

Minnesota  
F-29-R(P)-27  
Area 315  
Study 3  
May 20, 2009

Minnesota Department of Natural Resources  
Division of Fish and Wildlife  
Section of Fisheries

Mississippi River Smallmouth Bass Regulation Evaluation  
2000 - 2008

Completion Report

By

Joseph D. Stewig  
Montrose Area Fisheries Office

Funded under Federal Aid by the Sport Fish Restoration Act, F-29-R(P)-27

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## **INTRODUCTION**

In 1990 an experimental smallmouth bass regulation was implemented on the Mississippi River from Clearwater to Elk River after public concerns were raised regarding perceived over-harvest of larger smallmouth bass. The experimental regulation consisted of a 12 – 20 inch protected slot limit with a three fish daily bag limit one fish over 20 inches allowed in possession. The goals of this regulation were to improve the size structure of the smallmouth bass population and protect the fishery from over-harvest. The Minnesota Department of Natural Resources (MN-DNR) pursued an extension of the regulation area from the St.Cloud Dam to the Coon Rapids Dam in 1999 in order to provide a confined area for the regulation to be evaluated. However, due to concerns from stakeholders in the Anoka area, the regulation was only extended to include the stretch of river from the St. Cloud Dam to the confluence of the Crow River in Dayton (Figure 1).

A variety of methods have been used to assess the effectiveness of the experimental regulation. Creel surveys were conducted by the MN-DNR in 1992 (Wang and Diedrich 1993), 1997 (Sledge and Hiebert 1997) and 2007 (Altena 2008a). Electrofishing was conducted in 1992 (O'Shea and Hiebert 1993), 1993, and 1999. In addition, Excel Energy has been collecting smallmouth bass electrofishing data since 1979 in an effort to examine the effects of warm water discharge on the fish community near its power plant in Monticello.

To evaluate the effectiveness of the experimental smallmouth bass regulation following the regulation area extension in 1999, annual electrofishing surveys were conducted from 2000 – 2008. Sampling was conducted in July at ten stations along the Mississippi River from St Cloud to Coon Rapids (Figure 2). The regulated area extends from the St. Cloud Dam to Dayton and the unregulated area extends from Dayton to the Coon Rapids Dam (Figure 1).

## **STUDY AREA**

The Mississippi River between the St. Cloud Dam and the Coon Rapids Dam encompasses 96 river kilometers (60 miles) and is dominated by run habitat. The river has an average bankfull width of 264 meters (858 feet), a mean depth of less than 1.2 meters (4.5 feet) and a gradient of 0.5m/km (2.5 ft/mile). Substrates in this section consist primarily of coarse

gravel and cobble. The Montrose Fisheries Management Area extends 75.2 kilometers (47 miles) from the St Cloud Dam to the confluence with the Crow River, near the City of Dayton (Figure 1).

## METHODS

During July 2008, smallmouth bass, walleye and channel catfish were sampled by daytime electrofishing. Ten stations between St. Cloud and Coon Rapids (Figure 2) were sampled using a bow-mounted Smith-Root GPP5 electrofishing boat set on low voltage, with amperage ranging from 2 – 6 (typically around four amps). Start and end locations were marked with a Garmin GPSmap76CSx and plotted using Arc Map 9.2.

All smallmouth bass, walleye and channel catfish were measured (nearest mm total length, TL), weighed (nearest gram) and released. Structural indices (proportional stock density, PSD, and relative stock density, RSD; Gabelhouse 1984) for smallmouth bass were calculated from the total combined sample from the ten stations. A sub-sample of five smallmouth bass, walleye, and channel catfish were sacrificed per 25-mm length group for age analysis. Sagittal otoliths were removed from walleye and smallmouth bass and pectoral spines were removed from channel catfish and aged in the laboratory. Ages for non-aged smallmouth bass were assigned using a polynomial regression of fish age versus length at capture from smallmouth bass collected from 1999 – 2008. Year class survival of smallmouth bass was estimated using the Chapman-Robson survival estimate using the following equation:

$$\hat{S} = \frac{T}{n + T - 1}$$

where  $n$  is the total number of fish in the sample, beginning with the first age that is fully vulnerable to the sampling gear, and  $T$  is determined from the age distribution of the sample (Van Den Avyle and Hayward, 1999). Flow data for the sampling period was collected from the USGS web site for the gauging station in St. Cloud. Differences between the regulated and unregulated areas as well as the pre- and post-regulation data from Excel Energy were tested using one-way analysis of variance (ANOVA), with a threshold for significance of  $P_{\alpha} = 0.05$ .

## RESULTS AND DISCUSSION

During the summer of 2008 discharge was below average with the exception of a rain event that took place at the end of May (Figure 3). Mean discharge measured from the USGS gauging station in St. Cloud during the sampling period (July 20 – July 27) was 4,011 cubic feet per second (cfs). Discharge was above average during prime spawning temperatures (mid-May to mid-June) for smallmouth bass, with peak flows greater than 10,000 cfs occurring through most of May and June. May-June discharge averaged 12,844 and 11,122 cfs, respectively. When spring and summer flows are above normal, smallmouth bass young-of-the-year (YOY) survival and year class strength tends to be low in this portion of the Mississippi River (Swenson et al 1989, Simonson and Swenson 1990, Hiebert 1999). In contrast, when flows are lower and less variable, smallmouth bass year-class strength is usually higher. During 2000, 2002, 2003, 2004, 2006, and 2007 average flows in June were below 10,000 cfs, which possibly allowed for increased YOY smallmouth bass survival. In contrast, 2001, 2005, and 2008 June average flows were above 10,000 cfs and may have reduced YOY smallmouth bass survival.

