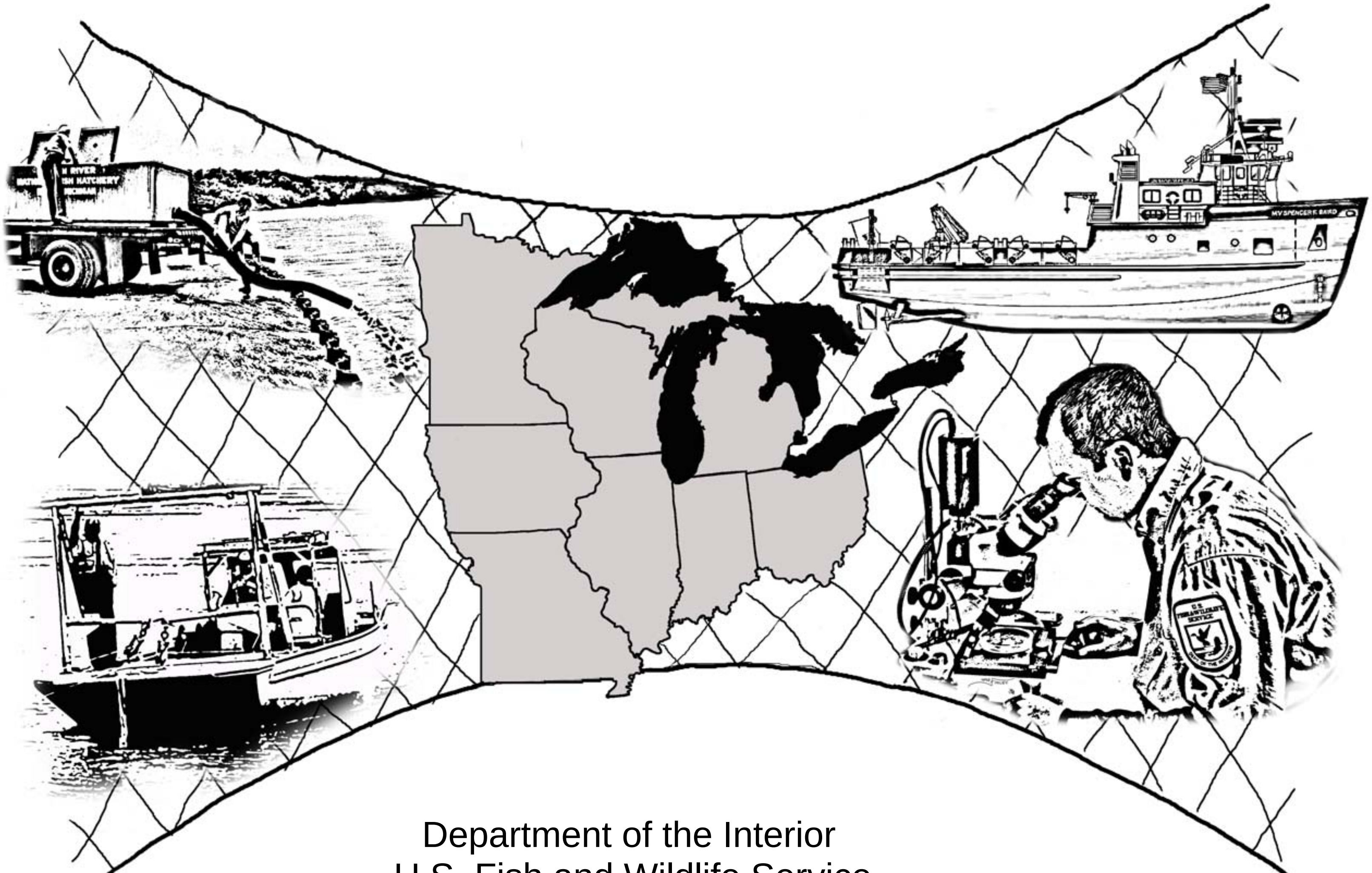
U.S. Fish & Wildlife Service

Region 3 Fisheries Data Series

FDS-2006-2

Fisheries Monitoring at Lock & Dam 22: July 2005 – May 2006



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U.S. Fish and Wildlife Service
Great Lakes-Big Rivers Region
Carterville Fishery Resources Office
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Introduction

The U.S. Army Corps of Engineers (USACE) Upper Mississippi River-Illinois Waterway System (UMR-IWW) Navigation Study was completed in September 2004 after more than 14 years of intensive study and evaluation of the navigation improvement and ecological restoration needs for the UMR-IWW system for the years 2000-2050. The final recommendation included a program of incremental implementation and comprehensive adaptive management to achieve the dual purposes of ensuring a sustainable natural ecosystem and navigation system. The program was initiated in 2005 as the working title of Upper Mississippi River (UMR) System Navigation and Ecosystem Sustainability Program (NESP) (USACE 2006).

