

## **State Wildlife Grants Program Project**

Final report for:

Status and critical habitat of threatened, special concern, and rare fish species in nonwadeable portions of the St. Croix River Basin.

Nick Proulx

Minnesota Department of Natural Resources – Ecological Services

(651) 284-3589

[nick.proulx@dnr.state.mn.us](mailto:nick.proulx@dnr.state.mn.us)

500 Lafayette Road – Box 25

St. Paul, MN 55155

### **Introduction**

In 2004, a survey of the nonwadeable portions of the St. Croix River Basin was performed to document occurrences and critical habitats for fish species that are rare or categorized as threatened or special concern (Table 1). The majority of the survey sites were located on the mainstem St. Croix River with six on the Kettle and the Snake Rivers. Surveys were separated into two major categories based on methodology; standardized whole fish community assessments using pulsed DC current from a boat mounted electrofisher and non-standardized methods utilizing various fish capturing equipment.

### **Methods**

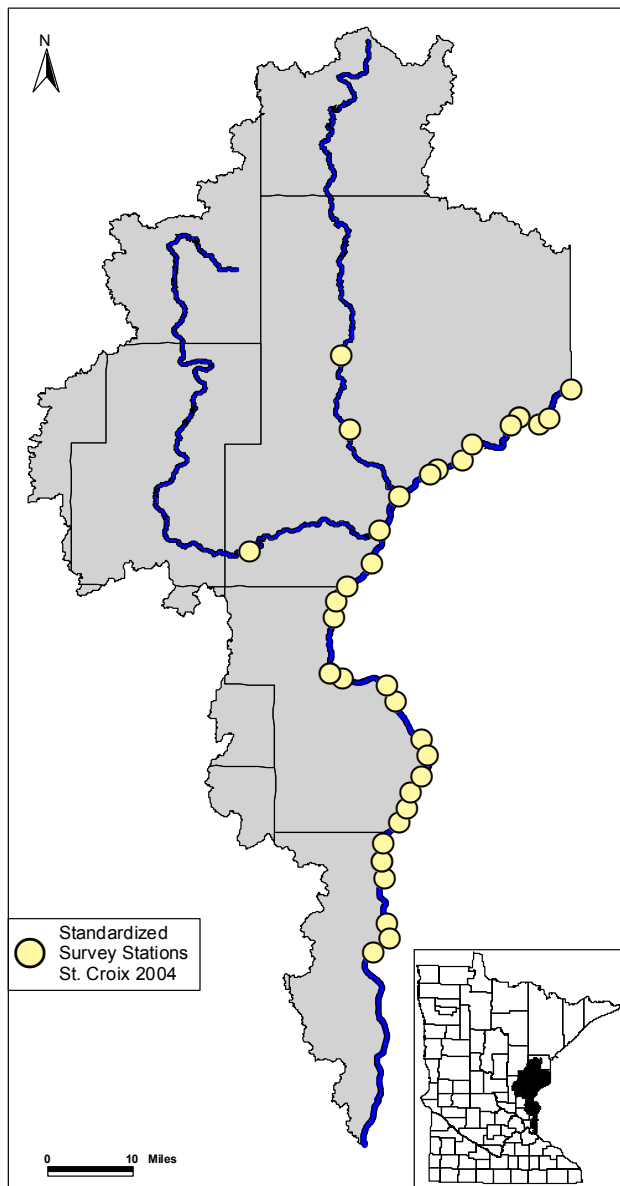
The standardized whole fish community assessments consist of electrofishing the main-channel-border habitats near a randomly selected bank for 1 mile (1600m) of river. At each station, all fish are collected, identified down to the species level, weighed, and measured. This information will be used in an Index of Biotic Integrity (IBI) and to describe common associated species. An IBI is created by using fish species characteristics and abundance at a given site, which will in turn be used as an indicator of how healthy that stretch of river is. The IBI will give resource managers additional information by locating least and most impacted river sections and hopefully guide future protection and/or restoration activities. It can also provide trend information when repeated, which is useful in assessing management efforts. A total of 37 surveys were completed on 34 different stations (Figure 1). Three of those surveys were repeated to verify the IBI. Raw data are available upon request and are summarized in Appendix A.

The non-standardized methods implemented were used primarily for rare fish occurrence information. These methods included sampling preferred fish habitat with trawling, nocturnal snorkeling, backpack electrofishing and gill netting. The Missouri trawl, which was recently developed by Fisheries Biologists at the Missouri Department of Conservation (DOC) (Herzog et al 2004), was tested on portions of the St. Croix in 2004. It's designed to sample small benthic fishes that other methods are unable to effectively sample. During the week of September 13, 2004 DOC personnel, along with MnDNR, demonstrated the trawling technique on 40 sites, which totaled over 90 trawl hauls (Figure 2). In addition to the trawling, a backpack electrofisher was used to sample wing and closing dams. Gill nets were also set in a couple of locations to target larger rare fish species, such as the lake sturgeon (Figure 3) and paddlefish. Finally, nocturnal

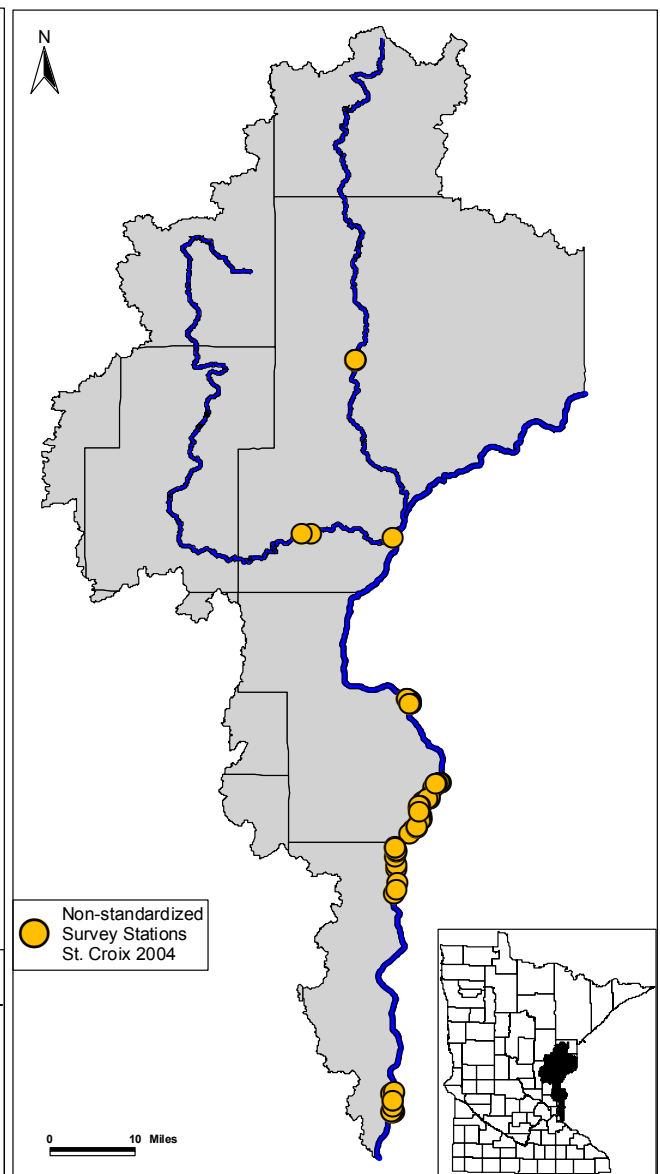
snorkeling in shallow (<4 feet) water was attempted in order to document the crystal darter (*Crystallaria asprella*), a species of special concern.