A total of 6.62 hours of effort was spent electrofishing smallmouth bass during July 2008. The overall catch rate was 94.7/hour, which was higher than average (80.1/hr; Table 1), but similar to 2007 (Table 2). The catch of smallmouth bass between 12 – 20 inches (21.6/hr) was slightly higher than average, but similar to the past 4 – 5 years (Table 3; Figure 4). Proportional stock density (PSD = 49) was also similar to the average of the past eight years (PSD = 46). Relative stock densities of 14 and 17 inch smallmouth bass (RSD – 14 and RSD – 17), however were higher than average (Table 1). This is probably due to several strong year classes (1999 – 2002) moving into those size groups. A total of 627 smallmouth bass were collected and ranged from 92 – 535 mm (3.6 – 21.1 inches; Figure 5) with a mean length of 228 mm (9.0 inches), similar to 2007 (Altena 2008b). Smallmouth bass growth for age 2 – 6 was slower than in Minnesota lakes. However, age 1 smallmouth bass growth was faster, which may indicate that abundant forage exists for smaller fish (Figure 6). Mean length at capture data from 2008 showed that smallmouth bass reach 280 mm (11 in), 356 mm (14 in), and 432 mm (17 in) in

approximately 4, 6, and 8 years, respectively (Table 4). Survival estimates for ages 1 – 9 ranged from 45 to 75 percent (Table 4).

No significant differences were found between the regulated and unregulated areas of the river sampled between 2000 and 2008. All indices used to test for differences in the smallmouth bass population were similar between the regulated (St. Cloud to Dayton) and unregulated (Dayton to Coon Rapids) areas of the river (one-way ANOVA; all  $P > 0.05$ ; Table 5). Examining the length frequencies of the regulated and unregulated areas also indicated that there was little difference between the two areas (Figure 7). The fact that there is no barrier between the regulated and unregulated areas limiting fish migration likely explains the lack of difference between the two areas.

Excel Energy has been electrofishing the Mississippi River since 1979 in an effort to examine the effects of warm water discharge on the fish community near its power plant in Monticello. This long-term dataset is useful when examining the effects of an experimental regulation. All indices used to measure the change in the smallmouth bass population showed a positive increase since the regulation was put in place in 1990 (Figure 8 and Table 6). The only index not showing a significant increase was CPUE (one-way ANOVA;  $P = 0.08$ ), however CPUE increased from 25.2/hr pre-regulation to 38.6/hr post-regulation (Table 6). All other metrics (CPUE 12 – 20, PSD, RSD-14, RSD-17 and mean length) showed a significant increase post-regulation (one-way ANOVA; all  $P < 0.01$ ; Table 6). Length frequency data also indicates an increase in the size structure likely due to the regulation (Figure 9).

Other sport fish species sampled during 2008 electrofishing included channel catfish and walleye. A total of 144 channel catfish were sampled with an overall catch rate of 21.8/hr. The catch rate was lower than the two previous years, but was still higher than the 2000 – 2007 average (14.5/hr; Figure 10). Channel catfish ranged in length from 273 (10.7 in) to 715 mm (28.1 in) TL. Mean length (530 mm, 20.9 in) was similar to previous years (Figure 10). Age data indicates that channel catfish reproduction has been consistent over time, with all age classes from 1995 to 2006 represented in the age sample. The 2001 and 2002 year classes dominated the age sample, comprising 30% and 19%, respectively (Table 7). Channel catfish reached 305



mm (12 in), 508 mm (20 in), and 610 mm (24 in) in 3, 6, and 8 years, respectively. This growth was faster than reported from the Crow River in 2000 where channel catfish reached 305 mm (12 in), 508 mm (20 in) and 610 mm (24 in) in 3, 9, and 11 years, respectively (Altena 2000).

During July 2008 a total of 16 walleye were sampled, with an overall catch rate of 2.4 fish/hour. The catch rate in 2008 was lower than 2007, but was similar to the average from 2000 – 2007 (4.1 fish/hour; Figure 11). Walleye sampled ranged in length from 243 mm (9.6 in) to 480 mm (18.9 in). Mean length was 340 mm (13.4 in), similar to previous years (Figure 11). Age estimates from otoliths indicate that walleye reach 280 mm (11.0 in) by age 1 and 365 mm (14.4 in) by age 2 (Table 8). This was faster than that reported from the Crow River where age 1 and 2 walleye were 223 mm (8.8 in) and 296 mm (11.7 in), respectively (Altena 2000), but slower than reported from the Mississippi River at Lake Pepin (age 1 = 12.7 in and age 2 = 15.7 in; Jon Meerbeek. pers comm.). Walleye were sampled, but were not specifically targeted during this survey. Walleye catch tended to be higher at stations further upstream (St. Cloud and Clearwater) than at the lower stations.

## **MANAGEMENT IMPLICATIONS**

An evaluation of the smallmouth bass data collected pre- and post-regulation showed an improvement in the size structure of the smallmouth bass population. Based on Excel Energy data, it appears that the special smallmouth bass regulation is having a positive effect on the smallmouth bass population in the Mississippi River. However, the impact of the regulation may be masked by several other factors such as the issuance of consumption advisories, catch and release practices, lack of a barrier between the regulated and unregulated areas, and others that are not completely understood. Telemetry data showed that smallmouth bass would travel great distances in order to find suitable habitat for spawning, with many fish moving between the regulated and unregulated areas (Altena 2003). Since there is no barrier between the two areas, it is likely that the positive effects of the regulation have benefited the unregulated area.

In 2008, based on the Excel Energy data and a MN-DNR creel survey conducted in 2007, the MN-DNR proposed to make permanent the experimental smallmouth bass regulation and

extend it to include the unregulated portion of the river from Dayton to the Coon Rapids Dam. Creel survey data indicated that there was an overwhelming acceptance of the smallmouth bass regulation. Overall, 97% of all surveyed anglers supported the regulation. Also, 96% of surveyed anglers in the regulated area and 89% of the surveyed anglers in the unregulated area supported extending the regulation to the Coon Rapids Dam. However, major opposition was met from the City of Anoka and the surrounding communities. This combined with the fact that there were no statistical differences in the smallmouth bass populations between the regulated and unregulated areas and that harvest was minimal (2.4% of the total smallmouth bass), led to the regulation not being extended to the Coon Rapids Dam. The regulation was, however, made permanent from the St. Cloud Dam to the confluence of the Crow River in Dayton and includes all tributaries up to the first dam or major road crossing.

### **RECOMMENDATIONS**

The Mississippi River is one of the largest waters within the Montrose fisheries management area and contains a nationally recognized smallmouth bass fishery. For these reasons it is recommended that the smallmouth bass fishery be monitored every five years to document any changes that occur. Sampling would include electrofishing the same ten stations that have been previously sampled and possibly adding a couple more sites in the unregulated area in cooperation with the West Metro fisheries office.

