

Population characteristics of Black
Sturgeon River lake sturgeon
(*Acipenser fulvescens*)



UPPER GREAT LAKES
MANAGEMENT UNIT

Lake Superior

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EXECUTIVE SUMMARY

Spring gill netting was carried out on the Black Sturgeon River (below the Camp 43 dam) from 2002 to 2004 to collect baseline information on the population status of adult lake sturgeon utilizing the Black Sturgeon River as a spawning site. This study also provided the opportunity to contribute tissue samples for a study funded by the Great Lakes Fishery Trust to assess the genetic population structure of lake sturgeon in Lake Superior and the Great Lakes basin. This project has shown that (i) the number of lake sturgeon migrating up Black Sturgeon River in each of the years surveyed is small (ii) the total length distribution is skewed toward small and presumably young fish and (iii) lake sturgeon congregate below the Camp 43 dam.

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INTRODUCTION

Lake Superior stocks of lake sturgeon (*Acipenser fulvescens*) declined in the late 18th century and into the early part of the 19th century (Ono *et al.* 1983). Three factors have been cited as reasons for the decline: physical impacts on spawning and nursery habitat, barriers to migration and over-fishing (Auer 1999 as cited in Ferreri and Taylor 1999). Historic and current information indicate that at least 21 Lake Superior tributaries once supported lake sturgeon populations (Harkness and Dymond 1961; Slade and Auer 1997; Holey *et al.* 2000). To address this decline, the Lake Superior Technical Committee of the Great Lakes Fishery Commission produced a *Lake Sturgeon Rehabilitation Plan for Lake Superior* (Auer 2003). The goal for lake sturgeon rehabilitation is to maintain, enhance and rehabilitate self-sustaining populations where the species historically occurred basin-wide. The plan lists nine Lake Superior tributaries currently known to support self-sustaining lake sturgeon populations; the Black Sturgeon River is one of them.

The Black Sturgeon River is Lake Superior's seventh largest north shore tributary, draining a watershed of approximately 2,980 km² before emptying into the north end of Black Bay. The river is approximately 100 km in length, has a mean annual flow of 19 m³·s⁻¹ and originates at the outlet of Black Sturgeon Lake (Swainson 2001) (Figure 1 and 2).

From 1937 to 1965, the entire Black Sturgeon River watershed was utilized extensively for log drives. To manipulate water levels, dams were constructed at various lake outflows including Eskwanonwatin Lake (Camp 1 Dam, destroyed in a 1999 forest fire and partially removed), Black Sturgeon Lake (Split Rapids Dam - was completely removed in the 1980's), Shillabeer Lake, Sturge Lake, Little Sturge Lake, Leckie Lake, Fog Lake, and Muskrat Lake (Figure 2).

The only remaining dam on the system is the Camp 43 dam (also known as the Twin Rapids dam) that was constructed in 1959-60 approximately 16.3 km

upstream from Lake Superior (OMNR Engineering Archive Files Original Source, as cited in Sakamoto, 2002) (Figure 2). In 1966, to prevent the upstream passage of sea lamprey, the fishway in the dam was filled with concrete, and steel overhanging plates were installed on the top stoplogs of the dam. Prior to this, sea lamprey were able to migrate upstream to the Camp 1 dam. In 1968, the Camp 43 dam was reengineered with a large spill wall constructed on the east side of the dam to mitigate the effect of a flood that occurred in the spring of that year (Figure 3).

The 16.3 km section of river from the Camp 43 dam to the river's confluence with Lake Superior can be divided into four reaches. Reach 1 is 3.6 kms in length and is an example of a wave-dominated delta. This straight river channel was created as a result of predominant north-easterly waves moving the river's sediment uniformly along each shore of Black Bay (Sakamoto 2002) (Figure 4). Reach 2 is 4.6 kms in length, is slow moving, has an average depth of 4.0 m and consists mainly of sand, silt and organic substrates (Figure 5). Reach 3 is 6.1 kms in length, commences downstream of the first set of rapids and consists of a pool-riffle complex comprised of large amounts of cobble and gravel (Figure 6). The upper portion of this reach (downstream of the railway) is deep, meandering and has steep eroding banks. Reach 4 is located approximately 1.0 km upstream of the Trans-Canada Highway, is slow moving and meandering, terminating at the rapids below the Camp 43 dam (Figure 7).

The Camp 43 dam continues to act as a barrier to the upstream migration of adult sea lamprey and, therefore, only the portion of river below the dam is routinely treated by the Department of Fisheries and Oceans Sea Lamprey Control.