**Table 1. List of the targeted threatened, special concern, and rare fish species for the St.Croix River Basin.**

Species	Threatened	Special Concern	Rare	Delisted	Historical	Threatened (WI)	Special Concern (WI)
<i>Polyodon spathula</i> (Paddlefish)	X						
<i>Acipenser fulvescens</i> (lake sturgeon)		X					
<i>Crystallaria asprella</i> (crystal darter)		X					
<i>Cycleptus elongatus</i> (blue sucker)		X					
<i>Ichthyomyzon gagei</i> (southern brook lamprey)		X					
<i>Notropis amnis</i> (pallid shiner)		X			X		
<i>Percina evides</i> (gilt darter)		X					
<i>Campostoma oligolepis</i> (largescale stoneroller)			X				
<i>Carpionodes carpio</i> (river carpsucker)			X				
<i>Carpionodes velifer</i> (highfin carpsucker)			X				
<i>Coregonus clupeaformis</i> (lake whitefish)			X				
<i>Cottus cognatus</i> (slimy sculpin)			X				
<i>Etheostoma flabellare</i> (fantail darter)			X				
<i>Fundulus diaphanus</i> (banded killifish)			X				
<i>Hiodon tergisus</i> (mooneye)			X				
<i>Ichthyomyzon unicuspis</i> (silver lamprey)			X				
<i>Ictiobus bubalus</i> (smallmouth buffalo)			X				
<i>Lampetra appendix</i> (American brook lamprey)			X				
<i>Lepisosteus osseus</i> (longnose gar)			X				
<i>Lepisosteus platostomus</i> (shortnose gar)			X				
<i>Minytremma melanops</i> (spotted sucker)			X				
<i>Myoxocephalus thompsoni</i> (deepwater sculpin)			X				
<i>Notropis blennioides</i> (river shiner)			X				
<i>Notropis heterodon</i> (blackchin shiner)			X				
<i>Opsopoeodus emiliae</i> (pugnose minnow)				X			
<i>Scaphirhynchus platyrhynchus</i> (shovelnose sturgeon)				X			
<i>Alosa chrysochloris</i> (skipjack herring)					X		
<i>Hiodon alosoides</i> (goldeye)						X	
<i>Lepomis megalotis</i> (longear sunfish)						X	
<i>Macrhybopsis aestivalis</i> (speckled chub)						X	
<i>Moxostoma valenciennesi</i> (greater redhorse)						X	
<i>Moxostoma carinatum</i> (river redhorse)						X	
<i>Notropis anogenus</i> (pugnose shiner)						X	
<i>Ammocrypta clara</i> (western sand darter)							X
<i>Anguilla rostrata</i> (American eel)							X
<i>Etheostoma asprigene</i> (mud darter)							X
<i>Etheostoma microperca</i> (least darter),							X
<i>Macrhybopsis storeriana</i> (silver chub)							X
<i>Notropis texanus</i> (weed shiner)							X



**Figure 1. Standardized fish survey locations, St. Croix basin 2004.**



**Figure 2. Non-standardized fish survey locations, St. Croix basin 2004.**

**Figure 3. Lake sturgeon (*Acipenser fulvescens*).  
(Photo by MPCA)**



## Results

### Standardized Fish Survey Results

The standardized fish surveys captured 13 targeted fish species, which at least one occurred at every station sampled and had a total of 191 individuals. Four special concern species occurred at 10 stations and totaled 25 individuals (Table 2) (Figure 4). The most common targeted fish collected was the river redhorse (*Moxostoma carinatum*) (Figure 5) with the western sand darter (*Ammocrypta clara*) second. Of the four special concern species, the gilt darter (*Percina evides*) occurred the most frequently. Although second in frequency within the special concern category, the southern brook lamprey's final tally may increase due to the difficulty identifying larval lampreys (ammocoetes). For these surveys, all lamprey ammocoetes were collected and are currently housed in aquariums until they transform into adults. The adult lamprey is then easily identified and vouchered. At the time of this report the seven documented southern brook lampreys have emerged into adults between the months November 2004 – January 2005. Given the number of ammocoetes remaining, it is suspected that the final number of southern brook lampreys will increase.

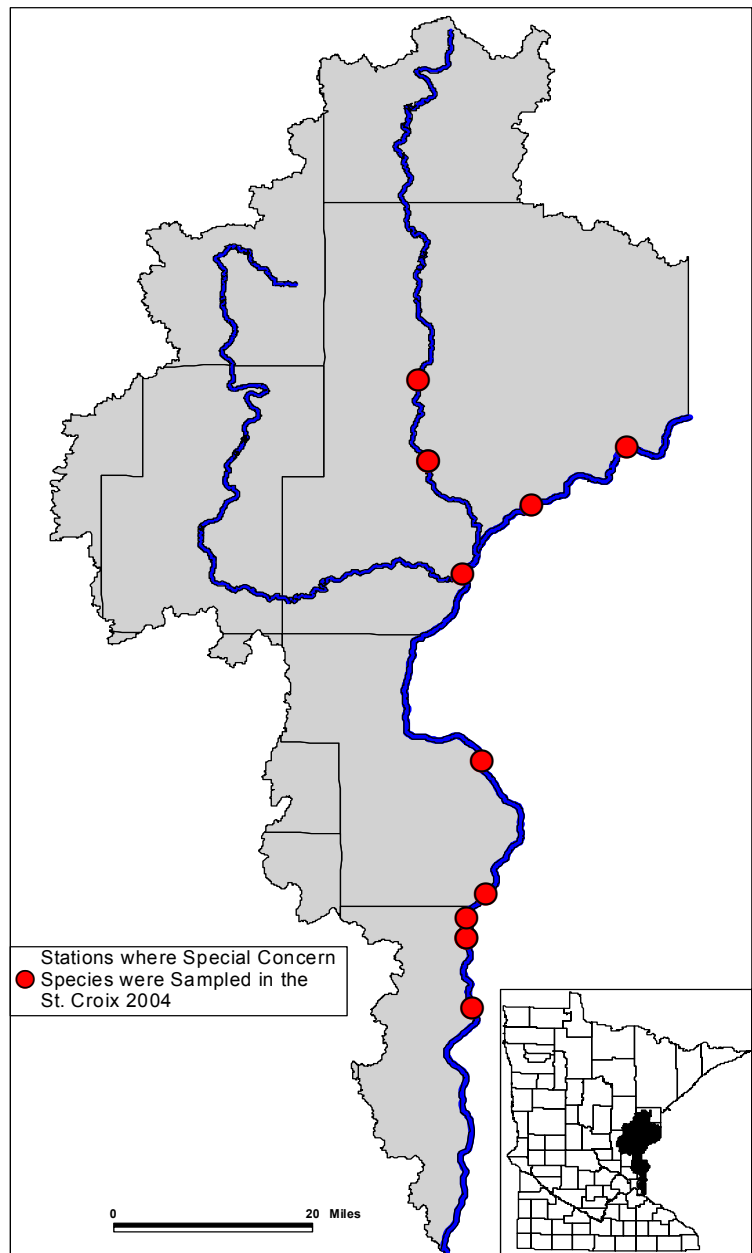
**Table 2. Number of stations and targeted fish species collected from the standardized surveys.**

