

**Lake Sturgeon Assessment Assistance by Great Lakes  
Commercial Fishers  
2001-2002**

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**ABSTRACT**

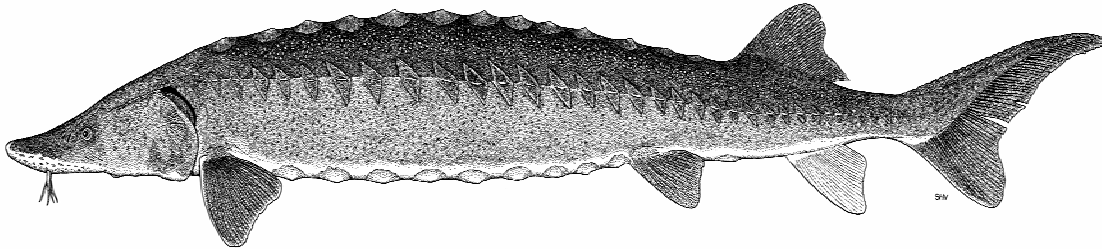
Currently there is no commercial fishing for lake sturgeon, (*Acipenser fulvescens*), in U. S. waters of the Great Lakes and sport fishing is limited. Canada allows commercial harvest from Ontario waters of Lake Huron only. Lake sturgeon is considered threatened or endangered by 19 of the 20 states within its original range in the U.S. Lake sturgeon abundance was reduced dramatically in the late 1800's by commercial overfishing and habitat degradation. The life history characteristics of lake sturgeon, late maturity and infrequent spawning after maturity, prevent populations from rebounding quickly after such catastrophes.

Fishery agencies are providing training and equipment to commercial fishers for data collection from lake sturgeon. Commercial fishers gather biological data and tag lake sturgeon incidentally caught, release the fish, and provide the data to fishery management agencies. This arrangement was initiated in Lake Huron in 1995, and has been expanded to Lakes Michigan, Superior, and Erie.

Since 1995, nearly 700 incidentally caught lake sturgeon have been encountered by commercial fishers involved in this survey. The data is used by biologists to determine the number, distribution, and movement of lake sturgeon in the Great Lakes, and to supplement current information on growth and reproduction. Through assistance of commercial fishers, agencies gather data that would not otherwise be obtained. This innovative and economical project will greatly assist lake sturgeon restoration efforts in the Great Lakes.

## INTRODUCTION

The largest indigenous fish to the Great Lakes is the lake sturgeon (*Acipenser fulvescens*) reaching lengths over 6 ft and weighing over 200 lbs. The largest on record was 7' 11" and weighed 310 lbs. Sturgeon are the oldest known taxa of fish living today, dating to the Upper Cretaceous period (136 million years ago). Lake sturgeon are relatively young for sturgeon species, and are thought to have evolved from the Mississippi River Valley sturgeon 14,000 years ago. Since that time lake sturgeon have flourished in the Great Lakes and now occupy all five of the lakes.



Native Americans have always used lake sturgeon for products such as: food, oil, and leather (Holzkamm and Wilson 1988). Holzkamm and McCarthy (1988) indicated that some Native American tribes supplied isinglass (a clarifying agent made from lake sturgeon swim bladders) to the Hudson Bay Company. By 1880, European settlers began utilizing lake sturgeon for such products as caviar, isinglass, fresh, smoked, or salted flesh, oil, fertilizer, leather, and delicacies from the brain, notochord, and belly (Prince 1905). This new demand for lake sturgeon initiated a commercial harvest that reached its peak in 1885-1889 with 15,806,100 lbs harvested, basin wide, during the five-year period. For the five-year period 1890-1994, the harvest of lake sturgeon had fallen to 1,781,316 lbs (Auer 1999).

Currently there is no commercial fishing for lake sturgeon in U. S. waters of the Great Lakes and sport fishing is very limited. Canada does allow some commercial harvest on Lake Huron and the St. Lawrence River and some sport fishing. Both are very limited. Lake sturgeon are now considered threatened or endangered by 19 of the 20 states within its original range in the U.S. (Auer 1991). The primary cause for the decline in abundance was commercial over-fishing in the late 1800's and loss of habitat due to man-made obstructions such as hydroelectric dams, which block access to spawning habitat, pollution, and sedimentation from urbanization. Lake sturgeon, as a species, cannot rebound quickly from these effects because of their life history characteristics.

Lake sturgeon spend their entire life in fresh water, unlike most other sturgeon species that spend most of their life in the ocean only entering fresh water rivers to spawn. Lake sturgeon spawn from mid-April through early June. Males and females migrate to the spawning grounds when water temperature is 10-18°C. Peak spawning temperature for lake sturgeon is 15-16°C (Kempinger 1988). The habitat characteristics of lake sturgeon spawning grounds consist of water depths ranging from 2-15 ft, with varying velocities and substrates, usually cobble or pebble substrate (Organ 1978). An ovulating female may be accompanied by two or more males. Lake sturgeon do not create redds for their eggs but rather disperse them in the current. The males fertilize the eggs as they leave the

female. The eggs then adhere to the substrate of the spawning grounds. Females produce as many as 5,000 eggs per pound of body weight. These eggs are left unguarded by the parents and fall prey to many fish species such as white sucker (*Catostomus commersoni*), other sucker species, and the exotic round goby (*Neogobius melanostomus*). Eggs hatch within 5-10 days beginning the most vulnerable stage in a lake sturgeon's life, between hatching and development of the sharp bony scutes (plates on the outside of the body). For a short time after hatching the larvae stay close to the spawning site embedded in the gravel while they absorb their yolk sac. After the yolk is absorbed the larvae drift downstream to nursery areas where they feed on invertebrates such as zooplankton. It is during these drifts that the larvae are most vulnerable (Auer 2001).

Food items are taken in by a tube like structure that extends and retracts from the underside of the snout to suck prey from the substrate. Sensitive barbells (antenna like appendages) at the end of the snout are used to locate food items. As lake sturgeon grow they feed on nymphs and larvae of aquatic insects such as midges (Chironomids), mayfly (Ephemeroptera), caddis flies (Trichoptera) and spongellaflies (Neuroptera). As they grow they move to a more diverse diet that includes crayfish, fish eggs, fishes, worms (nematodes), leeches, amphipods, decapods, and a few plants (Harkness and Dymond 1961).

Lake sturgeon do not reach sexual maturity for several years. Males reach maturity at 12-22 yrs, females reach maturity at 14-33 yrs (Roussow 1957, Harkness and Dymond 1961, Houston 1987). Males reproduce every one to three years. Females reproduce every 4-6 yrs, but can be as long as nine years (Roussow 1957). Because these fish are long lived (the oldest recorded lake sturgeon was 154 yrs), slow growing, late maturing, and do not spawn every year it is impossible for these giants of the Great Lakes to rebound quickly from over-fishing and loss of habitat. Because of their life history, efforts to restore these fish will not be recognized for many years.

#### *Lake Michigan*

The U. S. Fish and Wildlife Service- Green Bay Fishery Resources Office (Green Bay FRO) began working with commercial fishers in Lake Michigan in 1998. Many of the lake sturgeon reported here were captured as by-catch by commercial fishers. Additional lake sturgeon were collected during standardized assessments of other fish species by federal, state, and tribal agencies and consulting firms. Data also was collected from several dead lake sturgeon found by private citizens or agency biologists.

#### *Lake Superior*

Beginning in 1998, agencies working on Lake Superior began utilizing commercial fishers to obtain some basic information from this pre-historic fish species. In 1998, the Michigan Department of Natural Resources (MDNR) recruited 2 trap net fishers to tag and collect biological data from lake sturgeon caught in their nets. In 2001, both Bay Mills Indian Community (BMIC) and the U. S. Fish and Wildlife Service-Ashland Fishery Resources Office (Ashland FRO) began recruiting both trap net and gill net fishers and have a total of 8 fishers participating between the two agencies. There are a total of 7 trap net fishers and 3 gill net fishers who are actively collecting information from lake sturgeon in U.S. waters of Lake Superior.

### *Lake Huron*

The U. S. Fish and Wildlife Service- Alpena Fishery Resource Office (Alpena FRO) began monitoring lake sturgeon in Saginaw Bay of Lake Huron in 1995. Lake sturgeon became a species of concern because of the potential for federal listing and the need for a recovery plan. This report summarizes the activities from Alpena FRO for 2001 and 2002. Previous years reports can be found on the Alpena FRO web page ([www.fws.gov/midwest/alpena/index.htm](http://www.fws.gov/midwest/alpena/index.htm)) under station reports.

### *Lake Erie*

The Alpena FRO began working with a commercial fisher on Lake Erie in 1996. From 1996-1998 Gerry Penner, a Canadian commercial fisher, regularly recorded biological data and tagged lake sturgeon that were incidentally caught during his regular commercial fishing activities. This data proved to be of value to lake sturgeon studies on Lake Erie, particularly in an area where data were generally lacking. As a result, in 2001, several USFWS employees participated as crew aboard Capt. Penner's vessel, assisting in all regular fishing activities. This program has been expanded by the U. S. Fish and Wildlife Service- Lower Great Lakes Fishery Resources Office (Lower Great Lakes FRO) to include five more fishers. These five fishers carry tagging boxes on their boats and report biological data and tag information to the USFWS on an annual basis. They also collect samples for genetic analysis.