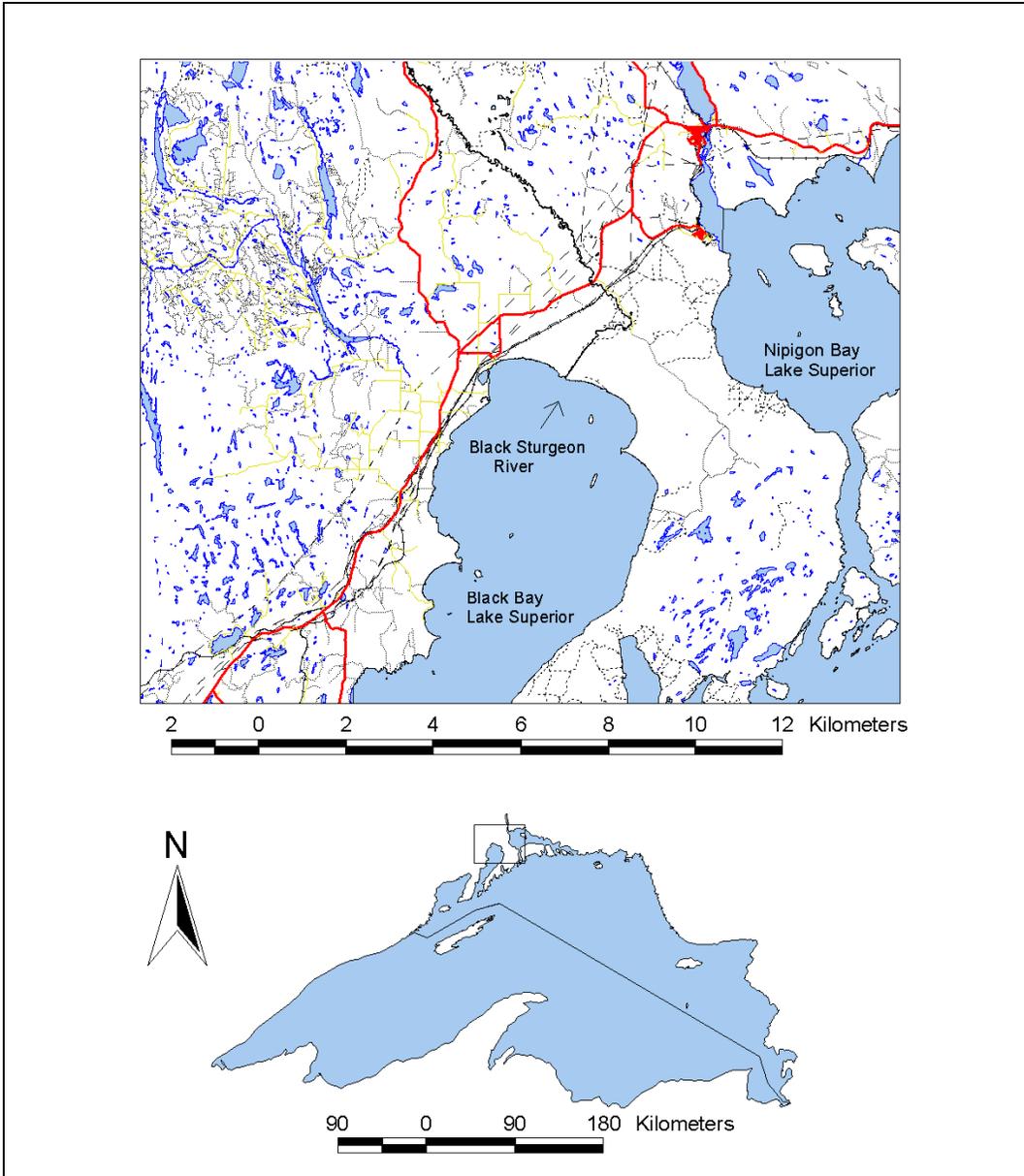


Figure 1. The Black Sturgeon River from Black Bay, Lake Superior to the Camp 43 dam.

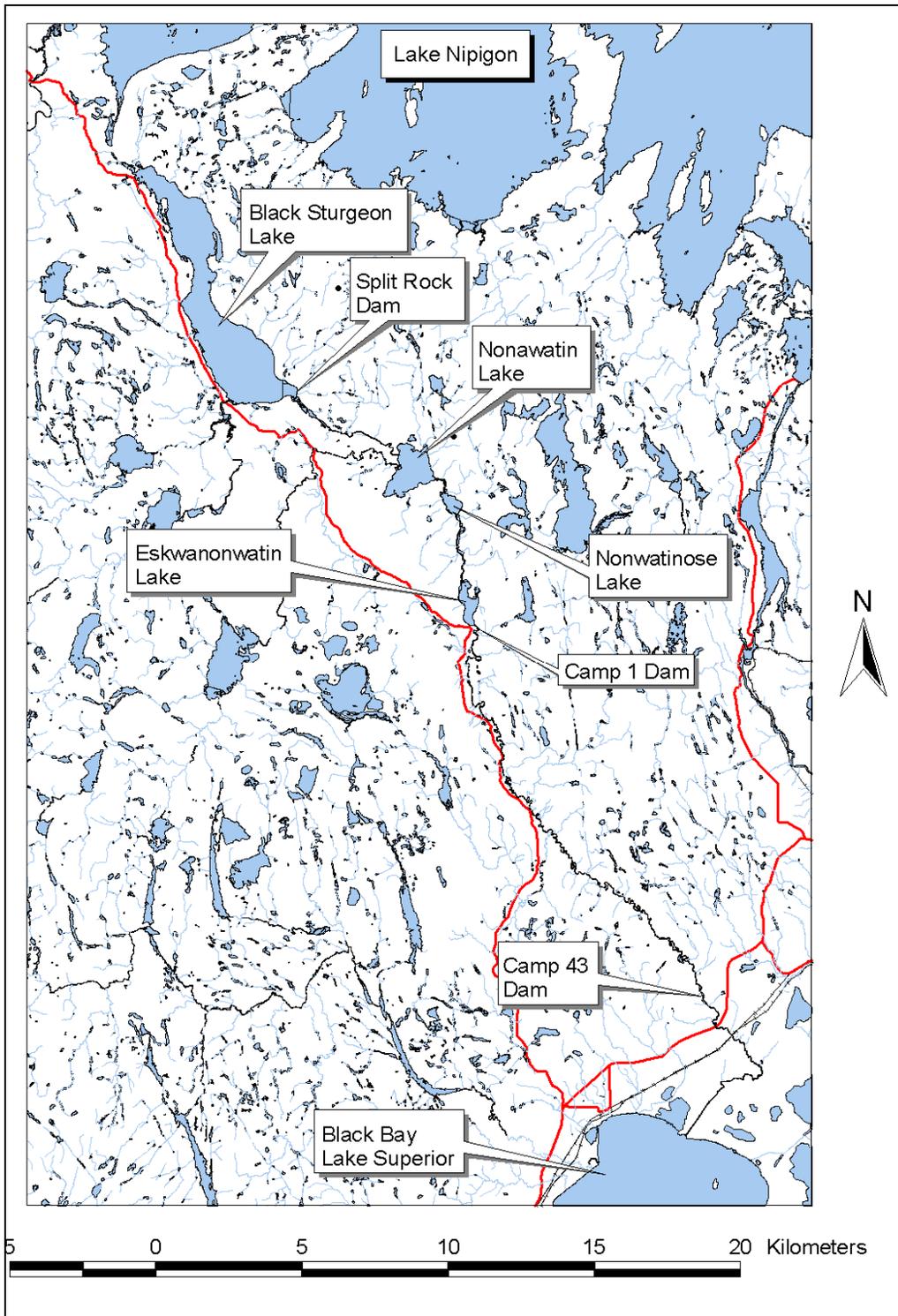


Figure 2. Location of present (Camp 43) and historical dams along the Black Sturgeon River.



Figure 3. Camp 43 dam with reengineered spill wall on the east side of the dam (September 9, 2003).

