Final Report for Lake Sturgeon Spawning in St. Clair River near Port Huron, Michigan

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Introduction

Lake sturgeon *Acipenser fulvescens* were once widely distributed in rivers and lakes throughout North America. Their historic range included drainage basins of the Mississippi, Hudson Bay and the Great Lakes (MacKay 1963; Scott and Crossman 1973). Although lake sturgeon are found primarily in freshwater, some populations are found in the lower St Lawrence River, Hudson Bay, and James Bay (Harkness and Dymond 1961). Within the last century, lake sturgeon populations have been dramatically reduced or extirpated from much of their native range (Harkness and Dymond 1961; Brousseau 1987). In the 1800s and early 1900s, habitat decline, excessive harvesting, and intentional reduction were determined to be the primary causes for their decline (Harkness and Dymond 1961; Brousseau and Goodrich 1989). In 1885 the combined commercial catch of lake sturgeon in Lakes St. Clair and Erie peaked at about 2.27 million kg (you use English units here but metric every where else switch to metric) per year, then declined to near zero and has remained there since about 1910 (Tody 1974).

To help reduce continued decline of the species, state governments in the United States and provincial governments in Canada have listed lake sturgeon as a protected species (Brousseau 1987; Johnson 1987). Within Michigan, lake sturgeon are currently listed as a state threatened species, and a controlled harvest is allowed only in a limited number of locations where the population is able to sustain itself (e.g. Lake St. Clair, Black Lake, and the Menominee River). Throughout other locations in the state fishing for sturgeon is illegal. Within Canadian waters, a limited commercial fishery still exists and recreational anglers are allowed one sturgeon per day.

Movement patterns of lake sturgeon are complex not only due to differences in systems where they reside, but also differences in habitats required for spawning, resting, foraging, and over-wintering. Results from mark-recapture studies in Wisconsin indicate that lake sturgeon in the Lake Winnebago system travel great distances up connecting rivers to spawn in the spring, returning to a home range in lakes after spawning (Priegel and Wirth 1971). In larger systems where lake sturgeon movements are not restricted, sturgeon usually move back into lakes after spawning (Priegel and Wirth 1971; Hay-Chimielewski 1987; Auer 1999). In the Wolf River, a tributary of Lake Winnebago, a unique population of sturgeon was detected that remained in the river year-round (Lyons and Kempinger 1992). Evidence of river resident lake sturgeon was also identified in the Lower St. Clair River (J. Boase unpublished data).

Critical to the recovery of lake sturgeon in the Great Lakes is the identification of spawning areas, movement patterns associated with spawning migrations, and the origin of sturgeon using those areas. In shallow systems researchers may be able to visually record spawning locations and behavior. However, in deeper or more turbid systems, telemetry and mark-recapture methods are used to detect spawning and movements associated with spawning.

Limited research has been conducted on lake sturgeon spawning in the connecting waterways between the Great Lakes. Perhaps this is linked to the ability to find and capture sturgeon in these environments. In the Upper St. Clair River a natural, deep-water reef exists near Port Huron, Michigan. The spawning site is the only known site in close proximity to US waters of Lake Huron. According to local divers and preliminary research by USGS, the spawning site begins approximately 1.2 km up river and ends about 1.6km down river from the bridge. The origin of sturgeon utilizing the spawning site and distribution of the adults and their resulting progeny was unknown. I hypothesized that sturgeon utilizing the deep-water reef were sturgeon originating from southern Lake Huron. The first objective of this study was to capture spawning lake sturgeon at this site, implant ultra-sonic transmitters and track the movement of those fish during and after spawning. This was a joint effort by personnel from the US Fish and Wildlife Service Alpena FRO, along with state, provincial, federal, university and NGO partners. The second objective was to gather information about the physical characteristics of the reef. Information gathered would provide essential data required to guide future habitat protection, enhancement, and restoration activities, as well as lake sturgeon recovery plans in this and other Great Lakes locations. This demonstration effort would be a crucial first step in determining the present and potential contribution of St. Clair River lake sturgeon to adjacent populations in Lakes Huron, St. Clair and Erie. Additionally, this effort would assist in the recovery of sturgeon from " state threatened" status.

Study Site

The study area encompassed an area south of 43^0 25’ N and 82^0 00’ W in Lake Huron, the St. Clair River, Lake St. Clair and the Detroit River (Figure 1). The St. Clair River system is unique to the Great Lakes region both physically and biologically. Water leaving Lake Huron travels 64 km in a southerly direction to Lake St. Clair and before the river enters Lake St. Clair it passes through the largest natural delta system in the Great Lakes (Edsall et al. 1988). The upper reaches of the river are dominated by heavy industry on both sides of the border. In the southern reaches urbanization is prevalent on the U.S. side while wetlands and some agriculture dominate the Canadian side. River velocities at the surface reach 3.2 km/hr with an average discharge rate of 5,121 m^3/s (Edsall et al. 1988). Once reaching the delta, flow is diverted between four main channels. Navigation-related dredging in the St. Clair system began as early as 1873 and continues to the present, with a minimum depth of 8.3 meters maintained in the shipping lane. Within the river there are natural deep holes >24 m while in other areas deposition of sand has created extensive submerged bars that are < 1 m deep (Edsall et al. 1988).

Methods

Setlines were used to collect lake sturgeon from the spawning site using similar methods described by Thomas and Haas (1999). Setlines were deployed from a 5.5m open hull, deep V boat from 29 May 2002 through 19 June 2002. We deployed 4 setlines/day at the Port Huron site except on two occasions. On those occasions (12 and 13 June 2002) two of the four setlines were moved to locations near other suspected spawning sites at Fawn Island and the gravel docks near Moortown Ontario (Figure 2). Depths of deployment ranged from 4.5 to 15 m. Due to current velocities (greater than 4 knots) and depths (greater than 15m) at the spawning site, setlines were never set perpendicular to the current as described in Thomas and Haas (1999). Instead, most setlines were deployed at an angle of about 45^0 or less with the current. Because most of the spawning site is located in the main shipping lane, and setlines could pose a navigation hazard, it was not possible to deploy the setlines within the shipping lanes.

Setlines were deployed between 0800 and 1700 hours and generally retrieved the following day before 1500 hours. However, when weather conditions prevented retrieval setlines were pulled after 48 hours. Fresh bait was used for the first set at the beginning of the week and for the remainder of the week only empty hooks or hooks with tattered bait were rebaited with fresh bait. Round goby *Neogobius melanostomus* was used as bait. Hooked lake sturgeon were brought aboard with the aid of a large landing net. Due to the size of the boat being used each fish had to be worked up as it was retrieved. The biological information collected included: total length (TL mm), fork length (FL mm), weight (kg), girth (mm), sex, location of lamprey wounds or scars if present, and if the fish had been previously marked. Commercial length (CL mm) was also measured to determine if the fish could be legally harvested in Canada by commercial fishers. Fish not having previous tags were marked with external Floy tags which were placed at the base of the dorsal fin. In addition, passive integrated transponder (PIT) tags were injected under the fourth dorsal scute. Due to concerns with the PIT tag potentially being ingested if the fish was harvested, the insertion point was moved to the area located dorsally between the end of the cranium and the first dorsal scute. The use of PIT tags would allow us to evaluate Floy tag retention. The leading edge of the left pectoral fin was removed for age determination (Roussow 1957; Rossiter et al. 1995) and genetic analysis.

Transmitters were implanted in lake sturgeon using similar procedures described in Summerfelt and Smith (1990). The fish were restrained in a net stretcher with their heads covered with wet cloth to reduce stress. A small incision approximately 5cm long was made in the abdominal cavity. Ultrasonic transmitters were inserted directly into the body. The fish were sutured with dissolvable nylon thread material. Fish were held until they were able to swim and then were released at the capture location. The fish were out of the water no longer than 12 minutes during the entire procedure. In addition to fish captured with setlines, two sturgeon captured in commercial trap-nets were also implanted with ultrasonic transmitters. The fish were captured in southern Lake Huron approximately 25km from Port Huron. Those fish were placed in a livewell and brought back to raceways located at Purdy Fisheries. They were implanted the next day and returned to the raceway. After four days the fish were returned to the location where they were captured and released. Sutures at the time of release were intact and beginning to heal.

During periods of calm wind and warm ambient temperature, differences in water temperature from the surface and the bottom were sometimes greater than 4^0C. Because of the importance of spawning temperature, all temperatures reported during the spawning period were bottom temperatures.

Lake sturgeon were tracked by boat using an ultrasonic receiver and a hand held directional hydrophone (Sonotronics Inc. Tuscon, AZ). A systematic grid of listening stations was used, and distance traveled between listening stations was dictated by weather conditions and sound attenuation caused by boat traffic or water surface disturbance. Typical detection ranges were greater than one nautical mile. Stations were generally separated by about 0.8 minutes latitude or 1.0 minute longitude. Using this method, large portions of southern Lake Huron and Lake St.

