shiner		0.42	0.01	0.25	0.10	0.15	0.51
Spottail Shiner							0.01
Esocidae							
Grass Pickerel		0.18	0.15	0.22	0.21	0.13	0.30
Northern Pike					0.87	2.74	13.08
Fundulidae							
Blackstripe Topminnow					0.01		
Ictaluridae							
Channel Catfish		30.90		124.98	176.03	48.33	441.44
Flathead Catfish		9.55	4.02	13.09	5.79	2.84	12.30
Yellow Bullhead						0.07	
Lepisosteidae							
Longnose Gar					37.54	10.99	11.89

Appendix XII (continued). Biomass (lb) of each species collected using pulsed DC electrofishing in the Iroquois and Kankakee Rivers in 2014. Species comprising <0.01 lb total biomass were not included in this table.

		Iroquois			Kankakee		
	Gear	Pulsed-DC			Pulsed-DC		
Family	Total Effort (h)	3.75	1.00	3.75	5.75	2.50	6.00
Species	Time Period	1	2	3	1	2	3
Moronidae							
White Perch							0.21
Yellow Bass		0.13		0.56			
Percidae							
Blackside Darter					0.01	0.01	0.03
Logperch			0.01	0.03	2.43	0.75	0.09
Slenderhead Darter		0.01			0.02	0.18	
Walleye		6.23	13.57	32.03	5.24	6.57	29.98
Yellow Perch						0.01	
Sciaenidae							
Freshwater Drum					22.59	1.19	85.63
Total Biomass		353.03	124.09	892.90	1348.27	490.35	2865.72

Appendix XIII. Summary of fish captured from the Iroquois and Kankakee Rivers during 2014 for which decigram-precise weights were obtained.

Family Species	Iroquois		Kankakee	
	Number of Individuals	Length (mm) Min-Max	Number of Individuals	Length (mm) Min-Max
Amiidae				
Bowfin			1	172
Atherinopsidae				
Brook Silverside	32	26 - 71	10	34 - 83
Catostomidae				
Bigmouth Buffalo	5	49 - 67		
Black Buffalo	3	53 - 73		
Black Redhorse			2	207 - 218
Golden Redhorse			6	64 - 223
Northern Hogsucker	1	112	4	72 - 111
River Redhorse			3	76 - 77
Shorthead Redhorse	31	60 - 238	90	74 - 226
Silver Redhorse	2	93 - 171		
Smallmouth Buffalo	1	150		
Spotted Sucker	3	83 - 183	9	63 - 186
Centrarchidae				
Black Crappie	4	50 - 71	30	36 - 155
Bluegill	13	35 - 110	66	21 - 168
Green Sunfish	10	43 - 110	29	40 - 107
Largemouth Bass	3	71 - 85	51	34 - 128
Longear Sunfish x Green Sunfish			1	57
Nothern sunfish	46	46 - 115	253	29 - 137
Orange Spotted Sunfish	159	24 - 93	20	55 - 103
Pumpkinseed			2	54 - 73
Rock Bass	1	153	89	23 - 162
Smallmouth Bass	12	57 - 168	80	19 - 195
Sunfish spp.			1	77
Unidentified Sunfish hybrid	1	85		
Warmouth			1	66
White Crappie	1	193	1	67
Clupeidae				
Gizzard Shad	69	101 - 192	96	39 - 177
Cyprinidae				
Bluntnose Minnow	12	27 - 66	74	27 - 81
Bullhead Minnow	9	38 - 80	42	22 - 83
Central Stoneroller			3	60 - 78
Common Carp	4	62 - 155	4	63 - 110
Emerald Shiner	4	91 - 104	6	40 - 98
Hornyhead Chub			3	103 - 122
Largescale Stoneroller	1	91		
Mimic Shiner	2	50 - 50	51	46 - 68
Red Shiner	22	46 - 94	2	77 - 80
Roseyface Shiner	2	51 - 55	19	33 - 72
Sand Shiner	3	46 - 58	52	46 - 72
Spotfin Shiner	109	25 - 108	146	36 - 100
Spottail Shiner			1	87
Esocidae				
Grass Pickerel	21	57 - 171	16	65 - 170
Northern Pike			4	171 - 256
Fundulidae				
Blackstripe Topminnow	5	36 - 45	6	42 - 62
Ictaluridae				
Flathead Catfish			1	250
Yellow Bullhead			1	130
Lepisosteidae				
Longnose Gar			4	60 - 105
Moronidae				
White Perch			2	113 - 182
Percidae				
Banded Darter	1	44	30	29 - 56

Appendix XIII (continued). Summary of fish captured from the Iroquois and Kankakee Rivers during 2014 for which decigram-precise weights were obtained.