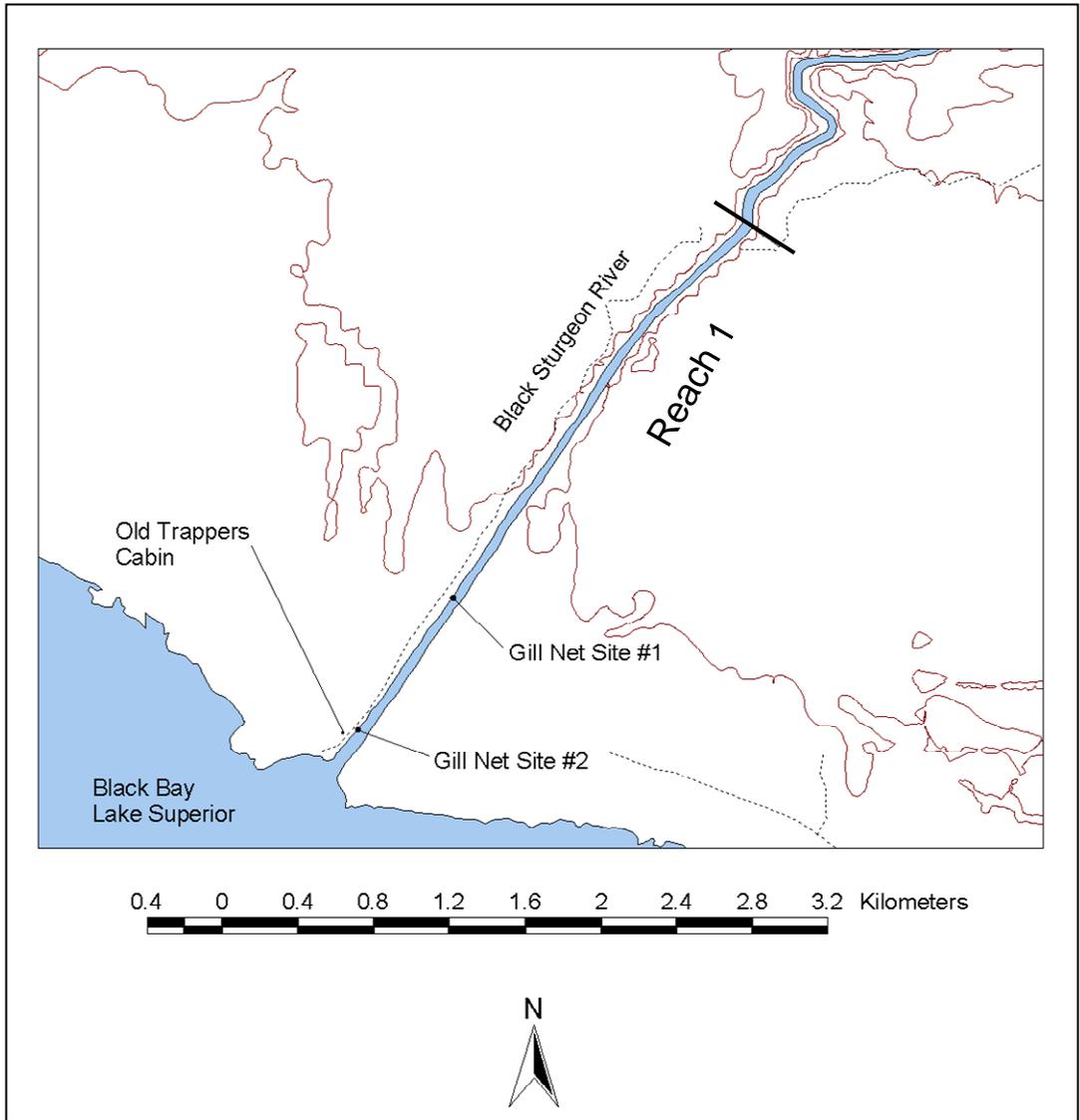


Figure 4. The Black Sturgeon River outlining reach 1 from Black Bay, Lake Superior to 3.6 km upstream.

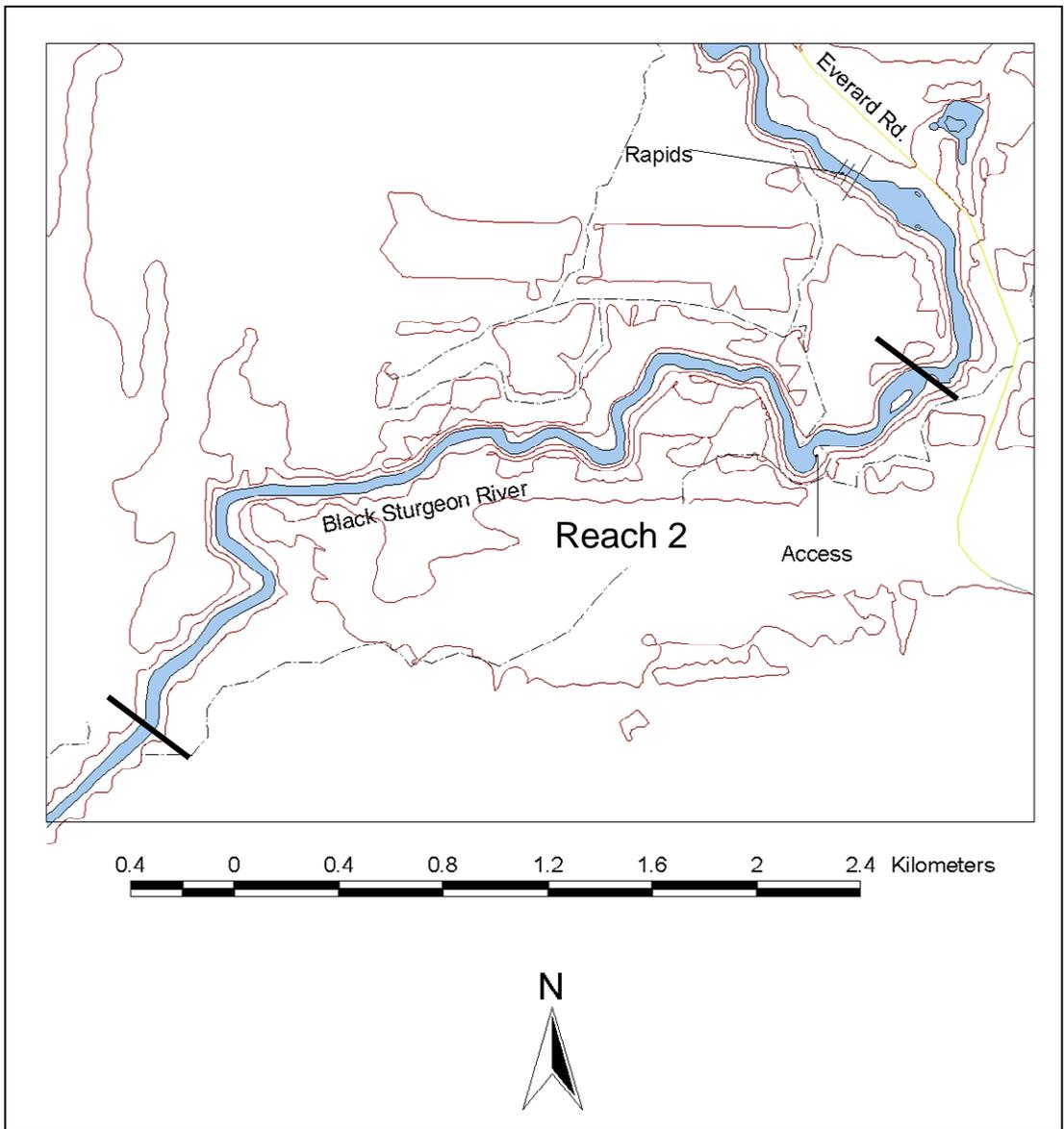


Figure 5. The Black Sturgeon River outlining reach 2 (4.6 km).