## **STUDY SITE**

Lake Michigan is a very deep, oligotrophic lake with a mean depth of 82 m and a surface area of 57,780 km<sup>2</sup>. It is connected to Lake Huron by the Straits of Mackinac, and is bordered by four states: Michigan, Wisconsin, Indiana, and Illinois. Lake Michigan is the only Great Lake located entirely in the United States (Figure 1). Most of the lake sturgeon collected from Lake Michigan during this project came from Green Bay. Green Bay is a long, relatively shallow extension of northwestern Lake Michigan, with depths of <30 m throughout most of its surface. The Green Bay watershed covers an area of 40,778 km<sup>2</sup>, approximately one-third of the entire Lake Michigan basin. The northern part of the watershed is sparsely populated, but the southern end is heavily industrialized.



Figure 1. The Great Lakes Basin includes Lakes Michigan, Superior, Huron, Erie, and Ontario.

Lake Superior is largest of the Great Lakes by surface area at approximately 82,100 sq. km. It is the largest fresh water lake in the world and it is the northern most and coldest of all the Great Lakes. The outlet for Lake Superior is the St. Mary's River which is the connecting waterway between Lake Superior and the lower Great Lakes. Lake sturgeon abundance was historically very high in Lake Superior. However, over-exploitation coupled with the damming of historic rivers utilized by this fish species as spawning habitat has reduced the population to about 1% of it's former size. In Lake Superior, very little is known about the lake sturgeon's current population size, habitat usage, and movement.

Lake Huron is the fifth-largest freshwater lake in the world. Bordered by the province of Ontario and the state of Michigan, Lake Huron averages 59 m deep with a maximum depth of 227 m and has a flushing time of about 22 years. About two-thirds of the lake's 135,454 km<sup>2</sup> watershed is still covered by forests, and the lake contains more than 30,000 islands. Lake Huron lies in the center of the Great Lakes and receives discharge from both Lakes Superior and Michigan (Eshenroder et al. 1992).

Most of the lake sturgeon collected for this study came from Saginaw Bay, Lake Huron. Saginaw Bay is the second largest bay in the Great Lakes. It is 42 km wide and is 82 km projected into the land mass (Beeton et al. 1967). It is a shallow, well-mixed extension of the western shoreline of Lake Huron. Bottom substrates in Saginaw Bay range from silt to mostly cobble and rock.

Lake Erie has the second smallest surface area (25,700 square kilometers), and is the shallowest and contains the smallest volume of the Great Lakes. Retention time is also the shortest at 2.6 years. Lake Erie is also most vulnerable to effects of urbanization and farming. These effects combined with overfishing caused near eradication of lake sturgeon in Lake Erie. Lake Erie is divided into three main basins which differ in habitat characteristics. The western basin is the shallowest (average depth 7 m) with mud, sand and vegetated habitat and the eastern basin is the deepest (maximum depth 64 m) with more rock and coldwater habitat. The only confirmed spawning areas remaining in the Lake Erie drainage are in the Detroit River-St. Clair River corridor. An increase in catches of juvenile sturgeon in the western basin of Lake Erie in recent years may be due to spawning success in the connecting waterway from Lake Huron. There are also several historical shoal and shoreline spawning sites in Lake Erie which may be contributing to recruitment and which will be critical for rehabilitation of the lake sturgeon population. Unfortunately, those sites have not been assessed recently and may be inhabited by round gobies or other egg predators.

## **METHODS**

Using trap nets, gill nets and pound nets to harvest lake whitefish, *Coregonus clupeaformis*, lake trout, *Salvelinus namaycush*, yellow perch, *Perca flavescens*, and channel catfish, *Ictalurus punctatus*, state-licensed and tribal commercial fishers sometimes catch lake sturgeon as by-catch. Canadian commercial fishers use trap nets and gill nets to catch lake whitefish, yellow perch, channel catfish, walleye, *Stizostedion*

*vitreum*, rainbow smelt, *Osmerus mordax*, white bass, *Morone chrysops*, white perch, *Morone americana* and lake sturgeon. These incidentally caught lake sturgeon are used to collect data needed to assist in preservation of the species. Additional lake sturgeon were collected during standardized assessments of other fish species by federal, state, and tribal agencies and consulting firms. Data also was collected from several dead lake sturgeon found by private citizens or agency biologists.

Total length (TL), fork length (FL), and girth were measured using a soft measuring tape or measuring board. The leading (marginal) ray of the left pectoral fin was removed from some fish to estimate age. The distal portion of the fin ray or a small piece of the caudal fin was collected for genetic analysis.

A variety of external tags were used for short-term identification of individual lake sturgeon. Floy cinch and Floy t-bar anchor tags, along with Monel self-piercing animal ear tags, are external tags that allow rapid identification of individual lake sturgeon by biologists and commercial fishers. Some lake sturgeon were also marked with PIT (passive integrated transponder) tags to allow long-term identification of individuals. These internal tags can only be detected with special PIT tag readers.

All materials necessary to collect the biotic information were provided by the USFWS (Figure 2). Abiotic data recorded for some lake sturgeon captured included: date, latitude/longitude, water depth and temperature, and bottom type. In addition, tag type, agency, and identification number of tag applied or observed (if fish was tagged) are recorded. All fish captured alive were released alive.



Figure 2. Example of equipment provided by USFWS to commercial fisherman for taking and recording data from captured lake sturgeon.

### *Lake Michigan*

To supplement incidental captures by volunteers, a contract was made with a commercial fisher to set four trap nets in waters of Green Bay where no commercial fishing is normally conducted, but where lake sturgeon were expected to be encountered. The nets were set in four locations along the west shore of Green Bay between Pensaukee and Marinette, Wisconsin, and fished continuously from 14 May to 06 July 2002. Personnel from the Green Bay FRO and the Wisconsin Department of Natural Resources (WDNR) were present when nets were checked to process any lake sturgeon captured. The presence of any fin cuts, wounds, lamprey scars, or deformities was recorded, and captured lake sturgeon were checked for and tagged with PIT and Floy (T-bar anchor) tags prior to release.

### *Lake Superior*

The area covered by commercial fishers participating in this project ranges from western Keweenaw Bay to eastern Whitefish Bay. Training for lake sturgeon data collection was provided to each of the commercial fishers and agencies participating. Onboard assistance was occasionally provided by the coordinating agencies (Ashland FRO and Bay Mills Biological Services Program).

### *Lake Huron*

To maximize the information being collected on Lake Huron lake sturgeon, the Alpena FRO has been working closely with the Ontario Ministry of Natural Resources-Lake Huron Management Unit (OMNR-LHMU). Coordination between OMNR-LHMU and the Alpena FRO resulted in standardized data collection for lake sturgeon. This coordination enhanced the chances of recovering tag information lakewide and allowed a better understanding of the seasonal movement patterns of Lake Huron lake sturgeon.

### *Lake Erie*

In 2001, Alpena FRO and Lower Great Lakes FRO personnel participated as crew on a commercial fishing vessel in western Lake Erie. Lake sturgeon data collection occurred from 16 April to 8 June 2001. Lake sturgeon were incidentally caught in monofilament gill nets in 6.3 cm to 11.4 cm mesh sizes which were set on the bottom or suspended 10 feet below the surface. Nets were pulled within three days of set. Water depths varied from 7.0 to 11.3 meters. In 2002, Lower Great Lakes FRO personnel provided five Canadian commercial fishers with tagging equipment and instructions to independently collect information from incidentally caught lake sturgeon.

## **RESULTS AND DISCUSSION**

### *Lake Michigan*

A total of 123 lake sturgeon captures have been reported from 1996-2002 (Table 1). Thirteen commercial fishers, three tribal resource agencies, Green Bay FRO and WDNR personnel, Consumers Energy, and several private citizens have provided data included in this report. Approximately 60% of the fish collected came from Green Bay (Table 2). Most of the other samples came from four locations: Grand Traverse Bay (MI), Little Traverse Bay (MI), Door County (WI), and east-central Lake Michigan (near Ludington and Manistee, MI).

Total length of captured lake sturgeon ranged from 28 to 213 cm, and pectoral spine samples revealed ages between 2 and 61 years. No dominant size class was apparent (Figure 3) and lake sturgeon less than thirty years old were well represented in the collection (Figure 4). Only two of the lake sturgeon whose ages were determined were older than 30 years. While these data suggest a fairly young population, the ages of most of the larger (>170 cm total length) sturgeon are unknown. In addition, large sturgeon are not as vulnerable to the gear types commonly used by commercial fishers and fishery assessment crews.