Family Species	Iroquois		Kankakee	
	Number of Individuals	Length (mm) Min-Max	Number of Individuals	Length (mm) Min-Max
Johnny Darter	15	36 - 57	127	28 - 62
Logperch	3	75 - 86	80	25 - 129
Slenderhead Darter	1	86	24	39 - 88
Walleye	3	94 - 204	19	88 - 225
Yellow Perch			1	77
Totals	**615**	**24 - 238**	**1575**	**19 - 256**

Appendix XIV. Publications, reports, and presentations that resulted from research conducted during segments 6-26 of project F-101-R, the Long-term Illinois River Fish Population Monitoring Program (funded under Federal Aid in Sportfish Restoration Act, P.L. 81-681, Dingell-Johnson, Wallup-Breaux).

I. Book Chapters

Irons, K.S., G.G. Sass, M.A. McClelland, and T.M. O'Hara. The Long Term Resource Monitoring Program: Insights into the Asian Carp Invasion of the Illinois River, Illinois, USA. *In* Invasive Asian Carps in North America. American Fisheries Society Special Publication. Bethesda, MD. 2010.

II. Publications. Manuscripts published or accepted for publication during Segment 26 are printed in bold.

McClelland, M.A., K.S. Irons, G.G. Sass, T. M. O'Hara, and T.R. Cook. 2013. A comparison of two electrofishing methods used to monitor fish on the Illinois River, Illinois, USA. River Research and Applications. 29:125-133

McClelland, M.A., G.G. Sass, T.R. Cook, K.S. Irons, N.M. Michaels, T.M. O'Hara, and C.S. Smith. 2012. The Long-term Illinois River Fish Population Monitoring Program. Fisheries 37(8):340-350.

McClelland, M.A and G.G. Sass. 2012. Assessing fish collections from random and fixed site sampling methods on the Illinois River. Journal of Freshwater Ecology. 27(3): 325-333.

Sass, G.G., T.R. Cook, K.S. Irons, M.A. McClelland, N.N. Michaels, T.M. O'Hara, and M.R. Stroub. 2010. A mark-recapture population estimate for invasive silver carp (*Hypophthalmichthys molitrix*) in the La Grange reach, Illinois River. Biological Invasions 12:433-436.

Irons, K.S. M.A. McClelland, and M.A. Pegg. 2006. Expansion of Round Goby in the Illinois Waterway. The American Midland Naturalist 156:198-200.

Irons, K.S., G.G. Sass, M.A. McClelland, and J.D. Stafford. 2007. Reduced Condition Factor of Two Native Fish Species Coincident with Invasion of Non-native Asian Carps in the Illinois River, USA: Evidence for Competition and Reduced Fitness? Journal of Fish Biology 71 (Supplement D), 258-273.

Koel, T.M. 2000. Ecohydrology and development of ecological criteria for operation of dams. Project Status Report 2000-02. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, Onalaska, Wisconsin.

Koel, T.M. 2000. Abundance of age-0 fishes correlated with hydrologic indicators. Project Status Report 2000-03. U.S. Geological Survey, Upper Midwest Environmental Sciences Center, Onalaska, Wisconsin.

Koel, T.M. 1998. Channel catfish (*Ictalurus punctatus*) in the Upper Mississippi River System. Project Status Report 98-11. U.S. Geological Survey, Environmental Management Technical Center, Onalaska, Wisconsin.

Koel, T.M., and R.E. Sparks. 2002. Historical patterns of river stage and fish communities as criteria for operations of dams on the Illinois River. River Research and Applications 18:3-19.

Koel, T.M., R. Sparks, and R.E. Sparks. 1998. Channel catfish in the Upper Mississippi River System. Survey Report No. 353. Illinois Natural History Survey, Champaign.