A series of 29 navigation locks and dams is used to manage water levels on 1,033 km of the northern reach of the UMR. Dams impose at least partial barriers to passage of the 143 indigenous fishes (Pitlo et al. 1995) in the UMR (Fremling et al. 1989). Improving upriver fish passage through the navigation dams is recognized as a way to manage the UMR toward a more sustainable river ecosystem (UMRCC 2001; Wilcox et al. 2004). Under the NESP, an interdisciplinary and interagency Navigation Study Fish Passage Team was formed to study fish passage opportunities and alternatives at navigation dams on the UMR (Wilcox et al. 2004).

The Fish Passage Team selected Lock and Dam 22 near Saverton, Missouri as the location for one of the first fish passage projects on the UMR navigation system. The objective of this study was to determine the species composition of fish aggregations identified through hydroacoustics below Lock and Dam 22. This primarily qualitative study took place in 2005 and 2006, and was accomplished through cooperation with the USACE M/V Boyer. Prior to each sampling event, the M/V Boyer conducted hydroacoustic surveys at the dam to locate fish aggregations. These aggregations were then sampled to determine which species were being located by the M/V Boyer.

This report is a synopsis of our findings from July 2005 through May 2006. The tailwater area of Lock and Dam 22 was broken down into three general areas that were repeatedly sampled throughout the year. Results and discussion for each area are treated separately.

Study Site

The study site for this project was the tailwater area of Lock and Dam 22 near Saverton, Missouri. The M/V Boyer did not identify any large aggregations of fish at Lock and Dam 22. However, throughout all sampling periods, the M/V Boyer did identify three general areas below the lock and dam that repeatedly held fish based on hydroacoustic surveys. Site 1 was the deep scour hole below and parallel to the spillway (Figure 1). Site 2 was the area below the last gate, along the drop-off on the left descending bank side of the river, and perpendicular to the dam. This site included a small wing dike and its associated scour hole. In addition, a large eddy in the shallow area between the dam and Cottel Island created a current seam and complex flow patterns along the length of Site 2. Site 3 was along the right descending bank (RDB), generally below the public boat ramp. Some limited sampling was conducted in this area above the boat ramp and along the lock wall, but not enough to make generalizations about that area.