Species	Stations	Number	Special Concern	Rare	Threatened (WI)	Special Concern (WI)
<i>Acipenser fulvescens</i> (lake sturgeon)	2	2	X			
<i>Cyprinostomus elongatus</i> (blue sucker)	1	2	X			
<i>Ichthyomyzon gagei</i> (southern brook lamprey)	4	7	X			
<i>Percina evides</i> (gilt darter)	4	14	X			
<i>Carpionotus carpio</i> (river carpsucker)	1	1		X		
<i>Carpionotus velifer</i> (highfin carpsucker)	2	2		X		
<i>Ichthyomyzon unicuspis</i> (silver lamprey)	3	3		X		
<i>Ictalurus bubalus</i> (smallmouth buffalo)	1	1		X		
<i>Lepisosteus osseus</i> (longnose gar)	3	3		X		
<i>Minytrema melanops</i> (spotted sucker)	1	1		X		
<i>Moxostoma valenciennesi</i> (greater redhorse)	6	11			X	
<i>Moxostoma carinatum</i> (river redhorse)	28	95			X	
<i>Ammocrypta clara</i> (western sand darter)	6	49				X

### Associated Species

One of the values of collecting whole fish community information is the ability to list species that are typically found with rare fish. These species lists can assist with indicating potential rare fish locations and habitat when evaluating other surveys and current associated fish distributions. Table 3 summarizes the top ten associated species found with the special concern species, excluding the blue sucker. This species was only found at one site and associated species could not be determined. However, it can be noted that the blue sucker (Figure 6) was captured with 26 other species.

**Figure 4. Stations where fish species of special concerns were collected in 2004 using standardized methodology.**



**Figure 5. River redhorse (*Moxostoma carinatum*). (photo by MnDNR)**





**Table 3. The percentage of the top ten associated species found at the same station as three special concern species.**

Associated Species	gilt darter - % associated	southern brook lamprey - % associated	lake sturgeon - % associated
rock bass	100	100	100
mimic shiner	100	75	100
spotfin shiner	100	100	100
smallmouth bass	100	100	100
silver redhorse	100	75	100
logperch	100	75	
lamprey spp	100	100	
golden redhorse	100	100	100
johnny darter	80		
shorthead redhorse	80		100
burbot		75	
northern pike		100	100
bluegill			100
northern hogsucker			100
walleye			100



**Figure 6. Blue sucker (*Cycleptus elongatus*). (photo by MnDNR)**

#### *Upper and Lower St. Croix Analysis*

The Upper and Lower St. Croix River have variations in fish community composition, frequency and distribution due to the fish barrier at Taylors Falls Minnesota/St. Croix Falls, Wisconsin. Separating the two will identify which targeted fish species are impacted by the barrier, help clarify distribution, and give a more detailed summary of how frequently surveyed each species was.

#### *Upper St. Croix Standardized Surveys*

The Upper St. Croix had 24 stations with two repeat surveys, totaling 11,875 fish captured (Table 4). Six targeted fish species were sampled with a total of 105 individuals. The southern brook lamprey (Figure 7) was the only targeted species sampled in the Upper St. Croix and not in the Lower St. Croix, although it has been

sampled once in a previous survey effort. The river redhorse was by far the most frequently sampled species overall at 92% and comprised a high percentage of the catch.

**Table 4. The number of fish, their batch weight, number of stations and sites, percent of the catch, frequency of the catch, and catch per unit effort (fish per hour) for each targeted fish sampled in the Upper St. Croix standardized survey.**

Species	Total Catch	Total Weight (g)	Stations	# of times Sampled	% Composition	% Frequency	Median CPUE (fish/hour)
gilt darter	3	9	2	2	0.03%	7.69%	1.36
southern brook lamprey	7	40	4	4	0.06%	15.38%	1.20
lake sturgeon	1	5,443	1	1	0.01%	3.85%	0.83
greater redhorse	9	8,309	4	4	0.08%	15.38%	1.72
river redhorse	84	132,584	22	24	0.71%	92.31%	2.10
silver lamprey	1	8	1	1	0.01%	3.85%	0.71
<b>Total</b>	<b>105</b>	<b>146,393</b>	<b>24</b>	<b>26</b>			
<b>Number of total fish captured = 11,875</b>							



**Figure 7. Southern brook lamprey (*Ichthyomyzon gagei*). (Photo by Konrad Schmidt)**

#### *Lower St. Croix Standardized Surveys*

The Lower St. Croix had 10 stations with one repeat and captured 6,486 fish. The targeted fish included 12 species and totaled 93 individuals (Table 5). The most commonly sampled targeted fishes or species were the western sand darter, gilt darter, and river redhorse. The blue sucker, river carpsucker (Figure 8), highfin carpsucker (Figure 9), longnose gar, smallmouth buffalo, spotted sucker, and western sand darter were only captured in the Lower St. Croix. The gilt darter was the most frequently sampled special concern species in the Lower St. Croix.

**Table 5. The number of fish, their batch weight, number of stations and sites, percent of the catch, frequency of the catch, and catch per unit effort (fish per hour) for each targeted fish sampled in the Lower St. Croix standardized survey.**

Species	Total Catch	Total Weight (g)	Stations	# of times Sampled	% Composition	% Frequency	Median CPUE (fish/hour)
gilt darter	11	11	2	3	0.17%	27.27%	2.46
blue sucker	2	3,820	1	1	0.03%	9.09%	1.56
lake sturgeon	1		1	1	0.02%	9.09%	1.19
greater redhorse	2	1,662	2	2	0.03%	18.18%	0.94
river redhorse	11	14,589	5	6	0.17%	54.55%	1.24
river carpsucker	1	1,020	1	1	0.02%	9.09%	1.03
highfin carpsucker	2	2,512	2	2	0.03%	18.18%	0.86
longnose gar	3	46	3	3	0.05%	27.27%	0.88
smallmouth buffalo	1	3,523	1	1	0.02%	9.09%	0.88
spotted sucker	1	2	1	1	0.02%	9.09%	0.82
western sand darter	56	66	7	7	0.86%	63.64%	5.91
silver lamprey	2	45	2	2	0.03%	18.18%	0.83
<b>Total</b>	<b>93</b>	<b>27,296</b>	<b>10</b>	<b>11</b>			

**Number of total fish captured = 6,486**



**Figure 8. River carpsucker (*Carpion carpio*). (Photo by Konrad Schmidt)**

**Figure 9. Highfin carpsucker (*Carpion velifer*). (Photo by Konrad Schmidt)**





### Non-standardized Fish Survey Results

Of the non-standardized gear methods implemented during the late summer, early fall, the Missouri trawl was, by far, the most often used gear (Figure 10). Table 6 summarizes the targeted fish sampled with the trawl. Of particular note is the speckled chub (Figure 11), which has not been sampled in the St.Croix River for over 25 years. It was found at 8 stations and totaled 49 individuals. The only special concern species sampled with the trawl, was the gilt darter. Historically, the gilt darter had been sampled regularly (15% average frequency- Table 9) in the basin, but the rate in which the darter was captured with the trawl (45% frequency) and the number of individuals captured was significant.

