Aquatic Invasive Species Monitoring Project

Year 2008 Report

To the

Fox River Navigational System Authority

By

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Objectives

As stated in the Aquatic Invasive Species (AIS) Control and Monitoring Plan of the Fox River Navigational System Authority (FRNSA, April 2006 version, Appendix B), the objective of the Rapide Croche AIS Monitoring Plan is to "monitor the presence and map the distribution of fish and invertebrate AIS in the Fox River two pools immediately up and downstream of Rapide Croche Lock."

Following consultation with the AIS Committee in 2007, the plan was amended to include sampling of three navigation pools immediately upstream and downstream of the Rapide Croche Lock. The project was conducted under the supervision of Dr. Bart De Stasio, Ph.D., of the Department of Biology, Lawrence University, Appleton, WI. Three students were employed during summer 2008 on the project: one was funded by the FRNSA, and two by Lawrence University (one from the Excellence in Science Fund and the other through the Wisconsin Alliance for Minority Participation (WiscAMP) grant).

Sampling Design

Monitoring occurred at six sites along the lower Fox River, WI during the summer of 2008. These sites were extensions of the six sites sampled in 2006 and 2007, with two sites remaining the same as in previous years. One site above and one below the Rapide Croche lock and dam (FR-3 and FR-6, respectively) were the same as those sampled in 2006 and 2007 (Tables 1 & 2, Figure 1). Each sampling site designated a general area for sampling efforts, and was further separated into mid-channel versus near-shore sampling locations, depending on the type of sampling performed. Extremely high water and fast currents delayed sampling efforts during the summer of 2008 until the second week of July. After that time we conducted 20 different sampling trips on 14 days during the summer (Table 3). Separate boats were employed upstream and downstream of the Rapide Croche dam site on each date. Upstream and downstream locations were sampled on different days, and all nets and equipment were sanitized thoroughly using bleach prior to the next sampling event according to the protocols established by the WI DNR to prevent the spread of AIS (http://dnr.wi.gov/fish/documents/disinfection_protocols.pdf).

Table 1. Latitude and Longitude coordinates of the six sites sampled along the lower Fox River, WI during summer 2006 and 2007.

Location	Latitude	Longitude
Upstream of Rapide Croche		
FR-1	N 44° 18.887	W 88° 12.691
FR-2	N 44° 18.889	W 88° 12.576
FR-3	N 44° 19.077	W 88° 11.962
Downstream of Rapide Croche		
FR-4	N 44° 18.947	W 88° 11.413
FR-5	N 44° 18.952	W 88° 11.022
FR-6	N 44° 19.238	W 88° 10.531

Table 2. Latitude and Longitude coordinates of the six sites sampled along the lower Fox River, WI during summer 2008.

Location	Latitude	Longitude
Upstream of Rapide Croche		
FR-A (above Cedar lock)	N 44° 16.562	W 88° 20.541
FR-B (above Kaukauna Guard lock)	N 44° 16.665	W 88° 17.042
FR-3 (above Rapid Croche lock)	N 44° 19.077	W 88° 11.962
Downstream of Rapide Croche		
FR-6 (Wrightstown Boat Launch)	N 44° 19.238	W 88° 10.531
FR-C (above DePere dam)	N 44° 25.813	W 88° 04.273
FR-D (below DePere dam)	N 44° 27.742	W 88° 03.354