Table 1. Number of lake sturgeon captures by participating commercial fishers, agencies, and other volunteers since 1996. (GTB = Grand Traverse Band of Ottawa and Chippewa Indians, LTBB = Little Traverse Bay Band of Odawa Indians, LRB = Little River Band of Ottawa Indians, USFWS = Green Bay FRO, WDNR = Wisconsin Department of Natural Resources, LWF = lake whitefish, YEP = yellow perch, LAT = lake trout, CHS = chinook salmon, LAC = lake chub, RUE = ruffe, and LAS = lake sturgeon)

Collector	Gear (Target Species)	Number of Samples
Bob Benson (WI commercial fisher)	Gill Net (LWF)	1
Val Drzewiecki (WI commercial fisher)	Gill Net (YEP)	1
Hickey Brothers (WI commercial fisher)	Pound Net (LWF)	6
Hickey Brothers (WI commercial fisher)	Trap Net (LWF)	2
Rick Johnson (WI commercial fisher)	Gill Net (LWF)	1
Rick Johnson (WI commercial fisher)	Trap Net (LWF)	1
Neil Teskie (WI commercial fisher)	Trap Net (LWF)	2
Jeff Weborg (WI commercial fisher)	Trap Net (LWF)	1
Greg Ruleau (MI commercial fisher)	Trap Net (LWF)	10
GTB Natural Resources Department	Unknown	2
Monte Carew (GTB commercial fisher)	Gill Net (LWF)	1
George Duhamel (GTB commercial fisher)	Gill Net (LAT)	3
William Fowler (GTB commercial fisher)	Gill Net (LAT)	3
William Fowler (GTB commercial fisher)	Gill Net (LWF)	2
Stuart Schwander (GTB commercial fisher)	Trap Net (LWF)	1
LTBB Natural Resources Department	Gill Net (CHS)	6
John Keshick (LTBB commercial fisher)	Gill Net (LWF)	6
Darren Mitchell (LRB commercial fisher)	Gill Net (LAC)	1
Darren Mitchell (LRB commercial fisher)	Trap Net (LWF)	1
Corey Kroesing (sport fisher)	Hook & Line (CHS)	1
Private Citizens	Found Dead	6 <sup>1</sup>
Consumers Energy	Graded-mesh Gill Net	9 <sup>2</sup>
USFWS	Trawl (RUE)	1
USFWS/WDNR	Trap Net (LAS)	51 <sup>3</sup>
WDNR	Found Dead	2
WDNR	Trawl (YEP)	1

<sup>1</sup> Dead fish found along the shore of Green Bay and reported by private citizens

<sup>2</sup> Fish captured in assessment gill nets near Ludington Pump Storage Facility

<sup>3</sup> Targeted lake sturgeon assessment in Green Bay (May-July 2002)



Table 2. Summary of total length and age data for lake sturgeon captured in Lake Michigan.

	Green Bay Trap Net Assessment <sup>1</sup>	Green Bay Volunteer Samples <sup>2</sup>	Lake Michigan Volunteer Samples <sup>2</sup>
Number of Fish	50	23	47
Mean Total Length (cm)	124.4	119.7	108.5
Total Length Range (cm)	60.7 - 200.7	28.1 – 208.3	38.2 – 213.4
Age Range <sup>3</sup>	4 – 61	9-27	2-35

<sup>1</sup> Targeted lake sturgeon assessment conducted during May-July 2002 in collaboration with Hickey Brothers commercial fishing business

<sup>2</sup> Includes all incidental captures and dead sturgeon found by private citizens

<sup>3</sup> Age was not determined for all lake sturgeon captured.

Individual lake sturgeon from Lake Michigan appear to be growing more rapidly than sturgeon from other populations in the Great Lakes region (Figure 5). This rate of growth may not be representative for lake sturgeon throughout Lake Michigan, because most of the fish included in this analysis came from the shallow productive waters of Green Bay.

Although total length and maximum girth generally were recorded, weight is unknown for many of the lake sturgeon reported by volunteers. Estimates of weight based on total length alone are imprecise, particularly for larger fish (Figure 6), thus, the girth measurements recorded by volunteers are essential for accurate weight estimation. Using data from 107 lake sturgeon captured during targeted assessments in Green Bay and surrounding tributaries, an equation was developed to estimate the weight of a lake sturgeon from its total length and maximum girth. The equation is

$$\text{Weight} = \log(\text{total length}) \times 1.6543 + \log(\text{girth}) \times 1.4003 - 4.7564$$

where weight is in kg and total length and girth are in cm. This equation fit the observed measurements very well (R-squared = 0.97).

Six lake sturgeon were captured on more than one occasion (Table 3). Two were recaptured near the original tagging location, while two other fish tagged in Green Bay tributaries (Fox and Menominee rivers) were later recaptured in Lake Michigan. The longest movement observed was for fish # 96-10-22-01. This fish was tagged in southern Lake Huron and recaptured in Baileys Harbor (Door County, WI) over two years later.

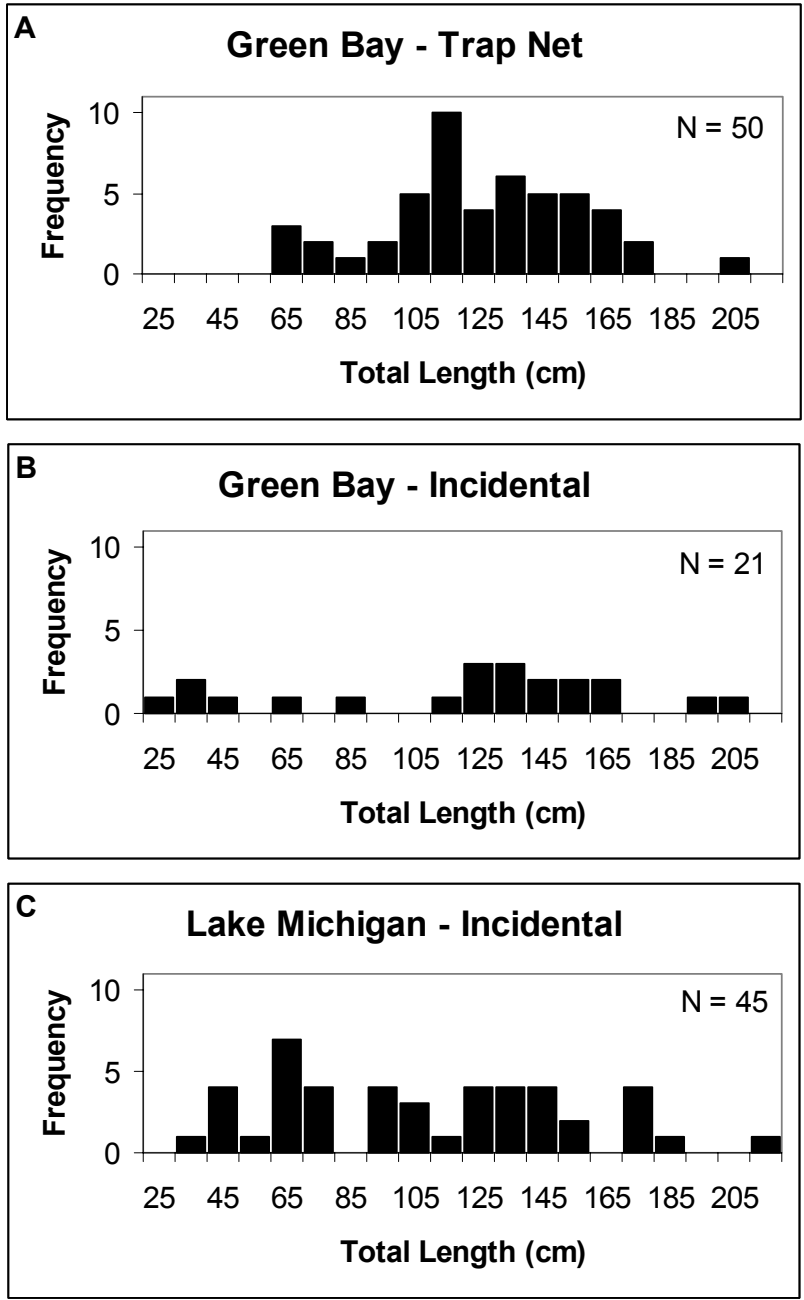


Figure 3. Length-frequency distributions for (A) lake sturgeon captured during the lake sturgeon trap net assessment in Green Bay, May-June 2002, (B) lake sturgeon captured incidentally and dead fish found by private citizens in Green Bay, 2001-2002, and (C) lake sturgeon captured incidentally in Lake Michigan, 1996-2002.

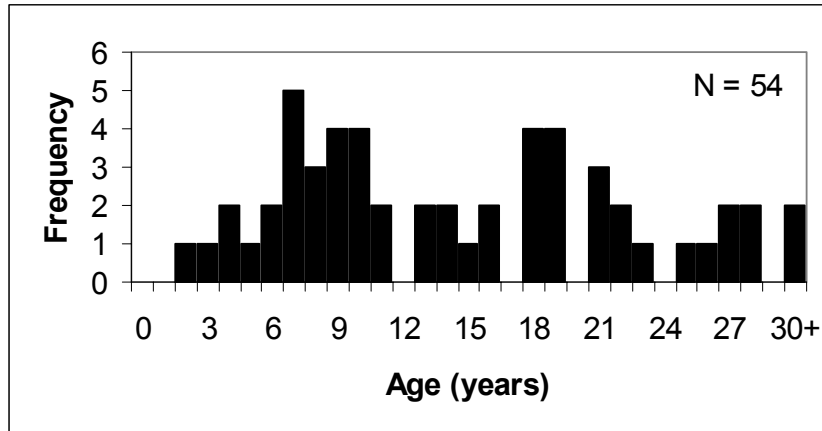


Figure 4. Age structure of lake sturgeon collected in Lake Michigan (including Green Bay) as determined by pectoral fin ray samples, 1996-2002.