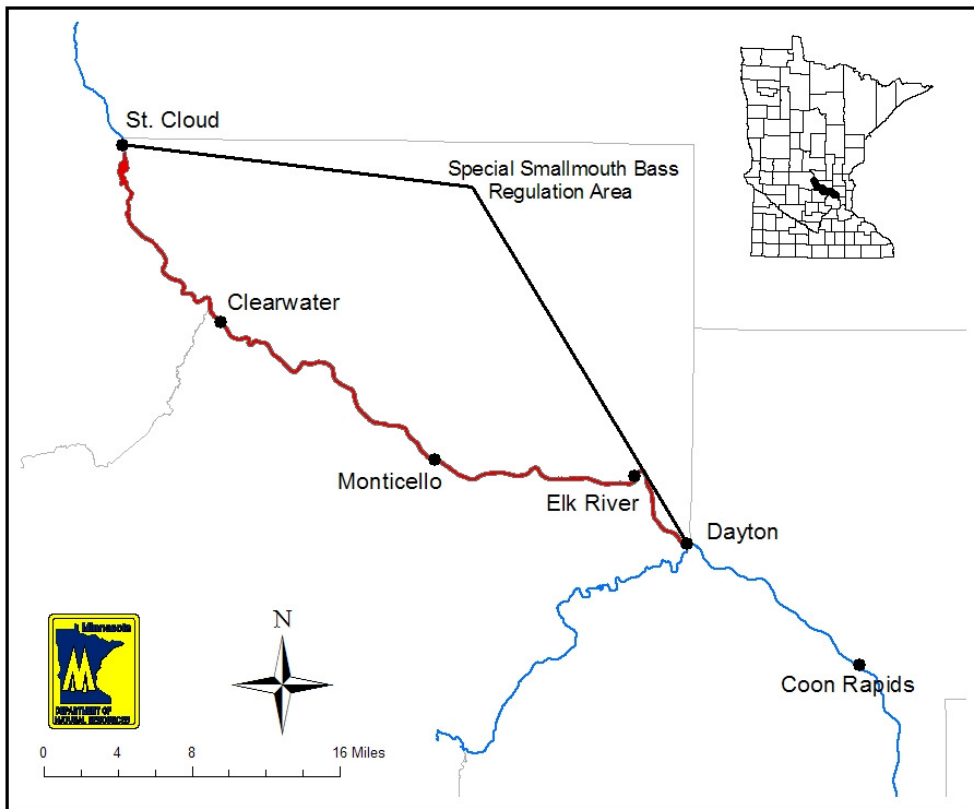
### **ACKNOWLEDGEMENTS**

I would like to thank all of the staff at the Montrose area fisheries office over the years that have been involved with collecting the data. I would also like to thank Dan Orr with Excel Energy for providing an excellent pre- and post-regulation dataset that was instrumental in determining the effects of the smallmouth bass regulation. Finally, I would like to thank Eric Altena, Paul Diedrich, and Mark Pelham for reviewing and editing this report.

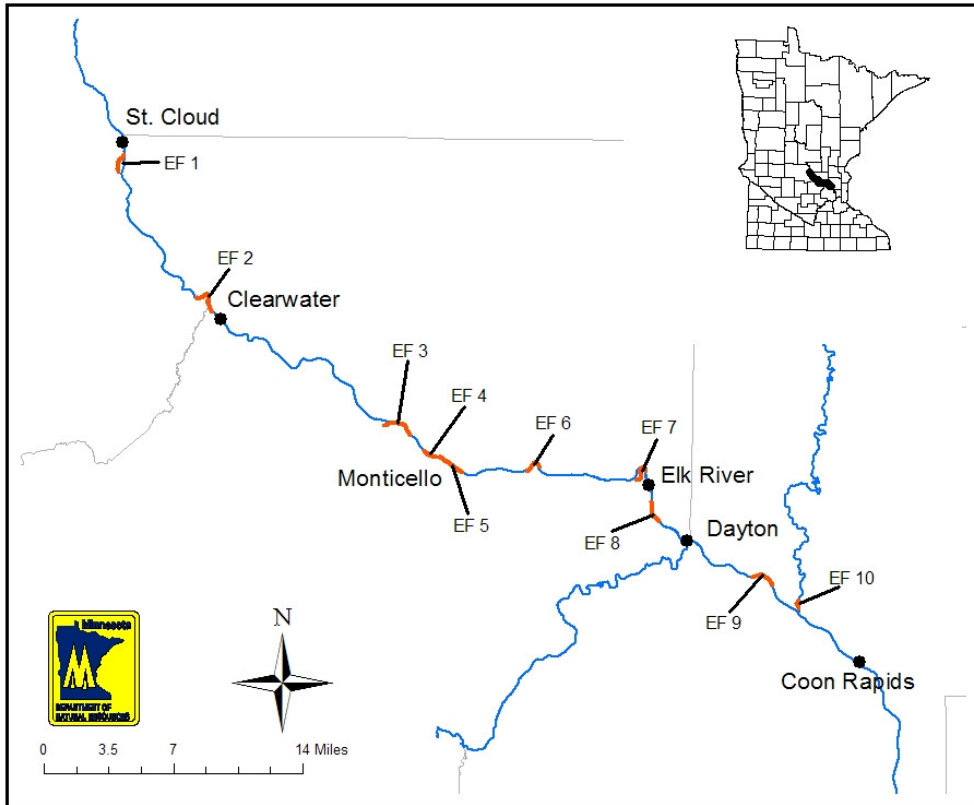
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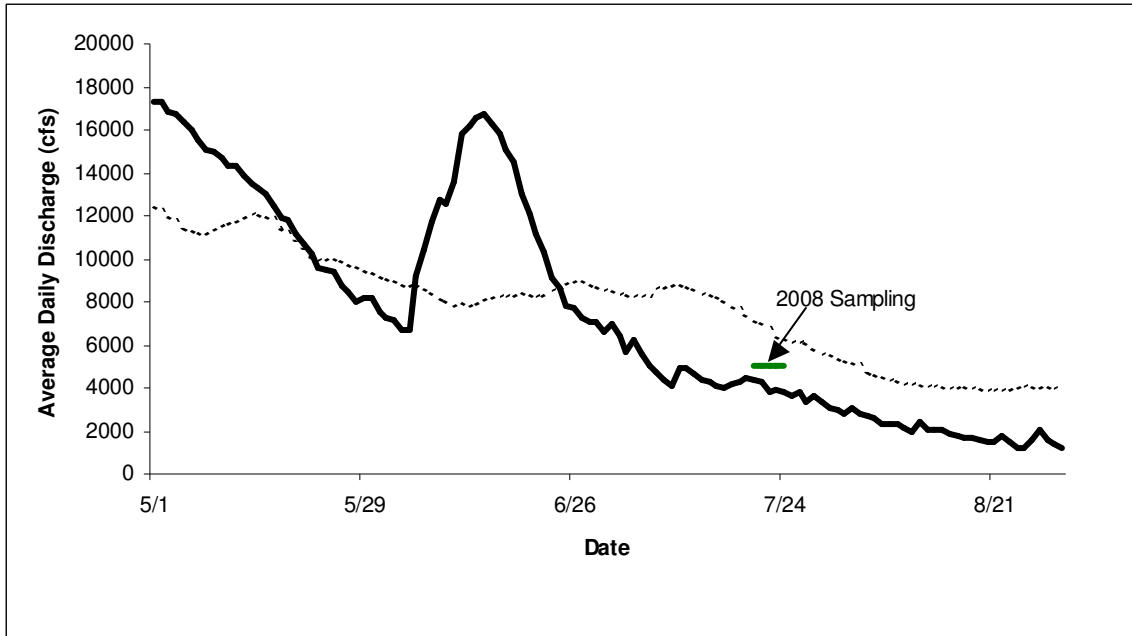
## FIGURES