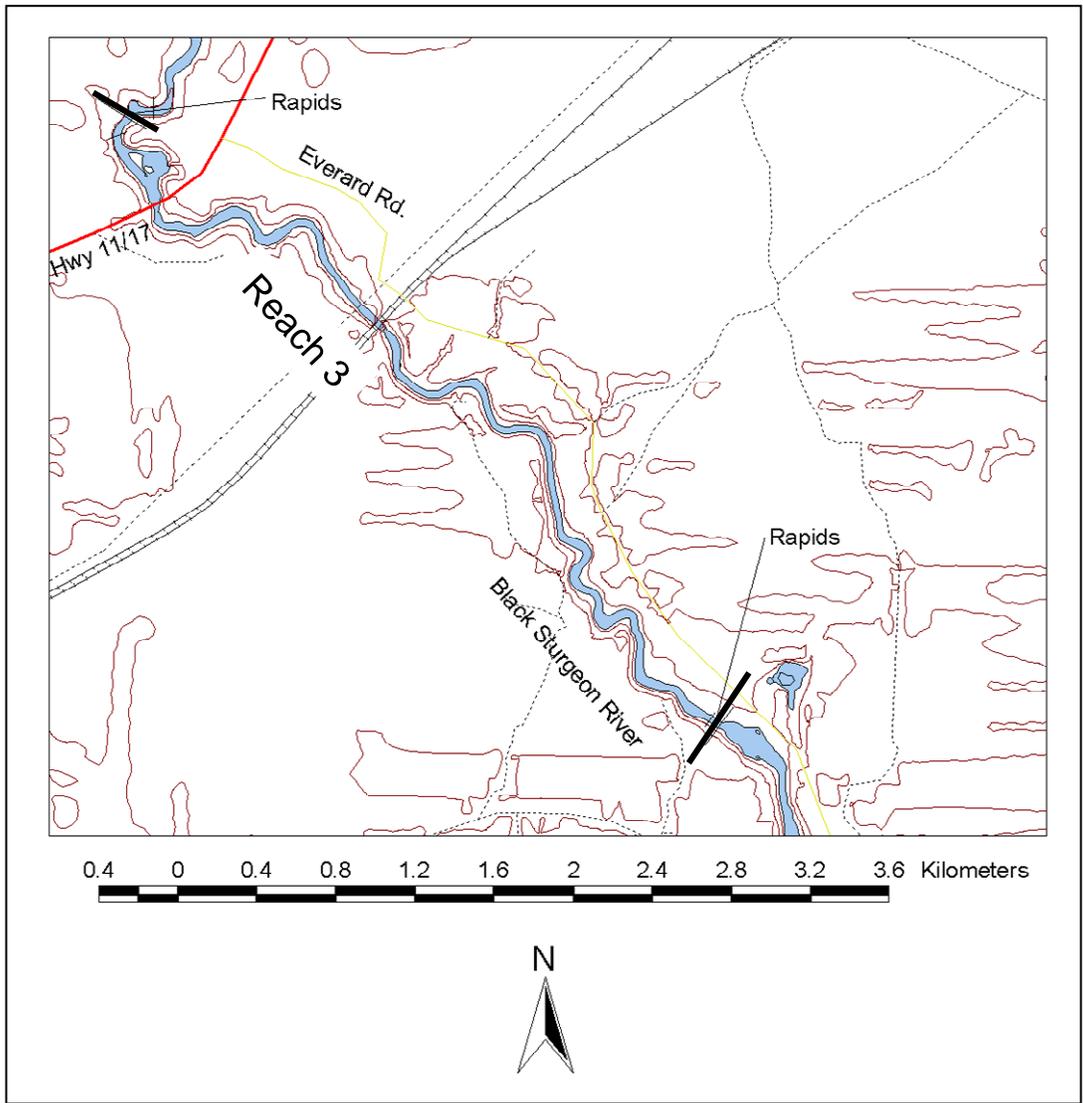


Figure 6. The Black Sturgeon River outlining reach 3 (6.1 km).