Clair could be searched with relatively low likelihood that fish were in the area but not detected. When fish were located some distance from the boat they were advanced upon until the transmitter signal exhibited equal strength in all directions. In the St Clair and Detroit Rivers listening stations were determined by direction changes in the river when distances between listening stations were less than one nautical mile. The amount of error locating fish due to hydrophone limitations was estimated to be $\pm$ 10 meters. Fish locations and listening locations were recorded using a Global Positioning System (GPS). When a fish was located, water depth and temperature were also recorded.

After initial lake sturgeon movement patterns were established, underwater video images were collected at suspected spawning locations and at locations above and below the spawning area. Substrate images were filmed midday, under ambient light conditions, during periods of low turbidity. A high-resolution underwater, video camera (Fuhrman Diversified Inc., Seabrook, TX) housed within a protective aluminum tube was used. Three external fins on the housing enabled control of direction and angle of the camera. The camera was attached by a coaxial cable to a video monitor/recorder located on the boat. Substrate images were recorded as the boat drifted downriver, with camera depth being maintained 5m from the bottom.

The area of the river surveyed included 2km upriver and 6km downriver from the bridge. Transects lengths ranged from 0.3 to 0.9km long and were located approximately 100m apart. The number of transects required to cover a given segment of the river ranged between 6 and 11. Transects were geo-referenced using GPS. Water temperature, water depth, and secchi depth readings were taken at the beginning and end of the river segments being surveyed. River bottom substrates were identified and classified from the video recordings and then plotted using ArcView Geographic Information Software (GIS) (ESRI, Inc., Redlands, California). Comparison of sturgeon locations with substrate images helped define lake sturgeon spawning habitats. Video footage collected by recreational divers during the spring spawning period in 1999 was used for reference (A. Gregory, Lakeport, MI).

Results

Setlines were deployed from 29 May – 20 June 2002 capturing a total of 47 lake sturgeon with one fish being recaptured (Figure 3). Four females and 9 males were ripe and running, along with what appeared to be 1 spent male (due to the flaccid soft ventral surface). The remaining 34 sturgeon were immature or the sex could not be determined. From the fish that were ripe and running, we chose 3 females and 3 males to implant with ultrasonic transmitters (Table 1).

In addition to the 6 fish implanted at the spawning site, two ripe female sturgeon collected in commercial trap nets were also implanted. Those two fish were captured on June 10, implanted on June 11, and released on June 15 (Figure 4). Catch per unit of effort peaked on June 4 with more than 3.5 sturgeon/setline/day being captured (Figure 5). Water temperature during peak CPUE was 11.4^{0}C, which is well within the optimum range (11.0 to 13.0^{0}C) for spawning sturgeon in the Lower St. Clair River (Thomas and Haas 2000).

Age and growth data were collected from the 47 lake sturgeon captured in 2002. A total of 19 year classes were represented with most recruitment from 1972 –1991, the exception was one fish from the 1954 year class (Figure 6). Mean age was 21 with minimum and maximum of 12 and 48 respectively (Table 2). Mean total length was 1,334 mm and is attained by age 19. Minimum and maximum total lengths were 904 and 1,876 respectively.

The time required to retrieve setlines each day prevented us from conducting extensive searches and locating each fish once they moved outside of the spawning area. On 5 June 2002, the 6 sturgeon that were implanted in the river were still located near the spawning reef as well as one fish that had been implanted on the Detroit River in May 2001. Water temperatures at the reef on 5 June were at 11.8^{0}C. On 6th and 7th June one of the fish implanted at the reef and the fish from the Detroit River were located in an area behind a shipwreck located just upriver from the bridge (Figure 7). Water temperatures were 12 and 13^{0}C respectively. Fish were not tracked over the weekend of 8 and 9 June. By 10 June 2002, water temperature was still at 13.0^{0}C. Three fish from the Port Huron Reef and the Detroit River fish were still near the spawning reef but were in areas where underwater obstructions caused an eddy or areas of reduced flow (Figure 8).

Because we had a sufficient number (6) of lake sturgeon implanted, by 12 June 2002, we decided to reduce the effort at the Port Huron site from 4 setlines/day to 2 setlines/day. The two extra setlines were deployed at Fawn Island on 12 June 2002, and at the Mooretown gravel docks in Ontario on 13 June 2002. Water temperature during those two sets was past the peak (> 14.0^{0}C) consequently only one fish was captured at each site.

We continued to deploy setlines at the Port Huron site and on 19 June 2002, a male sturgeon implanted 30 May 2002 was recaptured. One suture had pulled loose which may have been the result of its struggle while being attached to the setline. However, the skin had closed over and an opening to the peritoneum was not evident. The remaining sutures were pink and seemed to be healing. Two sutures were used to close the missing suture. Biological information collected revealed that the fish had lost 0.5kg of body weight, probably due to spawning. After the torn suture was replaced the fish was released.

The last observed fish location in Lake Huron was on 8 July 2002. Subsequent searches within the southern Lake Huron study area in August and September were unsuccessful. However, two fish were located moving downriver with one being located in the delta region of the St. Clair River (22nd June) and the other sturgeon being located in the southern basin of Lake St. Clair (16th July) (Figure 9). The fish located in Lake St. Clair had been captured and released by commercial fishers in Lake Huron. Searches of Lake St. Clair and the Detroit River in September and October failed to locate study fish. The other fish that was released in Lake Huron was never relocated.

A total of 212 minutes of substrate images were recorded on videotape at the Port Huron site. Analysis of the recordings revealed substrates composed of combinations of rounded igneous rock the size of cobble (10 – 40 cm in diameter), coarse gravel (< 8 cm in diameter) and occasional erratic rocks (> 50 cm). Three substrate compositions were found in the segments of the river that were analyzed. In areas where current velocities were highest, cobble dominated the substrate with most large rocks perched or elevated above a bed of coarse gravel. No estimates were made on the size of the void spaces. The extent of the cobble/gravel area was estimated to be 59 ha. Adjacent to the main current or just above and below the high current areas, the substrate was dominated by coarse gravel. Any larger cobble was embedded with smaller material. In areas where eddies were established the substrate was dominated by sand.

Discussion

Telemetry data from the fish implanted in 2002 indicate that at least half of lake sturgeon probably came from Lake Huron. Movement patterns from four of the eight implanted fish support this. Review of water temperature data indicates that optimal spawning temperatures occurred from 6 – 9 June. Following these dates the fish moved back out into Lake Huron over a period of 2 to 10 days. Unfortunately, the limited amount of contacts prevents an indication of home range for these fish.

Only two fish collected at the Port Huron site moved down river following spawning with one fish found in the St. Clair River and the other found in Lake St. Clair. However, the fish could not be relocated during return searches of the St. Clair River and Lake St. Clair. The following are possible results from these findings: 1) fish returned to Lake Huron, 2) transmitter failed, 3) fish were undetected, or 4) the fish moved out of the sampling area and into Lake Erie. Tag returns from mark-recapture studies and telemetry studies have demonstrated sturgeon have migrated from downriver locations such as, western Lake Erie, Detroit River, Lake St. Clair and the lower reaches of the St. Clair River (Thomas and Haas 2000; Caswell et al. 2002; J. Boase Unpublished data). The reason that sturgeon from these down river locations are traveling long distances to spawn may indicate the lack of suitable spawning habitat (McClain and Manny 2000; Manny and Kennedy 2002).

Sturgeon utilized areas of reduced water flow while at the spawning site. Within 1 km upriver from the spawning reef were four large underwater obstructions (three shipwrecks and a large debris field approximately 0.2 km wide by 0.7 km long). In addition, there was also a shipwreck adjacent to the spawning site that provided refuge from the current. Results from the telemetry data indicated that sturgeon could be consistently found at refuge locations before and after the peak spawn. Those findings were consistent with the spawning population in the lower St. Clair River near Algonac, MI (J. Boase, unpublished data). Sturgeon from that population could be consistently found close to the spawning site just prior and just after peak spawning at a location in the river where a deep-water eddy resulted in reduced flow rates. It is unclear if sturgeon need refuge areas in order to successfully spawn or if they just use them because they are there. If they are essential, efforts should be made by managers to incorporate these refuge area into habitat rehabilitation plans.

Although spawning has not been documented on the observed debris field, young-of-year (YOY) sturgeon were documented utilizing that location. The debris field located upriver from the Blue Water Bridge appeared to be naturally occurring and was composed of various sizes of fallen trees with mostly sand and the occasional patches of cobble/gravel as substrates. That type of substrate is inconsistent with what is found at other spawning locations and is not typical habitat for YOY sturgeon in other connecting waterways in the Great Lakes (LeHaye et al. 1992). One possible explanation is that spawning is taking place farther out in the lake and YOY sturgeon are drifting into the debris area and utilizing it as habitat.