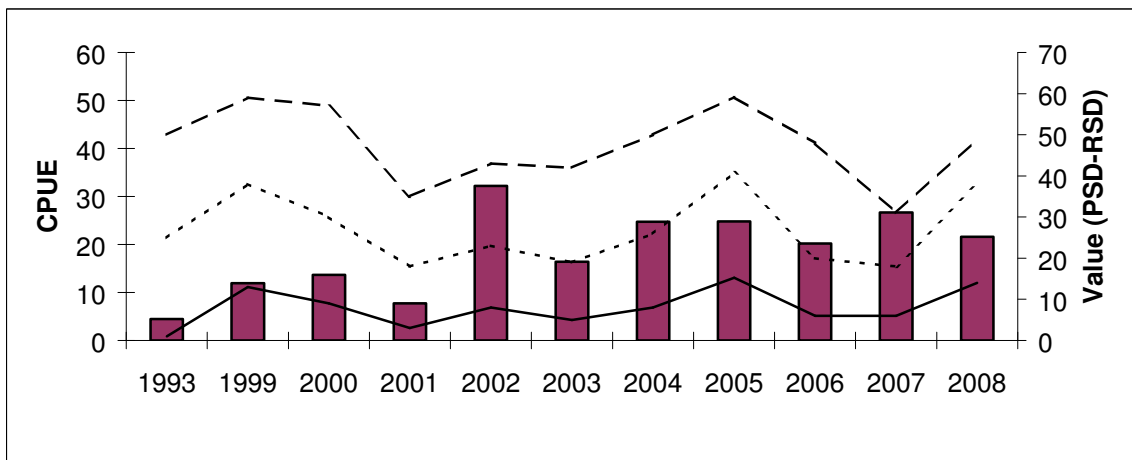
**Figure 1.** Map of the Mississippi River from St. Cloud to Coon Rapids showing the sample area and smallmouth bass regulation area.



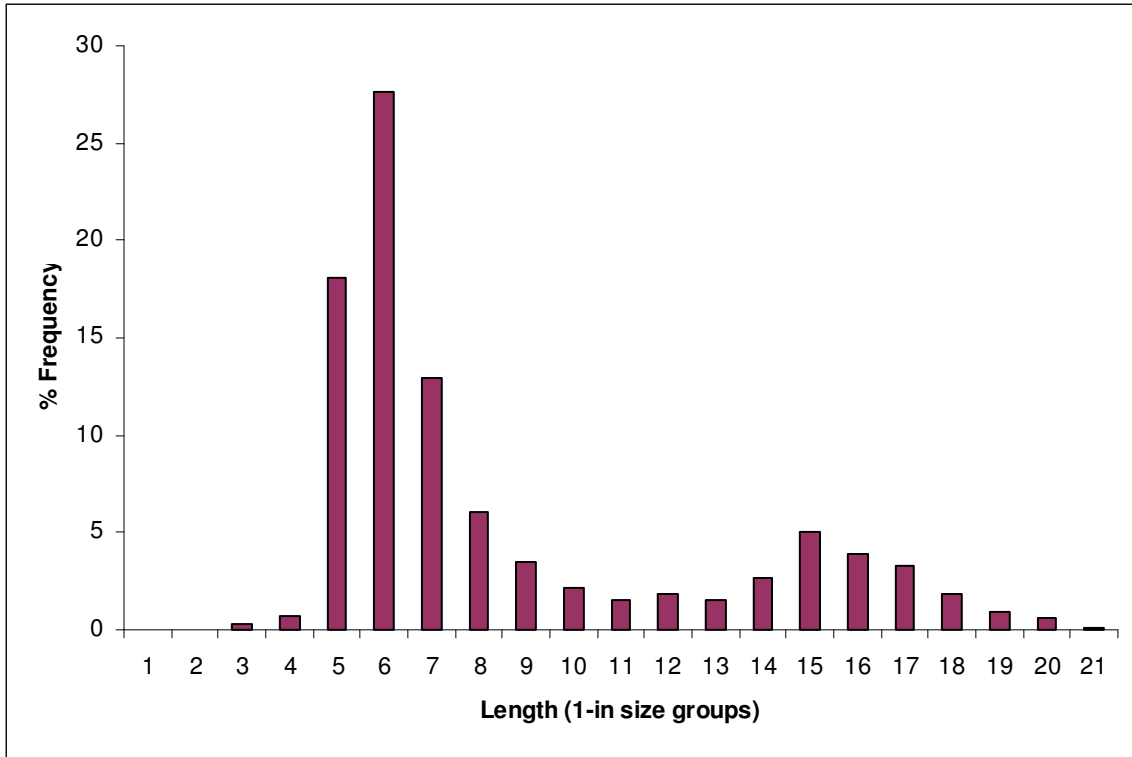
**Figure 2.** Smallmouth bass electrofishing sites on the Mississippi River between St. Cloud and Coon Rapids.