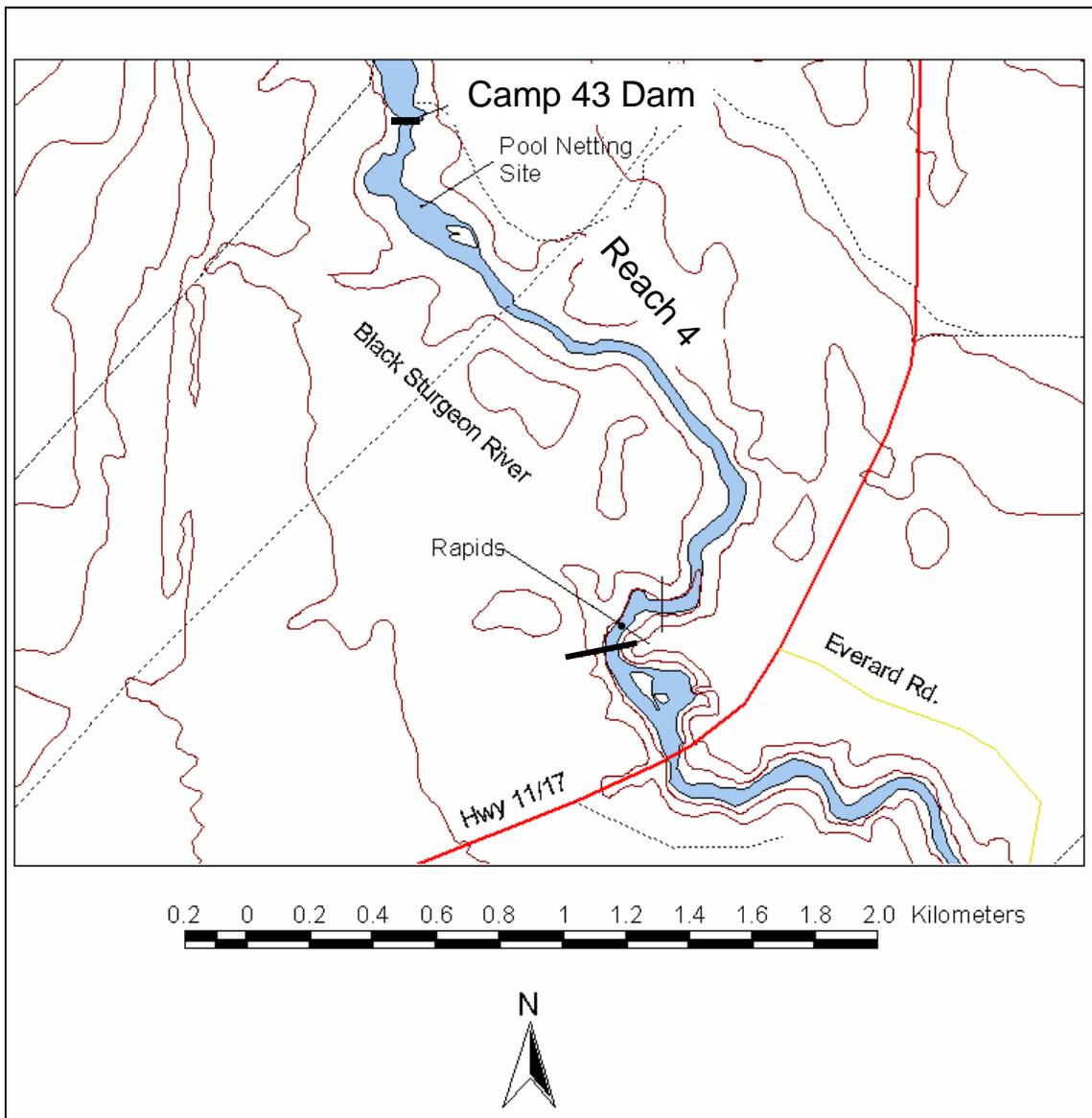


Figure 7. The Black Sturgeon River outlining reach 4 (2.0 km) that terminates at the Camp 43 dam.

PURPOSE

The purpose of this study was to collect information on the population status of adult lake sturgeon utilizing the Black Sturgeon River as a spawning site, to contribute tissue samples for a study funded by the Great Lakes Fishery Trust to assess the genetic population structure of lake sturgeon throughout the Great Lakes basin and to follow-up assessment work that was carried out in 1998 (Stephenson 1999). This project therefore, contributes to the Fish Community Objectives for lake sturgeon rehabilitation in Lake Superior.

METHODS

Over three field seasons, the majority of the index netting was conducted in a pool approximately 500 m downstream of the Camp 43 dam. This site was selected because it is easily accessible; it is the last “holding pool” downstream of the suspected spawning area and adult sturgeon are known to congregate here in the spring. Netting locations were selected to avoid the main river current and the woody debris that collects at the tail end of the pool (Figure 8). Gill nets were also set upstream of the river’s mouth in the spring of 2004 (Figure 4). All lake sturgeon captured were sampled for length (fork, total, legal) weight, girth (taken in 2004), and were tagged with a 5 digit, white floy tag applied laterally along the left-hand side of the dorsal fin. Fish were weighed on a cradle constructed of waterproof canvas attached to airplane grade aluminium poles. Ropes from the ends of the poles were attached to a 45 kg (100 lb) brass Chatillon spring scale which was checked for accuracy and adjusted as required.

A 1 cm by 1 cm section of the distal portion of the pectoral fin was removed for genetic analysis. Genetic samples were placed in scale envelopes, dried and submitted to the Department of Animal Science, Genomic Variation Laboratory at the University of California at Davis for analysis.

Depth and temperature data were recorded at each site. Minimum and maximum water depth (meters) at each netting site was determined using an Eagle Ultra-Classic depth sounder. Water temperature was taken at the time of setting and lifting the nets using a YSI tele-thermometer model 43 TD. Air temperature was taken at the same time using a hand-held thermometer. A temperature data logger (Vemco Minilog-T) was used to record mean hourly water temperatures approximately 500 m downstream of the Camp 43 dam in 2003 (May 12 to October 31) and 2004 (May 11 to October 4) (Figure 8) (Appendix I, Figure A1).

2002

Multifilament gill nets (45 m) in mesh sizes of 254 mm (10") and 305 mm (12") were set overnight from May 27 to June 14, 2002 (11 lifts) in the pool downstream of the Camp 43 dam (Appendix II, Figure A2). Gear depth ranged from 0.6 m to 4.0 m.

2003

Multifilament gill nets in lengths of 45 and 73 m (50 and 80 yds) and mesh sizes of 254 mm (10"), 280mm (11") and 305 mm (12"), were set overnight in the pool downstream of the Camp 43 dam from May 21 to June 28 (65 lifts) (Appendix II, Figure A2). Gear depth ranged from 2.3 m to 3.4 m.

Five of the captured fish (from May 24 to 26) were also selected for internal radio tagging. Transmitters consisted of five 75 g tags with an expected battery life of 1095 d and five 25 g tags with a life of 400 d. Individual transmitters were identified by a separate frequency and operated within the 150.999 to 151.999 MHz band. The surgical procedure for implanting radio transmitters was adapted from Martin et al. (1995).

Netting resumed in the pool downstream of the Camp 43 dam from August 27 – 28 (11 lifts) for the purpose of implanting the remaining five radio transmitters. Multifilament gill nets that were 73 m in length (80 yds) with 254 mm (10") mesh were used. Gear depth ranged from 2.4 m to 3.6 m.

2004

From May 10 to May 21, multifilament gill nets were set (14 lifts) overnight at two sites in the lower river (upstream of the mouth) to tag fish as they entered the river (Figure 4). The depth ranged from 3.0 m to 4.9 m.

From May 25 to June 30, gill nets were set (30 lifts) in the pool downstream of the Camp 43 dam with the intention of recapturing previously marked fish. Gill net mesh size was 254 mm (10") and 305 mm (12") in 45 and 91 m (50 and 100 yd) lengths (Appendix II, Figure A2). Gear depth ranged from 2.1 m to 4.1 m.



Figure 8. Netting location approximately 500 metres downstream of the Camp 43 dam (photo taken September 15, 2005).

RESULTS

NETTING SUCCESS

2002

Nine individual sturgeon (7 males, 2 unknown) were captured during the study period. No other fish species were captured. The mean daily discharge from May 27 to June 15 ranged from 34.6 to 50.4 m³·s⁻¹. The average air temperature during the set and the lift was 16.3 and 17.6°C.

2003

Fifty six individual sturgeon (7 males, 49 unknown) were captured during the study period. Six were radio tagged (one with a 25 g tag and five with 75 g tags). A shorthead redhorse (*Moxostoma macrolepidotum*) and a white sucker (*Catostomus commersoni*) were also captured. The mean daily discharge from May 21 to June 28 ranged from 15.1 to 36.4 m³·s⁻¹ and water temperature ranged from 11 to 20.9°C.