The Michigan Department of Natural Resources *Lake Sturgeon Rehabilitation Strategy*, lists the identification and characterization of spawning sites as important for lake sturgeon restoration (Hay-Chmielewski and Whelan 1997). To date only three known spawning sites have been identified in the St. Clair and Detroit Rivers (Caswell et al. 2002; Manny and Kennedy 2002; and Thomas and Haas 2002). Recent comparisons of the sites revealed that only the Port Huron site was composed of naturally occurring substrates and was the least altered site (Manny and Kennedy 2002). According to the authors, that site met the four spawning habitat requirements as defined by Bruch and Binkowski (2002): 1) clean, rocky substrates layered to provide interstitial, void space; 2) water current velocity in excess of 0.5 m/s; 3) water temperatures between 12 and 16^{0}C; and 4) accessible to adults. The Port Huron spawning site was estimated by Manny and Kennedy (2002) to be >67 ha. Our estimates were similar though slightly smaller at 59 ha. In this study only substrates that were in the high current area of the river, composed mostly of cobble, and free of periphyton were defined as suitable spawning habitat (Figure 10). Our findings were based on comparisons with the under water video images recorded in 1999 by recreational SCUBA divers (A. Gregory, Lakeport, MI). Quantification of the highest quality spawning areas and the fry production from the Port Huron site should be considered in future research. The Port Huron site also offers multiple locations where sturgeon can find refuge from the current, which may not be consistent with other spawning site located in the connecting waterways. Because lake sturgeon came from Lakes Huron, St. Clair, and possibly Erie, and there are so few known spawning locations in the connecting waterways, protection of the sites from alteration should be a high priority for managers. As sturgeon populations continue to decline around the world, the demand for caviar and sturgeon meat will increase making areas like the spawning reef vulnerable to poaching. Managers need to recognize this and take necessary precautions.

Anecdotal evidence from local recreational fishers suggests that a spawning site existed near Fawn Island and the Mooretown, Ontario gravel docks. Unfortunately, water temperatures at those locations were above optimal (14^{0}C) spawning temperatures and only one juvenile sturgeon was captured at each location. Video recordings later in the season revealed steep banks near the shore and uniform hard clay substrates at both locations. Future research may reveal closer locations more suitable for spawning at these two sites.

Setlines were deployed slightly upriver from the spawning site and as a result may have been biased to selection of fish coming from Lake Huron. Because setlines pose a maritime hazard and the majority of the spawning site is located in the shipping channel, setlines had to be deployed just upriver from the spawning site at the mouth of the St. Clair River. It was not until the video recordings had been collected and analyzed that another location adjacent to the shipping channel and part of the continuum of suitable spawning habitat was discovered. That site was located near the downriver end of the spawning reef. If setlines had been deployed at the new location or if setlines could have been deployed in the main channel at the downriver end of the spawning reef, more sturgeon may have been captured that were coming upriver to spawn. In future research, deployment of setlines above and below the spawning reef may provide the best representative sample of fish if most are originating form downriver locations.

Most fish captured during 2002 recruited from a 19 year span beginning in 1972 and ending in 1991. These results are consistent with the results of Thomas and Haas (2002). They suggest that changes in water quality following the enactment of the federal Clean Water Act of 1972 may be partly responsible for the increased recruitment during that period. Younger year classes are not represented in our study most likely because sturgeon have not reached sexual maturity and would not be at the spawning site. Comparisons of length weight ratios between the upper (Port Huron site) and lower (Algonac site) St. Clair River revealed that both populations grow at the same rate until they reach 1,000 mm, then sturgeon from the lower St. Clair River increase in body mass faster than fish from the upper St. Clair River (Figure 11). Growth of lake sturgeon in the upper St. Clair River was good, with fish attaining a total length of 1,000 mm by age 10 (Figure 12). Relative to populations in the lower St. Clair River and the inland lakes in Michigan, sturgeon from the upper St. Clair River grew slower during the first 5 years and then grew faster than both populations after age 15. However, results may be an artifact of the small sample size of the upper St. Clair River population.

Implications for Rehabilitation of Lake Sturgeon

At the onset of this project one of the primary goals was to document the spawning of lake sturgeon in the upper St. Clair River near Port Huron and determine their origin. Because we are dealing with remnant populations of lake sturgeon in the Great Lakes and so few spawning sites have been identified in the waterways connecting Lake Huron to Lake Erie, documenting the Port Huron spawning site was our primary goal. This project demonstrated that lake sturgeon are not only coming from Lake Huron but are also coming from locations downriver such as Lakes Erie, St. Clair, and the Detroit River. The fact that sturgeon are coming from distant locations to spawn at the Port Huron site possibly indicates the lack of suitable spawning habitat at those locations. If true than the Port Huron site could be functioning as a source population to other areas of the Great Lakes. Therefore, disturbance or alteration to the site could have profound effects on local and distant populations of lake sturgeon. Critical to the rehabilitation of lake sturgeon in this region of the Great Lakes is the maintenance and protection of the spawning reef at Port Huron.

The second primary goal of this project was to characterize the habitat parameters of the spawning site. We found that underwater structures played an important function for sturgeon at the Port Huron site. The structures provided refuge from the current and were used before and after spawning, those findings were consistent with other locations. In 2003 construction of an artificial spawning reef for lake sturgeon will be taking place on the Detroit River. Findings from our research could be directly applied to the proposed spawning reef on the Detroit River and may enhance the success of that project. Because information about the importance of refuge areas is lacking, further research should be considered. Funding by the National Fish and Wildlife Foundation made it possible to achieve the objectives proposed and with the completion of this project added new knowledge about lake sturgeon in the Great Lakes.

Future Research

In the spring of 2003, if funding continues, we plan to reestablish contact with the implanted sturgeon to continue tracking their movements. The implanted transmitters will continue to provide valuable information about the location of each lake sturgeon if they return to spawn in 2003 and 2004. Video research in 2002 revealed two new potential spawning sites; in the spring of 2003 we plan to target those locations using both setlines and egg mats to verify spawning at those locations and if so determine recruitment. We will continue to seek out new spawning locations and YOY sturgeon habitat in the upper and lower St. Clair River. Continued research is critical if our rehabilitation efforts are to be successful.

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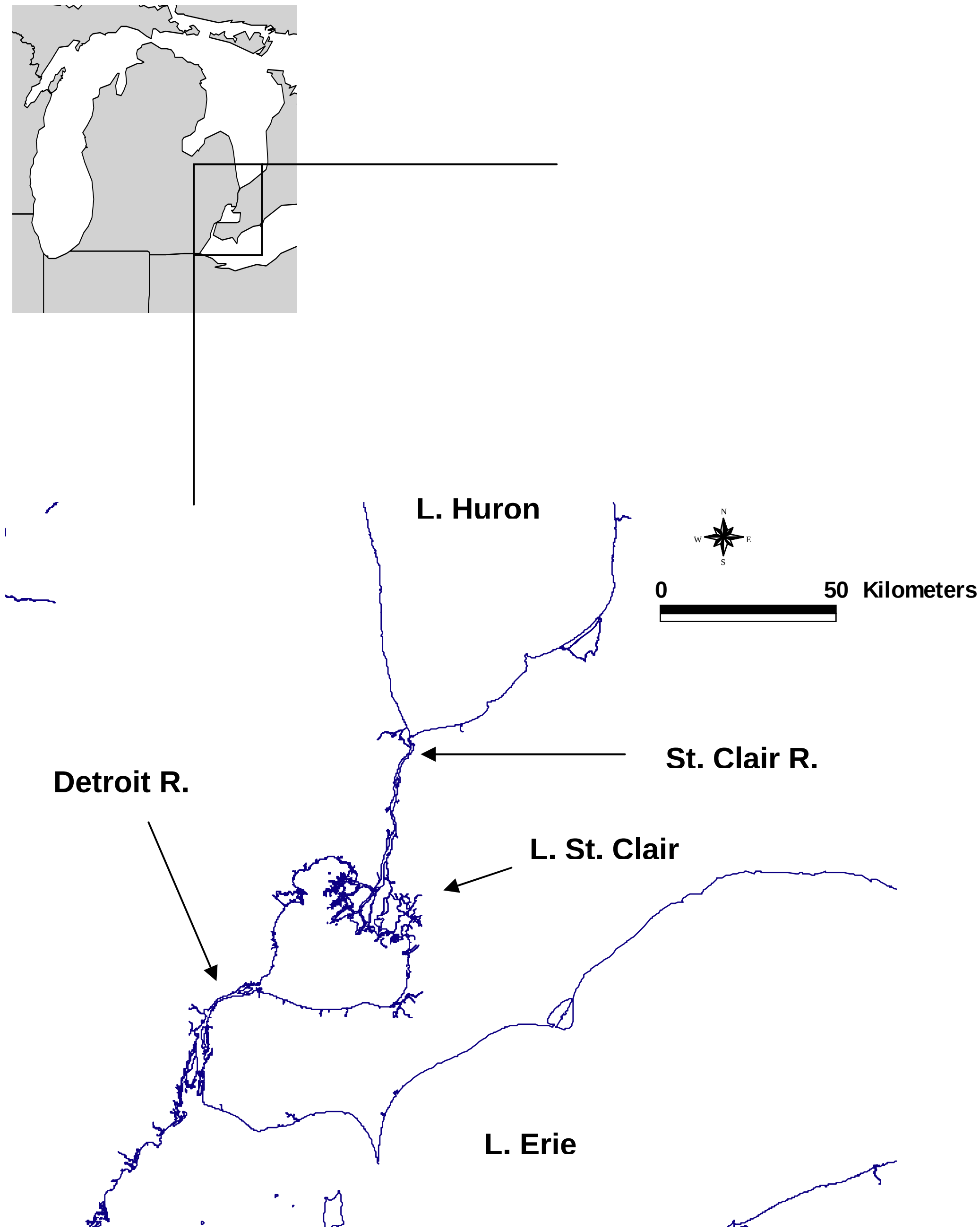

