2014 Lake Huron Lake Sturgeon Working Group Report

Prepared by members:

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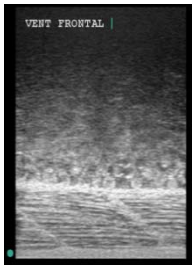
Location: Southern Lake Huron

Project Title: Using Ultrasound to Determine the Sex and Maturity of Lake Sturgeon in the Field

Project Description: Sex determination of fish species in the field is difficult to assess when sexual dimorphism and gametes are not apparent. For threatened and endangered fish species, unobtrusive techniques are needed when determining sex to minimize stress and the potential for mortality. The current study evaluated the use of a portable ultrasound unit to determine sex of lake sturgeon in the field. The sex and maturity of 41 female and 107 male lake sturgeon was determined by visually inspecting gametes through a small incision. Six images (ventral transverse, middle transverse, anterior transverse, ventral frontal, middle frontal, and anterior frontal) were collected from each fish using a SonoSite MicroMaxx ultrasound unit. The average time spent collecting images was 3 minutes, and ranged between 2-5 minutes once comfortable with operating procedures. Images were analyzed and sex and maturity was assigned and compared with the 148 sturgeon of known sex and maturity. Analysis indicates F4 (black egg), F5 (black egg-spawning) female, and M2 (fully developed) male gametes can be accurately identified during the spring spawning season. This work shows the utility of using an ultrasound unit in the field to determine sex of female and male lake sturgeon in later reproductive stages around the spawning season.

		Number Correctly Assigned	
Sex & Maturity	Number Field Verified	Reader 1	Reader 2
Male - Fully Developed	107	95 (89%)	103 (96%)
Female - Yellow Egg	9	6 (67%)	3 (33%)
Female - Black Egg	32	32 (100%)	32 (100%)
OVERALL	**148**	**133 (90%)**	**138 (93%)**
MALES	**75 (70%)**	**95 (89%)**	**103 (96%)**
FEMALES	**2 (5%)**	**39 (95%)**	**36 (88%)**



Project Duration: Spring 2015 – Fall 2016

Contact Information: Justin Chiotti, USFWS, Alpena FWCO (Waterford Substation)
Phone: 248-891-0087, justin_chiotti@fws.gov

Location: Southern Lake Huron and Detroit River

Project Title: Restoration of lake sturgeon (*Acipenser fulvescens*) in the Detroit River and the importance of milt quality

Project Description: The lake sturgeon (*Acipenser fulvescens*) population in the Detroit River was nearly extirpated during the 20th century due to habitat destruction and human interference. Recent efforts have been made to restore the natural spawning habitat through the use of artificial spawning reefs to enhance reproductive success in the wild. This population of lake sturgeon has a relatively low number of spawning adults (~ 1% of historical size) and appears to receive little gene flow from surrounding populations. As such, it is possible that this population could have reduced gamete quality due to increased risk of mating between relatives. In the current study we took milt samples from males in the Detroit River as well as from a more abundant and relatively less isolated Lake Huron population. The goal of this study was to answer two questions, 1) how lake sturgeon sperm morphology relates to velocity and longevity metrics in general, and 2) does sperm quality differ between these two populations? In order to answer these questions, we investigated sperm morphometric characteristics (including head shape and tail length) as well as sperm motility parameters related to reproductive success (i.e. velocity, longevity, and path straightness) for each of the populations. Most variables did not differ between the populations, but sperm from the Detroit river population were significantly faster at 5 and 10s post-activation. The data from this study do not suggest that DET males have lower sperm quality than their LHU counterparts. Further investigation on the differences in sperm morphology is still in progress.

Project Duration: 2014-2015

Contact Information: Jennifer Smith, Department of Biological Sciences, University of Windsor
Trevor Pitcher, Great Lakes Institute for Environmental Research, University of Windsor
Phone: 519-253-3000 ext. 2710, tpitcher@uwindsor.ca

Location: Southern Lake Huron

Project Title: Lake Sturgeon Population Assessment in Southern Lake Huron

Project Description: Southern Lake Huron (Upper St. Clair River) contains one of the largest populations of lake sturgeon in the Great Lakes. In 1995, the Ontario Ministry of Natural Resources began a mark-recapture study to gain a better understanding of lake sturgeon population demographics at this location. Tagging operations ceased in 2008. Overall, 1,657 lake sturgeon were marked and it is estimated that the lake sturgeon population is near 30,000 individuals. In 2015, the U.S. Fish and Wildlife Service along with the Ontario Ministry of Natural Resources are going to resurrect lake sturgeon tagging operations at this location. Lake sturgeon will be tagged annually with the cooperation of Purdy Fisheries. The goal of this work will be to obtain more precise estimates of lake sturgeon abundance and monitor trends in abundance overtime.