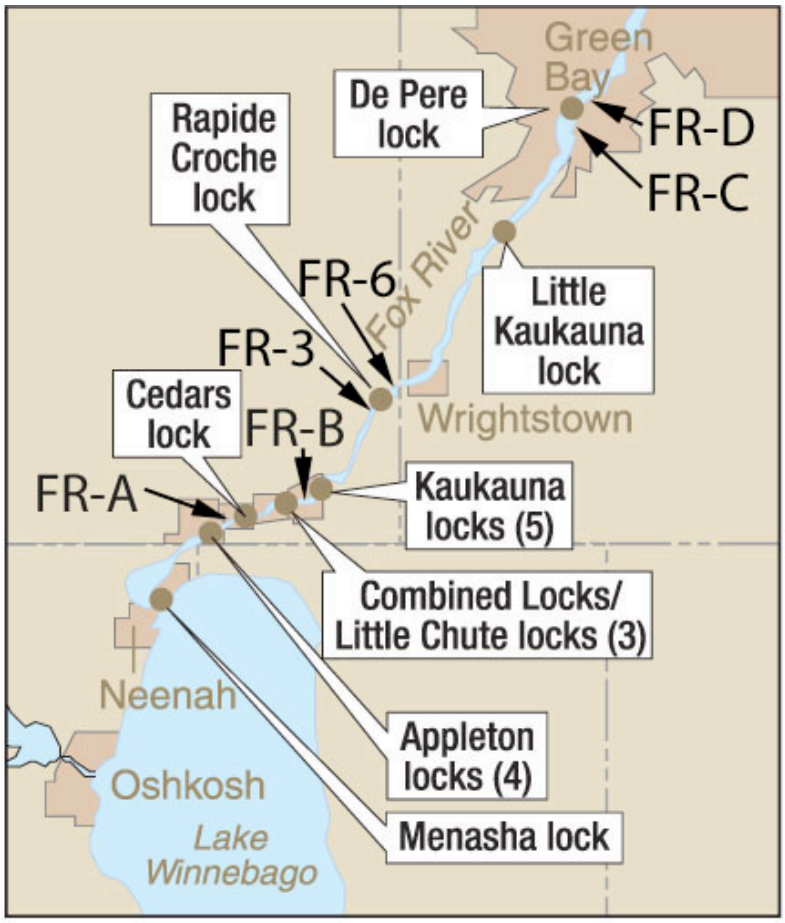

Figure 1. Map of sampling locations along the lower Fox River, WI during summer 2008.

Table 3. Sampling effort upstream and downstream of the Rapide Croche dam on the lower Fox River, WI during summer 2008. Dates on which sampling was performed are indicated for each type of sampling effort. Totals indicate the total number of days sampled, and for fish trapping, the total number of hours of effort in trapping.

Date and Site	Dip Net	Plankton Tow	Benthic Grab	Seine Netting	Fish Trap
7/08 FR A	X	X	X		
7/08 FR B	X				
7/10 FR B	X	X	X		
7/10 FR 6	X	X	X		
7/16 FR 3	X	X	X		
7/17 FR C	X	X	X		
7/17 FR D	X	X	X		
7/21 FR A	X	X			
7/23 FR 6	X	X	X		
7/29 FR B	X	X		X	
7/30 FR 3	X	X		X	
8/15 FR A	X	X		X	
8/19 FR 3				X	X
8/19 FR 6				X	X
8/20 FR 6				X	
8/21 FR D	X	X		X	X
8/21 FR C	X	X		X	X
8/22 FR D				X	
8/25 FR A				X	X
8/25 FR B				X	X
TOTALS	14 days	13 days	7 days	11 days	144 hr
Upstream	8	8	3	6	72 hr
Downstream	6	5	4	5	72 hr

Sampling Activities

Plankton: On each sampling date duplicate oblique tows were performed at the mid-channel location of each site using a Wisconsin-type plankton net with retaining collar (mouth diameter=0.13m, mesh size=63 um). Samples were preserved in 80% ethyl alcohol and examined in the laboratory using 10X to 400X magnification. All zooplankton in the samples were identified to the species level, when possible, using Edmonson (1965), Balcer et al. (1984), Pennak (1989), Hopkins (1990), and Thorp and Covich (1991). Abundances in samples were not enumerated, but entire samples were examined to determine presence of each species.

Benthic invertebrates: Mid-channel areas were sampled using a standard Ekman grab sampler (0.15m X 0.15m box size). Duplicate grab samples were collected at each site and filtered through a wash bucket with mesh bottom (mesh size=500um). Both

shoreline areas at each site were sampled with a combination of dip netting and beach seining techniques. Animals captured were washed into sorting trays and transferred with forceps to bottles with 80% ethyl alcohol preservative. Specimens were identified in the laboratory to the species level, where possible, using the references listed above for plankton identifications and Hilsenhoff (1995).

Invertebrates that attach to solid substrates from a planktonic phase (i.e. zebra and quagga mussel veligers, *Dreissena polymorpha* and *D. bugensis*) were sampled using floating periphyton samplers. Each sampler contained 16 glass slides suspended in the water, onto which organisms settled. Samplers were anchored at each of the sites upstream and downstream of the Rapide Croche dam for two-week sampling periods (Table 4). Glass slides were removed at the end of each two-week period and preserved in 80% ethyl alcohol. Specimens on the slides were identified to the species level, when possible, using the references listed previously.

Table 4. Sampling periods during 2008 for periphyton samplers at six stations upstream and downstream of the Rapide Croche dam in the lower Fox River, WI.