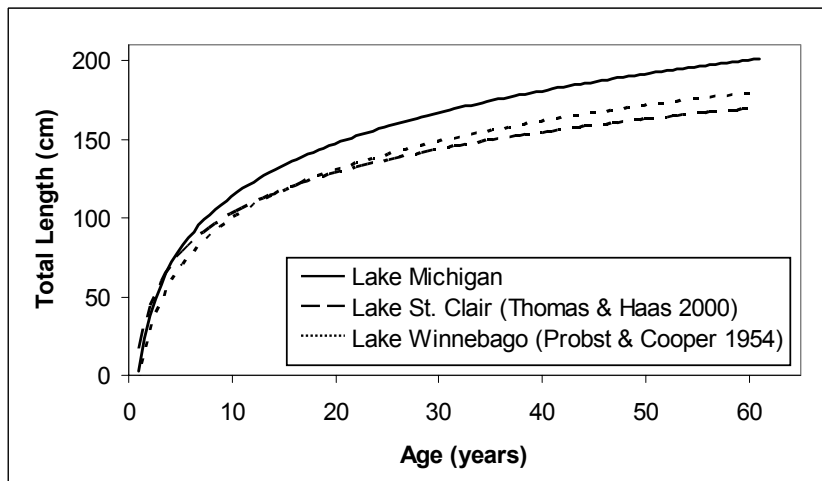


Figure 5. Growth rates of lake sturgeon from Lake Michigan (present study; 1996-2002), Lake St. Clair (Michigan), and Lake Winnebago (Wisconsin).

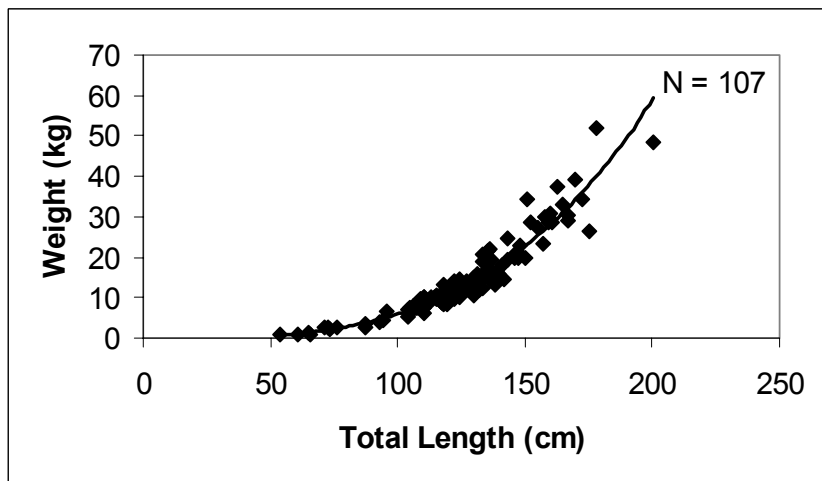


Figure 6. Relationship between total length and weight for lake sturgeon captured in Green Bay and surrounding tributaries during April-July, 2002.

Incidental catch-per-unit-effort (CPUE) of lake sturgeon is typically very low (Table 4). For example, a commercial fisher operating out of Little Traverse Bay caught only five sturgeon in 792,200 feet of gill net effort. This low CPUE is probably representative of most commercial fishing operations targeting lake whitefish for two reasons. First, the gill nets used for catching whitefish are size-selective and are not designed to capture large lake sturgeon. Second, commercial fishers targeting lake whitefish generally set their nets in deep (depth >20 m) water, whereas lake sturgeon spend most of their time in shallow water (Harkness and Dymond 1961; Figure 7). The trap nets used during the targeted assessment in Green Bay were deployed in  $\leq 17$  m of water and, thus, were more likely to be encountered by lake sturgeon. Trap nets also are less size-selective than gill nets, and lake sturgeon of a variety of sizes were collected during the assessment (Figure 1). Although lake sturgeon were not targeted, LTBB personnel had a high CPUE (1.00 fish/1000 ft) during their salmon assessments. These assessments involved setting large-mesh gill nets in relatively shallow water (around 7 m) and, thus, were similar to many targeted lake sturgeon assessments. Overall, depths at lake sturgeon capture locations ranged from 1.8 to 115.8 m.

Table 3. Summary of lake sturgeon recapture information for 1998-2002. (TL = total length, WDNR = Wisconsin Department of Natural Resources, USFWS = United States Fish and Wildlife Service, OMNR = Ontario Ministry of Natural Resources, GTB = Grand Traverse Band of Ottawa and Chippewa Indians, and LTBB = Little Traverse Bay Band of Odawa Indians)

Fish #	Date Tagged	Date Recap.	Tagging Location	Recapture Location	TL (cm) at Tagging	TL (cm) at Recapture	Tagging Fisher	Recap. Fisher
91-07-17-01	7/17/91	7/3/98	Menominee River	North Bay	134.6	149.9	WDNR	Hickey Bros. & USFWS
96-10-22-01	10/22/96	4/6/99	Southern Lake Huron	Baileys Harbor	91.0	134.6	OMNR	Hickey Bros.
98-10-14-01	10/14/98	8/22/99	Grand Traverse Bay	Grand Traverse Bay	175.9	---	GTB	C. Kroesing & GTB
00-06-08-01	6/8/00	5/16/01	Grand Traverse Bay	Little Traverse Bay	66.2	---	GTB	LTBB
02-05-19-102	5/19/02	7/6/02	Green Bay	Green Bay	155.0	---	WDNR & USFWS	WDNR & USFWS
00-04-27-16	4/27/00	7/27/02	Fox River	Green Bay	157.5	163.8	USFWS	M. Evans & USFWS

Table 4. Catch-per-unit-effort (CPUE) of lake sturgeon collected in various gear types. (GN = gill net, LTBB = Little Traverse Bay Band of Odawa Indians, LWF = lake whitefish, LAS = lake sturgeon, CHS = chinook salmon)

Collector	Location	Gear (Target Species)	Effort	Catch	CPUE	Sampling Period
commercial fisher	Little Traverse Bay	4.5" GN (LWF)	792,200 ft	5	0.006	2001-2002
Consumers Energy	Ludington Pump Storage Facility	Graded-Mesh GN	55,800 ft	6	0.108	2001-2002
LTBB	Little Traverse Bay	8" GN (CHS)	5,000 ft	5	1.00	2001-2002
USFWS/Hickey Bros.	Green Bay	Trap Net (LAS)	198 lifts*	51	0.258	May-July 2002

\* Lead was 1000 ft long by 20-25 ft deep

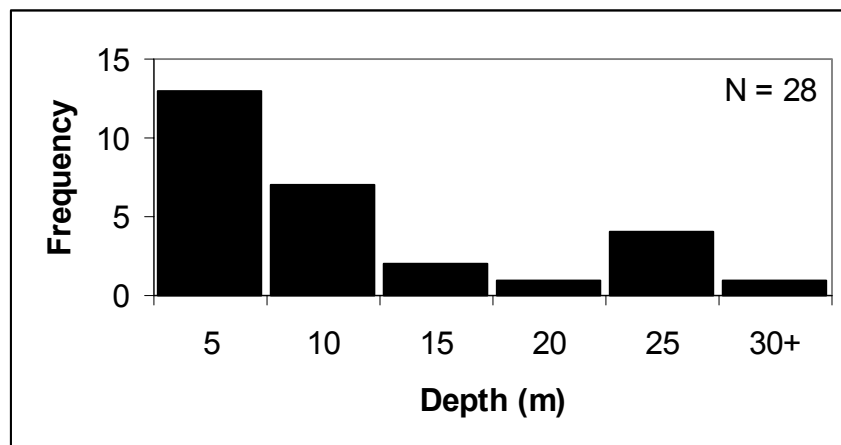


Figure 7. Distribution of lake sturgeon captures by water depth for incidental captures by volunteer commercial fishers, agency assessment crews, and consulting firms (1996-2002).

Lake sturgeon captures by commercial fishers were most common during the month of October (Figure 8). This phenomenon likely has more to do with the behavior of commercial fishers than the behavior of lake sturgeon, as this is the time of year when fishers targeting lake whitefish move their nets into shallower water.

