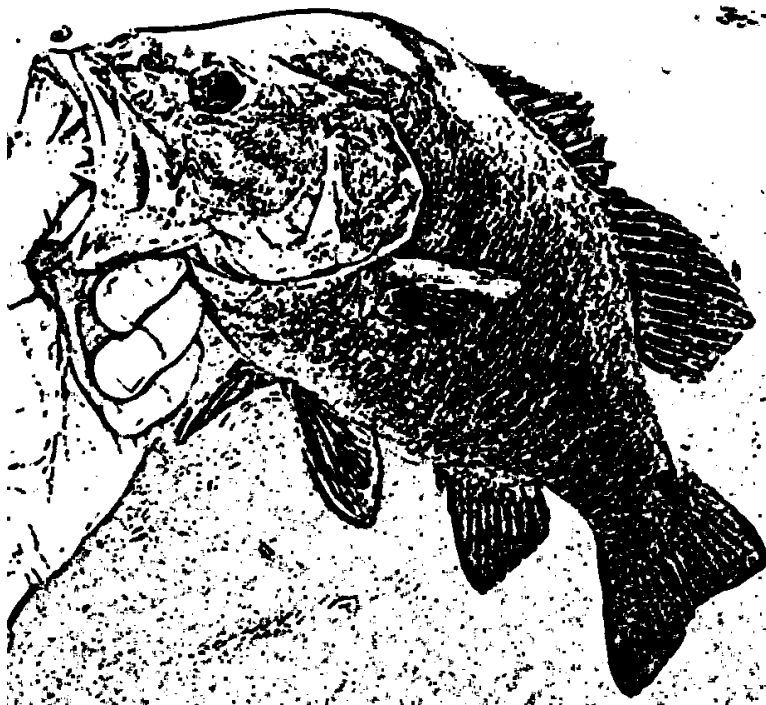


Minnesota
F-29R(P)-27
Study 3, Job 4
Area F212

**MISSISSIPPI RIVER SURVEY REPORT
BRAINERD FISHERIES MANAGEMENT AREA
CROW WING COUNTY, MINNESOTA**



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Summary

A survey of the approximately 480 miles of the upper Mississippi River from the headwaters to the Coon Rapids Dam on the northwest side of the Twin Cities Metropolitan Area was conducted by the Minnesota Department of Natural Resources in 2007. The seven DNR Fisheries offices with management areas along the upper Mississippi surveyed the fish community, main channel depths, water chemistry, and other physical features. This sampling was the first broad-scale sampling of the fish community in the Mississippi since the 1960's. This document represents a preliminary report of the sampling conducted by the Brainerd Area Fisheries Office in Crow Wing County. In 2008, detailed channel morphology surveying will be done and the results included in the final report. A total of thirty-four fish species were found in the Mississippi River in Crow Wing County. Shorthead redhorse and rock bass were the only species found at all electrofishing sites. Three channel catfish were caught in lake survey gill nets set in Rice Lake. This is the first record of channel catfish in the Mississippi above the Brainerd Dam in Crow Wing County. The distribution of common carp in the upper Mississippi basin appeared to be limited by the Brainerd Dam. Smallmouth bass were the most common and widely found large game fish species. Other game fish included walleye, muskellunge, northern pike, channel catfish, and largemouth bass as well as bluegill, black crappie, rock bass, and yellow perch. Fish community IBI scores for the Mississippi River in Crow Wing County were in the fair to good range. The section influenced by the Brainerd Dam had the lowest average score (55, fair) and was the only section or reach to have an average rating in the fair range; all other reaches had an average rating of good. The reach below Brainerd had the highest average score (72, good). A diverse fish community was found in the Mississippi River in Crow Wing County, Minnesota. The fish community included several gamefish and panfish species and the river supports a popular fishery.

Introduction

A survey of the approximately 480 miles of the upper Mississippi River from the headwaters to the Coon Rapids Dam on the northwest side of the Twin Cities Metropolitan Area was conducted by the Minnesota Department of Natural Resources in 2007. The seven MNDNR Fisheries offices with management areas along the upper Mississippi surveyed the fish community, main channel depths, water chemistry, and other physical features. This sampling was the first broad-scale sampling of the fish community in the Mississippi since the 1960's.

This document represents a preliminary report for the sampling conducted by the Brainerd Area Fisheries Office in Crow Wing County. In 2008, detailed channel morphology surveying will be done and the results included in the final report. An additional set of water chemistry samples will also be collected in 2008. Results of the fish age estimations obtained from examining bony structures collected from fish sampled in 2007 will also be included in the final report. After each of the Area reports are completed a comprehensive report covering the Mississippi River from its headwaters downstream to the Coon Rapids Dam will be written.

Study Area

The Brainerd Fisheries Office management area on the Mississippi River generally corresponds with the boundaries of Crow Wing County. However, no sampling was done by the Brainerd Office upstream of Highway 6 to Aitkin County in eastern Crow Wing County. Thalweg depth mapping on this section was done by Aitkin Area Fisheries. The Little Falls Fisheries Office management area generally begins at the confluence with the Crow Wing River. The Little Falls Fisheries Office also conducts fish sampling on the Mississippi in Crow Wing County below the Brainerd Dam including sample sites in Crow Wing State Park above the Crow Wing River and in Brainerd below the dam. This sampling has mainly targeted smallmouth bass and other gamefish.

Hydrology

A USGS gage is located on the downstream side of the Brainerd Dam (station number 05242300). This gage has a period of record from 24 April 1987 through the present. The drainage area is 7,320 square miles. The average discharge is 3,600 cfs. The maximum daily discharge for this site was 17,400 cfs in April 2001 and the minimum discharge was 348 cfs in July 1988. Bankfull discharge (1.5 year recurrence interval) is about 8,900 cfs. Peak flows usually occur in April or May with the lowest flows occurring in August and September (Figure 1).

When sampling for this study was conducted in the summer of 2007 the Mississippi was at normal flows in June, and then quickly fell to often record low-flows in August.

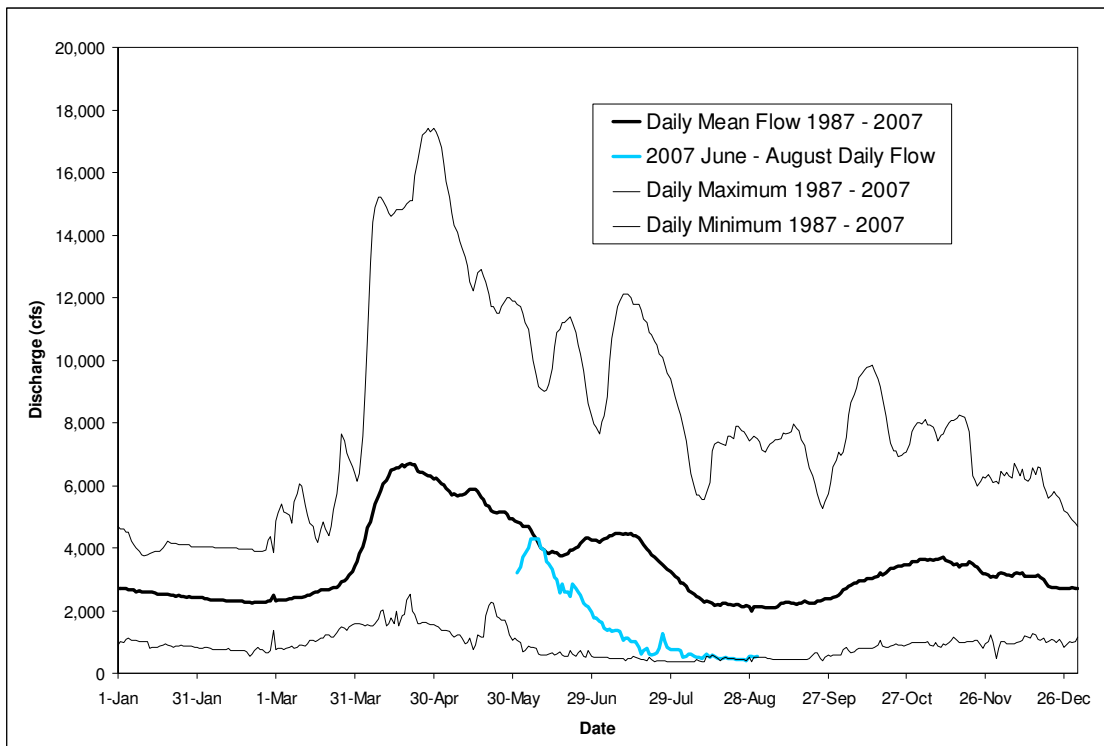


Figure 1. Daily mean, maximum, and minimum discharge and June through August 2007 daily discharge of the Mississippi River in Brainerd, Minnesota. Daily mean, maximum, and minimum discharged is based on the period from April 24, 1987 through September 30, 2007.

Similar Reaches

Within Crow Wing County the Mississippi can be divided into two general sections: above the Brainerd Dam, and below the Brainerd Dam. Within these two sections the river is comprised of six similar reaches, three in the section below the dam and three in the section above the dam (Figure 2). Reaches are numbered sequentially downstream from the headwaters at Lake Itasca to the Coon Rapids Dam. Forty-nine similar reaches were identified from Lake Itasca to the Coon Rapids Dam. River Miles were also calculated and are shown for Crow Wing County in Figure 3.