Project Duration: Spring 2015 – Fall 2016

Contact Information: James Boase, USFWS, Alpena FWCO (Waterford Substation)
Lloyd Mohr, Ontario Ministry of Natural Resources
James Boase - Phone: 248-894-7594, james_boase@fws.gov
Lloyd Mohr – Phone: 519-371-5669; lloyd.mohr@ontario.ca

Location: Southern Lake Huron

Project Title: Characterization of the Migratory Phenotype in Lake Sturgeon

Project Description: The goal of this collaboration is to better understand the genomic basis for migratory phenotypes in lake sturgeon (*Acipenser fulvescens*) of the Great Lakes. Most lake sturgeon reside in the lakes, only entering the rivers to spawn. However, the coexistence of both river resident and out-migrating lake sturgeon indicates the possibility of a genomic mechanism for differences in migration tendencies. Our hypotheses are that 1) there are differences in morphometrics due to migratory phenotypes, and 2) migratory phenotypes correlate to gene expression differences. Expression may be partially regulated by epigenetic mechanisms, notably, DNA methylation. The objectives are to elucidate genome-wide methylation patterns and to measure differential methylation between these migratory phenotypes.

To date, morphometrics have been analyzed for the 2012 and 2013 field seasons. Photographs were taken of 60 telemetered fish. Based on the telemetry data, 35 fish were determined to be residents and 25 were out-migrators. Using the software program, ImageJ, we measured 17 morphometric characters. Morphometric data, analyzed with Principal component analysis (PCA), did not support morphologic differences between migratory phenotypes.

Differential methylation was measured using the methylation sensitive (MS)-AFLP protocol. MS-AFLP is a method of measuring methylation by incorporating methylation sensitive restriction enzymes into the standard AFLP protocol, the result being a set of amplified fragments that can be visualized on a polyacrylamide gel. MS-AFLP allows for a genome wide approach to understanding which genes are being expressed. If a gene is methylated, this typically infers that the gene will not be expressed. MS-AFLP was performed on 14 individuals (7 migrants and 7 residents) from the 2013 season. An AMOVA performed for individual loci detected two restriction sites that were nearly statistically different (ϕ=0.05, P=0.063). Locus 118 and 153 were methylated in four of seven individuals of the migrant phenotype, but were unmethylated in all resident individuals. Two additional years of data will be added to increase the power of this analysis. It appears epigenetic changes were the only differences between the two phenotypes and may be the most useful tool for evaluating rapid adaptation in the presence of substantial gene flow.

Project Duration: 2012-2014

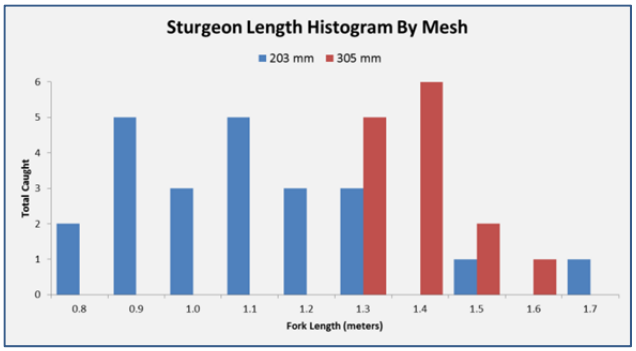
Contact Information: Justine Whitaker, Wildlife and Fishery Resources Program, West Virginia University
Amy Welsh, Wildlife and Fishery Resources Program, West Virginia University
Phone: 304-293-0718; Amy.Welsh@mail.wvu.edu

Location: Ontario waters of Lake Huron

Project Title: Lake Sturgeon Population Assessment

Project Description: To monitor staging lake sturgeon at mouth to Nottawasaga River as they enter and/or leave the river during the spring spawning period. Document tagged fish recaptures.