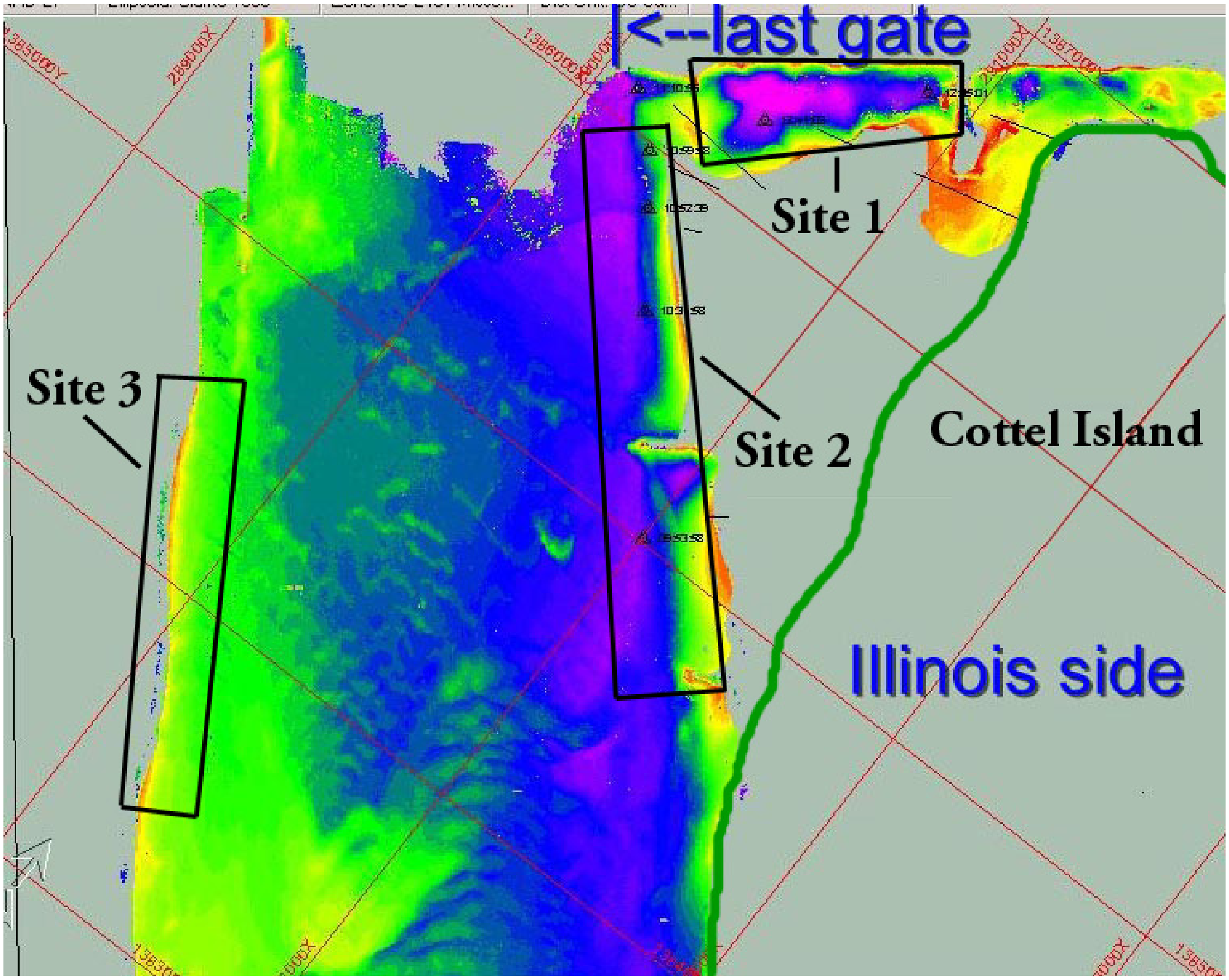

Figure 1. Bathymetric map of the Lock and Dam 22 tailwater area showing sampling sites for deep-water electrofishing and netting from July 2005 to May 2006.

Methods

Sampling methods for this project have evolved through time. The original intent for this project was to use only deep-water electrofishing for sampling fish aggregations below Lock and Dam 22. We used a 5000-W, 3-phase AC generator (Multi-Quip Model GDP 5000H) wired to three 1.2-m x 6.0-cm diameter electrodes constructed from galvanized steel fence posts. A 12-V powered relay was used with a dual dead-man safety switch system. Wires running to the individual electrodes were 16-ga. multi-strand copper wire. Ropes were used to suspend the electrodes and attach the wires. A chase boat was used to retrieve fish that surfaced away from the electrofishing boat, and each boat had one person to dip fish.

The first deep-water electrofishing attempts at another location in May 2005 was unsuccessful, likely due to high water temperature (22^{o}C) which increases the conductivity of fish but decreases their susceptibility to electrofishing. Deep-water electrofishing is not reputed to be effective in water temperatures over 20^{o}C (Jim Garvey, SIUC, pers. comm.). We then sampled the tailwater area of Lock and Dam 22 with a variety of gill and trammel nets. Nets used at Lock and Dam 22 included: 1) 5.1-cm bar mesh monofilament gill nets (45.7 m X 2.4 m), 2) experimental multifilament gill nets (30.5-m X 1.8 m), 3) 8.9-cm bar mesh trammel nets (91.4-m

X 2.4-m), and 4) 8.9-cm bar mesh floating trammel nets (91.4 m X 3.0 m) (See Table 1 for locations and dates). Nets were set on the bottom, at the surface, or drifted as needed to capture fish identified by the M/V Boyer. Deep-water electrofishing, rather than nets, was used at Lock and Dam 22 during November 2005. Cooler water temperatures (9.3-11.0°C) allowed this method to be used effectively during November while allowing us to target fish at specific depths including the middle of the water column.

Table 1. Net types used and dates of use at sampling sites below Lock and Dam 22 during July 2005 – May 2006. Net types include 1) monofilament gill, 2) experimental multifilament gill, 3) floating trammel, and 4) trammel.

Site	Dates			
	July 05	Nov 05	April 06	May 06
1	1[a], 1:2[b]	-	1:2[b]	1
2	1:2[b], 3[c]	-	1:2[b]	1, 2, 1:2[b], 4
3	-	-	-	2, 4

[a] surface set

[b] colon indicates tandem set

[c] drift

Similar to November 2005, the water temperatures during the April 2006 survey were also cool enough (~13.5°C) to make deep-water electrofishing effective. The intent for the April and May trips was to survey the tailwater of Lock and Dam 22 before and just after the river went to "open river" conditions. Unfortunately, the gates were pulled out of the water just minutes after the M/V Boyer completed its work in April 2006. As a result, we sampled twice during open river conditions. Deep-water electrofishing had proven to be moderately effective in capturing fish at various depths, but during the April 2006 survey, we found it was especially effective for fish that were on or near the substrate. As such, we electrofished along the bottom for much of the time we were sampling. In addition, we used gill nets to supplement the electrofishing catch. Water temperatures were warmer (17.3°C) during the May 2006 survey, so deepwater electrofishing was less effective. We concentrated our efforts on netting during this sample, using a combination of gill and trammel nets.

Results and Discussion

Site 1

The first trip by the M/V Boyer to Lock and Dam 22 in July 2005 showed a concentration of fish in the deep scour hole just below, and parallel to, the spillway. We used two tandem monofilament/ experimental multifilament gill nets, and one floating gill net set parallel to the spillway. The tandem nets were set overnight, while the floating gill net was set for approximately three hours. Netting in this location resulted in the capture of 164 fish representing seven species (Table 2). We captured 155 shovelnose sturgeon (*Scaphirhynchus platorynchus*) and two lake sturgeon (*Acipenser fulvescens*). The shovelnose sturgeon length range was 233 mm – 729 mm fork length. The remaining seven fish represented five species, and were primarily captured in an area where the end of the net extended into relatively shallow water (~1.5 m).   These fish included one striped bass (*Morone saxatilis*), one quillback (*Carpoides cyprinus*), and one shorthead redhorse (*Moxostoma macrolepidotum*).