Lamer, J. T., Sass, G. G., Boone, J. Q., Arbieva, Z. H., Green, S. J., and J. M. Epifanio. 2014. Restriction site-associated DNA sequencing generates high-quality single nucleotide polymorphisms for assessing hybridization between bighead and silver carp in the United States and China. Molecular Ecology Resources. 14(1):79-86

Lerczak, T.V., R.E. Sparks, and K.D. Blodgett. 1994. Some upstream-to-downstream differences in Illinois River fish communities. Transactions of the Illinois State Academy of Science 87(Supplement):53. (Abstract)

Lerczak, T.V. 1995. Fish community changes in the Illinois River, 1962-1994. American Currents

(Summer Issue).
Lerczak, T.V. 1995. The gizzard shad in nature's economy. Illinois Audubon. (Summer Issue). Reprinted in Big River 2(12):1-3.
Lerczak, T.V., and R.E. Sparks. 1995. Fish populations in the Illinois River. Pages 7-9 in G.S. Farris, editor. Our living resources 1994. National Biological Survey, Washington, D.C.
Lerczak, T.V., R.E. Sparks, and K.D. Blodgett. 1995. Long-term trends (1959-1994) in fish populations of the Illinois River. Transactions of the Illinois State Academy of Science 88 (Supplement):74. (Abstract)
Lerczak, T.V., R.E. Sparks, and K.D. Blodgett. 1995. Long-term trends (1959-1994) in fish populations of the Illinois River with emphasis on upstream-to-downstream trends. Proceedings of the Mississippi River Research Consortium 27:62-63.
Lerczak, T.V. 1996. Illinois River fish communities: 1960's versus 1990's. Illinois Natural History Survey Report No. 339.
Liss, S.A., G.G. Sass, and C.D. Suski. 2013. Spatial and temporal influences on the physiological condition of invasive silver carp. Conservation Physiology (2013) 1: doi:10.1093/conphys/cot017.
Liss, S.A., G.G. Sass, and C.D. Suski. 2014. Influence of local-scale abiotic and biotic factors on stress and nutrition in invasive silver carp. Hydrobiologia: doi: 10.1007/10750-014-1880-y
McClelland, M.A., M.A. Pegg, and T.W. Spier. 2006. Longitudinal Patterns of the Illinois Waterway Fish Community. Journal of Freshwater Ecology. 21/1:91-99.
Parker, J., J. Epifanio, A. Casper, and Y. Cao. 2015. The effects of improved water quality on fish assemblages in a heavily modified large river system. River Research and Applications. DOI: 10.1002/rra.2917
Pegg, M.A. and M.A. McClelland. 2004. Assessment of spatial and temporal fish community patterns in the Illinois River. Ecology of Freshwater Fish 13:125-135.
Pegg, M.A. 2002. Invasion and transport of non-native aquatic species in the Illinois River. Pages 203-209 in A.M. Strawn, editor. Proceedings of the 2001 Governor's conference on the management of the Illinois River System, Special Report Number 27, Illinois Water Resources Center, Champaign, Illinois.
Raibley, P.T., K.D. Blodgett, and R.E. Sparks. 1995. Evidence of grass carp (*Ctenopharyngodon idella*) reproduction in the Illinois and upper Mississippi Rivers. Journal of Freshwater Ecology 10:65-74.
Sparks, R.E. 1995. Value and need for ecosystem management of large rivers and their floodplains. Bioscience 45:168-182.
Sparks, R.E. 1995. Environmental effects. Pages 132-162 *in* S.A. Changnon, editor. The great flood of 1993. University Corporation for Atmospheric Research (UCAR) and Westview Press.

III. Essays

Pegg, M.A. 2002. Aquatic resource monitoring in the Upper Mississippi River Basin. INHS Reports. Number 371:8-9.

IV. Popular Articles

"Monitoring the Illinois River Fisheries." Greg G. Sass and Michael A. McClelland. Outdoor Illinois Magazine. XVII/12:18-19. December, 2009.

V. Technical Papers presented during F-101-R Segment 26 (presenters in bold, '*' denotes student presenter)

Miles*, C. R., J. A. DeBoer, and M. W. Fritts. 2015. Factors affecting the growth of Largemouth Bass in the upper Illinois River. Poster. The Nature Conservancy's Emiquon Science Symposium. Havana, IL.