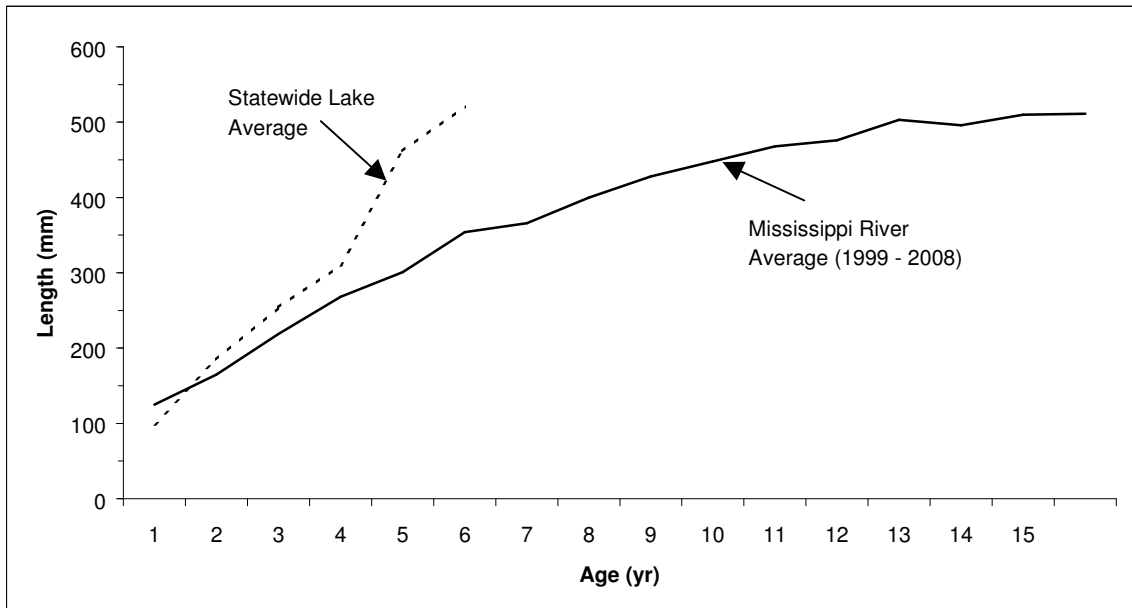
**Figure 3.** Mean daily discharge for the Mississippi River from May 1 through August 31, 2008 (solid black line). Data is from the USGS gauging station in St. Cloud. Dashed line represents mean daily discharge from 1988 – 2007.



**Figure 4.** Catch-per-unit-effort (CPUE) of 12 – 20 inch (305 – 508 mm) smallmouth bass, proportional stock density (PSD, large dashed line), and relative stock densities of smallmouth bass greater than 14 inches (RSD-14, short dashed line) and 17 inches (RSD-17, solid line).

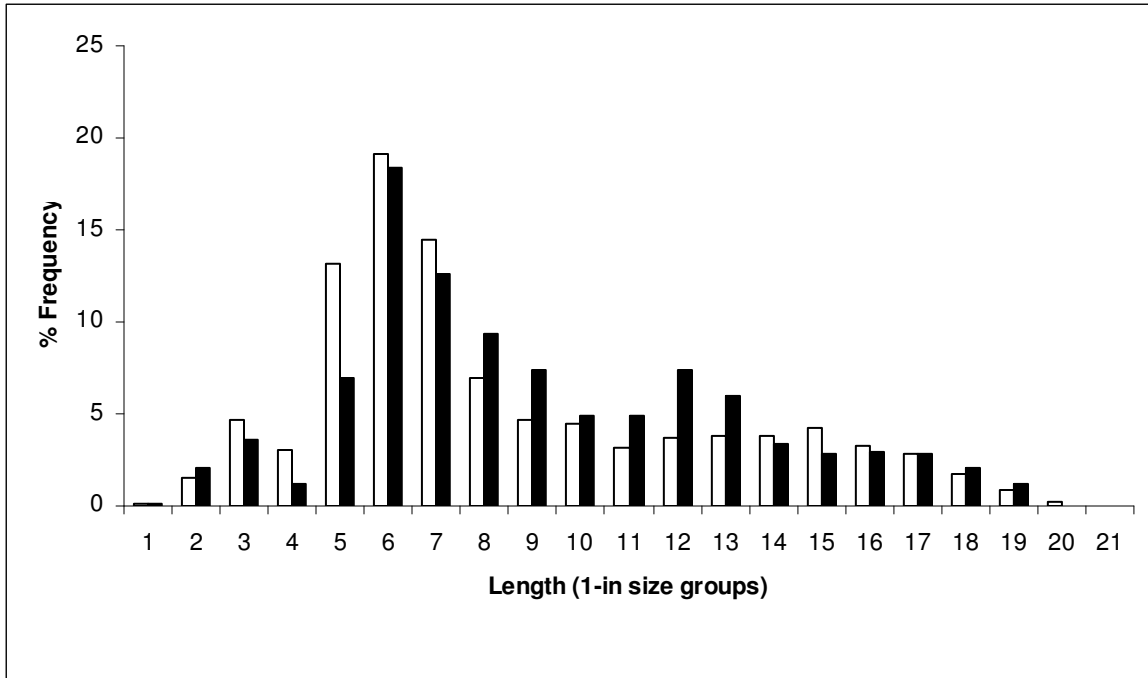


**Figure 5.** Length frequency of smallmouth bass sampled by electrofishing from the Mississippi River between St. Cloud and Coon Rapids from July 21 through July 25, 2008.