This project has been run every year since 2009. In 2014 sampling began 28 April and ended 13 May. A total of 41 large mesh gill net sets were completed with 40 lake sturgeon being caught, sampled, tagged and released. Two fish were recaptured, both had been tagged in or near the Nottawasaga River; one in 2003 at a spawning location in the river and one in 2010 at the mouth of the river.



Project Duration: 28 April, 2014 – 13 May, 2014

Contact Information: Jeff Speers, UGLMU, OMNR, Owen Sound, ON
Phone: 519-371-5059; jeff.speers@ontario.ca

Location: Ontario waters of Lake Huron

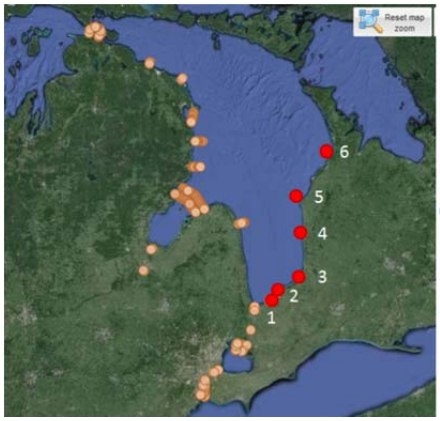
Project Title: Lake Sturgeon Movement Study, Ontario waters

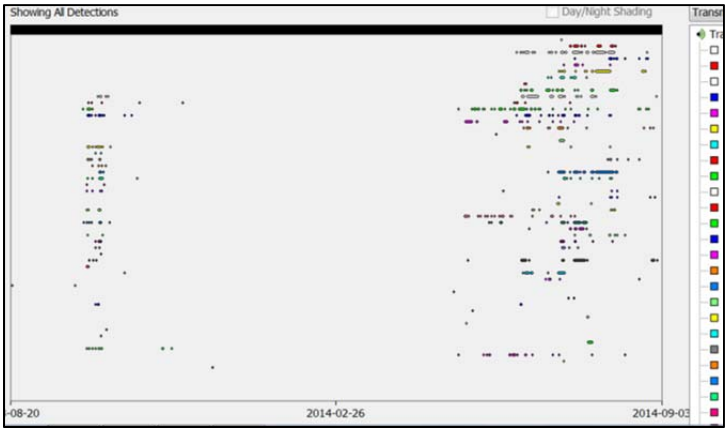
Project Description: This is part of the Lake Sturgeon Metapopulation Structure Study which began in 2012 and will continue until 2017 (Darryl Hondorp, USGS, Project Lead). The purpose of this project is to assess the movement and dispersal of spawning adults in the HEC, spawning site fidelity, survival rates of the different populations and range of feeding grounds used by lake sturgeon

There are currently 6 acoustic arrays in Ontario waters for this project. USGS has been monitoring the two most southerly while UGLMU has been monitoring the remainder. Two were put in place in 2013 and two were deployed in 2014.

Arrays were retrieved in the late summer and fall and were replaced at the same time. The two new arrays were deployed on 19 August and 2 September, respectively in 2014. Problems occurred trying to retrieve some of the receivers in 2014. All receivers at Grand Bend were buried in sand. All were located, however, one was not retrievable and divers will be called in in the spring. Only 3 of the 6 deployed at Goderich were actually found. Underwater video could not find them nor could extensive grappling. These were not replaced in 2014.

Preliminary review of data suggests extensive use of southern Lake Huron beginning in early May and ending in mid October by both lake sturgeon and walleye. There does not appear to be any movement/use of this part of the lake during the winter months.





Project Duration: 2012-2017

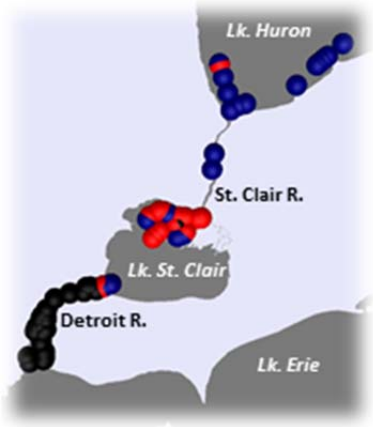
Contact Information: Lloyd Mohr, UGLMU, OMNR, Owen Sound, ON
Phone: 519-371-5669; lloyd.mohr@ontario.ca

Location(s): Detroit-St. Clair River System; Lake Huron; Lake Erie

Project Title: Geographic organization and population structure of lake sturgeon in the Lake Huron-to-Lake Erie corridor as inferred from long-term, population-scale movement patterns.