Reach 29. From Aitkin County downstream to the mouth of the Pine River. Above the Pine River the Mississippi is no longer influenced by the Brainerd Dam and boulder-cobble riffles are common (Figure 4). Approximately 17 small, mostly intermittent tributaries are present in this reach. A few areas of residential development are found mainly near the Highway 6 Bridge, but the reach is largely undeveloped with a wooded riparian zone. The only access is located at Highway 6. The next upstream access is in the City of Aitkin. This reach is 15.8 miles long with a sinuosity of 1.2. In the upper portion of this reach, below the mouth of Dean Brook the Mississippi has a watershed of 6,030 sq. mi.

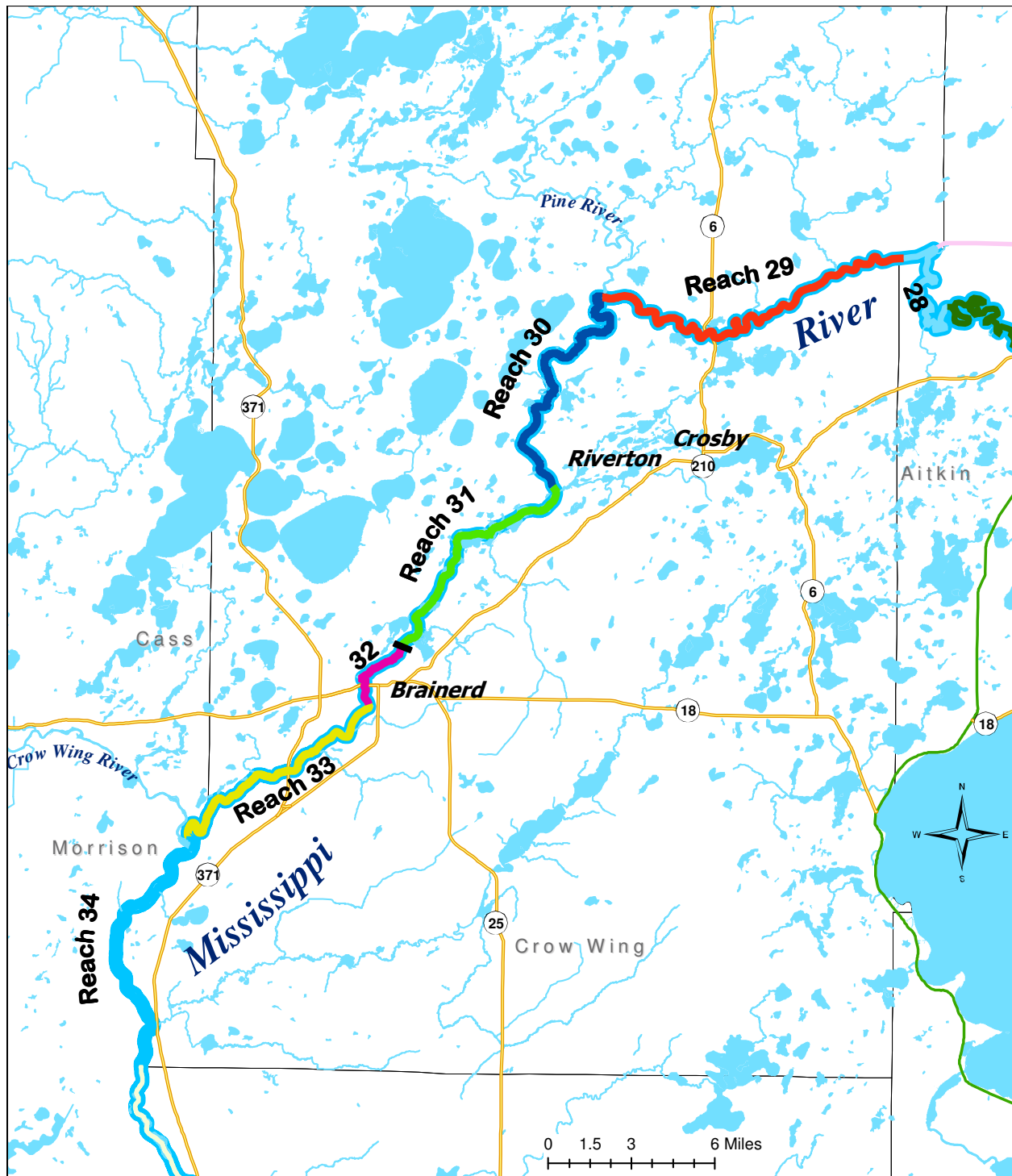


Figure 2. Location of the similar reaches of the Mississippi River in Crow Wing County, Minnesota.

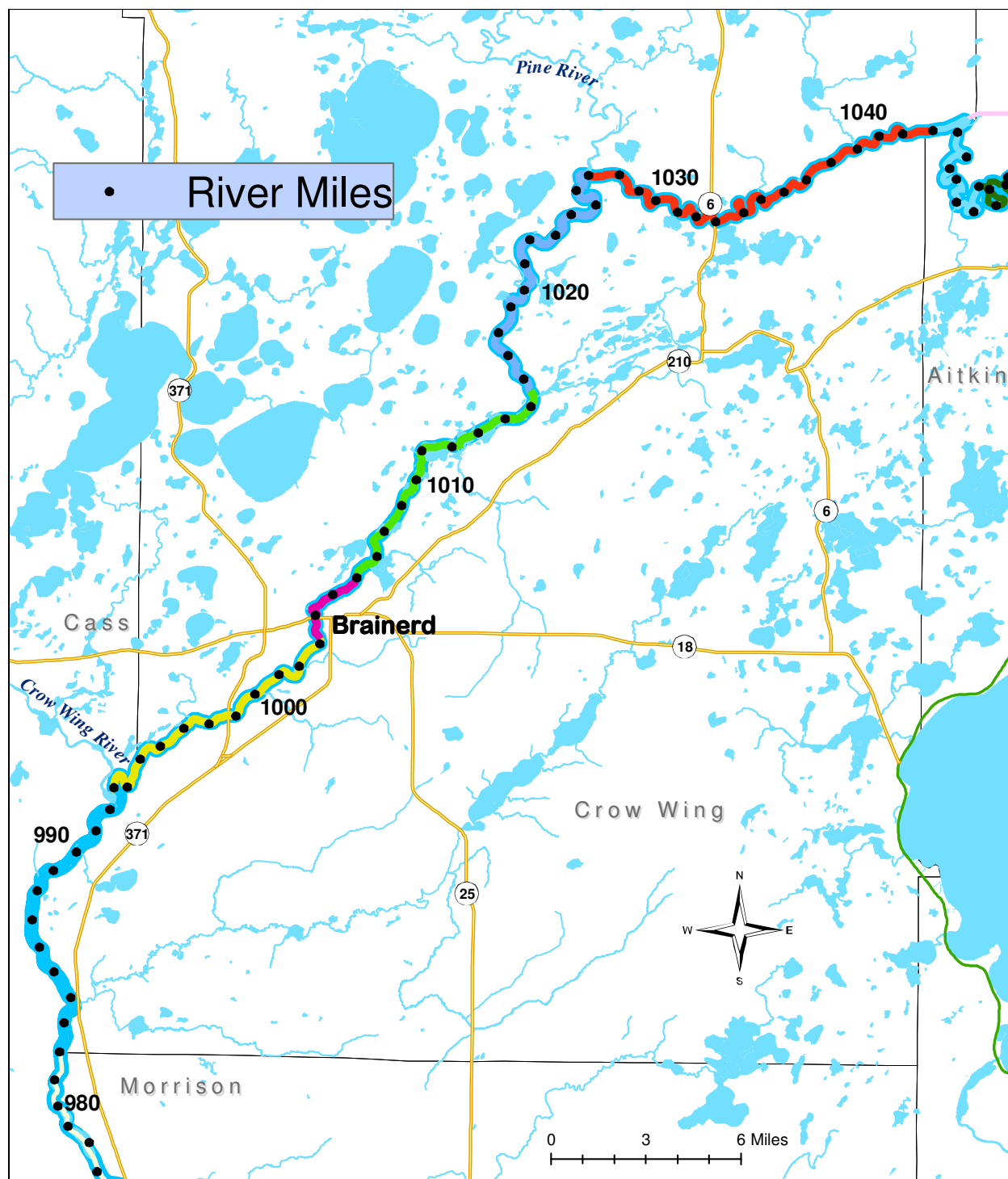


Figure 3. River mile points on the Mississippi River in Crow Wing County, Minnesota.



Figure 4. Examples of Reach 29 from 6/22/2007.

Reach 30. From the mouth of the Pine River downstream to the outlet of Little Rabbit Lake. Above the outlet of Little Rabbit Lake the Brainerd Dam still impounds water upstream to about the mouth of the Pine River (Figure 5). This reach is similar to Reach 31 in having a deep channel, however flooded backwaters are much less common. Much of the main channel within this reach is from 10 to 15 ft deep. Aquatic vegetation including wild rice is abundant along the channel margins. During low water the first mile below the Pine River is not affected by the dam and becomes shallow and rocky and is more similar to the reach above the Pine River. A few areas of residential development are scattered throughout this reach, but it is largely undeveloped with a natural wooded riparian zone. Access in this reach is available by coming down the Pine River from the launch on Highway 11, at the outlet of Black Bear Lake and at Half Moon Landing. Tributaries include the Pine River and Mission Creek. This reach is 11.1 miles long with a sinuosity of 1.2. At the confluence with the Pine River the Mississippi has a watershed of 6060 sq. mi. and the Pine River contributes a drainage area of 780 sq. mi. for a combined watershed of 6840 sq. mi. below the confluence.