Figure 1. Extent of study area included, Southern Lake Huron, St. Clair River, Lake St. Clair, and the Detroit River.

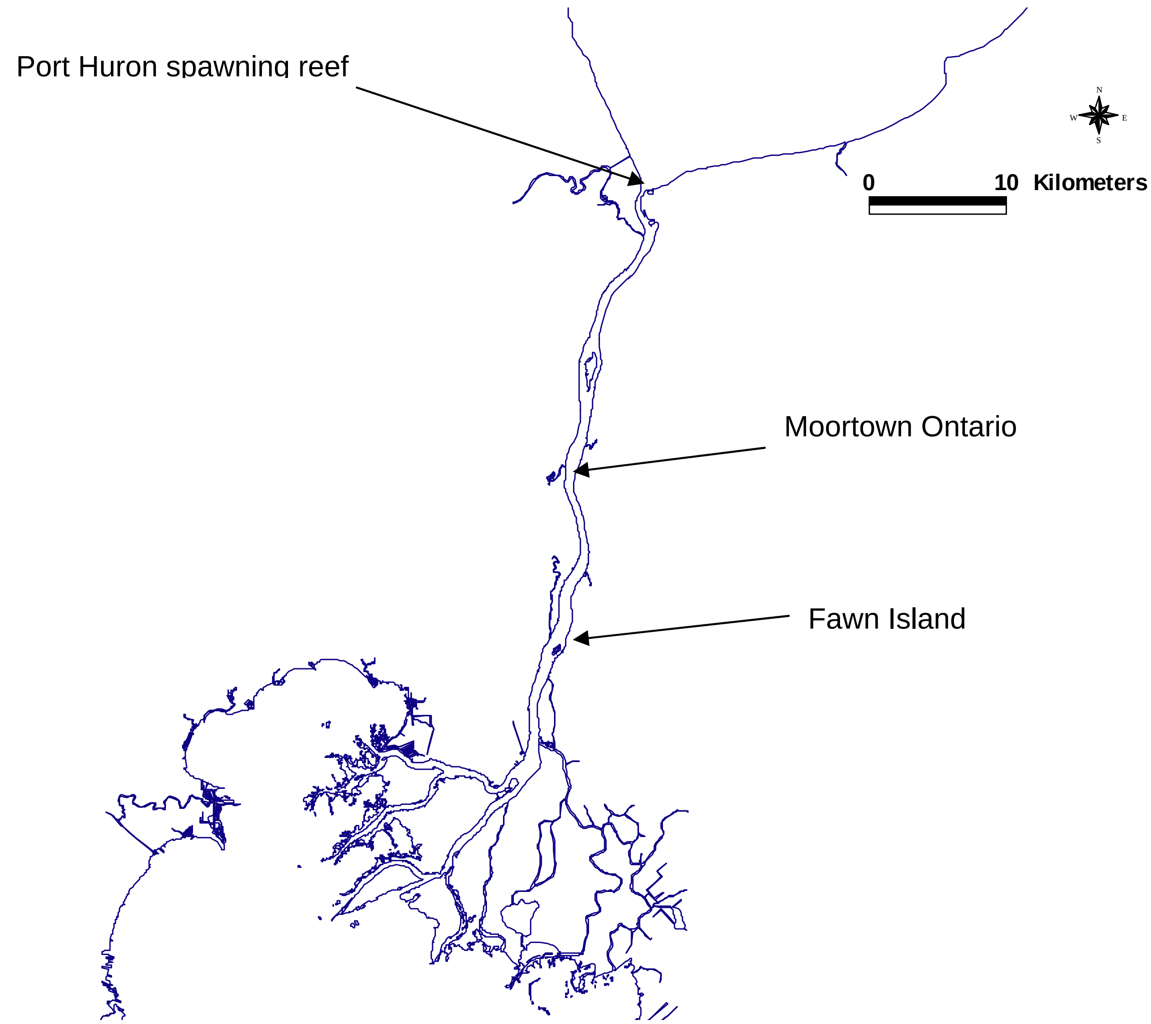

Figure 2. Location of setline sampling locations during the 2002 lake sturgeon spawning period.

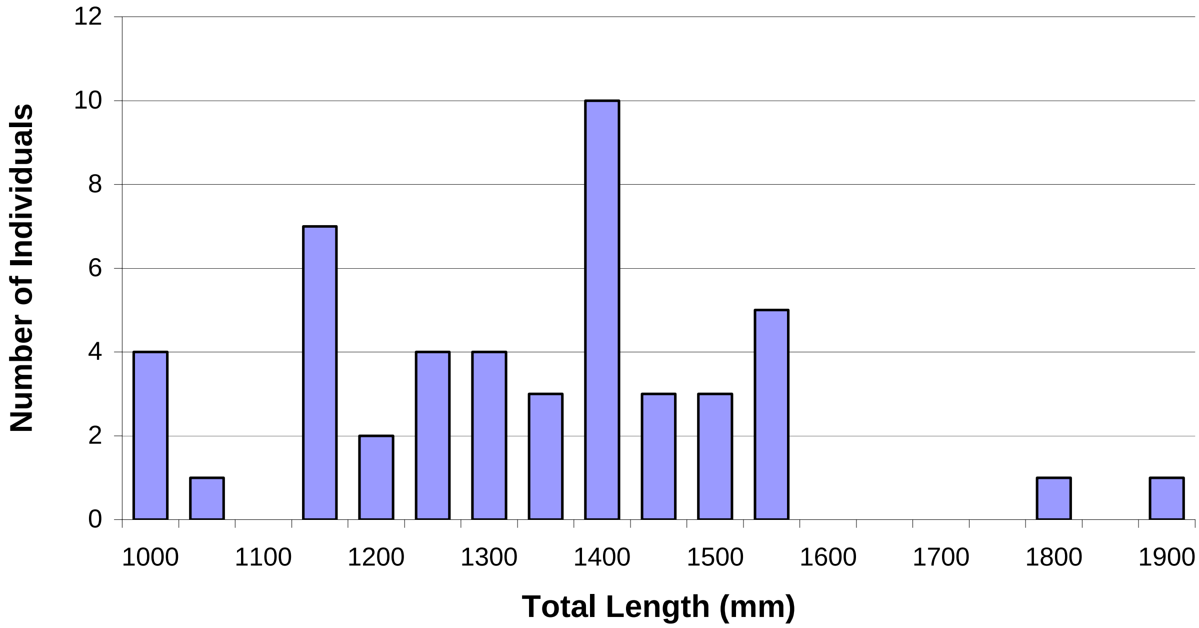

Figure 3. Length frequency distribution of lake sturgeon captured during the 2002 spawning period at the Port Huron spawning site in the upper St. Clair River.