Location	Dates
FR-A	7/21 - broken
FR-B	7/10 – 7/29
FR-3	7/16 – 7/30
FR-6	7/10 – 7/23
FR-C	7/17 - lost
FR-D	7/17 – 8/21

Fish: Fish were sampled at each of the sites using a combination of trapping and seining techniques. Three sizes of cod-end type traps were employed; standard "minnow" traps (length=0.42m, opening=22mm, mesh=6.4mm), elongated eel traps (length=0.78m, opening=40mm, mesh=6.4mm), and larger hand-made traps of the same design (length=2m, opening=125mm, mesh= 12.5mm). Traps were deployed for a maximum of 24 hours, emptied, and redeployed during three different periods of the summer (see Table 3). Traps were set with and without bait (cheese, bread, frozen fish, glow sticks) on different dates to optimize the potential catch. Trapping included mid-channel as well as shoreline locations at each site. If possible, specimens were identified in the field to the species level and then released. Specimens of new species compared to existing records or specimens difficult to identify in the field were saved live for later identification in the laboratory. Upon return to the laboratory specimens were transferred to ethyl alcohol (70%) for long-term preservation. Specimens were identified to the species level when possible, using Hubbs and Lagler (2004), Lyons et al. (2000), and the Wisconsin Fish ID software (2005).

Results

Fish:

A total of 20 species of fish were collected from the six sites during the summer of 2008 (Table 5). All 20 species were observed downstream of the Rapide Croche dam,

while only 10 out of the 20 species were found upstream of Rapide Croche. Only one invasive fish species, the round goby (*Neogobius melanostomus*), was documented during the summer. This species was found only at the sites above and below the DePere dam (FRC and FRD). As in previous years the common carp is a well-established non-native species found throughout all of the areas sampled in the Fox River. No sea lamprey (*Petromyzon marinus*) were collected at any sites during 2008. Seining was a more effective technique for sampling fish than the traps. Only two of the 20 fish species recorded was ever observed in our traps (Johnny darter and juvenile Bluegill).

Table 5. Fish species documented in the lower Fox River, WI upstream and downstream of the Rapide Croche dam during summer 2008. The round goby (highlighted) is the only invasive fish species observed.

Upstream	**Downstream**
	Skipjack herring (*Alosa crysochloris*)
Rock bass	Rock bass (*Ambloplites rupestris*)
	Freshwater drum (*Aplodinotus grunniens*)
Common carp	Common carp (*Cyprinus carpio*)
	Bluntnose darter (*Etheostoma chlorosoma*)
Johnny darter	Johnny darter (*Etheostoma nigrum*)
Green sunfish	Green sunfish (*Lepomis cyanellus*)
Bluegill	Bluegill (*Lepomis macrochirus*)
Smallmouth bass	Smallmouth bass (*Micropterus dolomieu*)
Largemouth bass	Largemouth bass (*Micropterus salmoides*)
	Round goby(*Neogobius melanostomus*)
Emerald shiner	Emerald shiner (*Notropis atherinoides*)
	Blacknose shiner (*Notropis heterolepis*)
Spottail shiner	Spottail shiner (*Notropis hudsonius*)
	Mimic shiner (*Notropis volucellus*)
Yellow perch	Yellow perch (*Perca flavescens*)
	Trout-perch (*Percopsis omiscomaycus*)
	Bluntnose minnow (*Pimephales notatus*)
	Fathead minnow (*Pimephales promelas*)
	Walleye (*Sander vitreus*)

Benthic Invertebrates:

As observed in all previous years, there were more groups of benthic invertebrates observed downstream than upstream of the Rapide Croche dam (Table 6). Of the 22 groups documented downstream of the dam, three are considered aquatic invasive species. These are the zebra mussel, the Rusty crayfish, and an amphipod, *Echinogammarus ischnus*. Zebra mussels and Rusty crayfish were also collected from the sites above the Rapide Croche. Zebra mussels were especially abundant in many

Table 6. Benthic invertebrate taxa documented upstream and downstream of the Rapide Croche dam during summer 2008. Highlighted groups are considered "invasive" species.