**Table 6. The targeted fish species surveyed using the Missouri trawl.**

Species	Total Catch	Stations	Trawl Hauls	Conservation Category
<b>gilt darter</b>	<b>146</b>	<b>18</b>	<b>22</b>	<b>Special concern</b>
speckled chub	49	8	14	Rare
Western sand darter	461	17	30	Rare
silver chub	1	1	1	Rare
<b>Total Targeted Species</b>	<b>657</b>	<b>26</b>	<b>42</b>	

**Figure 10. Missouri trawl demonstrated.**

Note: life jackets are under rain suits. (photo by MnDNR)



**Figure 11. Speckled chub (*Macrhybopsis aestivalis*). (Photo by Konrad Schmidt)**

#### *Upper St. Croix Non-standardized Surveys*

The trawling that occurred in the Upper St. Croix was limited due to very small catches, possibly a result of gear avoidance. The increased water clarity reduced the trawls efficacy, which resulted in moving to the Lower St. Croix earlier than anticipated. In the Upper St. Croix basin, the Kettle and Snake Rivers were sampled at a few locations. The highlight would be the 81 gilt darters captured in one trawl haul in the Kettle River just south of the Grindstone River confluence (Figure 12). Gilt darters were sampled at five out of eight sites (Table 7) and were not sampled in the Snake River.



**Figure 12. Gilt darters (*Percina evides*). (photo by MnDNR)**

**Table 7. Total number, weight, sites, percent composition of the catch, and the percent frequency of the catch for the Upper St. Croix River using the Missouri trawl.**

Species	Total Catch	Total Weight	Stations	% Composition	% Frequency
gilt darter	89	65	5	41.59%	62.50%
Total	89	65	8		
Number of total fish captured = 214					

#### *Lower St. Croix Non-standardized Surveys*

In the Lower St. Croix, 32 stations were sampled, 5,734 fish captured in 62 trawl hauls. The western sand darter (Figure 13) was the most abundant targeted fish which showed up at more than half of the stations (Table 8). The gilt darter and speckled chub had total catches of 55 and 49, respectively, with the gilt darter having a higher frequency (41%).

**Figure 13. Western sand darter (*Ammocrypta clara*). (Photo by Konrad Schmidt)**



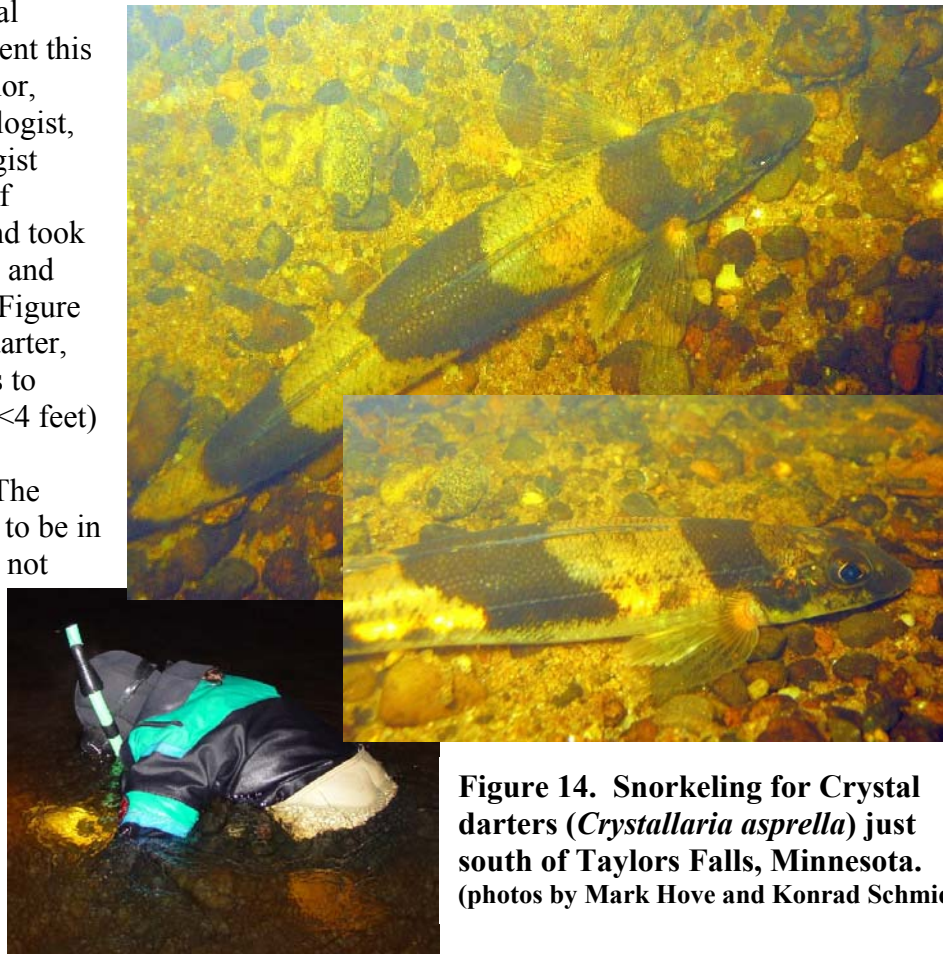


**Table 8. Total number, weight, sites, percent composition of the catch, and the percent frequency of the catch for the Lower St. Croix River using the Missouri trawl.**

Species	Total Catch	Total Weight	Stations	% Composition	% Frequency	Median CPUE (fish/hour)
gilt darter	55	23.7	13	0.96%	40.63%	20
western sand darter	461	93.7	17	8.04%	53.13%	60
speckled chub	49	14.0	8	0.85%	25.00%	53
silver chub	1	13.3	1	0.02%	3.13%	19
<b>Total</b>	<b>565</b>	<b>144.7</b>	<b>32</b>			
<b>Number of total fish captured = 5,734</b>						

The other non-standardized methods attempted did not yield the type of results the trawl did, but none-the-less were worth the effort. Targeting wing and closing dams were very effective at sampling darters (540 fish/hour), with the catch comprising mostly rainbow darters. The gill nets did not produce fish, but the effort (only two sets) was low.