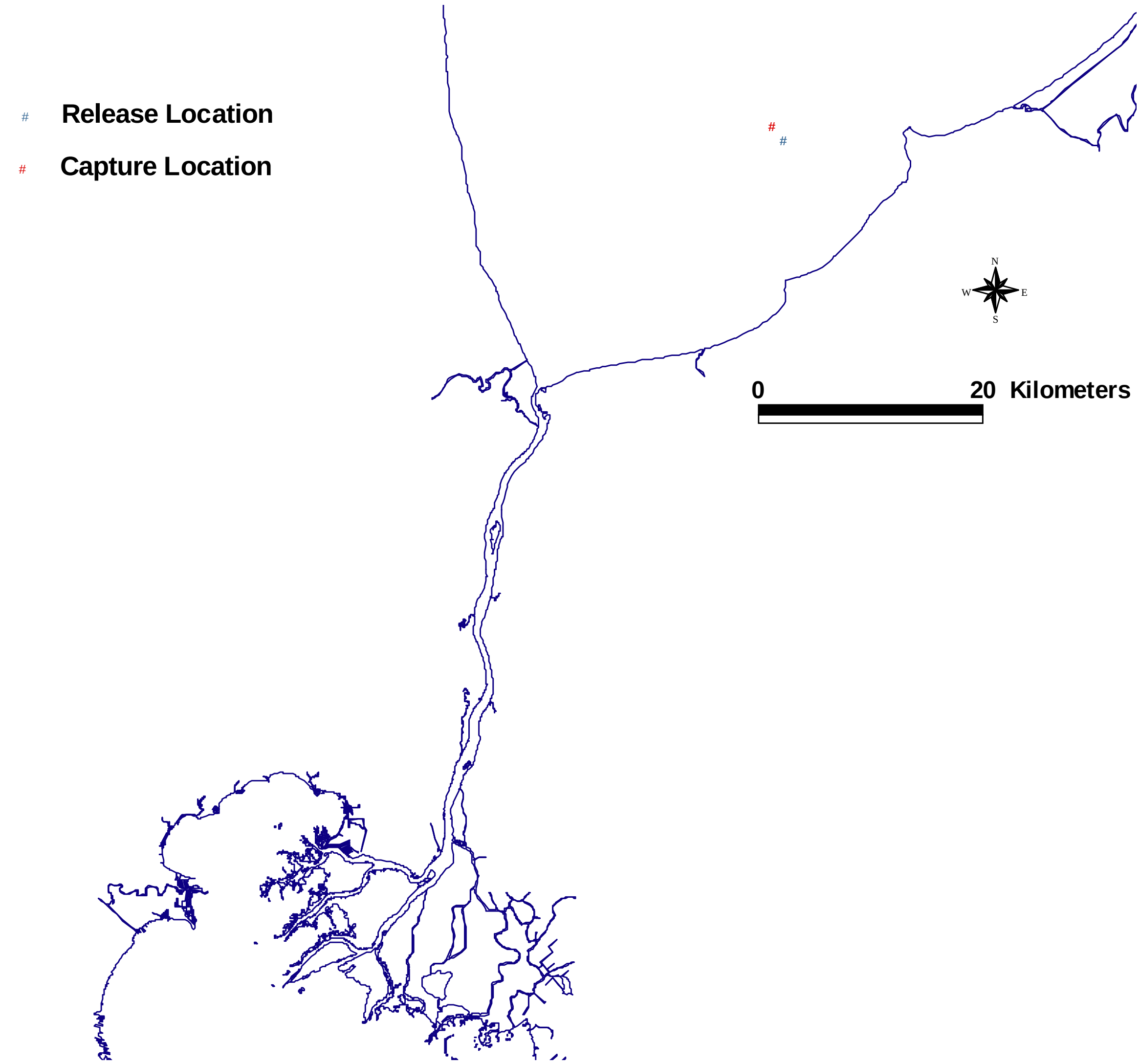

Figure 4. Location of commercial trap nets where lake sturgeon were captured on 11 June 2002 and their subsequent release locations on 15 June 2002.

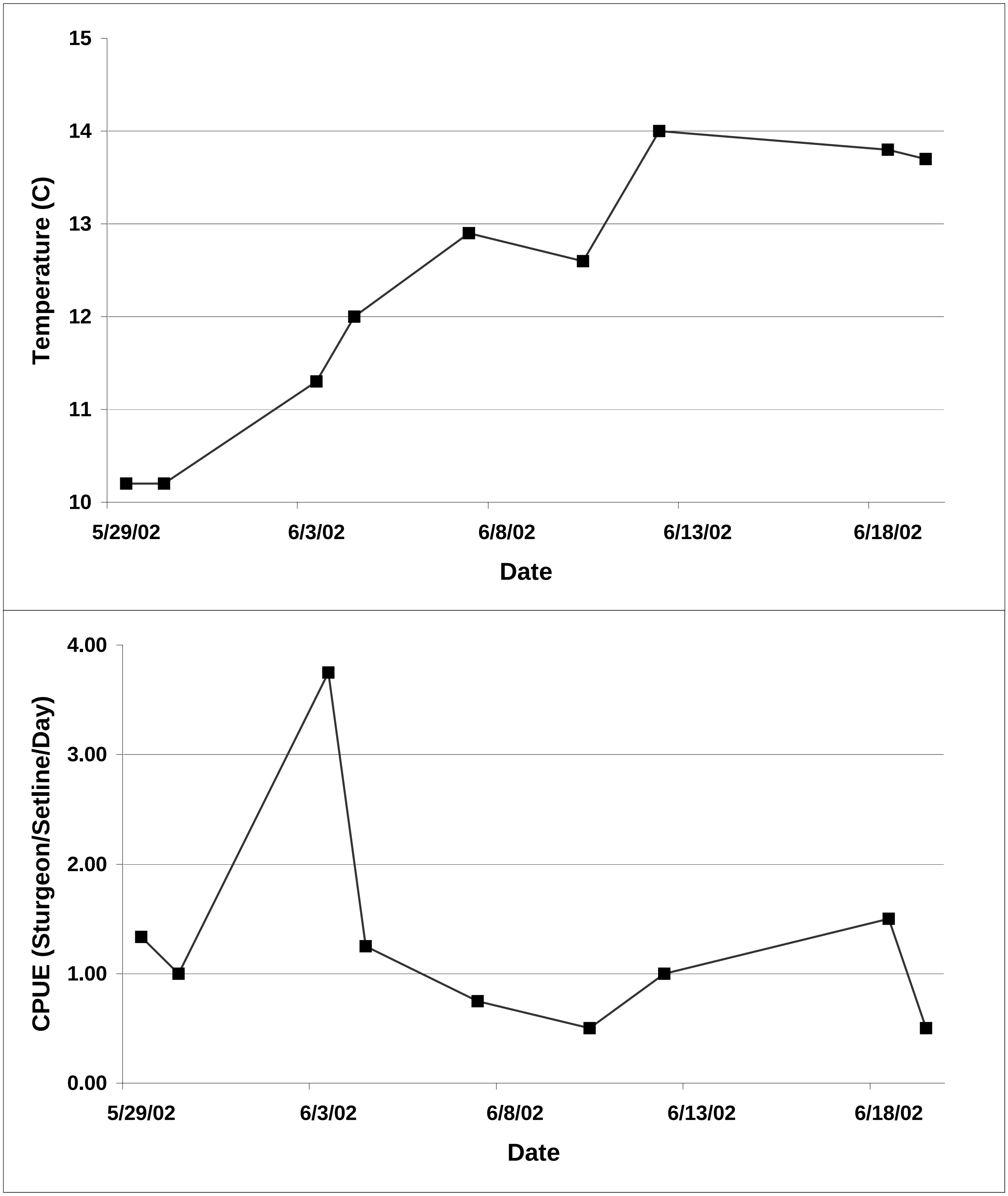

Figure 5. Lake sturgeon CPUE during the spring 2002 spawning runs at the Port Huron site and the corresponding water temperature.