Upstream	Downstream
	Anax sp. (dragonfly)
Argia sp. (damselfly)	*Argia sp.* (damselfly)
Belastoma sp. (Giant waterbug)	*Belastoma sp.* (Giant waterbug)
Buenoa sp. (water boatman)	*Buenoa sp.* (water boatman)
Caddisfly larvae (on periphyton samplers)	Caddisfly larvae (on periphyton samplers)
	Caecidotea sp. (isopod)
Chironomus sp. (midge fly)	*Chironomus sp.* (midge fly)
Coenagrion sp. (damselfly)	
Crangonyx sp. (amphipod)	*Crangonyx sp.* (amphipod)
Dreissena polymorpha (zebra mussel)	*Dreissena polymorpha* (zebra mussel)
	Echinogammarus ischnus (amphipod)
Enallagma sp. (damselfly)	*Enallagma sp.* (damselfly)
Gammarus sp. (amphipod)	*Gammarus sp.* (amphipod)
Gerridae (water strider)	*Gerridae* (water strider)
	Hyalella azteca (amphipod)
	Ischnura sp. (damselfly)
	Laccophilus sp. (water beetle)
	Limnogonus sp. (water strider)
	Monoporeia sp. (amphipod)
	Nehalennia sp. (damselfly)
Notonecta sp. (backswimmer)	*Notonecta sp.* (backswimmer)
Orconectes rusticus (Rusty crayfish)	*Orconectes rusticus* (Rusty crayfish)
Sialis sp. (alderfly)	*Sialis sp.* (alderfly)

areas, and the Rusty crayfish was very abundant in most shoreline areas. The amphipod *E. ischnus* was found in high abundances both above and below the DePere dam, but not at any other sites sampled. Ours is the first documentation of this AIS in the Fox River. Its presence was reported to the US Geological Survey Nonindigenous Aquatic Species Monitoring Program website (http://nas.er.usgs.gov/ARCIMS/interactive/interactive.asp?SpeciesID=23).

Plankton:

The compositions of the zooplankton communities were more similar upstream and downstream of the Rapide Croche dam than was the case for either fish or benthic

invertebrates (Table 7). A total of 12 species of zooplankton were recorded in 2008, with the majority of them occurring in both locations. Ten groups occurred upstream while 12 taxa were found at sites downstream of the Rapide Croche dam. None of the groups identified are considered aquatic invasive species at this time.

Table 7. Zooplankton documented from sites upstream and downstream of the Rapide Croche dam during Summer 2008. None of the groups observed are considered "invasive" species.

Upstream	Downstream
Acanthocyclops vernalis	*Acanthocyclops vernalis*
	Asplanchna sp.
Bosmina sp.	*Bosmina sp.*
	Brachionus sp.
Chydorus sp.	*Chydorus sp.*
Daphnia mendotae	*Daphnia mendotae*
Diacyclops thomasi	*Diacyclops thomasi*
Keratella sp.	*Keratella sp.*
Leptodiaptomus sicilis	*Leptodiaptomus sicilis*
Leptodiaptomus siciloides	*Leptodiaptomus siciloides*
Mesocyclops edax	*Mesocyclops edax*
Skistodiaptomus oregonensis	*Skistodiaptomus oregonensis*

Outreach

We continue to manage a website that is specific for the Aquatic Invasive Species Monitoring Program (http://www.lawrence.edu/dept/biology/FRNSA). The site contains descriptions of our sampling design and procedures, past and current data on presence and absence of species, and links to related web pages and resources. Eventually we envision this website being the primary location for dissemination of our findings to the public with an interest in the Fox River Locks AIS project.

In addition we also presented our 2006 and 2007 results at the Fox-Wolf Watershed Alliance Research Symposium (November 2007) and at the Lawrence University Earth Day Fair (April 2008). We also presented our 2006-2008 results at the Lawrence University Research Symposium (October 2008).

Suggested Modifications

Our methodology for sampling plankton and benthic invertebrates appears to be giving us good assessment of the taxa present in each of the sites. The expansion of the sampling sites further upstream and downstream of the Rapide Croche dam increased the number of fish species we documented compared to the two previous years of monitoring (2006: 18 species, 2007: 13 species, 2008: 20 species). Much of this resulted from samples collected above and below the DePere dam. Other invasive species that have been shown in the past to be resident in the lower Fox River below the Rapide Croche dam were again not observed (Cochran 1994, Cochran and Hesse 1994, ThermoRetec 2001, WI DNR 2001). These would include species such as sea lamprey (*Petromyzon*

marinus) and white perch (*Morone americana*), both of which have been recorded in Green Bay and the lower Fox River. Due to the late start of our sampling because of high water and fast current conditions it is not surprising that we did not catch sea lamprey below the DePere dam. Previous work has shown that adults occur primarily during spring and early summer when present (Cochran 1994). Overall, our sampling for fish appears to be providing a species list comparable to previous work on the lower Fox River. Fish species composition data from the mid 1990s used by the WI DNR in developing the Lower Fox River Integrated Management Plan indicated 24 main fish species in the stretch of river corresponding to our sampling efforts (not counting 11 species that were extremely rare and only occasionally discovered). Our total list of species recorded over the past three years is 24 species and compares well with the previously reported data.