The final method attempted was nocturnal sampling. Mussel Biologists from the MnDNR, who were using this method just south of Taylors Falls, Minnesota to document nocturnal mussel displays noted an unusual darter present on a regular basis. The unusual darter was eventually identified as a crystal darter (*Crystallaria asprella*), which is a species of special concern. To document this occurrence, the author, Non-game Fish Biologist, and a Mussel Biologist went out the night of October 12, 2004 and took several photographs and video of the darter (Figure 14). To locate the darter, the best method was to snorkel in shallow (<4 feet) water with bright underwater lights. The crystal darters seem to be in a state of torpor and not disturbed by the light or close proximity of divers.



**Figure 14. Snorkeling for Crystal darters (*Crystallaria asprella*) just south of Taylors Falls, Minnesota. (photos by Mark Hove and Konrad Schmidt)**

## Status of selected targeted fish species

### Standardized Surveys

During the years of 1975, 1986, and 1989 the Major Rivers Program within Ecological Services MnDNR performed whole fish community assessments using electrofishing, on 70 stations equaling 78 individual surveys on nonwadeable rivers within the St. Croix basin. Of those 78 surveys, 32 were on the Kettle River and 46 on the St. Croix River. Twelve targeted fish species were sampled during these surveys, while 13 species were sampled in 2004 (Table 9). For the most part, the targeted fish species for each group overlapped, with the exceptions of the blackchin shiner sampled only in 1989 and the southern brook lamprey and longnose gar (Figure 15) sampled in 2004. In the earlier survey effort, 20 stations captured at least one species of special concern (Figure 16) and in 2004, 10 stations captured at least one species of special concern. The distribution and number of stations where special concern species were sampled varied between these two survey efforts primarily because the number of surveys performed historically was double that of the 2004 effort. In both surveys the river redhorse was the most frequently sampled targeted fish, while the gilt darter was the most frequently sample special concern fish.

**Table 9. Comparison of the current and historical surveys of the Kettle and St. Croix Rivers. The number of fish, their batch weight, number of stations and sites, percent of the catch, frequency of the catch, and catch per unit effort (fish per hour) for each targeted fish sampled in the St. Croix Basin.**

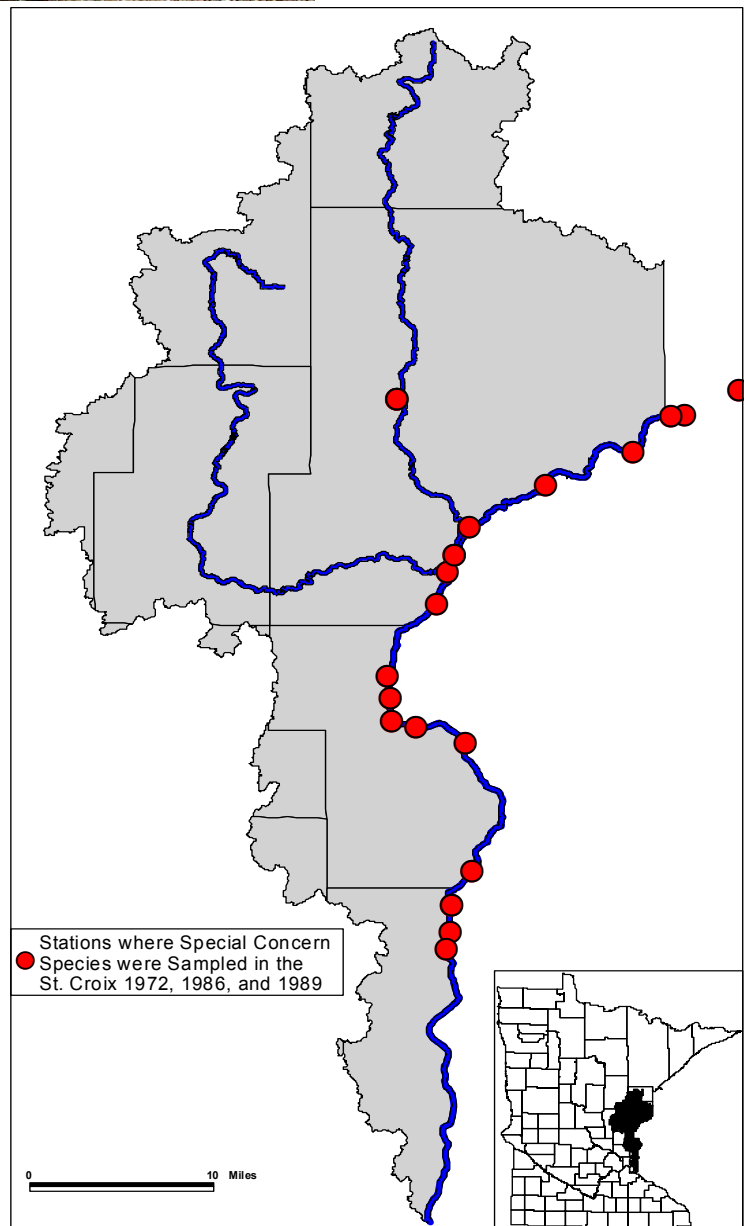
Species	Number		Stations		# of times Sampled		% Composition		% Frequency		Median CPUE (fish/hour)	
	H	C	H	C	H	C	H	C	H	C	H	C
Historical survey = H Current survey = C												
lake sturgeon	4	2	2	2	3	2	0.04	.01	3.8	5.4	1.7	1.0
blue sucker	4	2	4	1	4	1	0.04	.01	5.1	2.7	2.0	1.6
southern brook lamprey *		7		4		4		.04		10.8		1.2
gilt darter	125	14	15	4	15	5	1.13	.08	19.2	13.5	10.7	1.9
river carpsucker	8	1	3	1	3	1	0.07	.01	3.8	2.7	4.0	1.0
highfin carpsucker	11	2	4	2	4	2	0.10	.01	5.1	5.4	2.0	.86
silver lamprey	1	3	1	3	1	3	0.01	.02	1.3	8.1	1.4	.82
blackchin shiner	1		1		1		0.01		1.3		5.0	
longnose gar		3		3		3		.02		8.1		.88
smallmouth buffalo	2	1	2	1	2	1	0.02	.01	2.6	2.7	2.0	.88
spotted sucker	4	1	3	1	3	1	0.04	.01	3.8	2.7	2.7	.82
greater redhorse	85	11	27	6	27	6	0.77	.06	34.6	16.2	4.0	1.23
river redhorse	132	95	33	27	33	30	1.19	.52	42.3	81.1	6.7	2.04
western sand darter	5	56	2	7	2	7	0.05	.30	2.6	18.9	5.0	5.9
<b>Total</b>	<b>382</b>	<b>198</b>	<b>70</b>	<b>34</b>	<b>78</b>	<b>37</b>						
<b>Historical number of fish captured = 11,055</b>												
<b>Current number of fish captured = 18,361</b>												

\* Due to the difficulty in identifying larval lampreys, additional southern brook lampreys may emerge after this report is final.