An additional eleven sturgeon were captured from August 27 to 28. Four of these fish were radio tagged with 25 g tags. The mean daily discharge during these two days was 28.4 m³·s⁻¹ and water temperature was 20.2°C. The data collected from these fish was incorporated into the population dynamics analysis but not the population estimate.

2004

Only one sturgeon was caught during the initial netting in the lower river (May 10 to May 21) during flows that ranged from 66 to 79 m³·s⁻¹ and water temperature that ranged from 7 to 11°C.

Thirty four individual lake sturgeon (9 males, 26 unknown) were captured from May 25 to June 30 in the pool below the Camp 43 dam. The mean daily discharge ranged from 42 to 79 m³·s⁻¹ and water temperature ranged from 11° to 18°C.

CATCH-PER-UNIT-EFFORT

2002

A total of 532:53 netting hours resulted in the capture of 11 lake sturgeon (includes recaptures). The CUE for the 10" mesh was 0.05 fish/hour/km gill net. The CUE for the 12" mesh was 0.03 fish/hour/km gill net. The total CUE for all mesh sizes combined was 0.02 fish/hour/km gill net.

2003

A total of 1583:53 netting hours resulted in the capture of 76 lake sturgeon (includes recaptures). The CUE for the 10" mesh was 0.03 fish/hour/km gill net. The CUE for the 12" mesh was 0.02 fish/hour/km gill net. The total CUE for all mesh sizes combined was 0.02 fish/hour/km gill net.

2004

A total of 978:28 netting hours resulted in the capture of 40 lake sturgeon (includes recaptures). The CUE for the 10" mesh was 0.03 fish/hour/km gill net. The CUE for the 12" mesh was 0.03 fish/hour/km gill net. The total CUE for all mesh sizes combined was .03 fish/hour/km gill net.

POPULATION ESTIMATES

2002

A population estimate could not be calculated due to the small sample size (n=11) and small number of recaptures (n=2).

2003

A population estimate was calculated using the modified Schnabel formula (Ricker 1975). Based on recaptures, this estimate suggests there were 89 lake sturgeon in the examined area. The 95% confidence interval for this estimate ranged from 54 – 138 fish. This estimate is applicable only to fish susceptible to capture in the large mesh gill nets used during the study.

2004

A population estimate was calculated using the modified Schnabel formula (Ricker 1975). Based on recaptures, this estimate suggests there were 96 lake sturgeon in the examined area. The 95% confidence interval for this estimate ranged from 47– 240 fish. This estimate is applicable only to fish susceptible to capture in the large mesh gill nets used during the study.

WEIGHT-LENGTH RELATIONSHIP**2002**

The weight (kg) - length (cm) relationship of Black Sturgeon River lake sturgeon captured in 2002 is $W = 0.000008 L^{3.0333}$ (Figure 9).

2003

The weight (kg) - length (cm) relationship of Black Sturgeon River lake sturgeon captured in 2003 is $W = 0.00001 L^{2.9191}$ (Figure 9).

2004

The weight (kg) - length (cm) relationship of Black Sturgeon River lake sturgeon captured in 2004 is $W = 0.00002 L^{2.7814}$ (Figure 9).

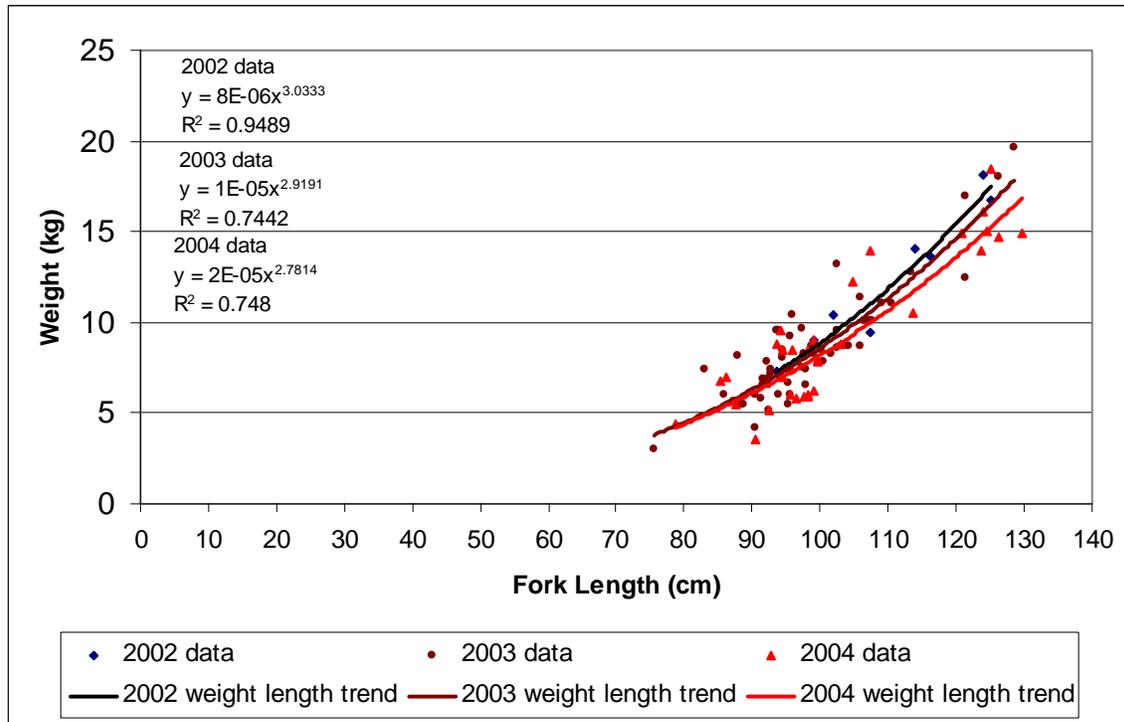


Figure 9. Fork length - weight relationship for 99 lake sturgeon captured from 2002 to 2004.

TOTAL LENGTH DISTRIBUTION

2002

Total length of these fish ranged from 99 cm to 130.6 cm with a mean of 115.3 cm (Figure 10).

2003

Total length ranged from 80.7 cm to 144.4 cm with a mean of 108 cm (Figure 10).

2004

Total length ranged from 90.4 cm to 142.7 cm with a mean fork length of 111.8 cm (Figure 10).