Figure 5. Examples of Reach 30 taken on 6/5/2007.

Reach 31. From the outlet of Little Rabbit Lake downstream to the Brainerd Dam. This reach is impounded by the Brainerd Dam and has extensive flooded backwaters including Rice Lake (Figure 6). Much of the main channel is from 15 to 20 ft deep. Aquatic vegetation is abundant along the channel margins and in the backwaters, including large areas of wild rice. Tributaries in this reach include Whitley's and Sand creeks, both designated trout streams, an unnamed

stream near the Sagamore mine pit, and the outlet of Little Rabbit Lake. Several power lines cross the river near Little Rabbit Lake. Residential development is common within Rice Lake with a smaller cluster of development on the left, north bank in the middle of the reach. Access in the reach is possible at Lum Park on Rice Lake in Brainerd, at French Rapids, at a canoe launch at Green's Point and at two accesses located on Little Rabbit Lake. This reach is 9.4 miles long with a sinuosity of 1.1. At the upstream end of this reach the Mississippi has a drainage area of 6,930 sq. mi. with the Little Rabbit Lake drainage contributing 45 sq. mi of this and the river above Little Rabbit Lake contributing 6,880 sq. mi.



Figure 6. Examples of Reach 31, looking upstream towards the outlet of Little Rabbit Lake (left) and downstream towards the French Rapids narrows (right). Pictures were taken on 6/1/2007.

Reach 32. From the Dam in Brainerd downstream to Boom Lake and the College Drive Bridge. This reach is within the City of Brainerd and includes four bridge crossings in a less than one-mile section at the downstream portion of the reach (Figure 7). Islands are common in the upper



Figure 7. Examples of Reach 32, looking downstream at the HW 210 and railroad bridges (left) and upstream at islands towards Evergreen Landing (right). Pictures were taken on 8/3/2007.

portion of this reach above the Highway 210 bridge. While this reach is within Brainerd, much of the immediate riparian zone is forested. One small tributary enters on the right bank about 0.3 miles above the Highway 210 Bridge. Several storm water system discharges are located in the section between the bridges. Access to this reach is possible at the Evergreen Landing 0.7 miles

below the dam and at the canoe launch below the College Drive Bridge in Kiwanis City Park. A fishing pier is also available at Kiwanis Park. This reach is 3.0 miles long with a sinuosity of 1.1. At the upstream end of this reach the river has a watershed of about 7000 sq. mi.

Reach 33. From Boom Lake and the College Drive Bridge in Brainerd downstream to the mouth of the Crow Wing River. This reach is characterized by interspersed riffles and deep pools with a few islands (Figure 8). Shallow riffles are more common downstream of the Highway 371 bridge. Three small tributaries enter the Mississippi in this reach. Little Buffalo Creek at First Island, Buffalo Creek at three small islands, and an unnamed stream downstream of the Highway 371 Bridge. Riparian residential development is common in the upper portion of the reach, particularly on the right bank above the Highway 371 Bridge. Below the 371 Bridge few houses are present and much of the left bank is part of Crow Wing State Park. The Brainerd wastewater treatment facility discharge point is located on the right bank about 0.5 miles below First Island. Access within this reach is possible at the boat ramp in Crow Wing State Park and at a canoe launch below the College Drive Bridge in Kiwanis City Park. A canoe access campsite is located on the right bank about 1 mile below the 371 Bridge. This reach is 10.6 miles long with a sinuosity of 1.1. At the downstream end of this reach before the confluence with the Crow Wing River, the Mississippi has a drainage area of 7,050 sq. mi. The watershed of the Crow Wing is 3,760 sq. mi. for a combined watershed of 10,810 sq. mi. below the confluence of the two rivers.



Figure 8. Examples of Reach 33 taken on 6/27/2007.

For some comparisons, some of the more similar reaches are combined. Reaches 32 and 33 below the Brainerd Dam are sometimes treated as one section in the results, and the two portions of the Brainerd Dam reservoir, reaches 30 and 31, are sometimes combined for some results. Some comparisons are also made between the two major sections – above and below the Brainerd Dam.

Methods

Thalweg Depth Mapping

Depth of the main channel thalweg was measured using a Garmin 178C GPS/sounder mounted on a boat. The GPS sounder recorded location and water depth at two-second intervals

while the boat was driven at slow idle speed down the thalweg. The GPS track log was then imported into ESRI ARCGIS and depths were corrected for transducer depth (0.8 to 1.0 ft) and river stage if necessary. Depth mapping for the section above the dam was done on three days between June 1 and 22, 2007 and on June 27, 2007 for the section from the Brainerd Dam downstream to the Crow Wing State Park boat launch. Aitkin Fisheries mapped the section above the Highway 6 Bridge. Significant areas of bank erosion were also noted while conducting the depth mapping.

The section from Highway 6 to the French Rapids access was mapped on three different days (Table 1), and the lowermost portion of these done on June 1, 2007 was mapped in an upstream direction. The depths for the three days were standardized to the flow on June 5, 2007. The June 22 mapping was corrected by 0.5 ft to make the depth similar to June 5 based on the Aitkin gage. The difference in flow has less influence on water depth further downstream, closer to the Brainerd Dam so no corrections were made for June 1. Downstream of the Brainerd Dam was mapped on June 27 and 29, 2007. Flows were similar between these two days and no adjustment was used.

Table 1. Details of dates and river discharge when thalweg depth mapping was conducted.

Date	Section mapped	Flow at Brainerd	Brainerd stage	Flow at Aitkin	Aitkin stage
6/1/2007	Little Rabbit to French Rapids	3200	6.7	2200	6.0
6/5/2007	Pine River to Little Rabbit	4010	7.3	2700	6.8
6/22/2007	Hw 6 to Pine River	2840	6.4	2350	6.3
6/27/2007	Brainerd Dam to Crow Wing Access	2160	5.9	1900	
6/29/2007	Crow Wing to Camp Ripley Crossing	1930	5.7	1670	

Water Chemistry

Water samples were collected from three sites in Crow Wing County on August 27, 2007 and analyzed by the MDA (Figure 9). Samples were collected at the Highway 6 bridge, at the Half-Moon Landing, and at the Highway 371 bridge.

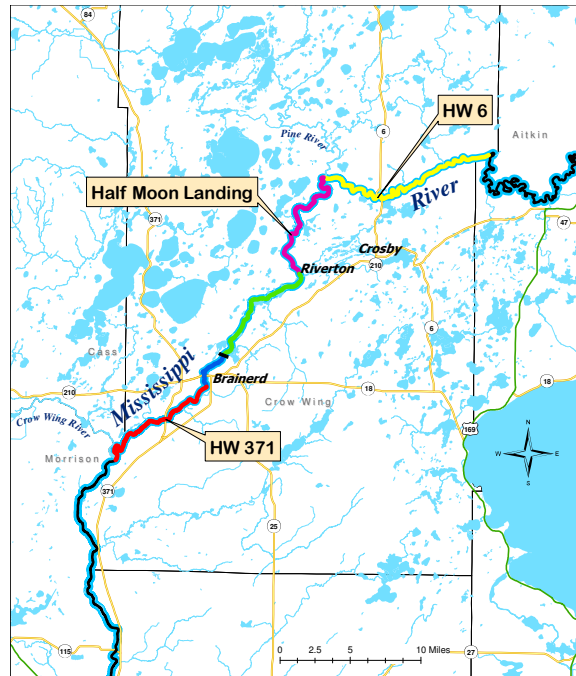


Figure 9. Location of the three water samples collected from the Mississippi River in Crow Wing County, Minnesota on August 27, 2007.

Fish Community

The fish community in the Mississippi River was assessed with boat and backpack electrofishers and trotlines. A Smith-Root boat electrofisher was the primary fish collection method. Nine sites were sampled with the boat electrofisher with two sites sampled in each similar reach except reach 31 where only one site was sampled (Figure 10, Table 2). At each site three runs were conducted, along each bank and in mid-channel. Fish sampling sites were labeled according to the reach they were located in, an area designation (e.g., BR for Brainerd area), a gear identifier code (e.g. BOEF for boat electrofisher, BPEF for backpack electrofisher, and TL for trotline) and L, R, or C left or right bank, or center of the channel (Appendix A). For simplifications the area and gear codes are not used and sites are referred to simply by the reach and site number (e.g., 29-8) in some parts of this report. Electrofishing sites 30-16 and 31-22 were not sampled mid-channel due to deep water at these sites. Site numbers above the dam correspond to sites sampled in 2004. Backpack electrofishing was conducted in shallow near-shore water at three sites. Ten 25-hook trotlines baited with cut white suckers were set above the Brainerd Dam in reaches 30 and 31 (Figure 11). Additionally, a MNDNR lake survey population assessment was conducted on Rice Lake in late August 2007 using standard gill net and trap net sets.