Fritts, M. W., J. A. DeBoer, A. K. Fritts, K. A. Kellock, R. B. Bringolf, and A. F. Casper. 2015. Intersex condition in male Largemouth Bass from the Upper Illinois River Waterway. Poster. The Nature Conservancy's Emiquon Science Symposium. Havana, IL.

Gilliland*, C. R., M. W. Fritts, and J. A. DeBoer. 2015. Effects of body condition on fecundity of Largemouth Bass (*Micropterus salmoides*) in the Upper Illinois River Watershed. Poster. Midwest Fish and Wildlife Conference. Indianapolis, IN.

Parker, J, J. Epifanio, and Y. Cao. 2015. The long-term effects of improved water quality on predatory fishes in the Illinois River Waterway. Platform. Midwest Fish and Wildlife Conference. Indianapolis, IN.

Gilliland*, C. R., **M. W. Fritts, and J. A. DeBoer**. 2015. Effects of body condition on fecundity of Largemouth Bass (*Micropterus salmoides*) in the Upper Illinois River Watershed. Poster. Illinois Chapter of the American Fisheries Society, Annual Meeting. Pere Marquette, IL.

Miles*, C. R., J. A. DeBoer, and M. W. Fritts. 2015. Factors affecting the growth of Largemouth Bass in the upper Illinois River. Poster. Illinois Chapter of the American Fisheries Society, Annual Meeting. Pere Marquette, IL.

Fritts, M. W., J. A. DeBoer, A. K. Fritts, K. A. Kellock, R. B. Bringolf, and A. F. Casper. 2015. Intersex condition in male Largemouth Bass from the Upper Illinois River Waterway. Platform. 75th Annual Midwest Fish and Wildlife Conference. Indianapolis, IN.

Fritts, M. W., J. A. DeBoer, A. K. Fritts, K. A. Kellock, R. B. Bringolf, and A. F. Casper. 2015. Intersex condition in male Largemouth Bass from the Upper Illinois River Waterway. Platform. Illinois Chapter of the American Fisheries Society, Annual Meeting. Pere Marquette, IL.

Gibson-Reinemer, D.K., A.F. Casper, J.H. Chick, J.A. DeBoer, and M.W. Fritts. 2015. Resilient sportfish and vulnerable invaders: insights from six decades of sampling on the Illinois River. Platform. Illinois Chapter of the American Fisheries Society, Annual Meeting. Pere Marquette, IL.

Lubinski, B.J. and J.H. Chick. 2015. Variation in the community structure of fishes from main channel border habitat among reaches of the Mississippi and Illinois Rivers. Platform. Illinois Chapter of the American Fisheries Society, Annual Meeting. Pere Marquette, IL

Parker, J.L., J.A. DeBoer, and M.W. Fritts. 2015. Establishment of length-weight regressions for small Illinois fishes. Poster. Illinois Chapter of the American Fisheries Society, Annual Meeting. Pere Marquette, IL.

Miles*, C. R., **J. A. DeBoer**, M. W. Fritts, and A. F. Casper. 2015. Factors affecting the growth of Largemouth Bass in the upper Illinois River. Poster. Mississippi River Research Consortium. LaCrosse, WI.

Fritts, M. W., **J. A. DeBoer**, A. K. Fritts, K. A. Kellock, R. B. Bringolf, and A. F. Casper. 2015. Intersex condition in male Largemouth Bass from the Upper Illinois River Waterway. Poster. Mississippi River Research Consortium. LaCrosse, WI.

Miles*, C. R., J. A. DeBoer, M. W. Fritts, and **A. F. Casper**. 2015. Factors affecting the growth of Largemouth Bass in the upper Illinois River. Poster. International Society for River Science. LaCrosse, WI.

VI. Data Requests received during F-101-R Segment 26

1. Mike McClelland, Illinois Department of Natural Resources.
2. Katherine McCain, US Army Corps of Engineers
3. Brian Metzke, Illinois Natural History Survey
4. Bob Hrabik, Missouri Department of Conservation
5. Nick Bloomfield, US Fish and Wildlife Service, LaCrosse Fish and Wildlife Conservation Office
6. John Belcik, Graduate Researcher, Loyola University, Chicago
7. Ruairi MacNamara, Postdoctoral Research Associate, Southern Illinois University