**Figure 15. Longnose gar (*Lepisosteus osseus*). (photo by MnDNR)**

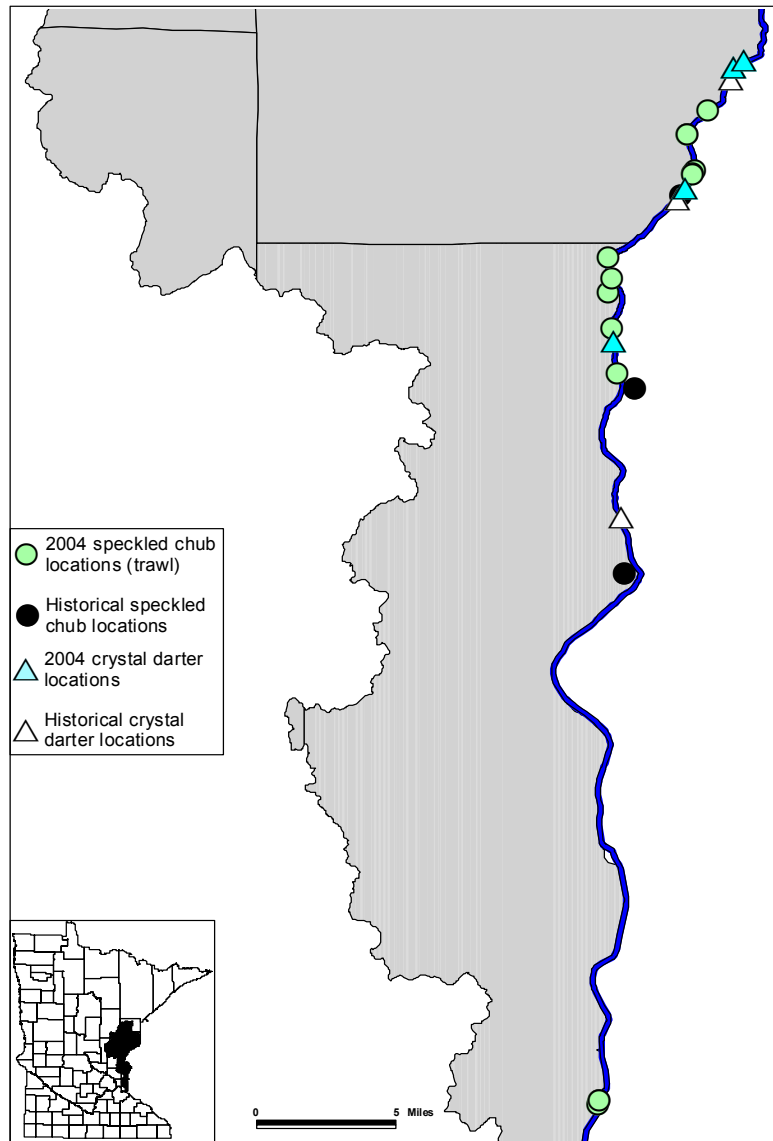


**Figure 16. Historical fish surveys where special concern fish species were sampled using standardized methodology.**

### Non-standardized Surveys

The trawling effort in 2004 increased our knowledge of the distribution of small benthic fish species in the St. Croix basin. One such species is the speckled chub, which seems to have a larger distribution within the St. Croix River than previously thought. Using records gathered for the Fishes of Minnesota Book, there were only three locations in the St. Croix where speckled chubs were sampled from 1960 to 1978 and in 2004, using the trawl, fourteen additional locations were documented (Figure 17). According to the same historical records, 41 locations and 358 individual western sand darters have been sampled since 1945. In 2004, there were 17 locations and 461 individual western sand darters sampled using the trawl. It is difficult to conclude that a given population has increased or decreased using these data, given the limited use of this method.

**Figure 17. Speckled chub and crystal darter distributional comparison between historical records and the 2004 surveys in the St. Croix basin.**

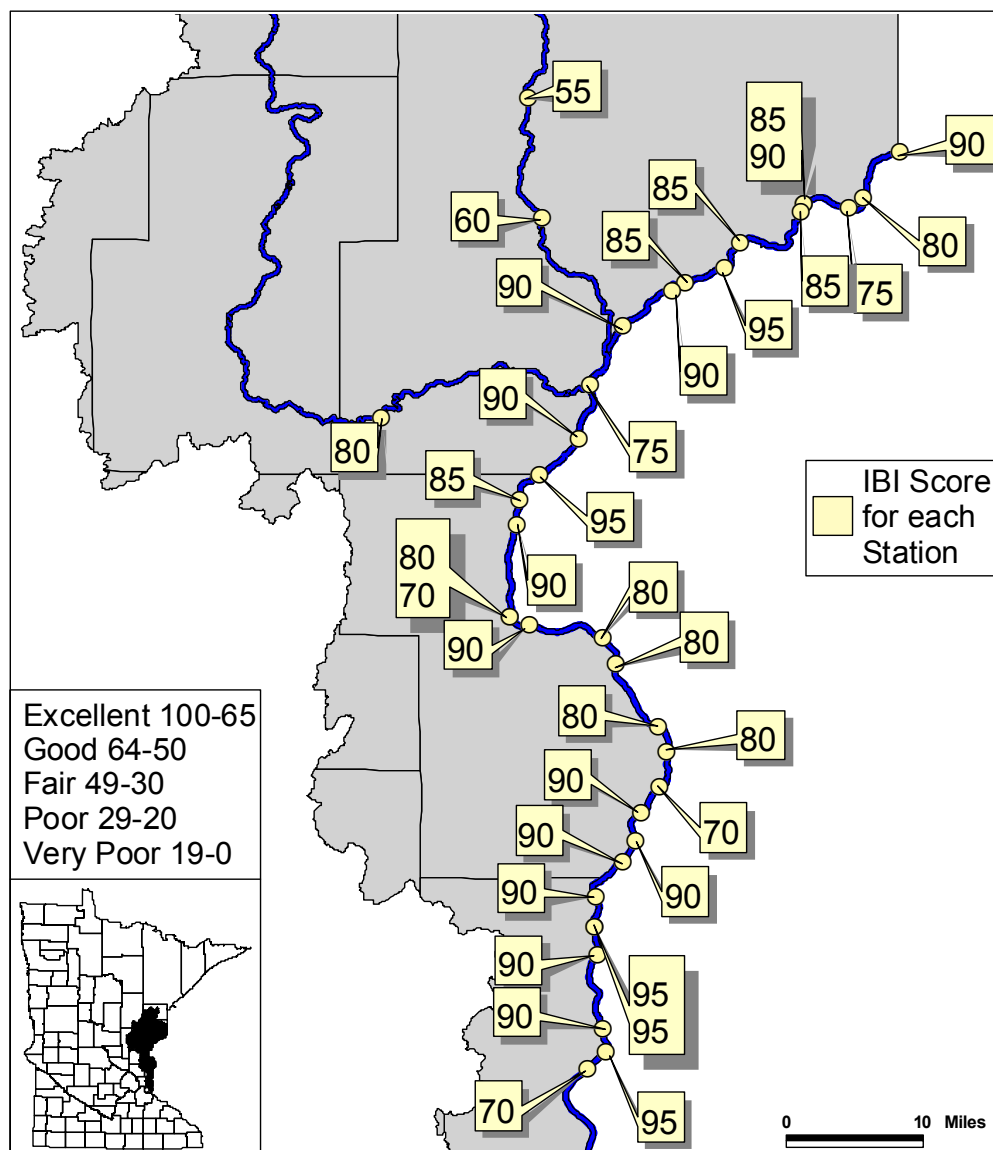


The crystal darter occurrences in shallow water at night, is an opportunity to explore questions regarding its abundance within the St. Croix River. Prior to 2004, only five specimens were recorded in the St. Croix (Figure 17). In 2004, two crystal darters were sampled using night electrofishing by ORSANCO (participant in a large river sampling methods comparison evaluation) and the multiple sightings by MnDNR Mussel Biologists during their nocturnal snorkeling surveys. In 2005, follow up nocturnal surveys will be done in similar habitats in the Lower St. Croix. Assuming that these darters behave similarly though out the system, we will either document additional

locations or confirm this occurrence as a localized event. This find will enhance our current limited knowledge of crystal darter distribution and behavior.