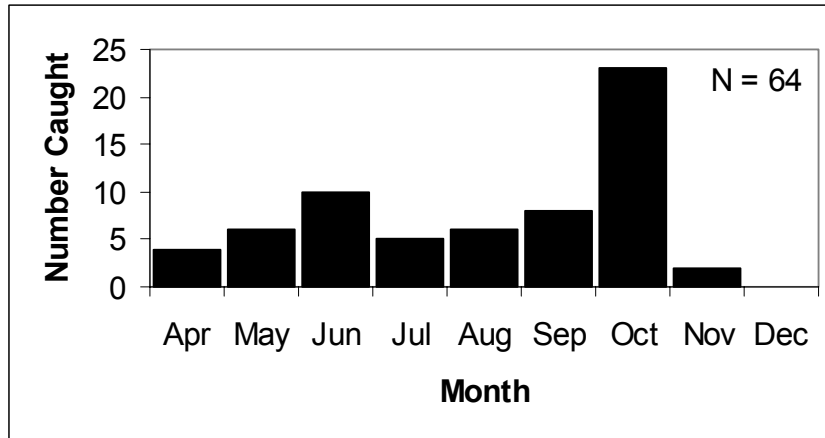


Figure 8. Number of incidental lake sturgeon captures by volunteer commercial fishers, agency assessment crews, and consulting firms by month, 1996-2002.

In recent years, a number of factors have reduced the ability of the Lake Michigan volunteer commercial fishers program to provide lake sturgeon data and samples. Beginning in 2001, commercial fisheries for yellow perch were closed throughout most of Lake Michigan, and the quota was reduced by 90% in Green Bay. Perch nets are generally set in shallow water, so perch fishers are more likely to encounter lake sturgeon. Incidental captures of sturgeon also may have decreased because of a change in lake whitefish distribution. Until recently, commercial whitefish fishers expended considerable effort in shallow water areas during the spring and fall. Currently, perhaps because of increased water clarity and changing food distribution, lake whitefish are spending less time in shallow water. In response, commercial fishers have shifted lake whitefish effort to deeper water and away from areas that are home to lake sturgeon.

High CPUE of sturgeon in some areas (e.g. Green Bay) is likely associated with proximity to spawning sites. Though river of origin may be inferred for lake sturgeon captured near known spawning tributaries, many lake sturgeon were captured in locations far from known spawning sites. In the near future, genetic analyses should allow determination of river of origin for most lake sturgeon captured in the open waters of Lake Michigan. Tissue samples have been collected from 100 of the 119 lake sturgeon captured during this project. In addition, tissue samples have been (and continue to be) collected from sturgeon captured during spawning runs in several Lake Michigan tributaries, which should allow characterization of the genetic structuring of these spawning populations. The genetic analyses of are being performed by Dr. Kim Scribner and graduate student Pat DeHaan at Michigan State University.

During late July-August 2002, six dead lake sturgeon were found by private citizens in the vicinity of Sturgeon Bay, WI. One of these fish had contusions on its head, indicating that it probably had been hit by a boat. The cause of death was not obvious for the rest of the fish. A necropsy was performed on one of the lake sturgeon by WDNR personnel. Although the findings were not conclusive, the suspected cause of death was botulism. It is not known if an unusually high number of sturgeon were dying during this period, or if the increase in reports was simply due to heightened public awareness of lake sturgeon in the area.

*Lake Superior*

Since initiation of this project, 51 lake sturgeon have been captured by fishers cooperating in the project. MDNR, Ashland FRO and BMIC have data from 21, 16, and 14 fish respectively (Table 5, BMIC and USFWS data). Of the 51 fish sampled only one fish was recaptured. This fish was first encountered on July 8, 2001 just west of Whitefish Point and was then re-captured on May 5, 2002 in Whitefish Bay. The range of total length for all the sturgeon captured is 52-167.5 cm (mean 105 cm, Figure 9). Most of these fish are sub-adult fish. The two months with the most frequent occurrence of sturgeon are May and October. This is primarily due to the fact that whitefish tend to be shallow at these times of the year and the fishermen move shallow to maximize whitefish catches. Water depth where sturgeon were captured range from 15-150 ft. with most fish being captured in 50 ft. or less.

Table 5. Biological and tag data from Bay Mills Indian Community and Ashland FRO from lake sturgeon caught on Lake Superior, 2001-2002.

Date	Grid	Gear	Bottom Type	Depth (ft)	TL (cm)	Girth (cm)	Tag Number	Recapture	Agency
7/8/2001	1443	TN	Sandy	25	133	49	51	No	Bay Mills
9/18/2001	1323	GN	na	30	73	23.5	501	No	USFWS
9/20/2001	1323	GN	na	22	103	38	502	No	USFWS
9/20/2001	1323	GN	na	15	72	23	503	No	USFWS
12/1/2001	1323	TN	na	50	167.5	71	na	na	USFWS
12/3/2001	1224	GN	na	20	63	24.5	504	No	USFWS
12/3/2001	1224	GN	na	20	61.5	23.5	505	No	USFWS
12/3/2001	1224	GN	na	20	68	25	506	No	USFWS
12/3/2001	1224	GN	na	20	66	22	507	No	USFWS
12/3/2001	1224	GN	na	20	52	21	508	No	USFWS
12/3/2001	1224	GN	na	20	57	20	509	No	USFWS
5/9/2002	1441	TN	Sandy	30	157	61	25	No	Bay Mills
5/11/2002	1544	TN	Sandy	150	135	53	51	Yes	Bay Mills
5/29/2002	1544	TN	Sandy	150	127	51	24	No	Bay Mills
9/18/2002	1224	TN	na	46	79	27	526	No	USFWS
9/24/2002	1444	TN	Sandy	20	135	48	23	No	Bay Mills
9/30/2002	1544	TN	Sandy	16	114	46	20	No	Bay Mills
9/30/2002	1544	TN	Sandy	19	155	53	22	No	Bay Mills
10/3/2002	1224	GN	na	na	81	29	951	No	USFWS
10/3/2002	1224	GN	na	na	59	22	952	No	USFWS
10/7/2002	1444	TN	Sandy	50	122	49.5	19	No	Bay Mills
10/7/2002	1444	TN	Sandy	26	119	43	18	No	Bay Mills
10/7/2002	1544	TN	Sandy	15	117	38	17	No	Bay Mills
10/9/2002	1444	TN	Sandy	19	107	39	16	No	Bay Mills
10/9/2002	1444	TN	Sandy	26	97	33	15	No	Bay Mills
10/9/2002	1224	TN	na	45	161	63	na	No	USFWS
10/9/2002	1224	TN	na	45	142	54	954	No	USFWS
10/14/2002	1444	TN	Sandy	16	99	37	13	No	Bay Mills
10/21/2002	1224	TN	na	45	105	37	527	No	USFWS
10/22/2002	1544	TN	Sandy	17	132	52	11	No	Bay Mills

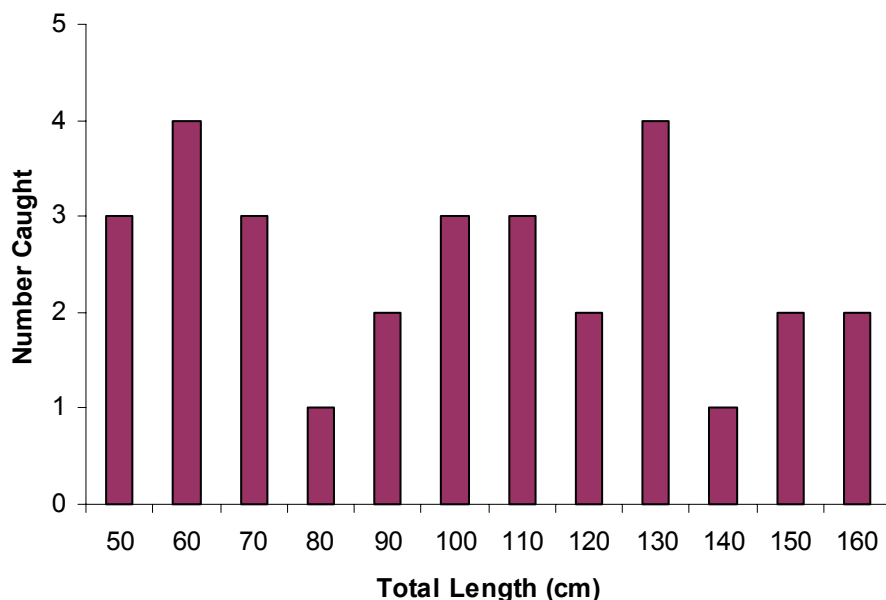


Figure 9. Length frequency classes for incidentally caught lake sturgeon in Lake Superior, 2001-2002.

First year (2001) was a successful start and we anticipate this program growing in participation in 2002 and future years. Without the help of commercial fishers this information would be quite difficult to obtain because of our budget and workload constraints. The data being collected will provide biologists with baseline information. The effort of commercial fishers will improve information on movement patterns, length at age estimates, growth and stock assessment from genetic analysis. This will allow biologists to determine if we have genetically unique stocks of fish across the lake or we have a population of fish that intermix on a more regular basis.

#### *Lake Huron*

Since 1995, 359 lake sturgeon have been captured from Michigan waters of Lake Huron. This would not have been possible without the assistance of commercial fishers (Table 6). During the 2001 fishing season, lake sturgeon were most frequently caught during the months of May and October. Figure 10 illustrates the months lake sturgeon were most frequently caught from 1995-2002.