Table 2. Totals and species of fish captured at Site 1 below Lock and Dam 22 during July 2005 – May 2006. Asterisks denote migratory species as defined in Wilcox et al. (2004).

Species	July 2005	November 2005	April 2006	May 2006	Total
Channel catfish, *Ictalurus punctatus**		2	14		16
Flathead catfish, *Pylodictis olivaris**				2	2
Freshwater drum, *Aplodinotus grunniens**	3	3	100	2	108
Gizzard shad, *Dorosoma cepedianum*			7		7
Goldeye, *Hiodon alosoides**	1				1
Lake sturgeon, *Acipenser fulvescens**	2		1		3
Paddlefish, *Polydon spathula**		1			1
Quillback, *Carpoides cyprinus**	1				1
River carpsucker, *Carpoides carpio*			1		1
Shorthead redhorse, *Moxostoma macrolepidotum**	1				1
Shovelnose sturgeon, *Scaphirhynchus platorynchus**	155	2	21	13	191
Silver chub, *Macrhybopsis storeriana*			1		1
Smallmouth buffalo, *Ictiobus bubalus**			3		3
Striped bass, *Morone saxatilis*	1				1
White bass, *Morone chrysops**			2		2
Total	**164**	**8**	**150**	**17**	**339**

Although fish were marked throughout the water column in this area during November 2005, there were no major aggregations identified. We electrofished this site at depths of up to 9 m for a total of 64 min., and captured only eight fish. The sample included two channel catfish (*Ictalurus punctatus*), three freshwater drum (*Aplodinotus grunniens*), one paddlefish (*Polydon spathula*) and two shovelnose sturgeon. Although we observed more sturgeon while electrofishing than we caught, the presence of shovelnose sturgeon in this sample indicated that the deep-water electrofishing was operating efficiently enough to capture benthic fish in water up to nine meters deep.

Similar to the previous samples, the M/V Boyer marked fish in this area during the April and May 2006 trips, but no large aggregations were present. We captured 150 fish during the April 2006 survey. The most abundant species were freshwater drum (N = 100), shovelnose sturgeon (N = 21), and channel catfish (N = 14). Only 17 fish were captured during the May 2006 sample, with the most abundant species being shovelnose sturgeon (N = 13).

Throughout the year we captured 15 species in this area including three lake sturgeon, one paddlefish, and 191 shovelnose sturgeon. Shovelnose sturgeon accounted for 56% of the overall catch (N = 339), and freshwater drum (N = 108) accounted for 32% of the catch. Of the 37 Upper Mississippi River “migratory” species identified in Wilcox et al. (2004), we caught 11 in this site. With the exception of shovelnose sturgeon and freshwater drum, however, these species were represented by few individuals. The shovelnose sturgeon exhibited a wide range of sizes but the majority of the freshwater drum were less than 300 mm total length (Figures 2-3).

The level of netting effort expended at this site was inconsistent, so only examining the total catch of shovelnose sturgeon could be misleading. However, the catch-per-unit effort (CPUE) for shovelnose sturgeon was consistent with the catch results. It was substantially higher in July 2005 (38.8 fish/net night) than in April (10.5 fish/net night) and May 2006 (13 fish/net night) This shows that the sturgeon were more abundant at this site in July 2005 than during any other sample. Further discussion and our recommendations for this site are included with the discussion of Site 2.