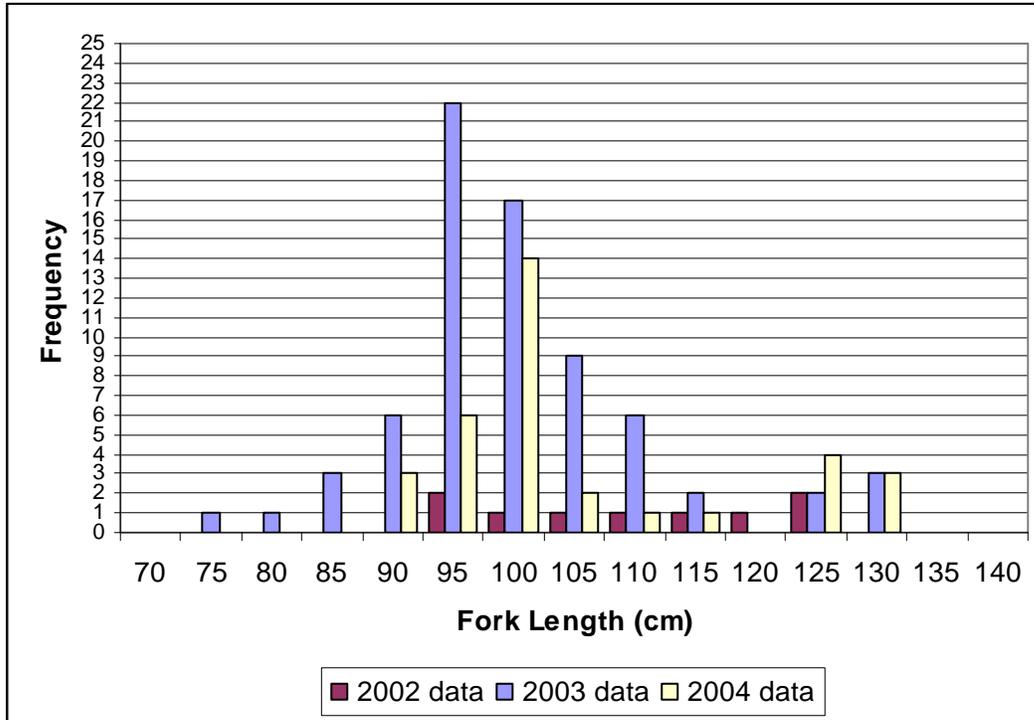


Figure 10. Total length distribution for all lake sturgeon captured from 2002 to 2004.

TOTAL LENGTH – LEGAL LENGTH MEASUREMENT RELATIONSHIP

In addition to seasonal restrictions, anglers are only allowed to harvest sturgeon greater than 114 cm in legal length. Legal length is measured from the posterior limit of the gill opening to the point where the posterior edge of the dorsal fin joins the body. Data were collected to establish the relationship between legal length and total length for possible future regulation changes to a standard total length measurement (Figure 11).

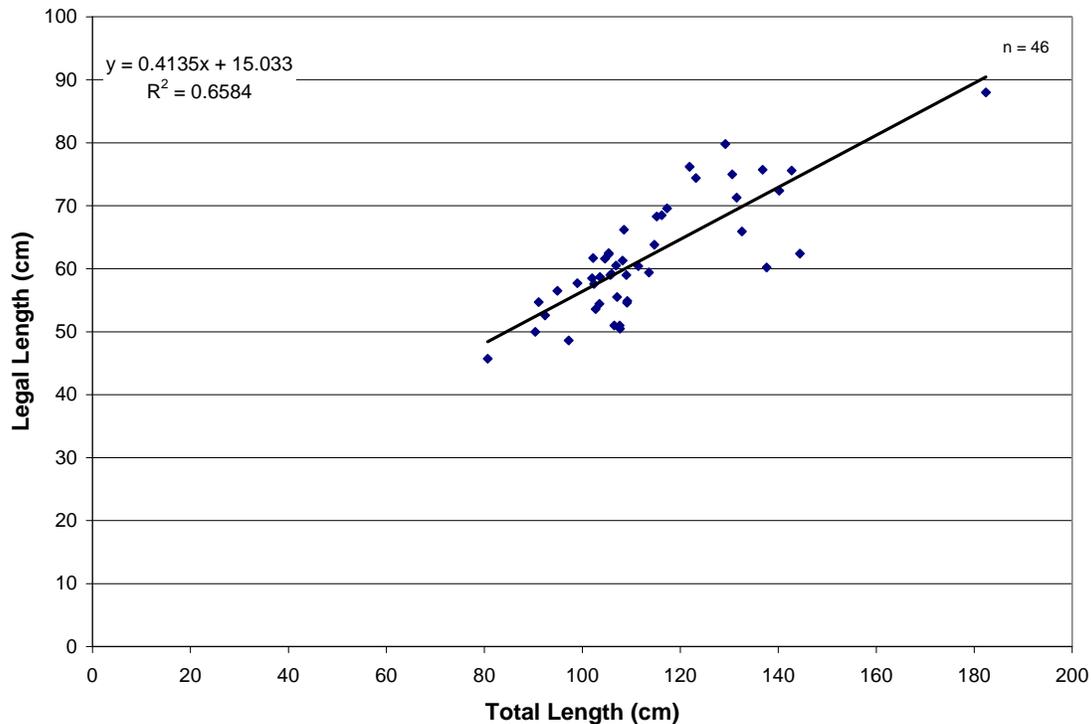


Figure 11. Legal length-total length relationship for 46 lake sturgeon measured from 2002 to 2004.

DISCUSSION

Catch-Per-Unit-Effort

CPUE (0.02 fish/hour/km gill net) for each of the years examined indicates low abundance when compared to other studies. Stephenson (1999) reported a CPUE value of .064 for the Kaministiquia River (a small population) while Seyler (1997b) reported a CPUE of 0.036 for the Groundhog River population in northeastern Ontario.

Population Estimates

The number of lake sturgeon that migrated up Black Sturgeon River in each of the years surveyed, appears to be small. The spawning population estimates calculated for 2003 and 2004, for the examined area, were approximately 100 for both years. In 2004 the survey was modified in an attempt to catch adults as they entered the river and allow them to be recaptured at random in the upper

River. This was unsuccessful as only one fish was captured in the lower river. These estimates are similar to the one calculated by Stephenson (1999) for the Kaministiquia River (n = 140). The lake sturgeon rehabilitation plan for Lake Superior (Auer 2003) defines a self-sustaining population of lake sturgeon as one with a minimum of 1,500 mature spawning adults using a common tributary for spawning, but not all of which spawn every year.

Length Distribution

There is a normal distribution of sizes in the catch (for all years combined) but the majority of fish sampled were small and presumably young fish. The average total length of fish caught in large mesh nets for all years combined (109.8 cm) is small when compared to other lake sturgeon populations (in Lake Superior tributaries) that have been sampled in the spring with similar gear. Stephenson (1999) reported a mean total length of 120.1 cm during netting on the Kaministiquia River and Friday (2004) reported a mean total length of 127.5 during spawning run netting on the Kaministiquia River. Auer (1999) reported an average total length of 153.4 cm for females and 134.5 cm for males captured at the spawning site on the Sturgeon River, MI. The largest fish sampled in the Bad River, WI are typically females from 122 to 183 cm total length (Slade and Rose 1994). The Black Sturgeon River length distribution suggests few large fish were present during the survey years.