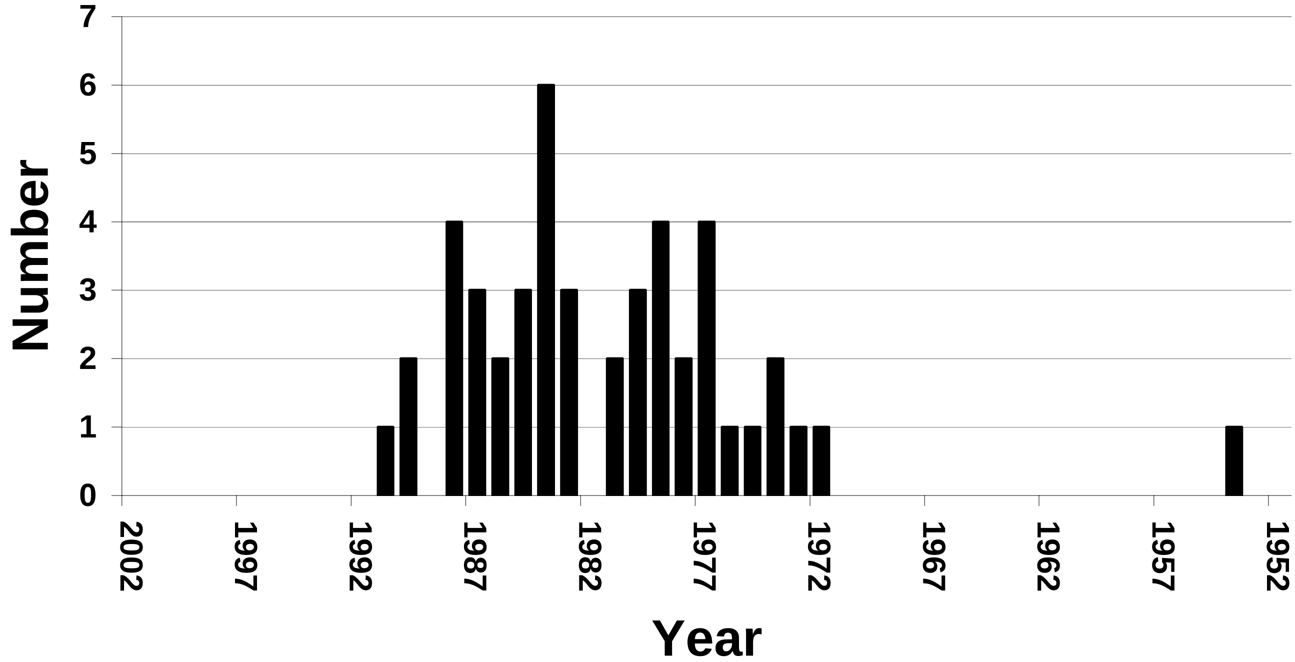

Figure 6. Age distribution of lake sturgeon captured at the Port Huron spawning site in the upper St. Clair River.

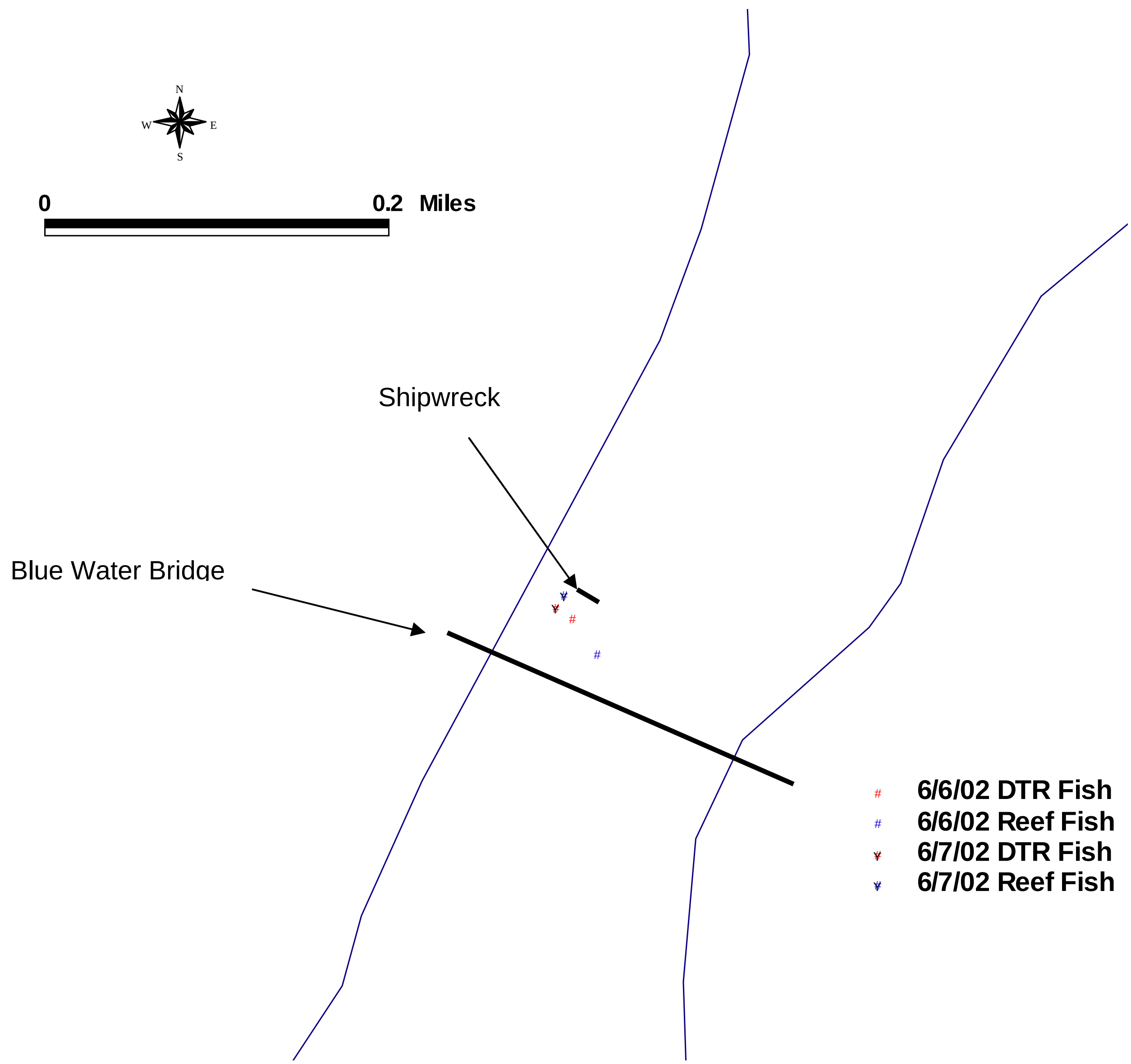

Figure 7. Locations of two lake sturgeon in the eddy behind a shipwreck in the St. Clair River, one fish was captured and implanted at the Port Huron site (Reef Fish), the other was implanted on the Detroit River (DTR Fish) in 2001.

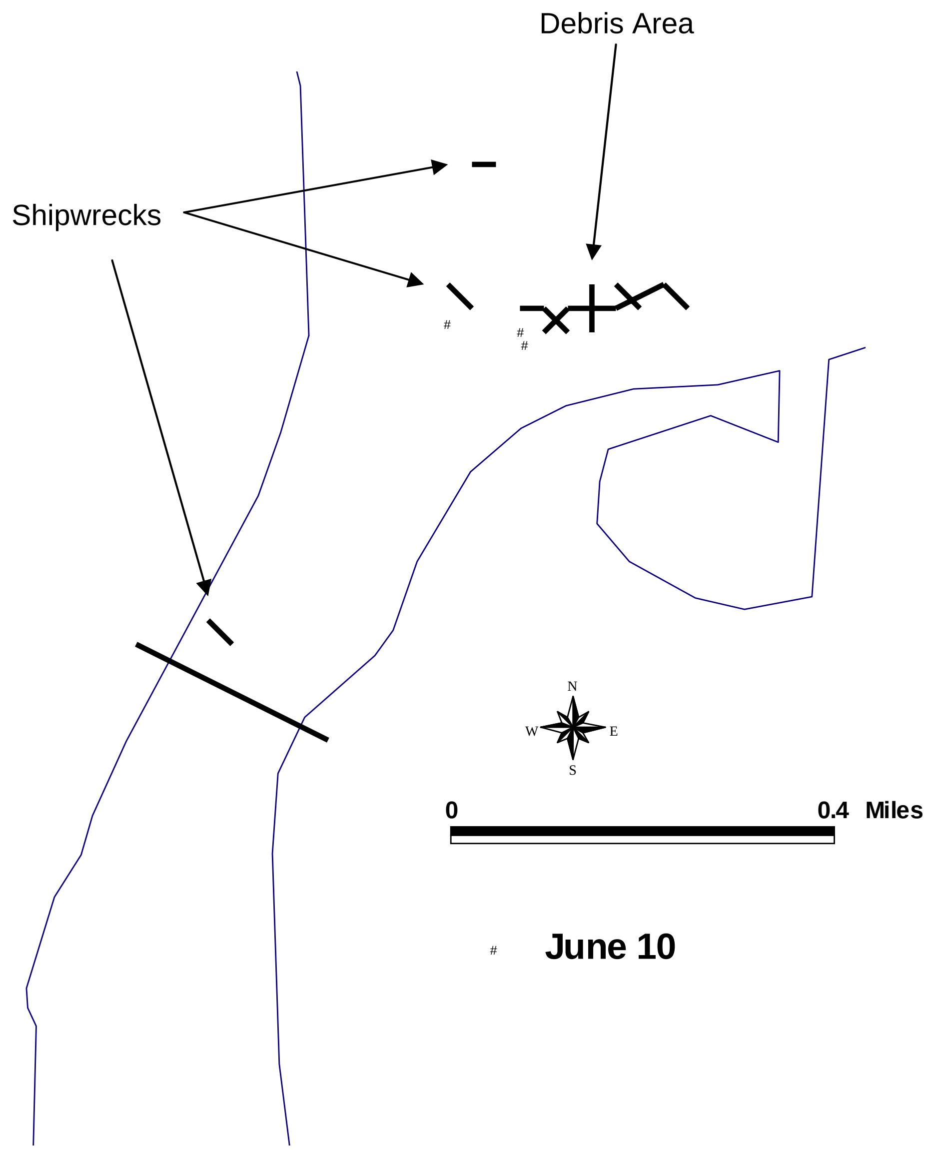

Figure 8. June 10 location of three lake sturgeon following peak spawning temperature, all fish are located in areas where the current has been reduced by underwater obstructions.