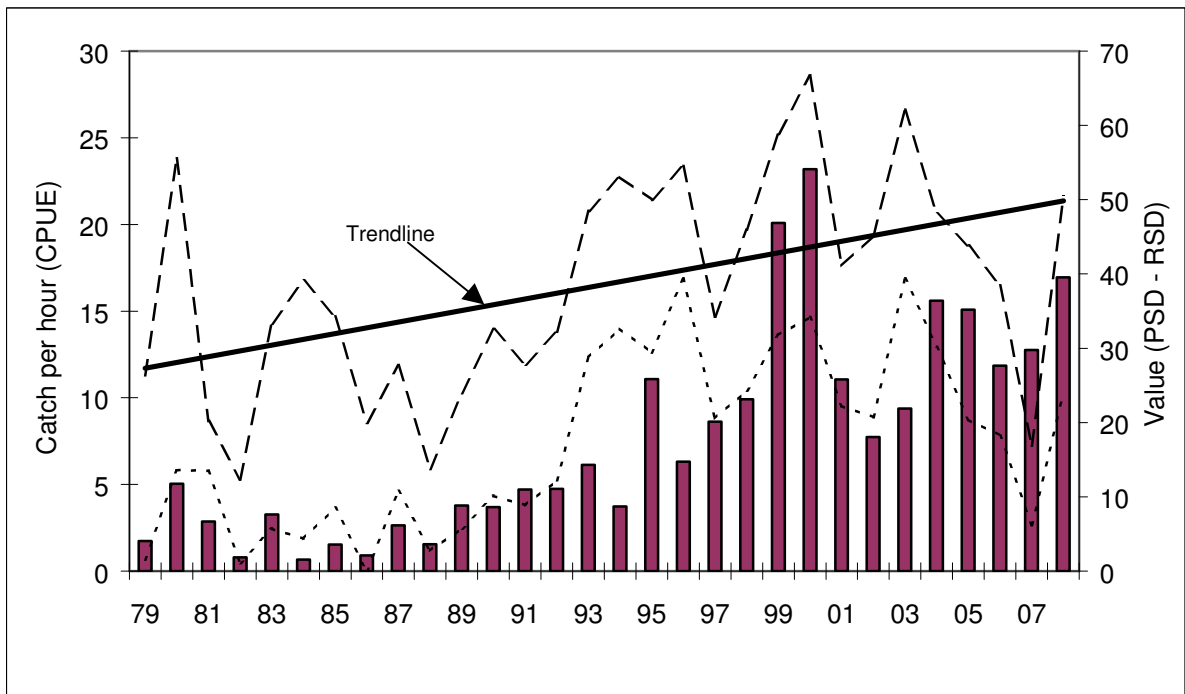


**Figure 6.** Mean length and age at capture of smallmouth bass sampled by electrofishing from the Mississippi River between St. Cloud and Coon Rapids (1999 - 2008).

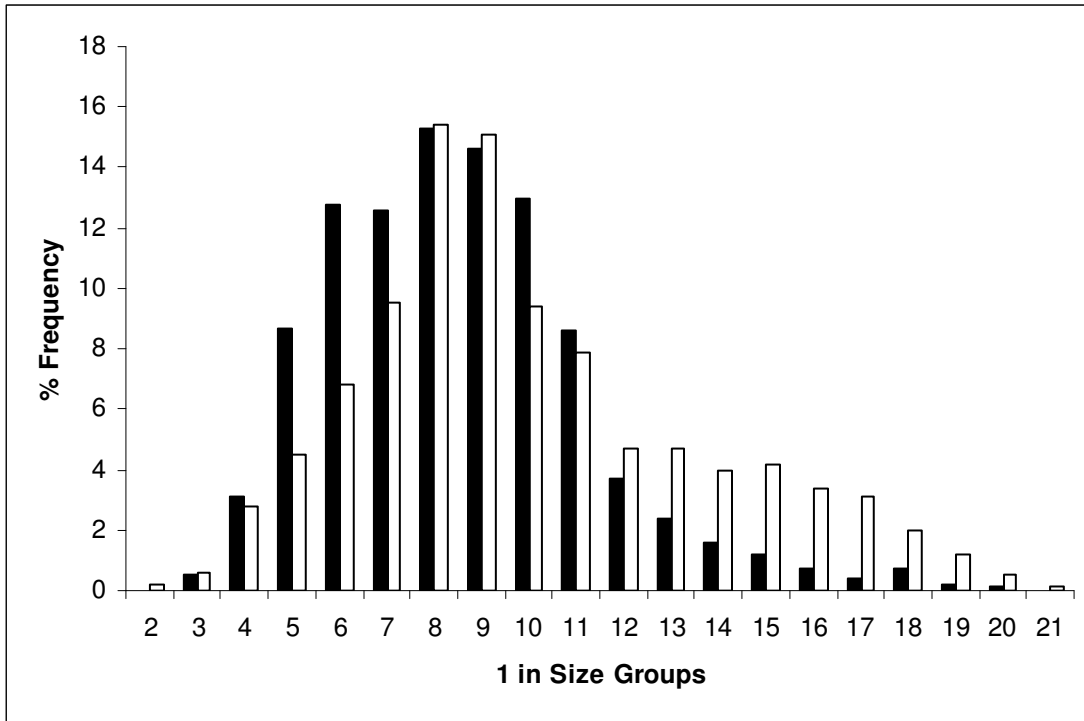




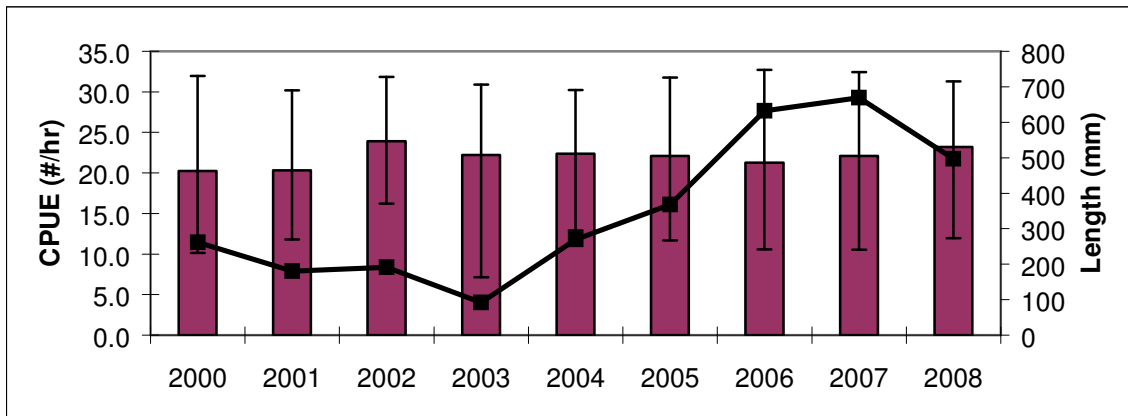
**Figure 7.** Length frequency of smallmouth bass sampled by electrofishing from the regulated (white bars) and unregulated (black bars) areas of the Mississippi River between 2000 and 2008.



