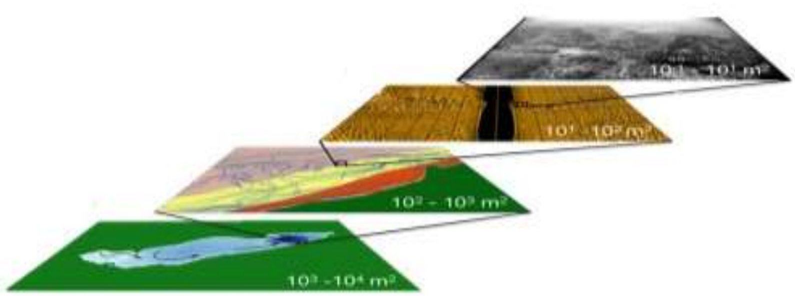
Report of the
Lake Erie Habitat Task Group
2014



Multiscalar habitat assessment of historical and potential lake trout spawning habitats in Lake Erie.

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Presented to:
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Section 1. Charges to the Habitat Task Group 2013-2014

1. Document habitat improvement projects and research into fish use of habitat in Lake Erie. Identify and prioritize potential projects and research for future funding.

2. Assist member agencies with the use of technology (i.e., sidescan, GIS, remote sensing, etc.) to facilitate better understanding of habitat in Lake Erie, particularly in the Huron-Erie corridor, the nearshore, and other critical areas.
    a. Sidescan Workshop
    b. Continued support of LE GIS/GLAHF development and deployment
    c. Spawning habitat mapping
    d. Nearshore substrate mapping

3. Support other task groups by compiling metrics of habitat use by fish.

4. Develop a strategic research direction for the Environmental Objectives.

Section 2. Document Habitat Improvement Projects

E. Weimer, C. Castiglione

The first charge to the HTG involves the documentation of habitat projects occurring throughout the Lake Erie and Lake St. Clair basins, including their associated watersheds. Although originally designed as a simple spreadsheet table, by 2007 it had evolved into an online, spatial inventory which, it was believed, would be an effective way of disseminating project information.

The habitat listing, presented as a spatial inventory presented with a map interface can be found online at:
http://www.glfc.org/lakecom/lec/spatial_inventory/inventory_index.htm

In 2009, the LEC modified the charge to "Identify and prioritize relevant projects to take advantage of funding opportunities". Currently, we are re-evaluating the objectives of this charge and believe it is essential to provide a tool that promotes collaboration and prevents duplication of effort. We continue to address the initial charge by documenting current habitat improvement and research projects identified by task group members and need to expand the inventory beyond the task group member knowledge. The following tables identify the number of projects within each basin (table 2-1), waterbody (table 2-2), and watershed (table2-3).

Table 2-1. Summary of Habitat Projects by Basin.

Basin	# of Projects
Central basin	11
East-Central	7
East basin	15
Huron-Erie corridor	19
Lake Erie basin	11
West-central basin	3
West basin	11

Table 2-2. Summary of Habitat Projects by Waterbody.

Waterbody	# of Projects
Crooked Creek	1
Detroit River	4
East Branch of Conneaut Creek, PA	2
Elk Creek	2
Four Mile Creek, PA	1
Lake Erie	13
Lake St. Clair	2
Middle Harbor	1
NA	39
Niagara River	2
North Maumee Bay	1
Sandusky River and Bay	1
Spooner Creek	1
St. Clair River	1
St. Clair River, Lake St. Clair	1
St. Clair River, Lake St. Clair, Detroit River	3
Walnut Creek, PA	1
Western and Central Basin of Lake Erie	1

Table 2-3. Summary of Habitat Projects by Watershed.