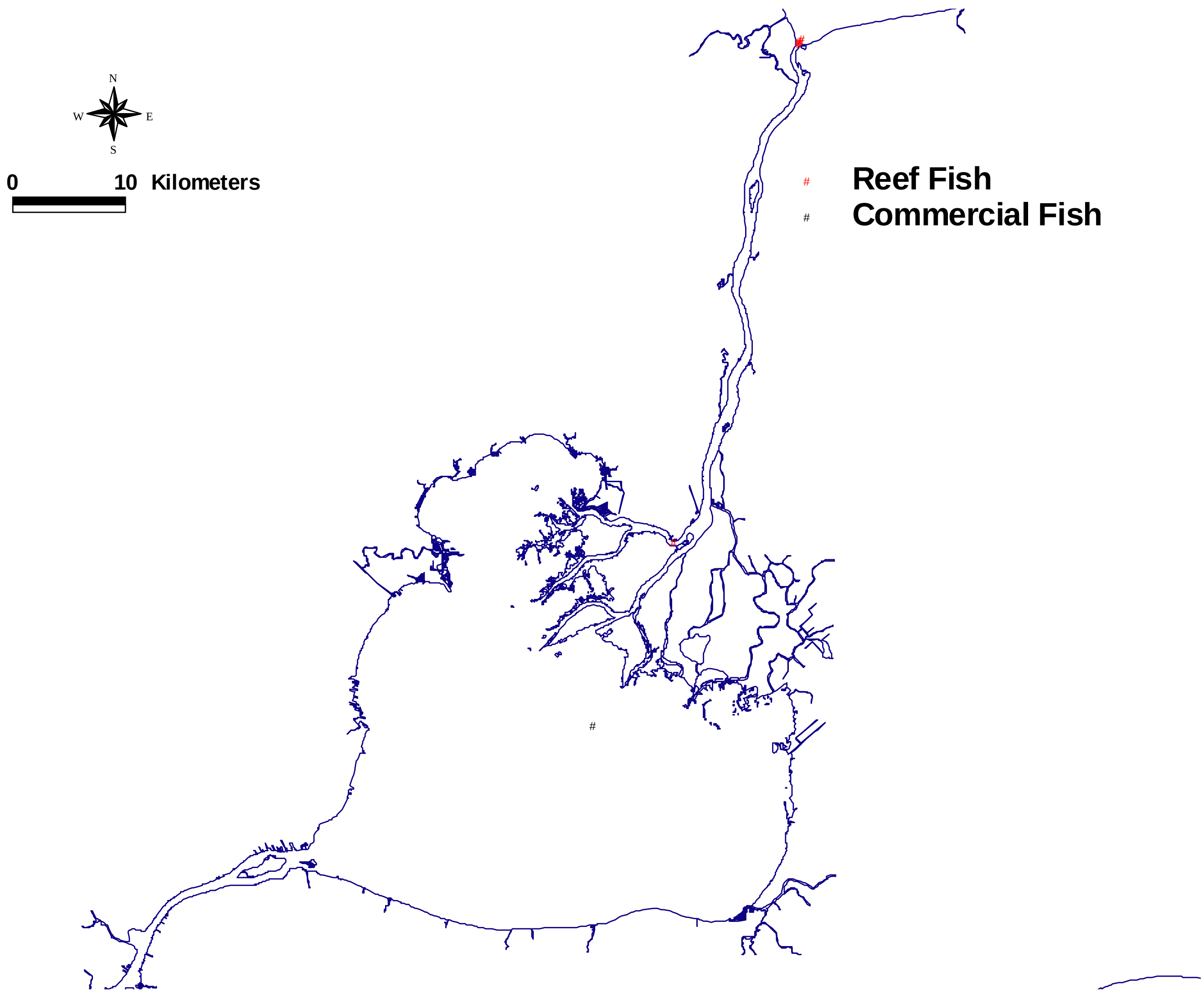

Figure 9. Location of the two lake sturgeon that moved downriver following spawning, the fish in Lake Huron (Commercial Fish) was initially captured and released approximately 25km from the Blue Water Bridge out in Lake Huron.

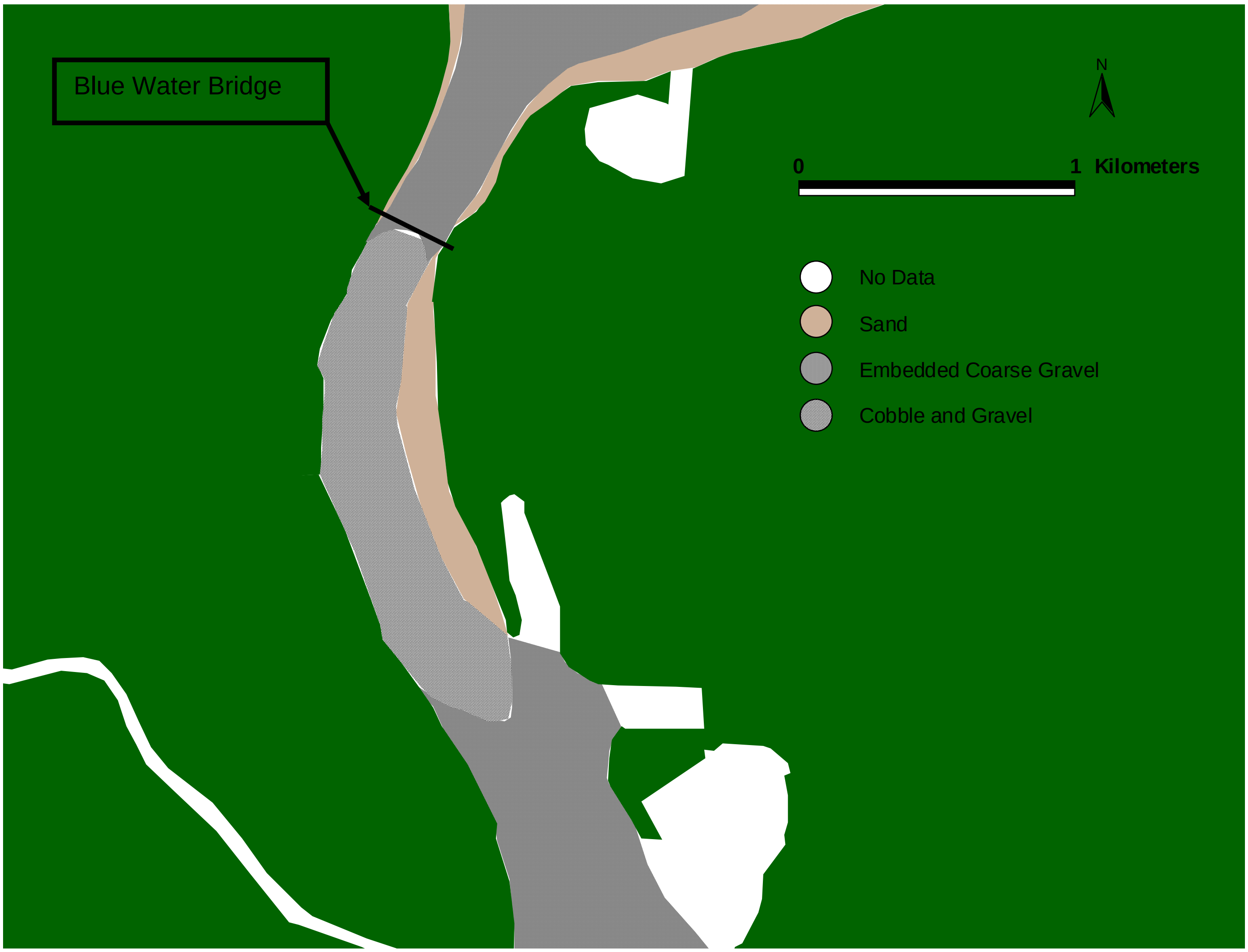

Figure 10. Spawning habitat composition and the adjacent habitats found on the upper St. Clair River near Port Huron. Cobble/gravel composition is estimated to be 59 ha.