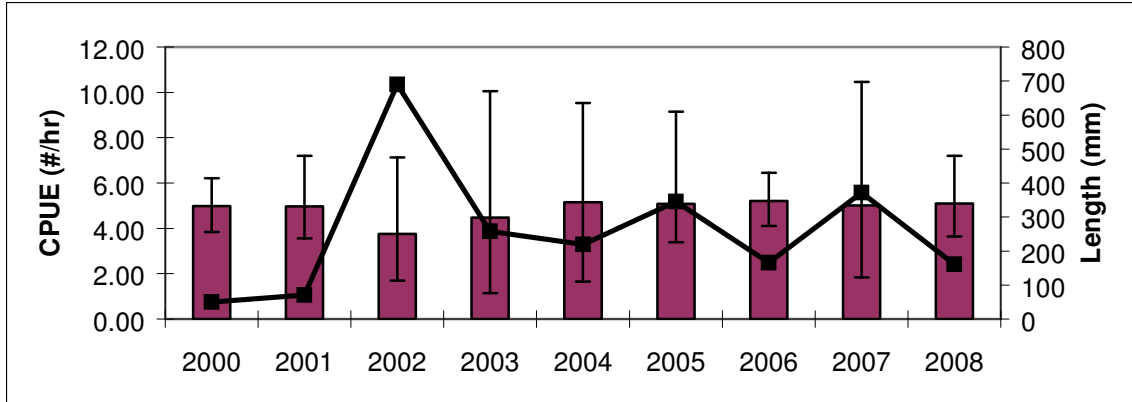
**Figure 8.** Catch-per-unit-effort (CPUE) of 12 – 20 inch (305 – 508 mm) smallmouth bass, proportional stock density (PSD, large dashed line), and relative stock density of smallmouth bass greater than 14 inches (RSD-14, small dashed line) from Excel Energy electrofishing surveys (1979 – 2008).



**Figure 9.** Length frequency of smallmouth bass from the Mississippi River sampled by electrofishing by Excel Energy from 1979 to 2008. Dark bars represent pre-regulation data (1979 – 1990) and light bars represent post-regulation data (1991 – 2008).



**Figure 10.** Catch-per-unit-effort (CPUE, solid line), minimum, maximum, and mean lengths (mm) of channel catfish sampled by electrofishing from the Mississippi River between St. Cloud and Coon Rapids (2000 – 2008).



**Figure 11.** Catch-per-unit-effort (CPUE, solid line), minimum, maximum, and mean lengths (mm) of walleye sampled by electrofishing from the Mississippi River between St. Cloud and Coon Rapids (2000 – 2008).

## **TABLES**

**Table 1.** Summary of smallmouth bass structural indices from July 2008 and study averages (2000 – 2008).

Index	2008	Avg (2000 - 2007)
CPUE	94.7	80.1
CPUE 12 – 20	21.6	20.1
PSD	49	46
RSD-14	38	24
RSD-17	14	8

**Table 2.** Summary of smallmouth bass catch-per-unit-effort (CPUE) by station from the Mississippi River between St. Cloud and Coon Rapids (2000 – 2008).

Area	Station	2008	Avg	2007	2006	2005	2004	2003	2002	2001	2000
St. Cloud <sup>1</sup>	1	84.4	<b>61.6</b>	100.0	65.2	56.4	63.4	35.3	98.2	47.5	26.9
Clearwater <sup>1</sup>	2	24.4	<b>25.2</b>	55.1	27.0	12.2	11.6	16.2	42.2	17.9	19.2
Xcel Energy <sup>1</sup>	3	40.0	<b>45.6</b>	9.4	32.8	46.2	44.1	45.3	120.0	41.0	25.9
Monti (up) <sup>1</sup>	4	77.8	<b>109.5</b>	192.0	126.3	119.5	134.4	78.8	153.8	51.1	19.7
Monti (dn) <sup>1</sup>	5	82.0	<b>67.3</b>	131.9	58.2	73.3	46.6	43.7	134.3	29.6	21.0
Otsego <sup>1</sup>	6	186.9	<b>86.9</b>	103.3	43.3	100.0	133.3	84.2	117.6	58.9	54.2
Elk R. (up) <sup>1</sup>	7	236.2	<b>227.8</b>	91.7	169.2	329.2	200.0	298.0	284.2	319.6	130.4
Elk R. (dn) <sup>1</sup>	8	55.4	<b>48.5</b>	38.5	46.2	29.1	137.7	30.3	62.5	15.9	28.1
Anoka <sup>2</sup>	9	72.0	<b>58.9</b>	95.2	28.6	36.7	128.1	54.5	68.8	16.4	42.9
Rum Dam <sup>2</sup>	10	187.8	<b>126.5</b>	247.6	159.4	115.4	167.6	116.7	86.5	57.7	61.1
Overall		94.7	<b>80.1</b>	98.6	67.8	86.8	100.4	75.5	111.2	63.0	37.8

<sup>1</sup> Regulated area.

<sup>2</sup> Unregulated area.

**Table 3.** Summary of smallmouth bass catch-per-unit-effort (CPUE) for fish between 12 and 20 inches by station from the Mississippi River between St. Cloud and Coon Rapids (2000 – 2008).