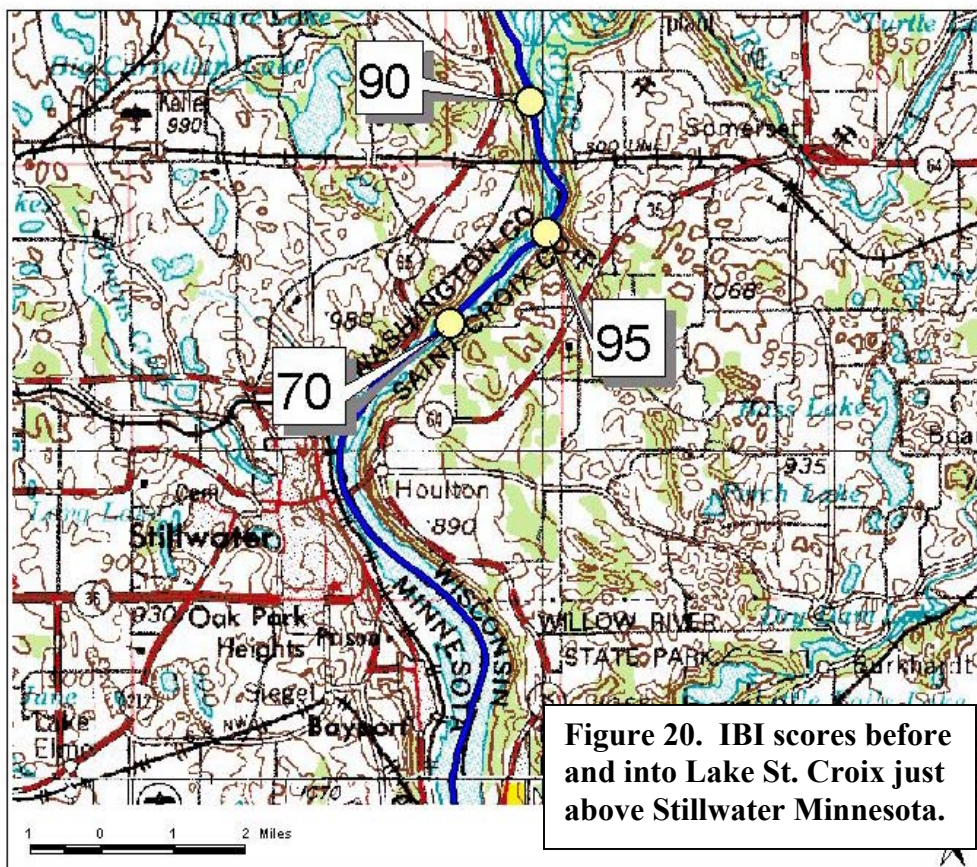
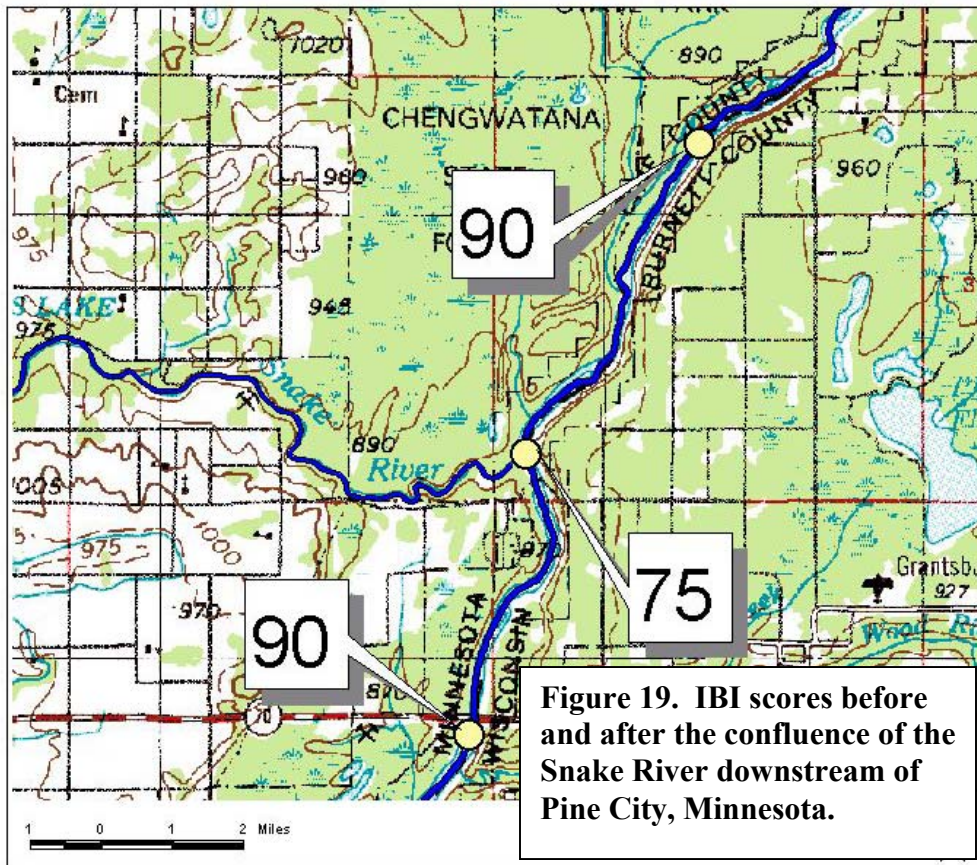
### Index of Biotic Integrity Scores

For this report, the metrics used to calculate the IBI are described in Lyons (2001). Since Lyons used the St. Croix River as part of the statewide large river IBI development in Wisconsin, his metrics should be applicable to this study. The majority of the IBI scores indicate healthy conditions throughout the system (Figure 18). A few sites on the St. Croix River scored lower due to impacts such as impoundments and their location downstream of populated areas (Figure 19-20). The Kettle River, which tends to be species depauperate, scored the lowest of all sites. The IBI metric will require modification to accommodate this natural characteristic.