The mean total length (TL) for lake sturgeon caught in 2001 was 114 cm, the smallest TL was 53 cm, and the largest TL was 191 cm. The mean girth was 45 cm, the smallest girth was 15 cm, and the largest girth was 83 cm. For lake sturgeon caught in 2002, mean total length was 115 cm (range 46 to 200 cm), and mean girth was 45 cm (range 14 to 109 cm). Lake sturgeon collected in 2001 and 2002 were consistent in size with previous years (Table 7). Lake sturgeon most frequently caught were in the 100 cm range in 2001 (Figure 11) and the 120 cm range in 2002 (Figure 12). Lake sturgeon in the 110 cm range were the most frequently caught overall (Figure 13). Lake sturgeon of length 90-110 cm are usually sexually immature for both sexes and average 11 yrs old.



Table 6. Number of lake sturgeon caught by Lake Huron commercial fisherman assisting with data collection since 1995.

Fisher	1995	1996	1997	1998	1999	2000	2001	2002	Total
Barbeaux		1	7	0	0	0	7	0	15
Bay Port Fish Company	13	7	10	8	12	3	2	0	55
Beardsley Fishery			0	0	0	0	1	0	1
Cedarville Fishery			1	7	9	4	7	2	30
Gauthier-Spaulling Fishery	2	0	2	2	4	1	0	0	11
Kuhl Fishery					1	0	2	1	4
Lentz Fishery	3	8	8	9	10	6	7	14	65
M & W Fish Company	1	3	4	4	2	14	17	21	66
Sebewaing Fish Company							2	6	8
Serafin Fishery		10	17	3	4	8	20	13	75
Warren Beers Fishery	2	0	1	0	0	0	2	0	5
Whytes Fishery	2	7	3	4	3	3	2	0	24
<b>Total</b>	<b>23</b>	<b>36</b>	<b>53</b>	<b>37</b>	<b>45</b>	<b>39</b>	<b>69</b>	<b>57</b>	<b>359</b>

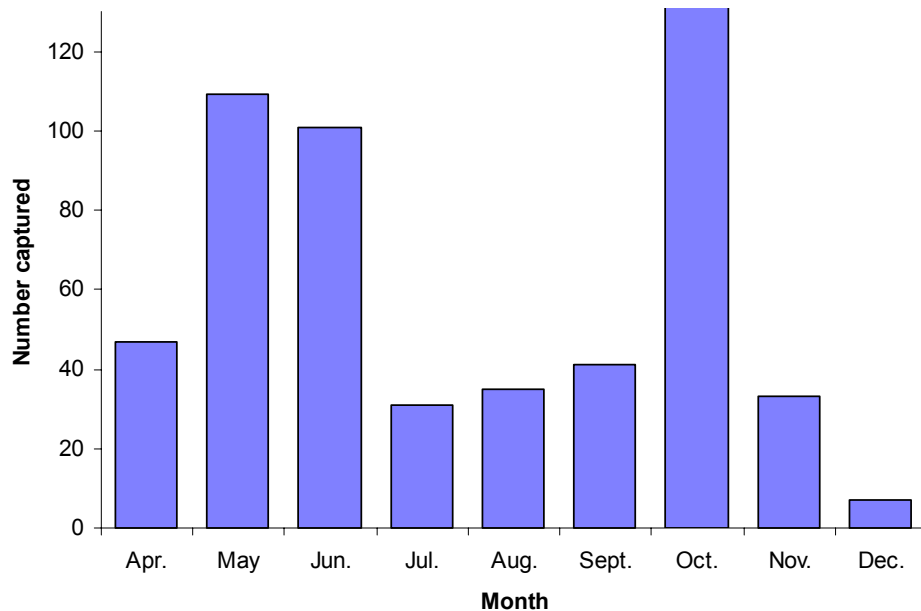


Figure 10. Number of lake sturgeon caught by month during the fishing seasons from 1995-2002 in Lake Huron by commercial fishers.

Table 7. Summary of total length (TL) and girth data for lake sturgeon collected by commercial fishers from 1995 through 2002 on Lake Huron.

	Total Length (cm)	Girth (cm)
Mean	116	39
Standard Error	3.27	2.47
Minimum	71	11
Maximum	186	109

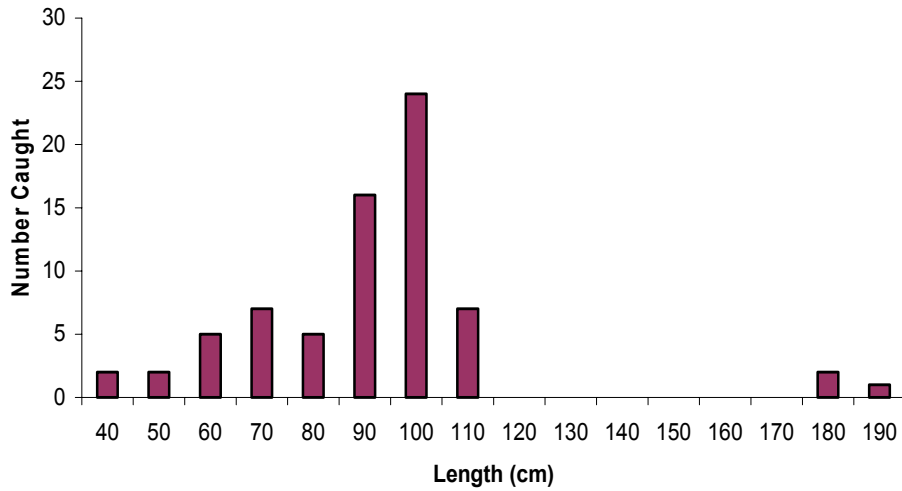


Figure 11. Number of lake sturgeon caught by commercial fishers on Lake Huron, by length, for 2001.

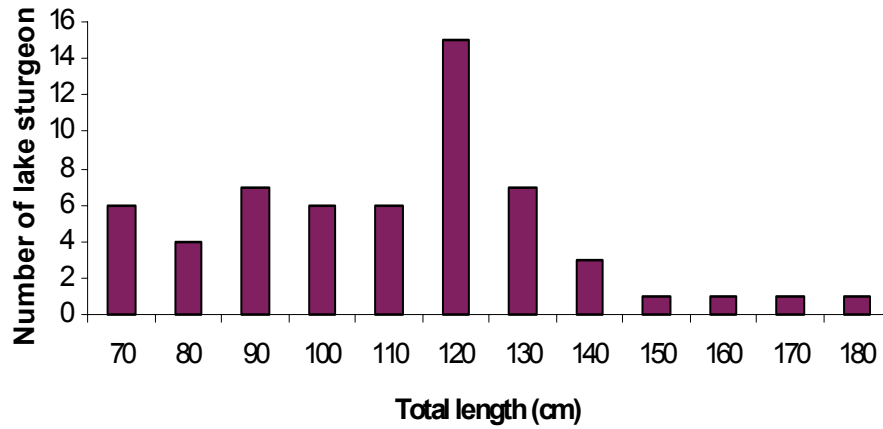


Figure 12. Number of lake sturgeon caught by commercial fishers on Lake Huron, by length in 2002.

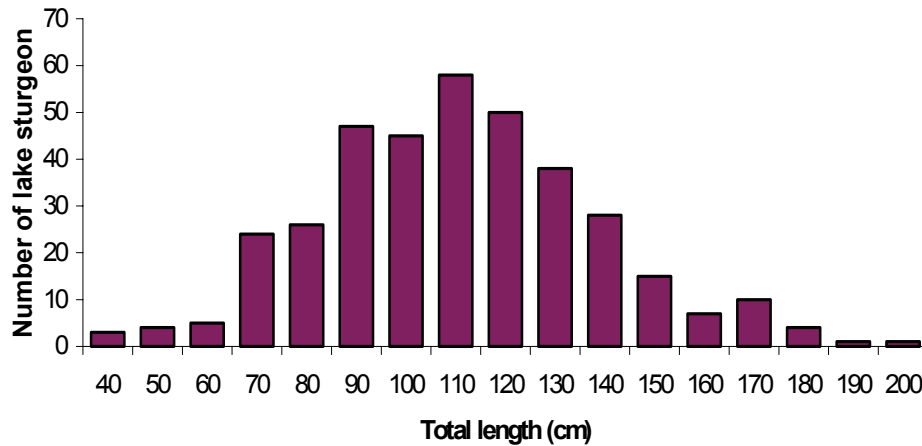


Figure 13. Length frequency of 254 Lake Huron lake sturgeon captured by commercial fishers from 1995 to 2002.

The age structure of lake sturgeon in Saginaw Bay shows that 11-20 yr old fish are most frequently caught (Figure 14). The sex of these fish is unknown; therefore, it is unknown whether these are sexually mature males or all sexually immature males and females. The next age group most frequently captured was ages 1 to 10 (Figure 14). Very few (if any) of these fish would be sexually mature.