Fish community Index of Biological Integrity (IBI) scores were calculated according to Niemela and Feist (2002) for rivers in the upper Mississippi River basin of Minnesota with drainage areas > 200 sq. mi. For the three sites where backpack electrofishing was used IBI scores were calculated with just the boat-collected fish, and with the boat collection combined with the backpack collection. For comparisons between reaches only the boat electrofisher scores are used.

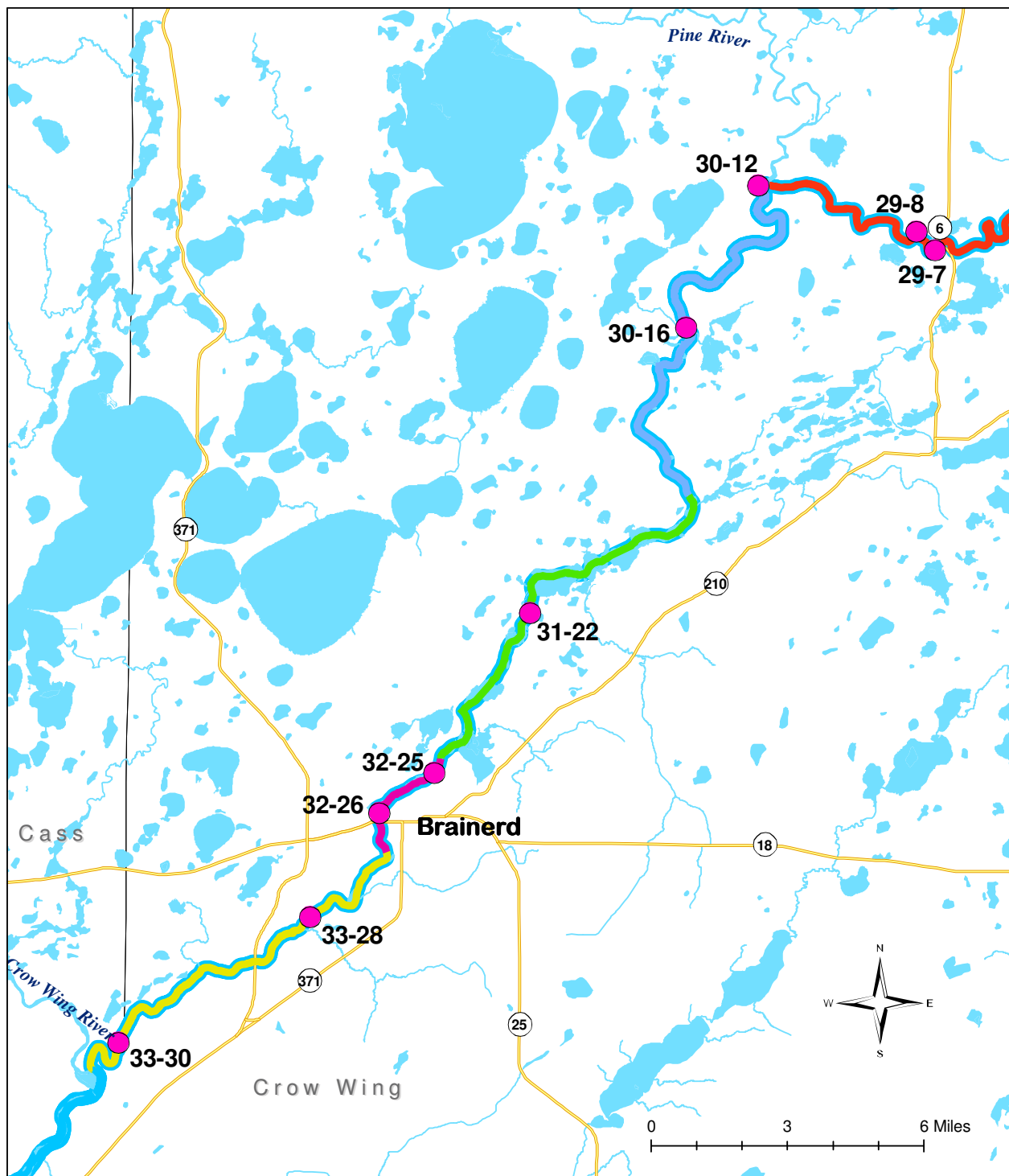


Figure 10. Location of the nine electrofishing sites sampled in August 2007 on the Mississippi River in Crow Wing County, Minnesota.

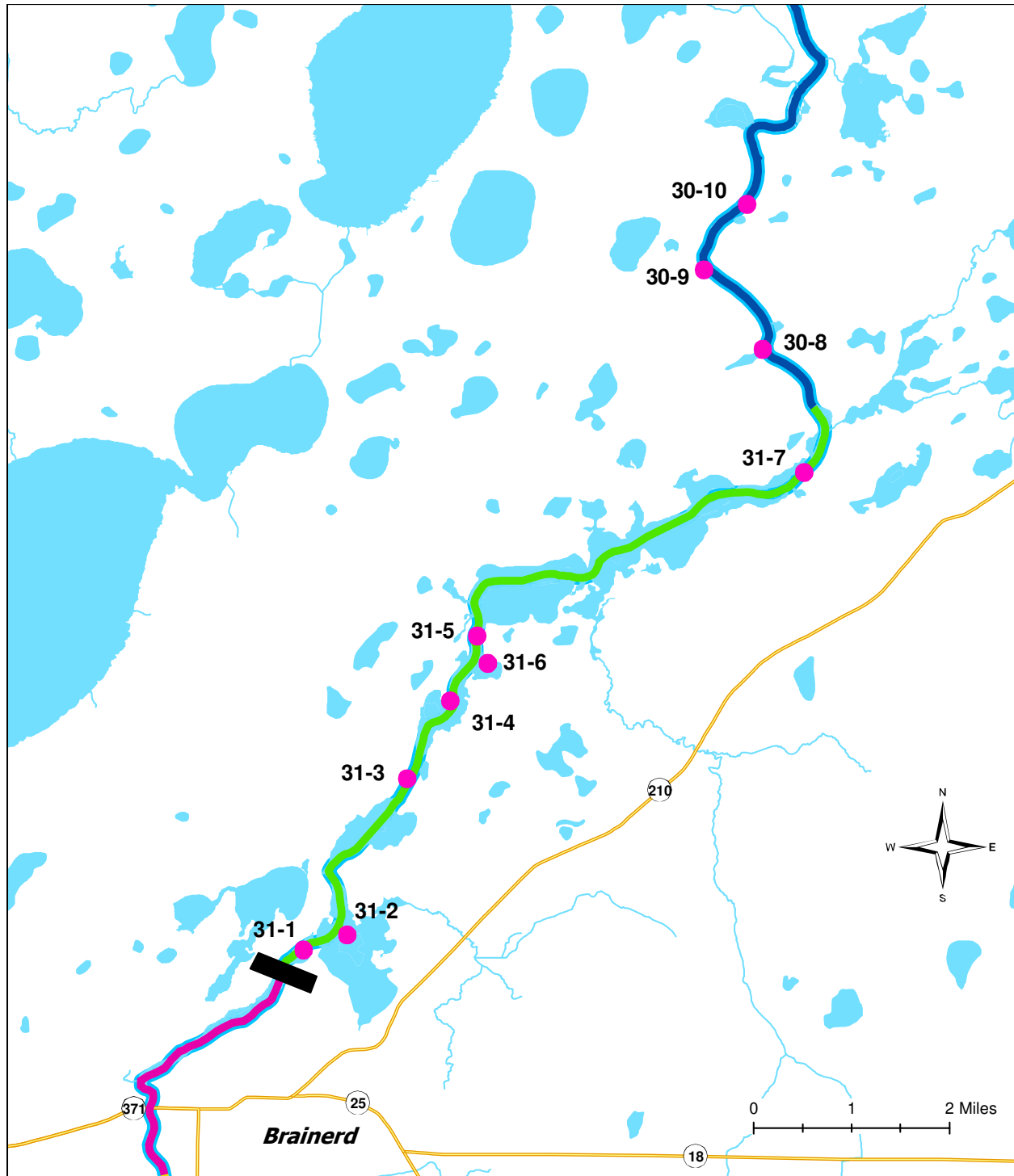


Figure 11. Location of the 10 trot lines set in the Mississippi River above the Brainerd Dam in August 2007, in Crow Wing County, Minnesota. No trotlines were set below the Brainerd Dam in Crow Wing County.

Table 2. Summary of backpack electrofishing, boat electrofishing, and trotline effort in the Mississippi River in Crow Wing County, Minnesota in August 2007.

Reach	Station	Gear type		
		BPEF (s)	BOEF (s)	Trotline (no. of hooks)
29	7		3002	
29	8	1200	2303	
30	12		2772	
30	16		2119	
31	22		2711	
32	25		2142	
32	26	1200	2110	
33	28		2446	
33	30	900	2412	
30	TL8			25
30	TL9			25
30	TL10			25
31	TL1			25
31	TL2			25
31	TL3			25
31	TL4			25
31	TL5			24
31	TL6			25
31	TL7			25

Fish Contaminates

Fish were collected from reaches 32 and 33 for analysis of contaminate concentrations. Fish were collected from within and just upstream of site 33-28 specifically for analysis of perfluorochemical (PFC) content. Site 33-28 is located less than one mile downstream of the Brainerd Waste Water Treatment Facility discharge, a suspected source of PFCs. Fish were not collected for contaminate analysis from above the Brainerd Dam as fish were analyzed from this section in 2004.