Project Description: This study uses acoustic telemetry to describe the spatial structure of lake sturgeon populations that spawn in the St. Clair and Detroit rivers in order to provide managers with information on habitat use by different sturgeon populations as well as on population-scale movements and dispersal patterns at ecologically-relevant temporal scales. Since 2011, a total of 268 adult lake sturgeon have been captured in the Detroit and St. Clair rivers, implanted with high-power acoustic tags with a battery life of 10 years, and then released near the capture site. Strategically-located acoustic receivers in the Detroit-St. Clair river system, Lake Huron, and Lake Erie (map to the right), are allowing scientists to track sturgeon movements between feeding, overwintering, and spawning grounds over thousands of square miles. Study results will be used to test the hypothesis that a number of separate sturgeon populations occur in the Lake Huron-to-Lake Erie corridor rather than one large population.

Results to date have shown that Lake sturgeon habitat use varies by release location. Lake sturgeon released into the Detroit River (black circles, left) tended to remain in the Detroit River or move up into Lake St. Clair, whereas lake sturgeon released into the lower St. Clair River (red circles) either remained in the St. Clair River or moved down into Lake St. Clair. Lake sturgeon released into the upper St. Clair river (blue circles) spread out to occupy Lake Huron, the St. Clair River, and Lake St. Clair. Significant mixing of release groups occurs in Lake St. Clair, whereas Lake Erie is rarely used by lake sturgeon, even those released into the Detroit River. The extent and timing of movements by different release groups suggest the potential for complex metapopulation dynamics, which could impact conservation strategies. Year-round tracking of lake sturgeon movements also has confirmed the existence of migratory and river-resident life histories. The high incidence of river residency in Detroit-St. Clair river lake sturgeon was a surprise.



Project Duration: 2012-2016

Contact Information: Darryl Hondorp, U.S. Geological Survey-Great Lakes Science Center (Ann Arbor, MI)
Phone: 734-214-7241, dhondorp@usgs.gov

Location: Garden River

Project Title: Lake Sturgeon Spawning Survey in the Garden River

Project Description: With funds from Ontario's Species at Risk Stewardship Fund, the A/OFRC and Garden River First Nation completed a Lake Sturgeon spawning survey in the Garden River. The objectives of this study were to identify Lake Sturgeon spawning locations in the Garden River and to estimate the reproductive significance of the Garden River to the St. Mary's River Lake Sturgeon population.

This study was undertaken between June 2 and July 1 when water temperatures ranged from 14°C to 21°C. Given the narrow and high gradient nature of the Garden River, gill netting was difficult and resulted in only two adult Lake Sturgeon being captured. Drift nets were more successful at assessing Lake Sturgeon reproduction in the Garden River, whereby 101 larval Lake Sturgeon were captured at various locations throughout the Garden River. Anecdotal reports and traditional knowledge have suggested that spawning likely occurs as far upriver as Elm's Flats, however given the relatively large larval Lake Sturgeon that were captured at this location in 2014, it is suspected that spawning likely occurs much further upstream. This hypothesis will be further investigated in 2015 with the continued support of Ontario's Species at Risk Stewardship Fund.

Contact Information: Kim Tremblay, Anishinabek/Ontario Fisheries Resource Centre
Phone: 705-472-7888 ext. #6; ktremblay@aofrc.org

Location: Magnetawan River

Project Title: Lake Sturgeon Presence/Absence Study in the Magnetawan River

Project Description: The Anishinabek/Ontario Fisheries Resource Center and Magnetawan First Nation completed a Lake Sturgeon presence/absence study on the Magnetawan River. Although the Magnetawan River Lake Sturgeon population is considered extant, there has been no evidence of spawning or reproductive success and only occasional observations of adults. The purpose of this study was to confirm the presence or absence of Lake Sturgeon in the Magnetawan River by targeting spawning adults during optimal spawning conditions.