Watershed	# of Projects
Ashtabula-Chagrin	1
Big Creek	1
Big Creek, Lower Grand	1
Black-Rocky	1
Buffalo-Eighteenmile	1
Cattaraugus	2
Cedar-Portage	1
Cedar Creek	1
Cedar Creek, Rondeau, Big Creek	1
Chautauqua	1
Chautauqua-Conneaut	8
Clinton	1
Cuyahoga	2
Detroit	1
Halfway Creek, Ottawa River	1
Huron	1
Lake Erie basin	9
Lake St. Clair, Clinton, Syndenham, Lower Thames, Cedar Creek	1
Lower Grand	3
Lower Thames	1
Maumee	3
Maumee to Cuyahoga	1
Maumee, Ashtabula-Chagrin	1
NA	16
Niagara	2
Raisin	1
Rondeau	3
Sandusky	2
Sandusky River	1
St. Clair, Lake St. Clair, Clinton	1
St. Clair, Upper Thames, Syndenham, Lower Thames, Lake St. Clair, Clinton, Detroit, Cedar Creek	1
Syndenham, Lower Thames, Cedar Creek, Upper Thames	1
Toussaint River	1
Upper Grand, Lower Grand	1
Upper Grand, Lower Grand, Big Creek, Niagara	1
Upper Thames, Lower Thames	2

Building on the development of the Environmental Objectives detailed in Section 5 (below), the second responsibility of this charge is focused on recommending projects and identifying gaps in research/restoration needs for future funding opportunities. These recommendations would be developed from expert opinion within the task group and prioritized within the framework of the Environmental Objectives.

Regardless of the state of our method of relaying the information, habitat related projects continue throughout the basin and we present a summary of notable ones below.

2a. Fish Habitat Assessment and Rehabilitation in the St. Clair-Detroit River System

G. Kennedy, J. Craig, E. Roseman, J. Boase, J. Chiotti, S. Ireland

Field and laboratory investigations continue in the St. Clair-Detroit rivers system to assess and measure the location, phenology, and density of fish eggs and larvae. Detailed sampling methods are available in Roseman et al. (2011a, b) and Figure 2a-1 displays sample sites for fish eggs and larval fishes. Information and data gleaned from these studies is being used to develop habitat restoration strategies that address BUIs and assess the efficacy of recently established spawning areas.

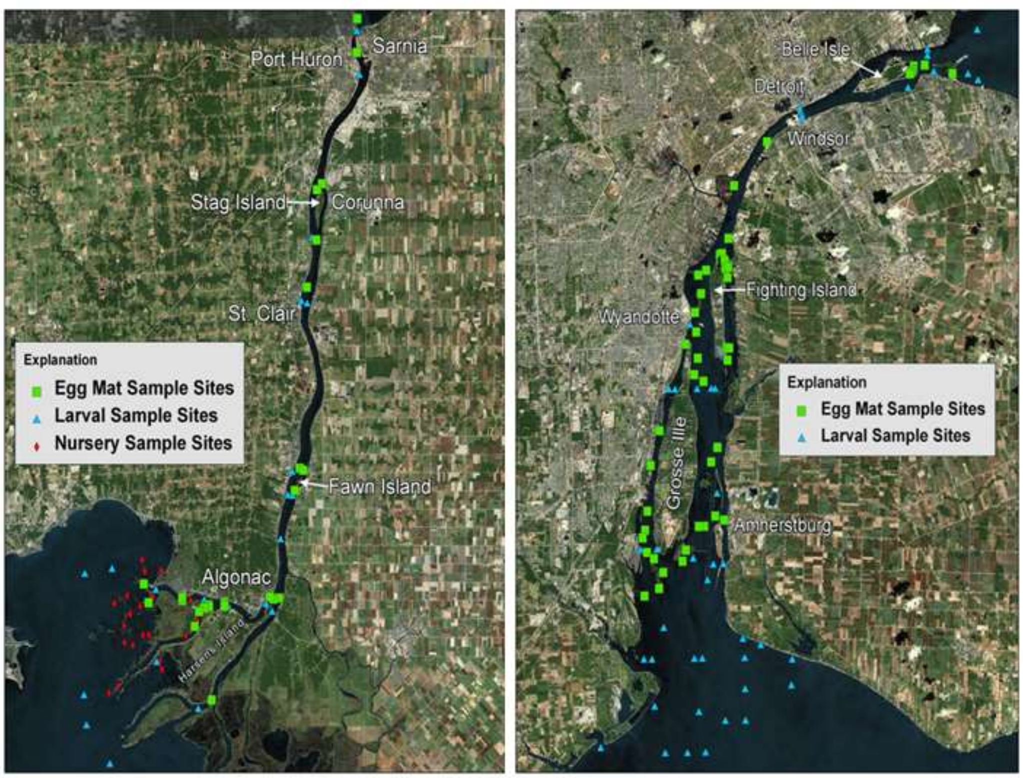

Figure 2a-1. Fish spawning and larval fish sampling sites in the St. Clair (left panel) and Detroit rivers.