Area	Station	2008	Avg	2007	2006	2005	2004	2003	2002	2001	2000
St. Cloud <sup>1</sup>	1	48.9	<b>33.2</b>	41.4	43.5	34.5	53.7	15.7	34.5	25.0	17.3
Clearwater <sup>1</sup>	2	10.5	<b>8.1</b>	15.4	12.7	3.1	10.1	4.1	8.4	0.0	10.6
Xcel Energy <sup>1</sup>	3	2.1	<b>10.6</b>	1.6	10.9	18.5	6.8	9.4	26.0	1.6	9.9
Monticello (up) <sup>1</sup>	4	22.2	<b>31.0</b>	32.0	18.4	46.3	15.6	12.1	76.9	17.8	13.6
Monticello (dn) <sup>1</sup>	5	34.0	<b>22.4</b>	42.6	16.4	35.0	12.1	15.5	45.7	8.5	3.7
Otsego <sup>1</sup>	6	18.0	<b>20.5</b>	28.3	11.9	35.0	23.8	12.3	26.5	5.5	20.8
Elk River (up) <sup>1</sup>	7	29.3	<b>27.3</b>	60.0	23.1	27.7	39.2	24.5	35.1	8.9	19.6
Elk River (down) <sup>1</sup>	8	14.3	<b>12.7</b>	3.8	21.2	12.7	18.9	3.0	26.6	1.6	14.1
Anoka <sup>2</sup>	9	16.0	<b>10.2</b>	6.5	7.1	10.0	17.5	10.9	9.4	1.8	18.6
Rum Dam <sup>2</sup>	10	43.9	<b>48.7</b>	52.4	65.6	73.1	88.2	42.9	32.4	15.4	19.4
Overall		21.6	<b>20.1</b>	26.9	20.4	24.8	25.1	14.4	28.6	7.0	13.8

<sup>1</sup> Regulated area.

<sup>2</sup> Unregulated area.

**Table 4.** Summary of smallmouth bass length at capture (mm), from the Mississippi River between St. Cloud and Coon Rapids Dam, July 2008.

Year class	Age	N (Exp <sup>1</sup> )	Mean	Min	Max	Std Dev.	Survival estimate <sup>2</sup>
2008	0	1	92	92	92	---	
2007	1	147	144	94	154	8.32	0.67
2006	2	276	176	155	216	16.45	0.63
2005	3	46	240	217	269	15.40	0.75
2004	4	17	294	272	315	13.91	0.74
2003	5	20	336	319	355	12.65	0.69
2002	6	32	376	358	391	11.46	0.62
2001	7	34	407	393	421	8.84	0.55
2000	8	25	435	422	446	7.27	0.50
1999	9	16	459	448	470	6.67	0.45
1998	10	8	483	473	491	5.32	
1997	11	1	508	508	508	---	
1996	12	3	517	514	523	4.93	
1995	13	1	535	535	535	---	

<sup>1</sup> Regression of TL/Age using aged fish (1999-2008) was applied to assign ages to unaged fish in the sample.

<sup>2</sup> Survival estimates were calculated using Robson-Chapman survival model from the expanded age distribution.

**Table 5.** Summary of smallmouth bass structural indices from regulated and unregulated areas of the Mississippi River between St. Cloud and Coon Rapids. Data collected by electrofishing during July (2000 – 2008). Like letters indicate no significant difference.

Index	Regulated Area <sup>1</sup>	Unregulated Area <sup>2</sup>
CPUE	80.3 <sup>a</sup>	87.2 <sup>a</sup>
CPUE 12 – 20	19.5 <sup>a</sup>	24.4 <sup>a</sup>
PSD	48 <sup>a</sup>	53 <sup>a</sup>
RSD-14	29 <sup>a</sup>	22 <sup>a</sup>
RSD-17	9 <sup>a</sup>	10 <sup>a</sup>
$\bar{X}$ TL (in)	11.4 <sup>a</sup>	11.6 <sup>a</sup>

<sup>1</sup> Sites include: St. Cloud, Clearwater, Xcel Energy, Monticello (up), Monticello (down), Otsego, Elk River (up), Elk River (down)

<sup>2</sup> Sites include: Anoka, Rum Dam

**Table 6.** Summary of smallmouth bass structural indices from Pre- (1979 – 1990) and Post-regulation (1991 – 2008) sampling conducted by Excel Energy near Monticello. Data was collected by electrofishing. Like letters indicate no significant difference.

Index	Pre-Regulation <sup>1</sup>	Post-Regulation <sup>2</sup>
CPUE	25.2 <sup>a</sup>	38.6 <sup>a</sup>
CPUE 12 – 20	2.6 <sup>a</sup>	10.4 <sup>b</sup>
PSD	26 <sup>a</sup>	45 <sup>b</sup>
RSD-14	6 <sup>a</sup>	25 <sup>b</sup>
RSD-17	2 <sup>a</sup>	10 <sup>b</sup>
$\bar{X}$ TL (in)	10.1 <sup>a</sup>	11.5 <sup>b</sup>

<sup>1</sup> 1979 – 1990

<sup>2</sup> 1991 – 2008

**Table 7.** Mean length at capture (mm) for channel catfish sampled from the Mississippi River between St. Cloud and Coon Rapids, July 2008.

<b>Year Class</b>	<b>Age</b>	<b>N</b>	<b>Mean</b>	<b>Min</b>	<b>Max</b>	<b>Std Error</b>
2006	2	1	349			
2005	3	4	345	273	423	34.5
2004	4	1	494			
2003	5	4	488	432	530	22.8
2002	6	10	533	441	610	16.6
2001	7	16	537	445	654	16.5
2000	8	3	622	549	675	37.7
1999	9	5	614	461	715	42.1
1998	10	5	608	489	680	34.8
1997	11	2	645	590	699	54.5
1996	12	1	658			
1995	13	1	600			

**Table 8.** Mean length at capture (mm) for walleye sampled from the Mississippi River between St. Cloud and Coon Rapids, July 2008.

<b>Year Class</b>	<b>Age</b>	<b>N</b>	<b>Mean</b>	<b>Min</b>	<b>Max</b>	<b>Std Error</b>
2006	1	6	280	243	310	9.5
2005	2	9	365	283	407	14.2
2004	3	1	480	480	480	

Minnesota  
F-29-R(P)-27  
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Study 3  
May 20, 2009

Minnesota Department of Natural Resources  
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2000 - 2008

Completion Report

By

Joseph D. Stewig  
Montrose Area Fisheries Office

Submitted by: \_\_\_\_\_ Date: \_\_\_\_\_

Approved by: \_\_\_\_\_ Date: \_\_\_\_\_  
Area Fisheries Supervisor

Approved by: \_\_\_\_\_ Date: \_\_\_\_\_  
Regional Fisheries Supervisor