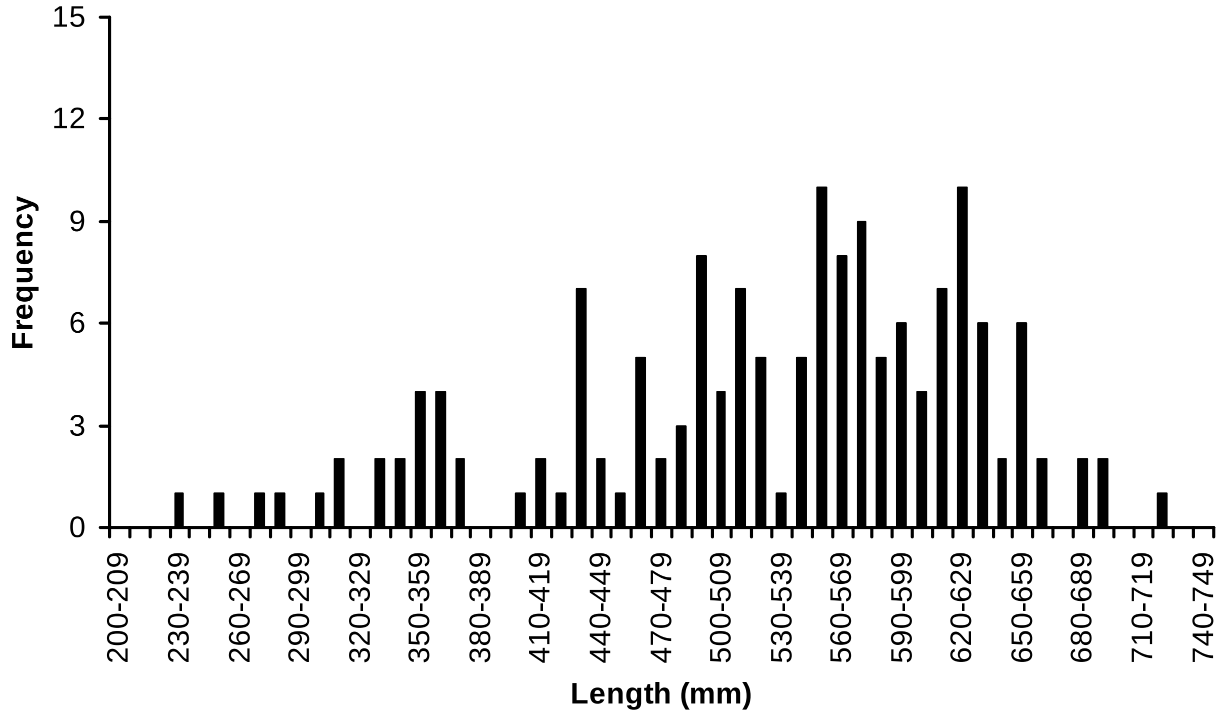

Figure 2. Length-frequency distribution for shovelnose sturgeon (*Scaphirhynchus platorynchus*; n = 191) captured at Site 1 below Lock and Dam 22 during July 2005 – May 2006.

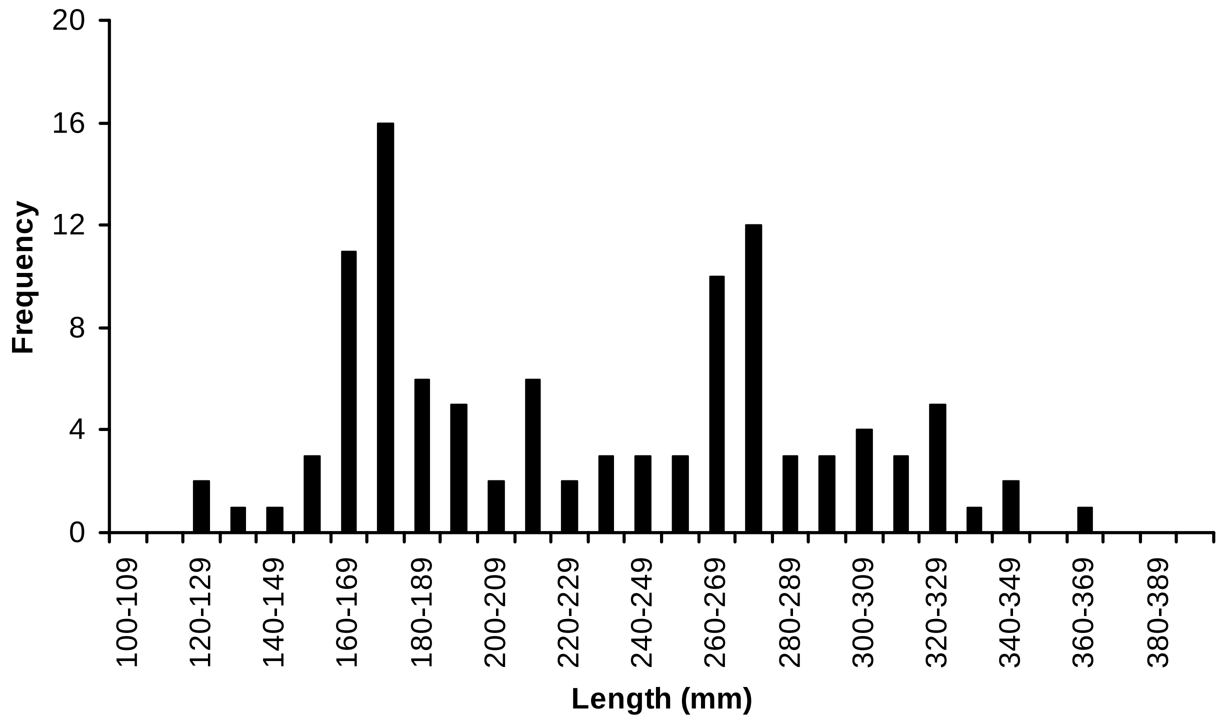

Figure 3. Length-frequency distribution for freshwater drum (*Aplodinotus grunniens*; n = 108) captured at Site 1 below Lock and Dam 22 during July 2005 – May 2006.

<u>Site 2</u>

Although there were never any major aggregations of fish located below Lock and Dam 22, Site 2 was where the most fish were located during each sampling trip. Fish appeared to be attracted to the drop-off and the complex flow patterns associated with it. During the first trip in July 2005, we used three tandem monofilament/ experimental multifilament gill nets, and one floating trammel net. The tandem nets were set overnight, while the trammel net was drifted for four 30-min. periods. Netting at Site 2 resulted in the capture of 82 fish from seven species (Table 3). We captured 75 shovelnose sturgeon and two lake sturgeon. The shovelnose sturgeon length range was 248 mm – 706 mm fork length.