**Figure 18. Index of Biotic Integrity scores for the standardized surveys.**







## Discussion

Overall 14 out of 39 targeted fish species were sampled using all gear types during this survey period. Two out of the seven threatened and special concern species listed for the St. Croix were not sampled, which are the paddlefish and pallid shiner. The paddlefish is extremely rare in the St. Croix with the only records coming from Lake St. Croix by commercial fishers and the pallid shiner are assumed to be extirpated.

Standardized surveys were comparable to historical efforts and in terms of number and distribution; little has changed for rare, special concern fish species in the St. Croix. The IBI scores indicate a healthy system with impacts from populated areas and impoundments. The non-standardized surveys, especially the Missouri trawl, demonstrated its utility as a method for sampling small benthic fishes and have increased our knowledge of the distribution of these fishes.

To keep the St. Croix River basin a valuable resource to Minnesota and Wisconsin, additional and continued protection from adverse land uses, protection of fish habitat, and evaluation of future negative anthropogenic activities should continue. To assess these protection efforts, long term monitoring utilizing an IBI, should be completed at regular intervals.

## **Acknowledgements**

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## Appendix A

Table of all species sampled, their total catch, number of times sampled, percent composition of catch, and percent frequency sampled.

Species	Total Catch	# of times Sampled	% Composition	% Frequency
black bullhead	50	1	0.27%	3%
black crappie	123	14	0.67%	38%
blackside darter	413	20	2.25%	54%
blue sucker	2	1	0.01%	3%
bluegill	286	27	1.56%	73%
bluntnose minnow	240	15	1.31%	41%
brassy minnow	3	2	0.02%	5%
brook silverside	42	9	0.23%	24%
burbot	133	27	0.72%	73%
central mudminnow	21	7	0.11%	19%
central stoneroller	76	8	0.41%	22%
channel catfish	15	14	0.08%	38%
chestnut lamprey	70	19	0.38%	51%
common carp	144	12	0.78%	32%
common shiner	1214	24	6.61%	65%
creek chub	1	1	0.01%	3%
emerald shiner	471	11	2.57%	30%
fathead minnow	1	1	0.01%	3%
flathead catfish	1	1	0.01%	3%
freshwater drum	33	8	0.18%	22%
gilt darter	14	5	0.08%	14%
gizzard shad	85	8	0.46%	22%
golden redhorse	2063	37	11.24%	100%
golden shiner	36	10	0.20%	27%
greater redhorse	11	6	0.06%	16%
highfin carpsucker	2	2	0.01%	5%
hornyhead chub	191	20	1.04%	54%
hybrid sunfish	2	2	0.01%	5%
johnny darter	164	28	0.89%	76%
lake sturgeon	2	2	0.01%	5%
lamprey ammocoete	124	28	0.68%	76%
largemouth bass	100	16	0.54%	43%
logperch	358	28	1.95%	76%
longnose gar	3	3	0.02%	8%
mimic shiner	4580	35	24.94%	95%
mottled sculpin	2	1	0.01%	3%
muskellunge	4	3	0.02%	8%
northern hog sucker	329	27	1.79%	73%
northern pike	139	29	0.76%	78%
pumpkinseed	2	2	0.01%	5%
quillback	23	9	0.13%	24%
rainbow darter	11	6	0.06%	16%
river carpsucker	1	1	0.01%	3%
river darter	6	5	0.03%	14%

<b>Species</b>	<b>Total Catch</b>	<b># of times Sampled</b>	<b>% Composition</b>	<b>% Frequency</b>
river redhorse	95	30	0.52%	81%
rock bass	251	33	1.37%	89%
sauger	8	4	0.04%	11%
shorthead redhorse	1143	35	6.23%	95%
silver lamprey	3	3	0.02%	8%
silver redhorse	432	37	2.35%	100%
slenderhead darter	34	10	0.19%	27%
smallmouth bass	768	37	4.18%	100%
smallmouth buffalo	1	1	0.01%	3%
southern brook lamprey	6	4	0.03%	11%
spotfin shiner	2288	36	12.46%	97%
spottail shiner	111	1	0.60%	3%
spotted sucker	1	1	0.01%	3%
stonecat	5	3	0.03%	8%
tadpole madtom	1	1	0.01%	3%
trout-perch	1	1	0.01%	3%
walleye	139	28	0.76%	76%
western sand darter	56	7	0.30%	19%
white bass	1	1	0.01%	3%
white crappie	1	1	0.01%	3%
white sucker	274	27	1.49%	73%
yellow perch	557	24	3.03%	65%
YOY redhorse	594	15	3.24%	41%

## Appendix B

Table of Index of Biotic Integrity scores for each station and survey.

<b>River Station</b>	<b>Field Survey Number</b>	<b>IBI Score</b>	<b>River Station</b>	<b>Field Survey Number</b>	<b>IBI Score</b>
Lower St. Croix 01	LR04-001	<b>90</b>	Upper St. Croix 07	LR04-022	<b>80</b>
Lower St. Croix 02	LR04-026	<b>95</b>	Upper St. Croix 08	LR04-020	<b>80</b>
Lower St. Croix 02	LR04-035 (repeat)	<b>95</b>	Upper St. Croix 09	LR04-017	<b>90</b>
Lower St. Croix 03	LR04-036	<b>90</b>	Upper St. Croix 10	LR04-016	<b>85</b>
Lower St. Croix 04	LR04-028	<b>90</b>	Upper St. Croix 11	LR04-015	<b>95</b>
Lower St. Croix 05	LR04-029	<b>90</b>	Upper St. Croix 12	LR04-011	<b>75</b>
Lower St. Croix 06	LR04-027	<b>90</b>	Upper St. Croix 14	LR04-021	<b>90</b>
Lower St. Croix 27	LR04-030	<b>70</b>	Upper St. Croix 15	LR04-009	<b>85</b>
Lower St. Croix 97	LR04-034	<b>70</b>	Upper St. Croix 16	LR04-008	<b>95</b>
Lower St. Croix 98	LR04-037	<b>90</b>	Upper St. Croix 17	LR04-006	<b>90</b>
Lower St. Croix 99	LR04-033	<b>95</b>	Upper St. Croix 18	LR04-024	<b>80</b>
Kettle River 01	LR04-005	<b>60</b>	Upper St. Croix 19	LR04-019	<b>90</b>
Kettle River 02	LR04-012	<b>55</b>	Upper St. Croix 20	LR04-014	<b>90</b>
Snake River 01	LR04-013	<b>80</b>	Upper St. Croix 21	LR04-007	<b>85</b>
Upper St. Croix 25	LR04-032 (repeat)	<b>70</b>	Upper St. Croix 22	LR04-003	<b>75</b>
Upper St. Croix 25	LR04-018	<b>80</b>	Upper St. Croix 23	LR04-004	<b>80</b>
Upper St. Croix 100	LR04-002	<b>85</b>	Upper St. Croix 24	LR04-010	<b>90</b>
Upper St. Croix 100	LR04-025 (repeat)	<b>90</b>	Upper St. Croix 26	LR04-023	<b>80</b>
Upper St. Croix 101	LR04-031	<b>85</b>			