Based on our three years of sampling experiences, it is clear that this project requires at least two student workers for the entire summer. Once trained, two students are fully capable of conducting all the sampling on their own, but it is important to have at least two individuals in the boat while sampling, both for logistical as well as safety reasons. I am not being paid for my time on this project, and training the students in the field, supervising their work in the laboratory and checking identifications is about the limit of my available time for this project. Therefore, having two students hired on the project is essential. Fortunately I have been able to secure grants from Lawrence University to hire additional students for the project for the past three years, but this will not likely be possible each year. As a result I am requesting that the budget be modified to enable us to hire a total of at least two students each summer instead of just one.

Conclusions

The sampling for aquatic invasive species in the lower Fox River to date has demonstrated that some invasive species are already present both upstream and downstream of the Rapide Croche dam. Both zebra mussels and Rusty crayfish were present at all sites examined above and below the dam in all years examined. During 2008 our extended coverage of navigational pools resulted in documenting two additional AIS downstream of Rapide Croche, the round goby and the amphipod *Echinogammarus ischnus*. Our data do not show the presence of other invasive fish species that have been observed below the dam previously (e.g. sea lamprey, white perch). Based on our results to date, it is apparent that our continued efforts should provide an early warning of additional AIS that become established in the lower Fox River in the navigational pools upstream and downstream of the Rapide Croche dam. In addition, they will provide a solid baseline against which we can compare future changes in the composition of fish and invertebrates in the river.

References Cited

Balcer, M.D., N.L. Korda, and S.I. Dodson. 1984. Zooplankton of the Great Lakes: A Guide to the Identification and Ecology of the Common Crustacean Species. The University of Wisconsin Press, Madison, WI.

Cochran, P.A. and P.J. Hesse. 1994. Observations on the white perch (*Morone Americana*) early in its invasion of Wisconsin. Transactions of the Wisconsin Academy of Sciences, Arts and Letters. 82:23-31.

Cochran, P.A. 1994. Occurrence and significance of the sea lamprey (*Petromyzon marinus*) in the lower Fox River, Wisconsin. Transactions of the Wisconsin Academy of Sciences, Arts and Letters. 82:17-21.

Edmonson, W.T. (ed.) 1965. Fresh-water Biology, 2nd edit. John Wiley and Sons, Inc. New York, NY.

Hilsenhoff, W.L. 1995. Aquatic Insects of Wisconsin. Natural History Museums Council, University of Wisconsin Press, Madison, WI.

Hopkins, G.J. 1990. The Zebra Mussel, *Dreissena polymorpha*: A Photographic Guide to the Identification of Microscopic Veligers. Queen's Printer for Ontario, Canada.

Hubbs, C.L. and K.F. Lagler. 2004. Fishes of the Great Lakes Region, Revised Edition (Revised by G.R. Smith). University of Michigan Press, Ann Arbor, MI.

Lyons, J., P.A. Cochran, and D. Fago. 2000. Wisconsin Fishes 2000: Status and Distribution, University of Wisconsin Press, Sea Grant Institute, Madison, WI.

Wisconsin Fish ID Software. 2005. Software for Identifying Fishes of Wisconsin. University of Wisconsin Center for Limnology, Sea Grant Institute, and Wisconsin Department of Natural Resources. http://www.wiscfish.org/fishid/.

Pennak, R.W. 1989. Fresh-water Invertebrates of the United States: Protozoa to Mollusca, 3rd edit. John Wiley and Sons, Inc. New York, NY.

ThermoRetec. 2001. Fox River Food (FRFood) Model Documentation Memorandum: Lower Fox River, Wisconsin Remedial Investigation and Feasibility Study. ThermoRetec Consulting Organization. Seattle, Washington.

Thorp, J.H. and A.P. Covich (eds.) 1991. Ecology and Classification of North American Freshwater Invertebrates. Academic Press, Inc. San Diego, CA.

Wisconsin Department of Natural Resources. 2001. Lower Fox River Basin Integrated Management Plan. WI DNR Report PUBL WT-666-2001.