Similar numbers of fish were located in this area during November 2005. The M/V Boyer marked fish along the drop-off at depths up to 7 m. We captured 60 fish from eight species at this site. The sample included 26 freshwater drum and 23 white bass (*Morone chrysops*). Most of the fish captured at this site were captured when the electrodes ran along the substrate on and near the drop-off slope.

Like the previous samples, the M/V Boyer marked fish along the drop-off in this area during the April and May 2006 trips (Figure 4). We captured 129 fish during the April 2006 survey. The most abundant species were gizzard shad (*Dorosoma cepedianum*; N = 40), channel catfish (N = 25), freshwater drum (N = 21), and shovelnose sturgeon (N = 23). We captured 273 fish during the May 2006 sample, with shovelnose sturgeon (N = 249) being the primary species captured. Eight species made up the remaining 24 fish in the sample.

Table 3. Totals and species of fish captured at Site 2 below Lock and Dam 22 during July 2005 – May 2006. Asterisks denote migratory species as defined in Wilcox et al. (2004).

Species	July 2005	November 2005	April 2006	May 2006	Total
Bighead carp, *Hypophthalmichthys nobilis**	1			1	2
Channel catfish, *Ictalurus punctatus**		4	25	1	30
Common carp, *Cyprinus carpio*				1	1
Flathead catfish, *Pylodictis olivaris**			2	1	3
Freshwater drum, *Aplodinotus grunniens**	1	26	21	6	54
Grass carp, *Ctenopharyngodon idella*	1				1
Gizzard shad, *Dorosoma cepedianum*		1	40	6	47
Goldeye, *Hiodon alosoides**	1				1
Lake sturgeon, *Acipenser fulvescens**	2		1	7	10
Paddlefish, *Polydon spathula**			1		1
Quillback, *Carpoides cyprinus**			6		6
River carpsucker, *Carpoides carpio*			2		2
Sauger, *Sander canadensis**		1	4		5
Shorthead redhorse, *Moxostoma macrolepidotum**		1			1
Shortnose gar *Lepisosteus platostomus*	1			1	2
Shovelnose sturgeon, *Scaphirhynchus platorynchus**	75	1	23	249	348
Silver chub, *Macrhybopsis storeriana*			1		1
Walleye, *Sander vitreum**		3			3
White bass, *Morone chrysops**		23	2		25
Yellow bass, *Morone mississippiensis**			1		1
Total	**82**	**60**	**129**	**273**	**544**

We captured 20 species in this area during July 2005 – May 2006 including 10 lake sturgeon, one paddlefish, and 348 shovelnose sturgeon. Shovelnose sturgeon accounted for 64% of the overall catch (N = 544). The next most abundant species were freshwater drum (N = 54) and gizzard shad (N = 47). Fourteen of the 20 species we captured at this site were classified as migratory by Wilcox et al. (2004). Similar to Site 1, with the exception of shovelnose sturgeon and freshwater drum, these species were represented by few individuals.

Similar to Site 1, the most abundant species in the overall sample at Site 2 was shovelnose sturgeon (N = 348). Also like Site 1, the shovelnose sturgeon exhibited a wide range of sizes (Figure 5). The CPUE for shovelnose sturgeon at this site was 12.5 fish/net night during July 2005, 11.5 fish/net night during April 2006, and 31.1 fish/net night during May 2006. These results are inconsistent with the CPUEs at Site 1. Given these results, we wish to refrain from any speculation regarding seasonal aggregations of shovelnose sturgeon at either one of these sites.

We believe that Site 1, which consists primarily of a large, deep scour hole, may be attractive to fish because of the of the depth diversity available in this site. Site 1 is not a slack water area due to the fact that the upper end of the large eddy flows through it, but it does not have the velocity present in Site 2. Site 2 has greater flow diversity than Site 1 and has similar depth diversity. Site 2 (S = 20) has greater species richness than Site 1 (S = 15), but three of the additional species were invasive carps. The upper end of Site 2 would be ideal for a fish passage structure, but given its proximity to Site 2, the west end of Site 1 would be suitable as well.