Results

Thalweg Depth and Channel Characteristics

Depth mapping of the main channel of the Mississippi River in Crow Wing County showed the deepest areas are associated with the Brainerd Dam (Appendix B). Much of Reach 31 above the Brainerd dam was from 15 to 25 ft deep under normal flow conditions. The maximum depth in the Brainerd Dam tailrace pool was about 27 ft. Below Highway 6 down to the Pine River the deepest pools were around 16 ft deep, while below Brainerd most pools were 8 to 14 ft deep.

Bank Erosion. — Eight areas of significant bank erosion were observed along the Mississippi from Highway 6 downstream to the Crow Wing River. Most areas were located

between the Half Moon Landing and Highway 6 in reaches 29 and 30 (Figures 12 – 20). No significant erosion areas were found in reaches 31 and 32.



Figure 13. Significant erosion site 1, located on the right bank just downstream of the Highway 371 bridge in Crow Wing County, Minnesota.



Figure 14. Significant erosion site 2 located downstream of First Island in Crow Wing County, Minnesota.

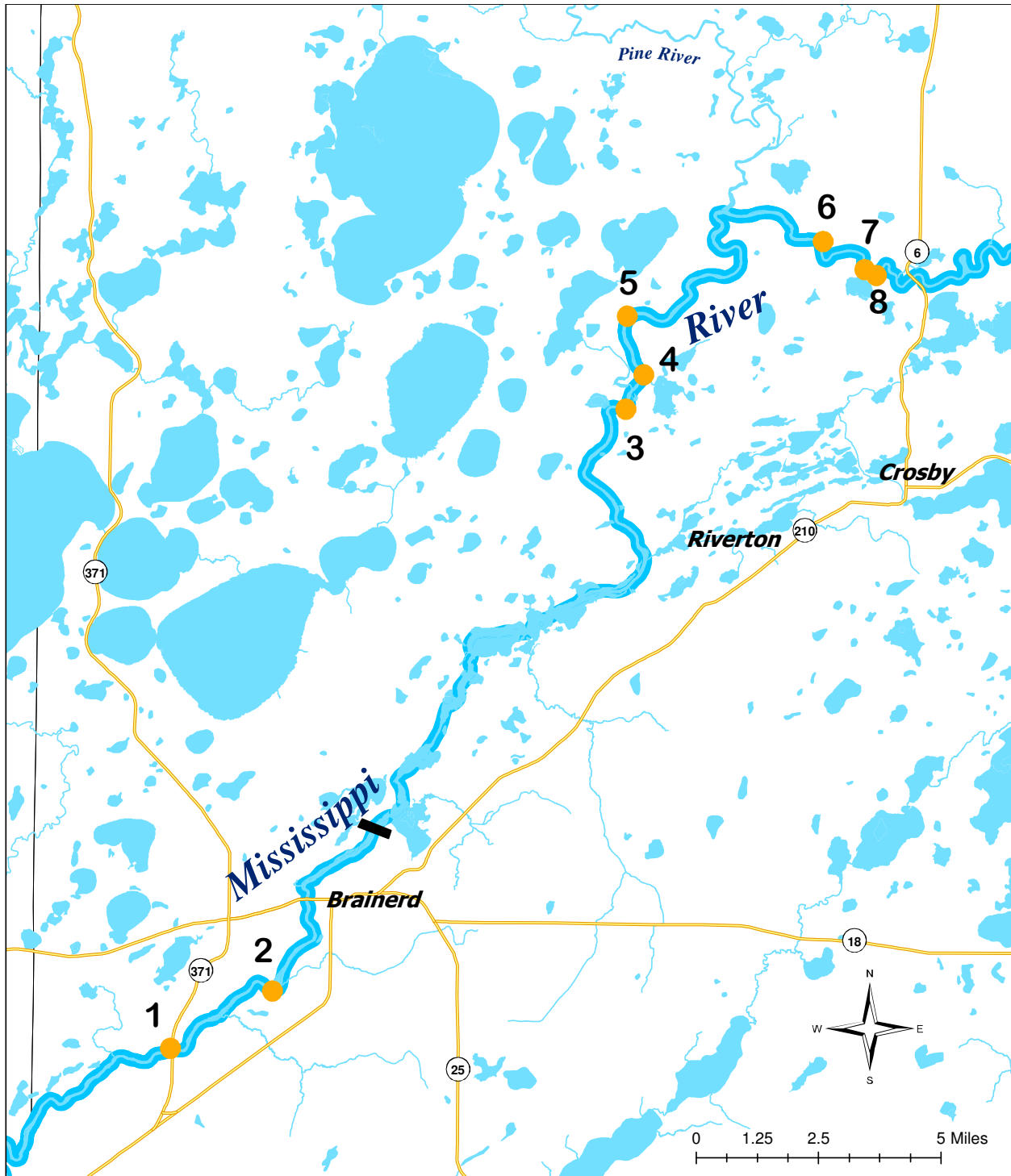


Figure 12. Location of the eight areas of substantial bank erosion on the Mississippi River below Highway 6 in Crow Wing County, Minnesota.



Figure 15. Significant erosion site 3 located above the Half Moon Landing access in Crow Wing County, Minnesota.



Figure 16. Significant erosion site 4 located downstream of the outlet of Black Bear Lake in Crow Wing County, Minnesota.



Figure 17. Significant erosion site 5 located east of Lower Mission Lake in Crow Wing County, Minnesota.



Figure 18. Significant erosion site 6 located on a sharp bend upstream of the Pine River near County Route 11 in Crow Wing County, Minnesota.



Figure 19. Significant erosion site 7 located downstream of the Highway 6 bridge in Crow Wing County, Minnesota.



Figure 20. Significant erosion site 8 located downstream of the Highway 6 bridge in Crow Wing County, Minnesota.

Water Chemistry

The water chemistry of the Mississippi River in Crow Wing County was characteristic of fairly hard water (Table 3). The three water samples were similar across the measured parameters, except total phosphorus and chloride which were elevated in the sample collected downstream of Brainerd. The flow of the Mississippi was quite low when the samples were collected thus the Brainerd sewage treatment plan discharge contributed a greater portion of the flow at the Highway 371 sampling site than it would under more normal, higher flow.

Table 3. Water chemistry from three sites on the Mississippi River in Crow Wing County, Minnesota. Water samples were collected on August 27, 2007 when the mean daily flow in Brainerd was 394 cfs.

Location	Total phosphorus (ppm)	Chlorophyll a (ppb)	Total alkalinity (ppm)	pH	Total dissolved solids (ppm)	Specific conductivity (umhos)	Chloride (ppm)
Highway 6	0.040	9.2	153	8.32	204	309	5.7
Half Moon Landing	0.034	11.8	150	8.36	196	302	5.5
Highway 371	0.117	8.9	155	7.93	204	313	10.4

Fish Community

A total of thirty-four fish species and one hybrid were found in the Mississippi River in Crow Wing County, Minnesota (Table 4). Slightly more species (30) were found in the section of river below the Brainerd Dam than above (28). Seven species were found in all 5 reaches and four species were found in only one reach (Table 4). Shorthead redhorse and rock bass were the only species found at all nine electrofishing sites, while bigmouth shiner, blacknose shiner, yellow bullhead, and brown bullhead were only found at one electrofishing sampling site each (Table 5). However, yellow bullheads were the most common fish species in the trotline catch (Table 6). Bluegills were the most abundant fish across all electrofishing samples with nearly 400 captured, twice as many as the next most common fish sampled, shorthead redhorse. Over one-half of the bluegills were collected at electrofishing site 31-22, which encompassed a large portion of shallow, vegetated backwater and channel margins within the impoundment above the Brainerd Dam.

Site 32-26 (including backpack sampled fish) had the greatest species richness in the Crow Wing County section of the Mississippi with 22 species sampled. Site 31-22 had the greatest species richness of the sampling sites above the Brainerd Dam with 17 species plus one hybrid found, although sites 30-12 and 29-8 (including backpack electrofisher collection) captured nearly as many species (16). All sites below the Brainerd Dam had at least as many species (17, including backpack sampled fish) as the most species rich site above the dam.

Three channel catfish were caught in lake survey gill nets set in Rice Lake. This is the first record of channel catfish in the Mississippi above the Brainerd Dam in Crow Wing County. No channel catfish were captured by electrofishing or trotlines above the dam. All other species captured in the lake survey gill nets and trap nets set in Rice Lake were also captured in the electrofishing done above the dam.

Game Fish. — Smallmouth bass were the most common and widely found large piscivore fish species. Smallmouth bass were absent from only the lacustrine and heavily vegetated site 31-22. Smallmouth ranged in size from 60 to 498 mm with an average length of 196 mm (Table 7, Figure 21). The most smallmouth bass were captured at the most upstream site, 29-7, and in Brainerd at site 32-26. Young-of-year smallmouth bass were found at seven sites with most found at the three most downstream sites 32-26, 33-28, and 33-30. Most large adult smallmouth bass greater than 300 mm long were captured above the dam at sites 29-7 and

30-12. Most juvenile smallmouth between 150 and 300 mm were captured at sites 29-7 and 32-25.