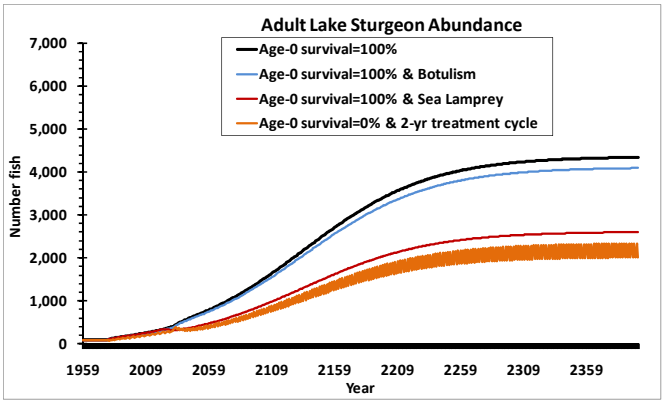
Large mesh gill nets ranging from 6" to 10" were set in the Magnetawan River between May 20 and June 6, 2014. Water temperatures during this time ranged from 12.5°C to 19.0°C and areas near suspected spawning sites were targeted to capture staging Lake Sturgeon. A total of 40 Lake Sturgeon nets were set over a three week period, however no Lake Sturgeon were captured. Apart from anecdotal reports of Lake Sturgeon being captured by anglers in the Magnetawan River, the only confirmed Lake Sturgeon capture in the Magnetawan River occurred in 2009 when a 32 kg Lake Sturgeon was captured in a research gill net near the uppermost navigable barrier.

Contact Information: Kim Tremblay, Anishinabek/Ontario Fisheries Resource Centre
Phone: 705-472-7888 ext. #6; ktremblay@aofrc.org

Location: Lakes Huron, Superior, Michigan

Project Title: Development of a Simple Model to Evaluate Lake Sturgeon Populations in the 1836 Treaty-Ceded Waters

Project Description: For centuries lake sturgeon were historically harvested and revered by Native American tribes in the Great Lakes basin. Currently, all tribes that are members of the Chippewa Ottawa Resource Authority (CORA) have endorsed plans for rehabilitating lake sturgeon populations in the 1836 ceded waters of lakes Superior, Huron, and Michigan. In addition, several CORA member tribes are actively involved in sturgeon rehabilitation through propagation programs, habitat rehabilitation, and surveys of existing populations. Because lake sturgeon and sea lamprey both seem to prefer similar types of Great Lakes tributaries for reproduction, there is potential for the sea lamprey control actions to suppress lake sturgeon populations, and conversely, for lake sturgeon recovery programs to interfere with effective control of sea lamprey populations. A simple lake sturgeon population model was developed to: 1) estimate the average number of spawning females in a tributary by using existing gill net survey data; 2) provide a quantitative tool to measure and project the effects of sea lamprey control actions on sturgeon; and 3) evaluate and consolidate Great Lakes lake sturgeon population parameters that may prove useful in developing a more comprehensive simulation model of sturgeon dynamics.



Sea lamprey marking data on lake sturgeon in the upper Great Lakes was consolidated and indicated low attack rates on juveniles, but high sea lamprey attack rates on adults.

Lake Sturgeon marking data (L. Mohr, H. Quinlan, R. Elliott)

Lake	Marks	Fish	Rate
Superior	3	6,575	0.05
Huron	56	3,379	1.66
Michigan	47	643	7.31
Total	106	10,597	1.00

Contact Information: Mark Ebener, Inter-Tribal Fisheries and Assessment Program, Chippewa Ottawa Resource Authority
Phone: 906-632-0072, mebener@lighthouse.net

Lake Huron

Table 1. Observations or general status of lake sturgeon populations in the Lake Huron Basin. Table includes water bodies that historically supported or recent evidence exists lake sturgeon may be present. Population status definitions are: **Extirpated** or **Extant**; **Re-I** (reintroduced) = fish stocked into a system with an extirpated population; **Supp** (supplementation) = fish stocked into a system with an extant population, or **Unk** = unknown. A "**Yes**" indicates regular observation or presumed annual occurrence. Occasional (**Occ**) observations are as noted. Successful reproduction was defined as recent capture of larval or juvenile sturgeon. Notes follow the table.