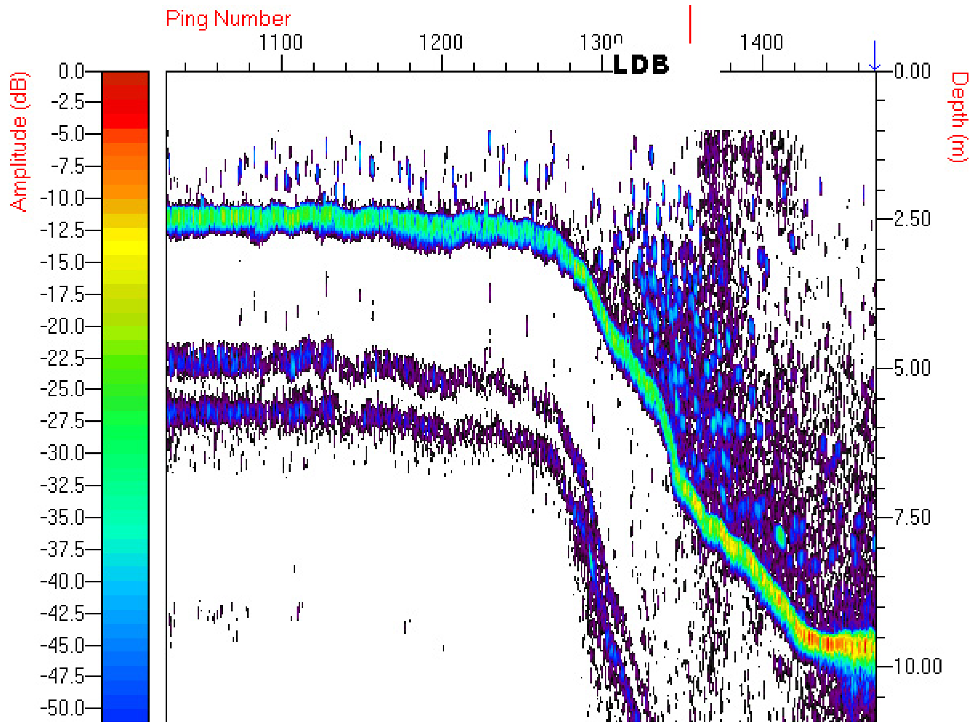

Figure 4. Hydroacoustic output from the M/V Boyer at Site 2 below Lock and Dam 22 during April 2006.

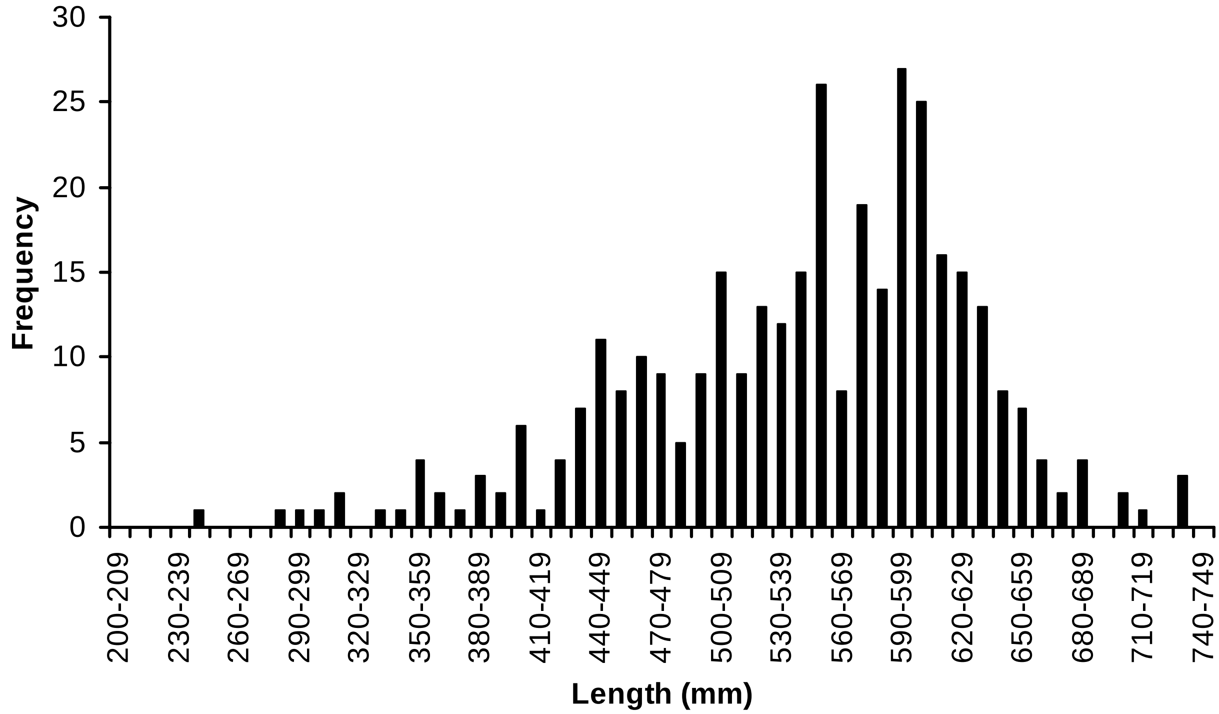

Figure 5. Length-frequency distribution for shovelnose sturgeon (*Scaphirhynchus platorynchus*; n = 348) captured at Site 2 below Lock and Dam 22 during July 2005 – May 2006.

Current proposals for fish passage structures at Lock and Dam 22 require that the scour hole in Site 1 be at least partially filled in. This allows for the entrance to the structure to be located near the last gate on the dam. Although part of Site 1 would be lost as a result, we do not feel that this would have a substantial negative effect on the fish community below Lock and Dam 22. We feel that the entrance to any fish passage structure needs to be close to the dam gates in order to attract fish, and we feel that the drop-off below the last gate may serve as a natural guide for fish migrating upriver.