Most channel catfish ranged from 500 to 689 mm in length and were captured at sites 32-25 and 32-26 in association with large wood (Table 7, Figure 22). One juvenile channel catfish (211 mm) was caught at site 33-30 and a few young-of-year catfish were caught by backpack electrofishing at sites 32-26 and 33-30.

The popular game fish walleye was captured in the Mississippi throughout Crow Wing County, absent from only the two sites influenced by the Brainerd Dam. Walleye ranged in length from 98 to 685 mm with a mean length of 242 mm (Table 7, Figure 23). Young-of-year walleye were most common at the two most downstream sites (33-28 and 33-30). Only one young-of-year walleye was captured above the Brainerd Dam, by backpack electrofishing at site 29-8. The largest walleye were found at the most upstream site (29-7) while the most yearling and larger walleye were sampled at site 33-28 (Figure 23).

Four muskellunge were observed at two sampling sites. The length of these fish was estimated; capture of the muskellunge was not attempted. The muskellunge were observed in the electric field and then the current was turned off to allow the fish to escape so as to reduce the handling stress to these large fish. An additional muskellunge of similar size to those reported in Table 7 was observed upstream of sampling site 33-28 while collecting additional fish for contaminate analysis.

Other gamefish found in the Mississippi included northern pike and largemouth bass as well as bluegill, black crappie, rock bass, and yellow perch. Northern pike were found in low numbers throughout the study area while largemouth bass and bluegill were most common in and immediately below the Brainerd impoundment.

Fish community IBI. —Fish community IBI scores for the Mississippi River in Crow Wing County were in the fair to good range (Tables 8, 9a, and 9b). The section influenced by the Brainerd Dam (reaches 30 and 31) sampled at sites 30-16 and 31-22 had the lowest average score (55, fair) and was the only section or reach to have an average rating in the fair range; all other reaches had an average rating of good. The reach below Brainerd sampled at sites 33-28 and 33-30 had the highest average score (72, good).

The number of piscivore species and the percent of individuals that are simple lithophilic spawners showed the greatest range in scores with scores ranging from 0 to 10 for these two metrics. The percent of individuals that are simple lithophilic spawners that also showed the greatest range in values with from 4 to 85% of the fish sampled simple lithophilic spawners. The lowest percentage of lithophils was found at the two sites within the Brainerd impoundment where centrarchids, particularly bluegill, comprised much of the fish community. The percentage of lithophils was highest at site 29-8 where redhorse comprised most of the catch. The number of darter, sculpin, and madtom species had the second greatest range in scores with scores from 0 to 7 (0 to 3 species). The highest score for this metric was at site 33-28 where a tadpole madtom, a johnny darter, and several logperch were caught. The percent of tolerant individuals was generally low, except for sample site 32-26 where 20 common carp were captured, 38% of the sample. The number of fish per 100 meters and the percent of fish with severe anomalies were the only metrics have a maximum score at all sites.

Combining the backpack-sampled fish with the boat-sampled fish increased the score of two of the three sites with both samples from a fair to a good rating. However, including backpack-sampled fish did not change the average rating of any reach.

Table 4. List of fish species found in the Mississippi River in Crow Wing County, Minnesota in August 2007 by reach. Hybrids are not included in totals.

Species	Reach				
	29	30	31	32	33
Amiidae					
Bowfin	<i>Amia calva</i>	X	X		
Cyprinidae					
Spotfin shiner	<i>Cyprinella spiloptera</i>	X	X	X	X
Common carp	<i>Cyprinus carpio</i>			X	X
Common shiner	<i>Luxilus cornutus</i>		X	X	X
Hornyhead chub	<i>Nocomis biguttatus</i>	X		X	X
Golden shiner	<i>Notemigonus crysoleucas</i>		X	X	
Bigmouth shiner	<i>Notropis dorsalis</i>				X
Blacknose shiner	<i>Notropis heterolepis</i>				X
Spottail shiner	<i>Notropis hudsonius</i>			X	X
Bluntnose minnow	<i>Pimephales notatus</i>			X	X
Catostomidae					
White sucker	<i>Catostomus commersonii</i>	X	X	X	X
Bigmouth buffalo	<i>Ictiobus cyprinellus</i>		X		
Silver redhorse	<i>Moxostoma anisurum</i>	X	X	X	X
Shorthead redhorse	<i>Moxostoma macrolepidotum</i>	X	X	X	X
Greater redhorse	<i>Moxostoma valenciennesi</i>	X	X	X	
Ictaluridae					
Yellow bullhead	<i>Ameiurus natalis</i>		X		
Brown bullhead	<i>Ameiurus nebulosus</i>		X		
Channel catfish	<i>Ictalurus punctatus</i>		X	X	X
Tadpole madtom	<i>Noturus gyrinus</i>				X
Esocidae					
Northern pike	<i>Esox lucius</i>	X	X	X	X
Muskellunge	<i>Esox masquinongy</i>		X	X	X
Gadidae					
Burbot	<i>Lota lota</i>	X		X	X
Atherinidae					
Brook silverside	<i>Labidesthes sicculus</i>	X	X	X	
Centrarchidae					
Rock bass	<i>Ambloplites rupestris</i>	X	X	X	X
Green sunfish	<i>Lepomis cyanellus</i>	X		X	
Pumpkinseed	<i>Lepomis gibbosus</i>		X	X	
Bluegill	<i>Lepomis macrochirus</i>	X	X	X	X
Hybrid Sunfish	<i>Lepomis sp.</i>	X	X		
Smallmouth bass	<i>Micropterus dolomieu</i>	X	X	X	X
Largemouth bass	<i>Micropterus salmoides</i>	X	X	X	X
Black crappie	<i>Pomoxis nigromaculatus</i>		X	X	X
Percidae					
Johnny darter	<i>Etheostoma nigrum</i>	X		X	X
Yellow perch	<i>Perca flavescens</i>		X	X	
Logperch	<i>Percina caprodes</i>	X	X	X	X
Walleye	<i>Sander vitreus</i>	X	X	X	X
Total number of species		17	20	18	24
Entire survey total species				34	

Table 5. Number of fish caught in the nine boat and three backpack electrofishing samples collected from the Mississippi River in Crow Wing County, Minnesota in August 2007.

	Site (reach-station)												Total
	29-7	29-8	29-8 BP	30-12	30-16	31-22	32-25	32-26	32-26 BP	33-28	33-30	33-30 BP	
Bowfin					5	1							6
Spotfin Shiner	2	1	8	3			18	2	62	20	17	34	167
Common Carp								20		1			21
Common Shiner				1			1	6	6	53	78		145
Hornyhead Chub			2					5	5	5	21	1	39
Golden Shiner						2	6	24					32
Bigmouth Shiner												13	13
Blacknose Shiner										2			2
Spottail Shiner									1	5			6
Bluntnose Minnow								4		8			12
White Sucker	2			6	3	2	4	5		22	13		57
Bigmouth Buffalo				2	2	3							7
Silver Redhorse	21	19		14	8	4	11	1			2		80
Shorthead Redhorse	46	51		50	9	2	16	1		6	12		193
Greater Redhorse	8	8		18	4	4	2						44
Yellow Bullhead						1							1
Brown Bullhead						1							1
Channel Catfish							15	5	1		1	2	24
Tadpole Madtom										1		3	4
Northern Pike		1		1		1	2			3	2		10
Muskellunge				1			3						4
Burbot	2		6					8	2			1	19
Brook Silverside		1		2	3	10			8				24
Rock Bass	2		12	6	2	1	2	7	1	10	6	1	50
Green Sunfish			1					1					2
Pumpkinseed Sunfish					1	7	1						9
Bluegill	4	2	3	32	72	212	33	9	14	5			386
Hybrid Sunfish			1			1							2
Smallmouth Bass	29	9	2	16	4		13	25	1	18	21		138
Largemouth Bass			1	8	6	20	10			1	1		47
Black Crappie					2	3	13	3		2			23
Johnny Darter			7						4	1	1	9	22
Yellow Perch						3	27	2					32
Logperch	1	1	2	2			9	8		6	10		39
Walleye	3		1	3			6	5		19	18		55
Total number of fish	120	93	46	165	121	278	192	141	105	188	203	64	1716
Number of species	11	9	12	16	13	17	19	19	11	19	14	8	

Table 6. Summary of the fish and turtles caught on ten 25-hook trotlines set August 6 – 7, 2007 in the Mississippi River above the Brainerd Dam in Crow Wing County, Minnesota.

Species	Number	Mean length (mm)
Bowfin	3	653
Yellow Bullhead	13	325
Brown Bullhead	2	357
Northern Pike	1	552
Rock Bass	1	212
Snapping Turtle	2	na
Spiny Softshell Turtle	13	372

Table 7. Mean, minimum, and maximum length and mean weight of fish captured by boat and backpack electrofishing from the Mississippi River in Crow Wing County, Minnesota in August 2007. Only minimum and maximum length and a batch weight were generally recorded for non-gamefish species.