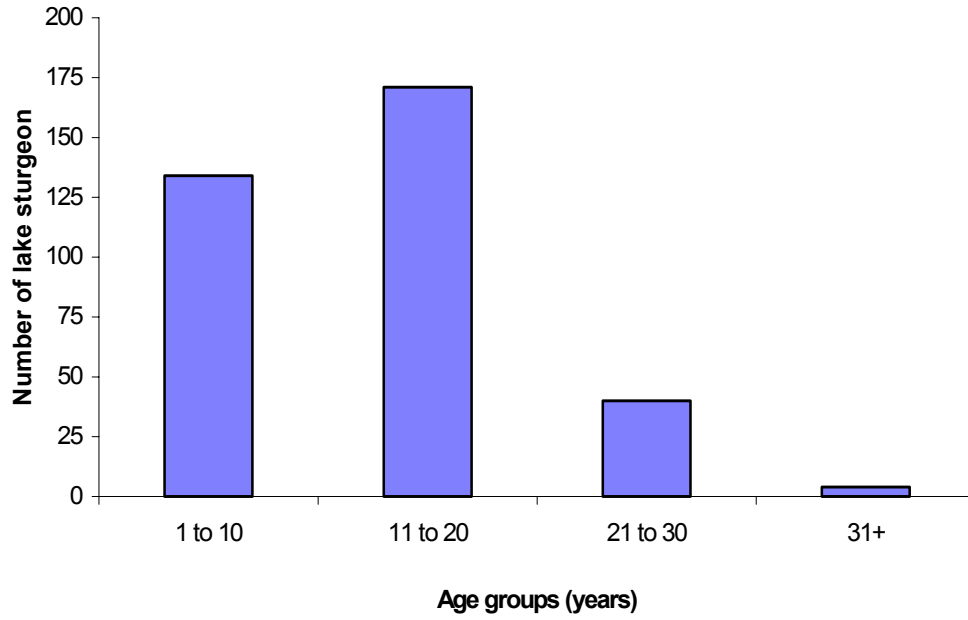


Figure 14. Age frequency of Lake Huron lake sturgeon caught by commercial fishers in Saginaw Bay from 1995 to 2002.

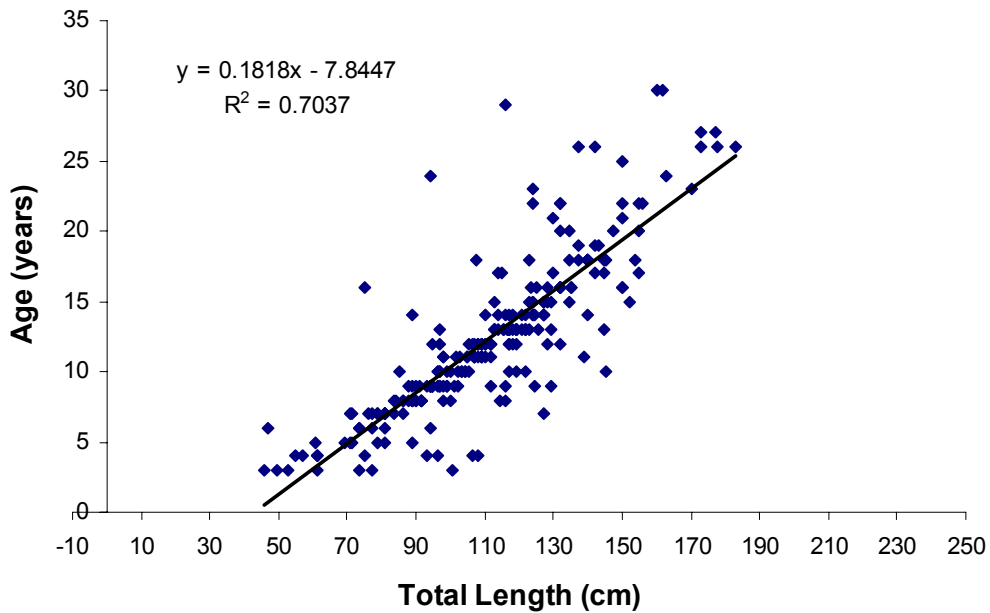


Figure 15. Age-length relationship for lake sturgeon caught by commercial fishers in Saginaw Bay from 1995-2001.

There were 12 lake sturgeon recaptured in Lake Huron in 2001. There were 9 lake sturgeon recaptured in 2002. Figure 16 gives the number of recaptured lake sturgeon from 1996 to 2002. Table 8 shows the date each recapture was originally tagged, date recaptured, TL at tagging, TL at recapture, girth at tagging, and girth at recapture. Not all fish were measured at tagging and/or recapture.

Not all lake sturgeon captured during this study have had aging structures collected. Therefore to get a complete age structure for the fish collected in this study three regressions (total length vs age, fork length vs age, and girth vs age) were developed for all the known age fish captured from 1995 through 2001. These regressions produce an equation that can be used to age fish with a known total length, fork length, or girth. All three regressions were applied to each sturgeon without an age structure. The results of each regression were then averaged and this value was assigned as the age of the fish. This process produced a product that on average was  $\pm 3$  years from the actual age of the fish (Figure 15). This process is not as reliable for assigning ages to lake sturgeon beyond 30 years.

Saginaw Bay seems to be an area occupied by juvenile to sub-adult lake sturgeon. This result may be biased by the gear used to collect the lake sturgeon. The trap nets may not be big enough for a large lake sturgeon (the target species are lake whitefish and yellow perch). Another reason may be that larger lake sturgeon are occupying different areas of Saginaw Bay than are being fished. Because limited numbers of adult lake sturgeon have been caught in Saginaw Bay and restoration of the species is dependent on spawning adults, future agency assessment should focus on determining whether or not adult lake sturgeon do occupy Saginaw Bay.

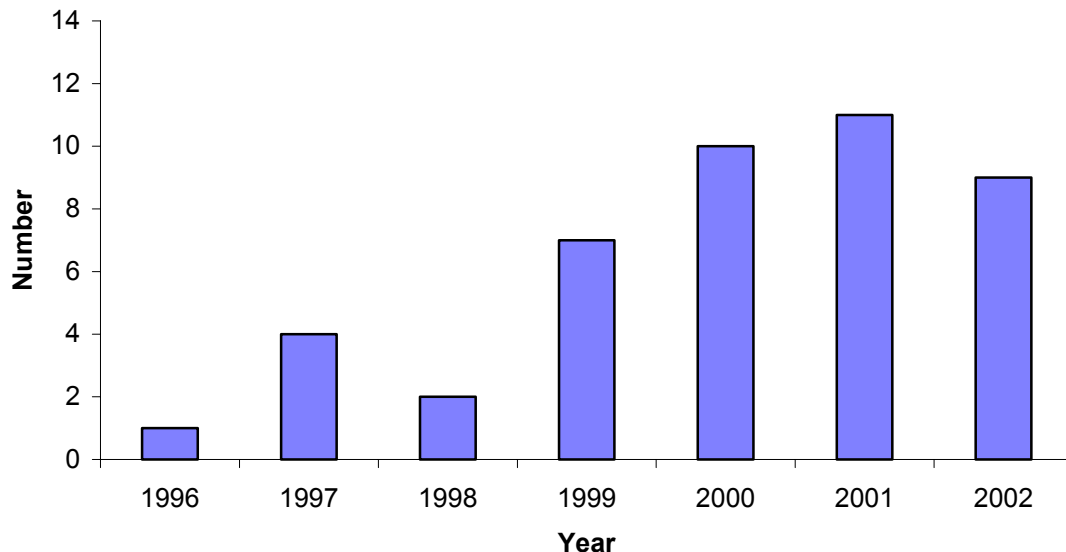


Figure 16. Number of lake sturgeon recaptured by commercial fishers on Lake Huron, from 1996 through 2002.

Table 8. Date and growth pattern of lake sturgeon recaptured from 1996 to 2002.

Tag Number	Date Tagged	Total Length Tagged	Girth Tagged	Date Recap	Total Length Recap	Girth Recap
650	09/29/02	120	45	10/8/02	120	45
4005	8/19/97	130	61	5/29/00	137	62
4016	10/11/01	119	41	11/19/02	122	46
4033	10/29/96	77	29	5/22/97	77	29
4036	4/26/97	104	38	4/26/00	112	39
4041	07/02/97	94	34	10/6/97	94	34
4043	08/25/97	118	43	8/28/98		
4047	10/06/97	116	48	6/3/99	117	46
4050	10/16/97	150	59	4/29/00	157	61
4054	4/28/97	103	39	2/28/01	128	49
4056	10/24/97	98	32	4/26/01	113	39
4059	5/4/98	90	33	5/20/99		
4064	9/25/99	89	31	5/22/00	91	32
4064				8/8/00	91	33
4066	10/24/00	107	38	12/2/2001	107	43
4068	10/22/01	130	44	5/1/2002	130	46
4087	10/04/98	147	57	10/10/98	147	57
4093	4/17/99	140	58	5/14/01	142	58
4110	11/17/98	152	56	10/11/99	150	55
4110				11/25/99	150	58
4110				5/21/00	155	58
4114	9/20/98	75	24	4/26/99		
4125	6/23/97	88	33	9/29/97	94	33
4125				10/30/01	117	36
4159	10/12/98	116	38	4/20/99		
4168	10/31/99	132	51	11/1/99	132	51
4169	04/28/00	118	45	10/24/02	122	51
4204	10/25/98	98	36	6/13/00	102	39
4204				5/18/01	108	37
4204				6/6/01	108	37
4214	9/16/01	102	43	10/24/01	97	42
4214				4/19/02	97	44
4214				7/29/02	97	44
4216	5/14/01	61	25	5/30/02	71	32
4255	5/30/00	140	55	2/28/01	139	56
4258	4/11/00	145	53	4/27/00	145	53
4277	06/05/01	97	36	11/7/2001	79	28
4432	10/04/01	112	39	11/6/2001	105	36
4434	10/08/01	97	32	6/7/2002	95	32
9106	05/07/01	117		10/2/02	120	47
6270	10/19/98			6/13/00	121	45
6785	11/2/95			12/2/00	117	38
100036	10/04/95	81	30	8/17/96	81	30
100049	09/28/95	124	57	12/25/97		

One possible future study would be to use trap nets with a larger pot opening or large mesh gill nets to see if adult lake sturgeon are caught. By doing this we would be able to assess whether gear bias is the reason for not catching adult lake sturgeon, and whether or not adult lake sturgeon do occupy Saginaw Bay.