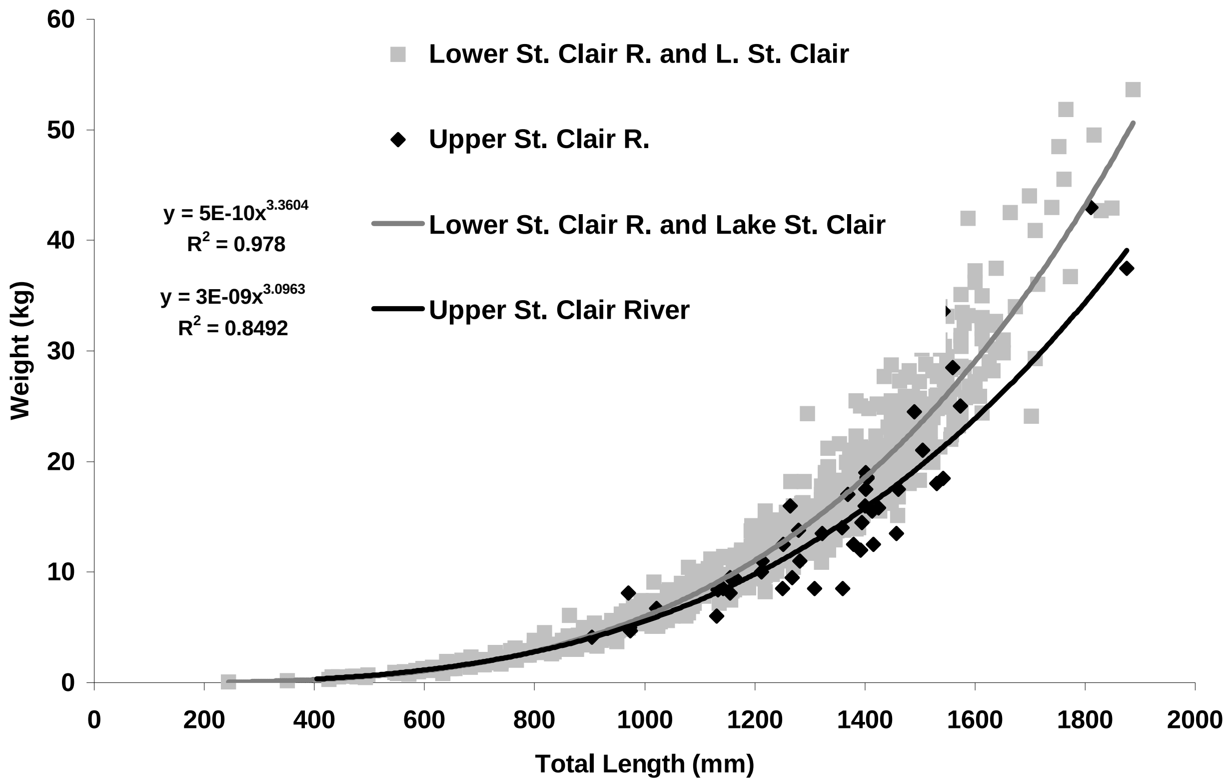

Figure 11. Comparison of length-weight relationships for lake sturgeon populations spawning in the upper St. Clair River with sturgeon from the lower St. Clair River and Lake St. Clair (M. Thomas, Michigan DNR, unpublished data)

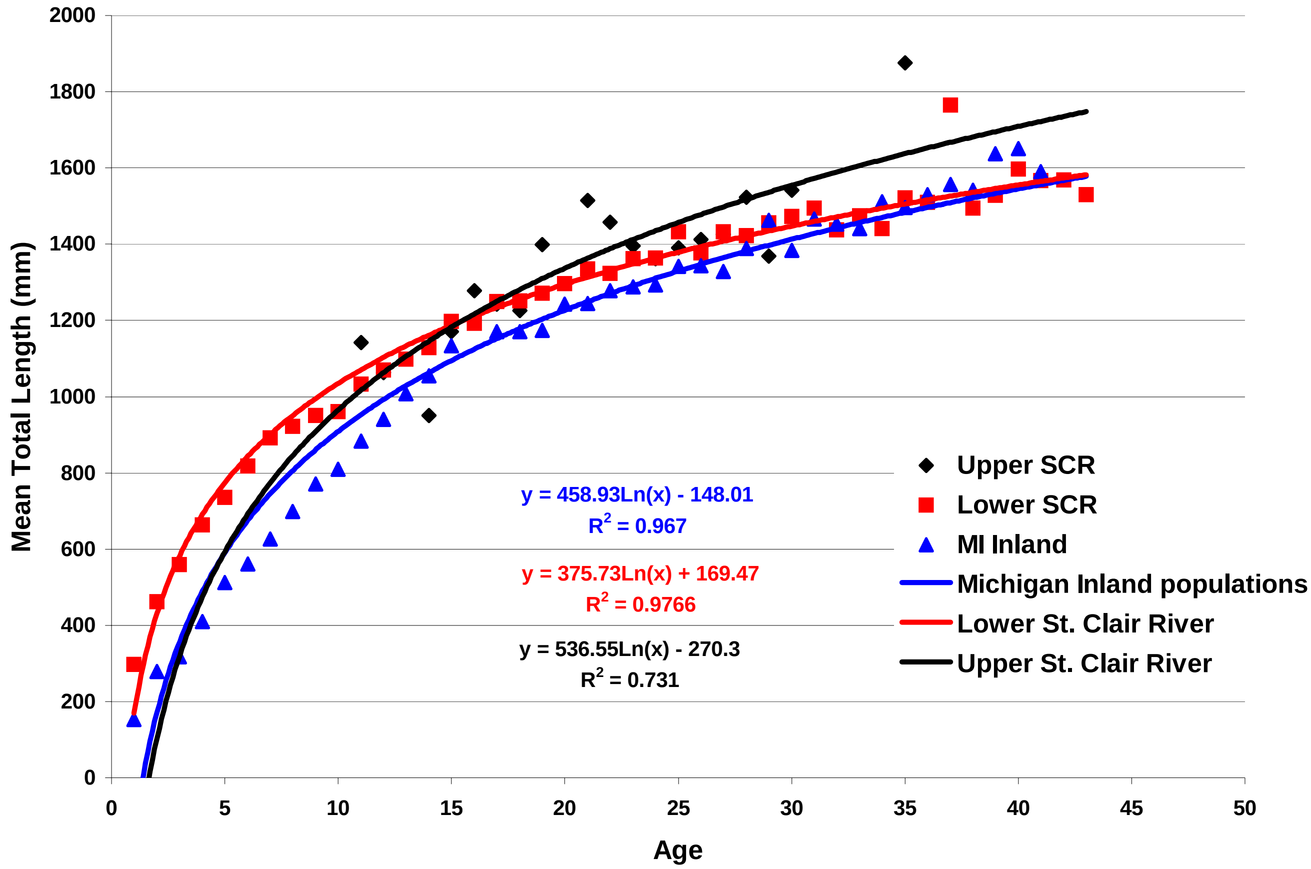

Figure 12. Comparisons of mean length-at-age data between lake sturgeon from the lower St. Clair River/Lake St. Clair, Michigan's inland lakes (Thomas and Haas 2002), and the upper St. Clair River.

Table 1. Biological and logistical information for lake sturgeon implanted near the Blue Water Bridge spawning site during the 2002 season.

Fish ID	Sex	Total Length (mm)	Weight (kg)	Age	Implantation Location	Implantation Date	Date Last Located	Number of Obs.
70 (4-4-5)	F	1461	17.5	23	USCR[a]	6/04/02	6/05/02	2
71 (7-7-7)	F	1876	37.5	35	USCR[a]	6/04/02	6/05/02	2
73 (3-4-5)	M	1490	24.5	23	USCR[a]	5/30/02	7/08/02	10
73 (15-15)	M	1404	18.5	19	USCR[a]	6/04/02	6/24/02	6
75 (3-4)	M	1457	13.5	21	USCR[a]	6/04/02	6/25/02	6
75 (8-5-5)	F	1404	18.6	25	USCR[a]	6/11/02[c]	6/11/02	1
76 (3-5-5)	F	1810	43.0	22	USCR[a]	6/05/02	6/25/02	3
78 (5-4-7)	F	1542	33.6	30	USCR[a]	6/11/02[c]	7/16/02	3
74 (3-4-7)					DTR[b]	5/01	7/15/02	1
74 (3-6-8)					DTR[b]	5/01	6/10/02	4
76 (2-5-4)					DTR[b]	5/01	7/15/02	1

Notes:
[a] USCR = Upper St. Clair River
[b] DTR = Detroit River
[c] Sturgeon captured in commercial trap nets 25 km from the Blue Water Bridge in Lake Huron.

Table 2. Summary of biological parameters collected from lake sturgeon from the upper St. Clair River spawning site.

	Age	Total Length	Weight	Girth
Mean	21.3	1134	14.8	525
Minimum	12	904	4.1	205
Maximum	48	1876	43	880
Count	47	47	47	47