None of the lake sturgeon captured during the three survey years were large enough to be legally harvested and yet angler reports to OMNR Enforcement indicate that fish are being harvested downstream of the Camp 43 dam. Based on regression analysis, lake sturgeon would have to achieve a total length of 239 cm before they could be legally harvested from the Black Sturgeon River. In comparison, lake sturgeon from the Kaministiquia River would have to achieve a total length of 186 cm before they could be legally harvested. Auer 1995 (cited in Slade and Auer 1997) concluded that illegal harvest of sturgeon can be detrimental to populations that congregate in streams to spawn. Eliminating

recreational fishing for lake sturgeon or implementing catch and release may reduce illegal harvest.

Genetics

The Black Sturgeon River represents one of only 7 Canadian tributaries to Lake Superior known to support a spawning population of lake sturgeon. The results of genetic analyses have shown that there is a great deal of genetic structuring of lake sturgeon populations within Lake Superior, (and the Great Lakes Basin) and most rivers are genetically distinct from other spawning locations (Welsh and McClain 2004) indicating that lake sturgeon may demonstrate spawning site fidelity. Conserving this genetically distinct and likely small spawning population is critical to meet the goals for lake sturgeon rehabilitation.

Trapped Sturgeon

In late July of 2001 Ontario Ministry of Natural Resources staff from Nipigon District notified the Upper Great Lakes Management Unit (UGLMU) of reports that lake sturgeon were congregated and “trapped” in bedrock pools directly below the Camp 43 dam. UGLMU staff traveled to the site on August 1, 2001 to confirm the sightings; remove the fish and collect biological information. Eight lake sturgeon were dip netted from these pools and were sampled for length (fork, total, legal), weight and were tagged with a 5 digit white floy tag applied laterally along the left-hand side of the dorsal fin. These fish ranged in fork length from 69.5 – 91.2 cm and weighed from 3 – 7.5 kg. The mean daily river flow was $19.9 \text{ m}^3 \cdot \text{s}^{-1}$. The small size of these fish and time frame that they were found below the dam (after typical spawning period) suggests they migrated to this location for reasons other than spawning. In the Kaministiquia River, spawning fish ranged in fork length from 112 to 142 cm and left the spawning site by the end of June (Friday 2004). Water levels at the time of this site visit were sufficiently low to hinder escapement. Whether fish were actually trapped in the bedrock pools is not known.

On June 12, 2002 UGLMU staff noticed lake sturgeon trapped in the same area as the previous year. Six lake sturgeon were dip netted from these pools and sampled in the same manner as 2001. A 1 cm by 1 cm section of the distal portion of the pectoral fin was removed for genetic analysis. These fish ranged in fork length from 72.1 – 95.0 cm and weighed from 3.3 – 5.7 kg. The mean daily river flow was $45.5 \text{ m}^3 \cdot \text{s}^{-1}$.

RECOMMENDATIONS

- Address the issue of illegal harvest by increasing enforcement below the Camp 43 dam (especially during the period of spawning).
- Protect this population by eliminating recreational angling or implement catch and release only.
- Investigate the restoration of historical access of lake sturgeon to the upper reaches of the Black Sturgeon River watershed.
- Increase public awareness of issues concerning lake sturgeon within Lake Superior and the Great Lakes.
- Continue to monitor the adult population at regular intervals to assess population growth.

ACKNOWLEDGEMENTS

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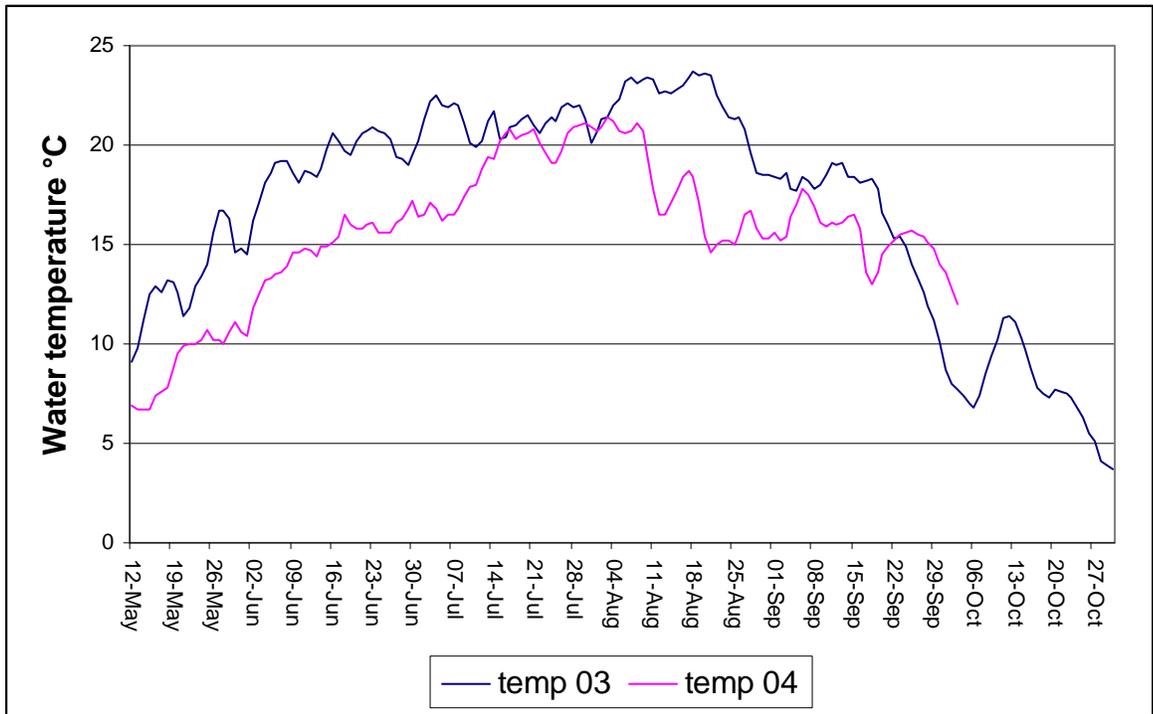
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APPENDIX I

Figure A1. Black Sturgeon River mean daily water temperatures 2003 and 2004.



APPENDIX II

Figure A2. Black Sturgeon River mean daily discharge (m³/s) 2002, 2003 and 2004 (study period shaded in blue)