Basin / Site Number	Site Name	Population Status	Size of Annual Spawning Run	Observations:				Juvenile Index (year)	Repr. Success?
				Adults	Spawning	Larva	Juveniles		
Lake Huron									
1	Carp River, MI	Extant	Unk	Yes	Occ	Unk	Unk		Unk
2	St. Marys River, MI ON	Extant	Unk	Yes	Unk	Unk	Yes		Yes
3	Root River, ON	Extirpated							
4	Garden River, ON	Extant	Unk	Yes	Yes	Yes	Unk		Yes
5	Echo River, ON	Extant	Unk	Yes	Unk	Unk	Occ	1.0 (2012)	Unk
6	Thessalon River, ON	Extant	Unk	Yes	Unk	Unk	Unk	0.0 (2012)	Unk
7a	Mississagi River, ON	Extant	150	Yes	Yes	Yes	Yes		Yes
7b	Mississagi River (upriver), ON	Extant	Unk	Yes	Yes	Unk	Yes		Unk
8	Blind River, ON	Extirpated					Occ	2.2 (2012)	Unk
9	Serpent River, ON	Extirpated					Occ	5.8 (2012)	Unk
10	Spanish River, ON	Extant	Unk	Yes	Yes	Unk	Yes	5.3 (2012)	Yes
11	French River, ON	Extant	Unk	Yes	Unk	Unk	Occ		Unk
12	Key River, ON	Unk	Unk	Unk	Unk	Unk	Unk	0.0 (2012)	Unk
13	Magnetawan River, ON	Extant	Unk	Occ	Unk	Unk	Unk	0.0 (2012)	Unk
14	Naiscoot River, ON	Extant	Unk	Occ	Unk	Unk	Unk		Unk
15	Seguin River, ON	Extant	Unk	Occ	Unk	Unk	Unk		Unk
16	Moon River, ON	Extant	Unk	Yes	Yes	Yes	Yes		Yes
17	Go Home River, ON	Extirpated							
18	Severn River, ON	Extant	Unk	Occ	Unk	Unk	Unk		Unk
19	Sturgeon River, ON	Extirpated							
20	Nottawasaga River, ON	Extant	≅ 200	Yes	Yes	Unk	Yes		Yes
21	Manitou River, ON	Unk	Unk	Yes	Yes	Unk	Unk		Unk
22	Sauble River, ON	Unk	Unk	Occ	Unk	Unk	Unk	0.0 (2012)	Unk
23	Saugeen River, ON	Unk	Unk	Occ	Unk	Unk	Unk	0.0 (2012)	Unk
24	AuSable River, ON	Extirpated						0.0 (2012)	

25	Blue Point, ON	Unk	Unk	Yes	Unk	Unk	Occ		Unk
26	Musquash River, ON	Unk	Unk	Occ	Yes	Unk	Occ		Unk
27	Saginaw River, MI	Extant	Unk	Occ	Unk	Unk	Unk		Unk
28	Saginaw Bay, MI	Extant	Unk	Yes	Unk	Unk	Unk		Unk
29	AuSable River, MI	Extant	Unk	Occ	Unk	Unk	Unk		Unk
30	Thunder Bay River, MI	Extirpated							
31	Cheboygan River, MI	Extant	Unk	Occ	Unk	Unk	Unk		Unk
32	Black Lake, MI	Supp	≅ 200	Yes	Yes	Yes	Yes		Yes
33	Burt/Mullett Lake (including lower Black River downstream Alverno Dam) MI	Supp	Unk	Yes	Occ	Yes	Yes	2009-2011	Unk
34	Rifle River, MI	Extant	Unk	Unk	Yes	Unk	Yes	0.0 (2013)	Unk
35	Au Gres River, MI	Unk	Unk	Unk	Unk	Unk	Unk		
36	Otsego Lake	Re-I	Unk	Yes	No	No	Yes		No
37	Kawkawlin River, MI	Unk	Unk	Unk	Unk	Unk	Unk		
38	Munuscong River, MI	Unk	Unk	Unk	Unk	Unk	Unk		
39	Ocqueoc River, MI	Unk	Unk	Unk	Unk	Unk	Unk		
40	Pigeon River, MI	Unk	Unk	Unk	Unk	Unk	Unk		
41	Tittabawassee River, MI	Extant	Unk	Occ	Unk	Unk	Unk		