The 2002 fishing season yielded 57 lake sturgeon, the second highest catch of lake sturgeon since 1995. The 2001 season was the highest season with 69 lake sturgeon caught. Of the 57 lake sturgeon caught in 2002, nine were recaptures. Prior to the 2002 catch there were 302 lake sturgeon at large in Saginaw Bay. Nine recaptures represent 3% of the tagged total. This is a low percentage, but one reason is that there may be a high population of lake sturgeon in the bay at this time. Another reason may be that because lake sturgeon move large distances, the same lake sturgeon are not always present in the bay and available for recapture.

### *Lake Erie*

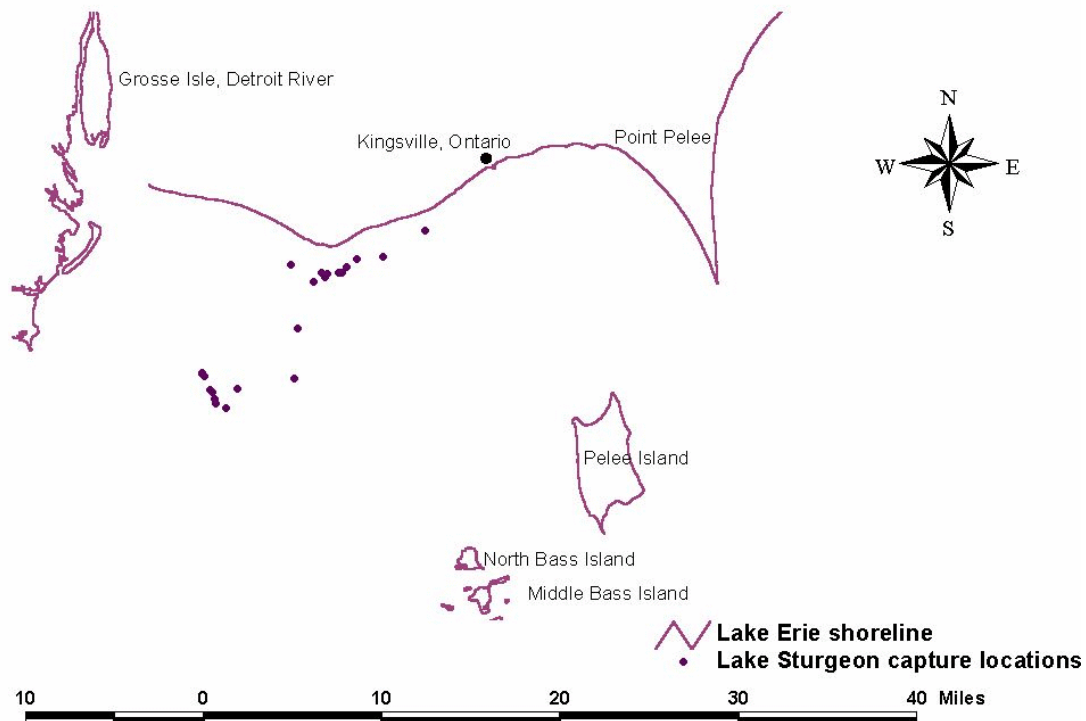


Figure 17. Locations of lake sturgeon caught and tagged in spring 2001.

Approximately 165 lake sturgeon have been captured during the course of this study. Twenty-five were caught in 2001. In 2001, total length ranged from 32 to 97 cm (Table 1). Length frequency of fish caught in 2001 was similar to length frequency of fish caught in 1996-1998 (Figure 1). Age estimates ranged from 2 to 7 years for live fish sampled. Mean age estimate was three years old. One fish caught was probably one year old, but a sample for aging was not collected. Another fish, which was dead before it became entangled in the net, was estimated at 20 years old.

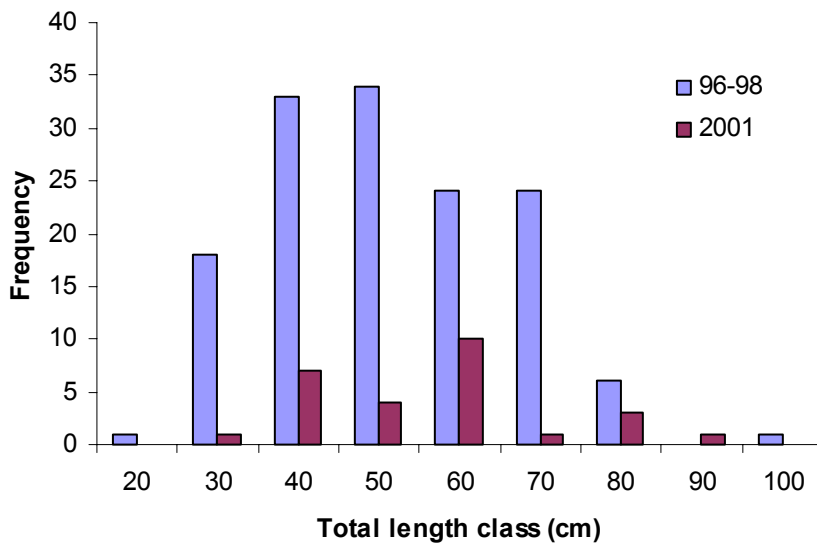


Figure 18. Length frequency of western Lake Erie lake sturgeon 1996 to 1998 compared to 2001.

Length and other biostatistics indicate that this is a population of juvenile and sub-adult fish. In 1996-1998, 26 lake sturgeon less than 420 mm were captured, in the spring of 2001 only one lake sturgeon less than 420 mm was captured. The smallest juvenile fish are no longer represented in our sampling efforts. These lake sturgeon would have been spawned in the last 1-5 years. There is a need to determine spawning periodicity and factors affecting survival of the smallest juvenile lake sturgeon including climatic and other environmental events. The adults in this stock may reside in the central or eastern basin or may be too large for the gear. Further investigation will determine these factors. Commercial fishers working in the eastern and central basins caught 7 lake sturgeon in 2002. Average size of these fish is larger (Table 10) compared to those caught in the western basin in 2001 (Table 9); however, they are not large enough to be considered adult lake sturgeon.

Table 9. Biostatistics on lake sturgeon caught and tagged in 2001 in the western basin of Lake Erie.

	Girth (cm)	Total Length (cm)	Weight (kg)
Mean	23.7	61.1	1.53
Minimum	11.5	32.0	0.06
Maximum	39.0	97.0	5.00

Table 10. Biostatistics on lake sturgeon caught and tagged in 2002 in the central and eastern basins of Lake Erie.

	Girth (cm)	Total Length (cm)	Weight (kg)
Mean	27.2	66.5	2.7
Minimum	17.5	47.5	0.6
Maximum	47.0	106.5	10.00

Although there were only a limited number of lake sturgeon sampled during 2001, this project provided the 'seed' money and energy to continue and grow the program. In general, established commercial fisher assistance programs in the upper Great Lakes have shown that spring fishing yields higher numbers of by-caught lake sturgeon, providing valuable data for managers. Likewise, with these four commercial fishers now trained and equipped to process incidentally caught lake sturgeon, an increase in the amount biological data available for Lake Erie fish can be expected. As more fish are tagged and as these fish are recaptured in future years, we will be able to determine where the Lake Erie lake sturgeon are spawning and whether or not they migrate out of the area (Figure 17). This information will be invaluable in protecting this stock and others throughout the Great Lakes.

## **ACKNOWLEDGEMENTS**

The information presented in this report was collected through the voluntary assistance of Barbeaux Fishery, Bay Port Fish Company, Beardsley Fish Company, Cedarville Fish Company, Gauthier-Spaulding Fishery, Lentz Fishery, Kuhl Fishery, M&W Fishery, Sebewaing Fish Company, Serafin Fishery, Beers Fishery, Whytes Fishery, Rick Meisner, Paul Minor, Joe Jackson, Larry Jackson, Jim Case, Gerry Penner, Bob Benson, Val Drzewiecki, Hickey Brothers, Rick Johnson, Neil Teskie, Jeff Weborg, Greg Ruleau, Monte Carew, George Duhamel, William Fowler, Stuart Schwander, John Keshick, Darren Mitchell, Corey Kroesing, and their crews. Their cooperation, interest, and enthusiasm continue to be invaluable in defining the current status and trends of this native Lake Huron fish species.

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