	Length (mm)			Mean weight (g)
	Mean	Minimum	Maximum	
Bowfin		525	655	2250
Spotfin Shiner		42	79	2
Common Carp		670	856	6295
Common Shiner		41	135	5
Hornyhead Chub		35	146	9
Golden Shiner		55	104	7
Bigmouth Shiner		57	73	2
Blacknose Shiner	53	50	56	1
Spottail Shiner		55	87	5
Bluntnose Minnow		50	72	3
White Sucker		134	545	570
Bigmouth Buffalo	756	685	870	6893
Silver Redhorse		151	650	1797
Shorthead Redhorse		139	544	515
Greater Redhorse		155	647	1578
Yellow Bullhead	195	195	195	100
Brown Bullhead	365	365	365	745
Channel Catfish	530	65	689	2282
Tadpole Madtom		35	82	7
Northern Pike	539	360	842	1214
Muskellunge	1054	890	1220	8475
Burbot	177	67	320	37
Brook Silverside		43	95	1
Rock Bass		22	270	131
Green Sunfish	88	85	90	14
Pumpkinseed	164	129	184	102
Bluegill	106	25	240	42
Hybrid Sunfish	160	115	205	138
Smallmouth Bass	196	60	498	305
Largemouth Bass	200	67	446	213
Black Crappie	149	65	270	72
Johnny Darter		30	70	1
Yellow Perch	119	88	185	21
Logperch		78	119	13
Walleye	242	98	685	372

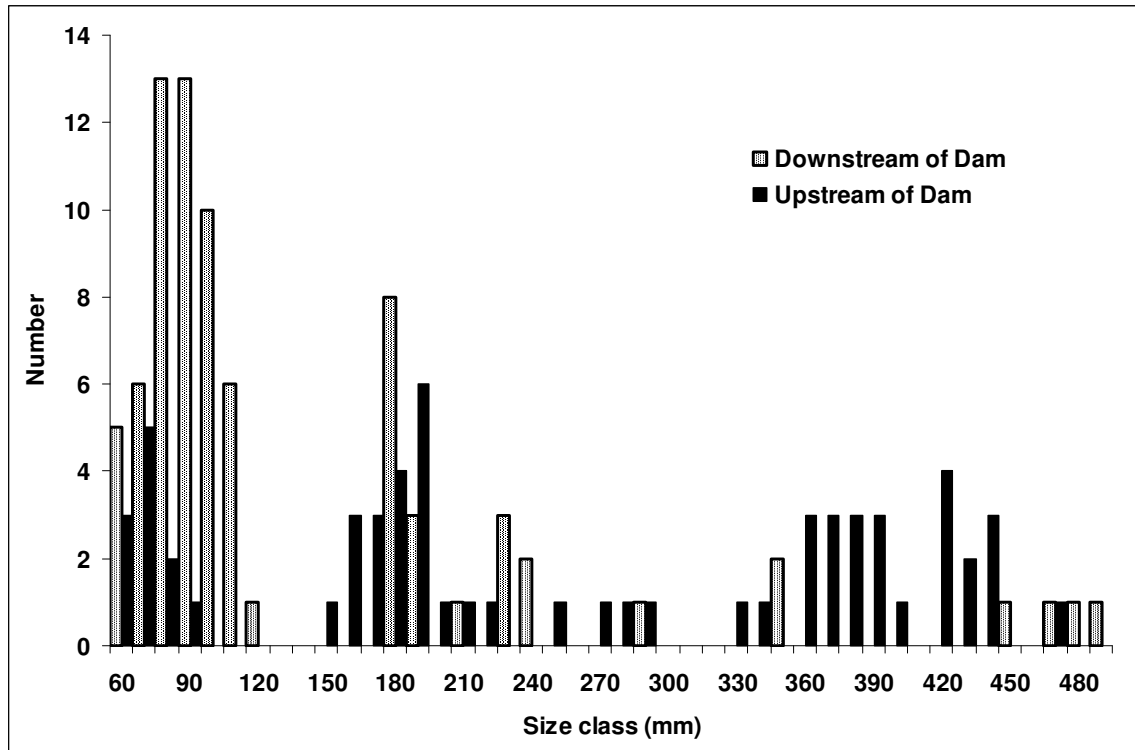


Figure 21. Length distribution of smallmouth bass caught in the Mississippi River with boat and backpack electrofishing in Crow Wing County, Minnesota.

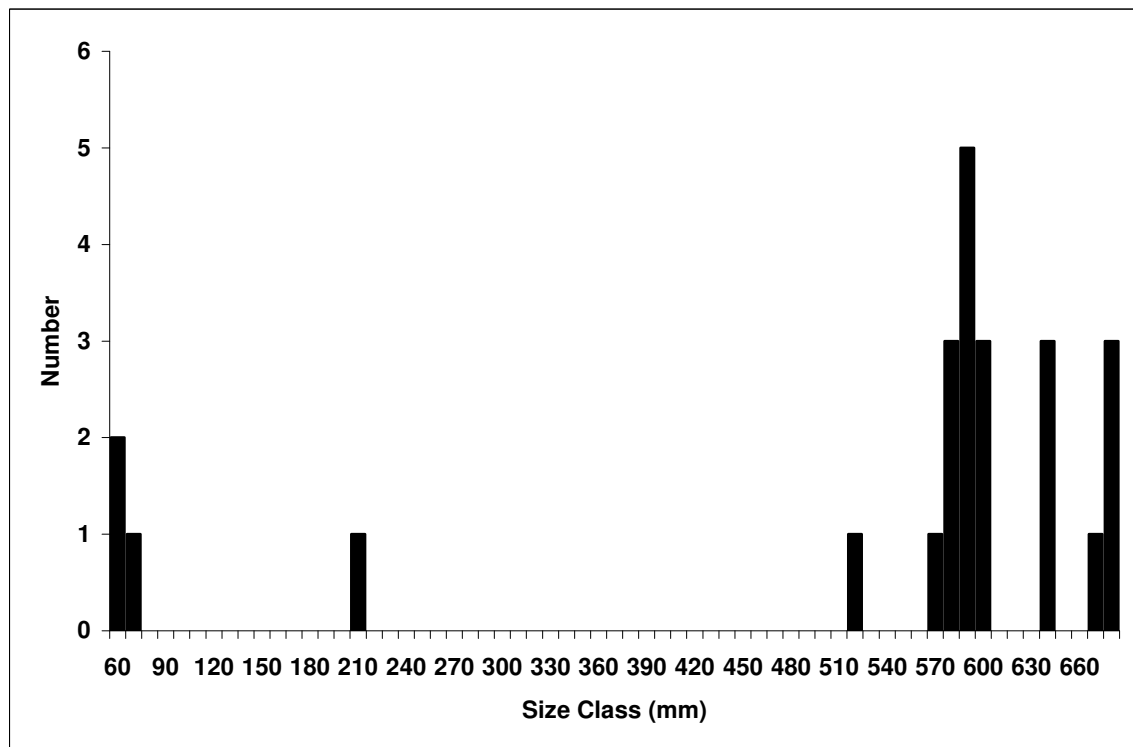


Figure 22. Length distribution of channel catfish caught in the Mississippi River with boat and backpack electrofishing below the Brainerd Dam in Crow Wing County, Minnesota.

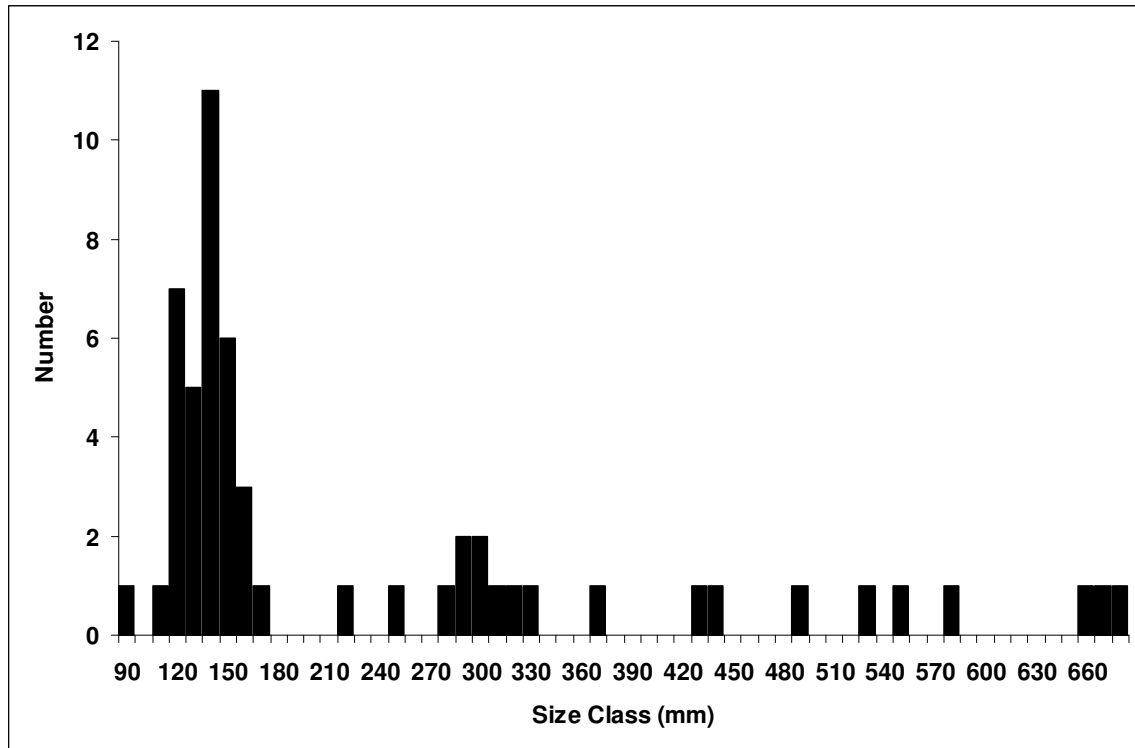


Figure 23. Length distribution of walleye caught in the Mississippi River with boat and backpack electrofishing in Crow Wing County, Minnesota.