<u>*Site 3*</u>

The M/V Boyer marked few fish in Site 3 during July 2005, so no sample was taken there. During the remaining sampling periods, Site 3 held fewer fish than the other sites. Fish that were in this site were typically located along the shoreline below the lock wall. The November 2005 and April 2006 samples produced similar results. Only eight fish from two species were captured during the November sample, and 40 fish from five species were captured during the April sample (Table 4). The most abundant species during the April sample were gizzard shad (N = 22) and freshwater drum (N = 10).

Table 4. Totals and species of fish captured at Site 3 below Lock and Dam 22 during July 2005 – May 2006. Asterisks denote migratory species as defined in Wilcox et al. (2004).

Species	July 2005	November 2005	April 2006	May 2006	Total
Bighead carp, *Hypophthalmichthys nobilis**				1	1
Blue catfish, *Ictalurus furcatus**	N			1	1
Bluegill, *Lepomis macrochirus**	O			1	1
Channel catfish, *Ictalurus punctatus**		3	5	9	17
Common carp, *Cyprinus carpio*	S			3	3
Emerald shiner *Notropis atherinoides**	A			1	1
Flathead catfish, *Pylodictis olivaris**	M			1	1
Freshwater drum, *Aplodinotus grunniens**	P	5	10	44	59
Gizzard shad, *Dorosoma cepedianum*	L		22	18	40
Golden redhorse, *Moxostoma erythrurum**	E			1	1
Lake sturgeon, *Acipenser fulvescens**			1	1	2
Quillback, *Carpoides cyprinus**				6	6
River carpsucker, *Carpoides carpio*				6	6
Sauger, *Sander canadensis**				3	3
Shorthead redhorse, *Moxostoma macrolepidotum**				1	1
Shovelnose sturgeon, *Scaphirhynchus platorynchus**				17	17
Silver chub, *Macrhybopsis storeriana*			2		2
Smallmouth buffalo, *Ictiobus bubalus**				1	1
White bass, *Morone chrysops**				3	3
Yellow bass, *Morone mississippiensis**				1	1
Total		**8**	**40**	**119**	**167**

During the May 2006 sample we captured 119 fish from 19 species at this site. The most abundant species were freshwater drum (N = 44), gizzard shad (N = 18), and shovelnose sturgeon (N = 17). We wish to note that this was the first and only time that this location was netted, and the nets accounted for 35 fish including all of the shovelnose sturgeon. The electrofishing sample was composed primarily of common riverine species with the exception of the single lake sturgeon captured in May 2006

Based on the information gathered to date, we would not recommend Site 3 for any type of fish passage structure. Although this area would be targeted for assisted fish lockage, Site 3 does not have the depth or the current velocity that exists at or near the other sites. In addition, Site 3 does not appear to attract numbers of the species that would most likely be the targets of a fish passage structure (sturgeons, paddlefish). Although some of these fish were captured in this site, Sites 1 and 2 attract them in greater numbers.

Recommendations

We recommend Site 1 and 2 for a fish passage structure at Lock and Dam 22. Proposed plans include structures that will encompass portions of both of these sites. At this time we do not recommend Site 3 as a suitable site for a fish passage structure.

We recommend that additional sampling be conducted at Lock and Dam 22 in order to learn more about the fish community below the dam at different times of the year under different annual water regimes. What we saw in 2005-2006 may not be what we would see in a year with a different water regime. We were unable to sample the tailwater in the spring of 2006 before the dam went to "open river" conditions. We don't know how many fish were there in the weeks leading up to that event. As such, we were unable to determine if the fish that congregate below the dam were simply able to pass through the gates. Ideally, we would focus our efforts during the spring when most migratory fish would be moving upriver. When water temperature is below 20^{o}C, a combination of deep-water electrofishing and netting will be used to collect future samples. Netting alone will be used when water temperatures are $\geq 20^{o}$C.

Regardless of the sampling regime selected for FY 2007, we feel that the Fish Passage Team should also discuss, and possibly redefine, the goals of this project. To date the project has been largely *qualitative*. This is acceptable as long as that is what we are looking for. If we simply want to know what fish the M/V Boyer is marking, we believe we have accomplished that. We have learned some very valuable information about the fish community below the dam. We could improve on the qualitative study by intensifying sampling at Sites 1 and 2 and reducing sampling at Site 3. By focusing our work on fewer areas below the dam we could follow even more closely behind sampling by the M/V Boyer which can be critical when the river approaches open river conditions.

If a *quantitative* approach is desired, we should reevaluate our methods. Until now, the M/V Boyer has mapped concentrations of fish, and we have attempted to sample those concentrations through whatever means was necessary. As previously discussed, sampling methods were inconsistent and have evolved over time. This prevents most quantitative analyses due to the bias introduced by continually changing methods. At this point we cannot even legitimately determine a necessary sample size to detect a change for a given species because the samples we have taken thus far are not similar. In order to make this a quantitative study to examine changes brought about by a fish passage structure, we would need to develop a consistent sampling protocol and would have to be less flexible in response to the information we receive from the Boyer. In short, the team needs to use the information we have gathered to date, and determine what course of action may be most beneficial to the project.

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