Table 8. IBI scores for the nine sites sampled with boat electrofishing in Crow Wing County, Minnesota in August 2007.

Reach	Station	RM	IBI Score	Miles from Itasca
29	7	1032.4	63	314
29	8	1031.5	59	315
30	12	1026.6	68	320
30	16	1020.6	56	326
31	22	1010.3	54	337
32	25	1005.7	74	341
32	26	1004.1	57	343
33	28	1000.5	73	346
33	30	994.5	70	352

Table 9a. IBI scores for the six sites sampled in the Mississippi River upstream of the Brainerd Dam in similar reaches 29, 30, and 31. Site 29-8 is listed twice, with only the boat collected fish used, and with the backpack collected fish combined with the boat collection.

	29-7		29-8		29-8 with backpack		30-12		30-16		31-22	
	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
Total number of species	11	0	9	0	16	2	16	2	13	2	17	2
Number of darter, sculpin, and madtom species	1	2	1	2	2	5	1	2	0	0	0	0
Number of intolerant species	3	7	2	5	4	10	4	10	3	7	2	5
Percent of tolerant individuals	2	10	0	10	1	10	5	10	4	10	3	10
Number of invertivore species	6	2	7	2	9	5	7	2	6	2	7	2
Percent of omnivore individuals	2	10	0	10	0	10	5	10	4	10	3	10
Number of piscivore species	4	5	2	0	6	7	6	7	5	5	5	5
Percent of individuals that are simple lithophils	69	7	85	10	63	7	57	5	20	0	4	0
Number of fish per 100 meters	18	10	16	10	23	10	21	10	14	10	45	10
Percent of anomalies	0	10	0	10	0	10	0	10	0	10	0	10
Overall score	63		59		76		68		56		54	
Rating	Good		Fair		Good		Good		Fair		Fair	

Table 9b. IBI scores for the four sites sampled in the Mississippi River downstream of the Brainerd Dam in similar reaches 32 and 33. Sites 32-26 and 33-30 are listed twice, with only the boat collected fish used, and with the backpack collected fish combined with the boat collection.

	32-25		32-26		32-26 with backpack		33-28		33-30		33-30 with backpack	
	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score
Total number of species	19	5	18	5	21	5	18	5	14	2	17	2
Number of darter, sculpin, and madtom species	1	2	1	2	2	5	3	7	2	5	3	7
Number of intolerant species	4	10	3	7	4	10	5	10	3	7	3	7
Percent of tolerant individuals	5	10	38	5	22	7	16	7	6	10	5	10
Number of invertivore species	8	5	7	2	10	5	9	5	6	2	8	5
Percent of omnivore individuals	2	10	18	7	10	10	12	7	6	10	5	10
Number of piscivore species	8	10	6	7	6	7	6	7	6	7	7	10
Percent of individuals that are simple lithophils	26	2	24	2	17	0	56	5	66	7	50	5
Number of fish per 100 meters	44	10	17	10	37	10	30	10	24	10	33	10
Percent of anomalies	0	10	0	10	0	10	0	10	0	10	0	10
Overall score	74		57		69		73		70		76	
Rating	Good		Fair		Good		Good		Good		Good	

Fish Contaminates

Perfluorooctane sulfonate (PFOS) was the only PFC found in the bluegill, smallmouth bass, walleye, and northern pike analyzed from in and near sample site 33-28. Of the fifteen individual fish tested from four species from the Mississippi River below the Brainerd WWTF discharge, all fish showed a PFOS concentration of at least 6.3 ppb with smallmouth bass having a mean concentration of 12.5 ppb, bluegill 9.8 ppb, walleye 8.9 ppb, and northern pike 7.0 ppb. The maximum concentration was found in a juvenile smallmouth bass at 18 ppb. All fish were below the MNPCA threshold for no consumption restriction of 38 ppb.

Discussion

A diverse fish community was found in the Mississippi River in Crow Wing County, Minnesota. The fish community included several popular gamefish and panfish species and the river supports a popular fishery. A 1996 creel survey estimated 22,600 angler hours on the section of the Mississippi from Brainerd downstream to Little Falls (Bublitz et al. 1997). Angling is also popular on the Mississippi above the Brainerd Dam, particularly in Rice Lake for both open water and ice fishing.

Channel catfish are a recent addition to the fish community of the Mississippi River in Crow Wing County. Below the Brainerd Dam channel catfish have been present since at least the early 1990's following stockings of channel catfish made into Boom Lake in the early 1990's and the Crow Wing River in the early 1970's. The channel catfish captured in Rice Lake and in Aitkin County are the first record of this species above the Brainerd Dam. There have been angler reports of channel catfish above the Brainerd Dam for only the past few years. At this time the number of catfish above the dam appears low, but they may increase in abundance in the future. The channel catfish were most likely illegally introduced above the Brainerd Dam by anglers transporting them from other waters, possibly from below the Brainerd Dam.

Of the species captured below the Brainerd Dam, but not above, common carp are the only species for which the distribution in the upper Mississippi basin appears to be limited by the Brainerd Dam. Common carp have never been captured from any waters in Crow Wing County that connect to the Mississippi above the Brainerd Dam, and it is assumed this is true for the entire Mississippi basin upstream of Brainerd.

The 2007 boat electrofishing samples collected more species and greater numbers of fish compared to the survey conducted in 2004. In 2007, 24 species were collected by boat electrofishing in the three reaches (29, 30, 31) above the Brainerd Dam, while the 2004 boat electrofishing collected 19 species despite sampling in many more sites than in 2007. Species captured by boat electrofishing above the Brainerd Dam in 2007 but not in 2004 were spotfin shiner, yellow bullhead, muskellunge, burbot, and logperch. Sampling in 2004 was conducted during much higher stream flow than in 2007. Discharge at the Aitkin gage ranged from 2,300 to 3,900 cfs and from 2,600 to 4,300 cfs in Brainerd on days when electrofishing was done in 2004. The Mississippi discharge was much lower when electrofishing above the Brainerd Dam was done in 2007 and ranged from 440 to 460 cfs in Aitkin and from 480 to 520 cfs in Brainerd. The low water conditions appeared to improve the catchability of most fish species above the Brainerd Dam in 2007 compared to 2004. However, low and clear water conditions when sampling below the Brainerd Dam may have reduced the catchability of smallmouth bass and other large fish. Springtime sampling targeting smallmouth bass conducted by the Little Falls Fisheries Office may

provide a better index of smallmouth bass population size structure and relative abundance below the Brainerd Dam.

A survey of the Mississippi River fish community conducted by electrofishing and trap nets in 1965 through 1967 captured 30 species (plus noting the presence of muskellunge) from Grand Rapids downstream to Brainerd (Johnson 1968). Species reported in Johnson (1968) that were not captured in Crow Wing County in 2007 were lake whitefish, black bullhead, and central mudminnow. Three species, spottail shiner, bluntnose minnow, and tadpole madtom were reported by Johnson upstream of the Brainerd Dam, but were only found downstream of the Brainerd Dam in 2007. The lake whitefish were captured in gill nets in Rice Lake; none have been captured in any subsequent surveys in Rice Lake or the Mississippi. Black bullheads were caught in low numbers and the gear and location of the small species could not be determined from the 1968 report.

A 1965 electrofishing survey of the Mississippi River from Brainerd to Elk River captured 13 species in the section between the Brainerd and Little Falls dams (Schneider 1966). Only gamefish, panfish, and suckers species were reported in this survey, no minnows (except common carp) or other small fish species were reported. All species reported from 1965 were also found in the 2007 survey. The 1965 survey did report the capture of golden redhorse *Moxostoma erythrurum* above Little Falls, but these may have actually been greater redhorse *Moxostoma valenciennesi* as golden redhorse are not known from the upper Mississippi River (Hatch et al. 2003).

The USGS reported the capture of 21 species from the Mississippi near Brainerd below the dam and 23 species at Fort Ripley with a boat electrofisher in 1998. Brassy minnow, trout perch, and banded killifish were the only species reported from near Brainerd in 1998 not also captured in the 2007 survey. Trout perch and mottled sculpin were also found at Fort Ripley. However, the USGS also supposedly captured river redhorse and golden redhorse from the Mississippi in Aitkin County. Neither of these species is known to occur in the upper Mississippi River watershed (Hatch et al. 2003).

While PFOS was found in several species collected just downstream of the Brainerd WWTF, the concentrations were low and are not considered a health risk being well below the 1 meal per week restriction concentration of 38 to 160 ppb. Results of the Mercury and PCB testing are not yet available.

Zebra mussels are now present in the Mississippi River downstream of the Pine River. During the lake survey netting in Rice Lake in August 2007 zebra mussels were noted to be quite abundant on aquatic vegetation. Zebra mussels were also observed in moderate abundance in the first mile of river below the Brainerd Dam. The abundance of zebra mussels below Brainerd will likely increase substantially in the next few years.

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