Spawning Reef Construction

The Middle Channel reef in the lower St. Clair River was constructed in summer, 2012. Lake sturgeon responded positively to the establishment of this reef by spawning on it while it was being constructed (http://gallery.usgs.gov/videos/543) and again in spring of 2013 when viable eggs were collected. To assess larval lake sturgeon production form the Middle Channel reef, we employed an upstream/downstream/control survey design (Figure 2a-2).

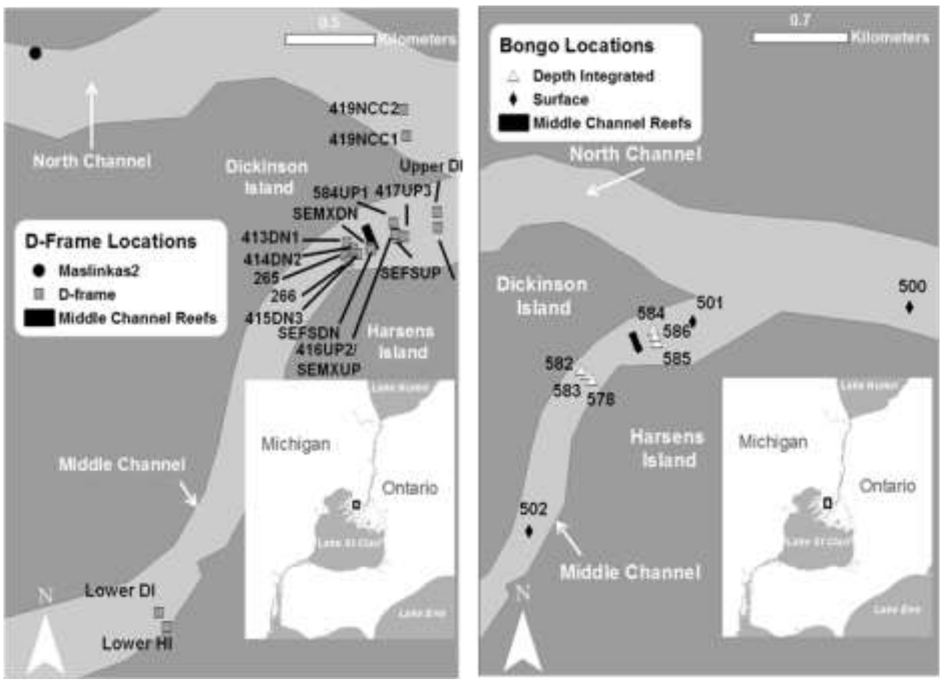

Figure 2a-2. D-frame net sampling sites for lake sturgeon larvae in the St. Clair River, 2013.

Sampling for drifting larval lake sturgeon in 2013 resulted in collection of 148 larval lake sturgeon and showed no difference in larval CPUE between sites upstream and downstream of the reef (Figure 2a-3).

Similar to the Fighting island reef in the Detroit River, video and SCUBA surveys show that the southeast side of the Middle Channel reef is filling in with sand and was not used by spawning fishes 2013. Physical and biological assessment of the efficacy of this reef will continue in 2014. Two new fish spawning reefs are scheduled for establishment in the St. Clair River in 2014. These include Hart's Light and Pt. Aux Chenes (Figure 2a-4).

In the Detroit River, three new fish spawning reefs are being evaluated for construction at Northeast Belle Isle, Fort Wayne, and Northeast Grassy Issle (Figure 2a-4). The Fighting Island reef, a known lake sturgeon spawning area (Roseman et al. 2011a) was enlarged in 2013 and ecological assessments will occur in 2014 to assess the use of this expanded habitat by spawning fishes.

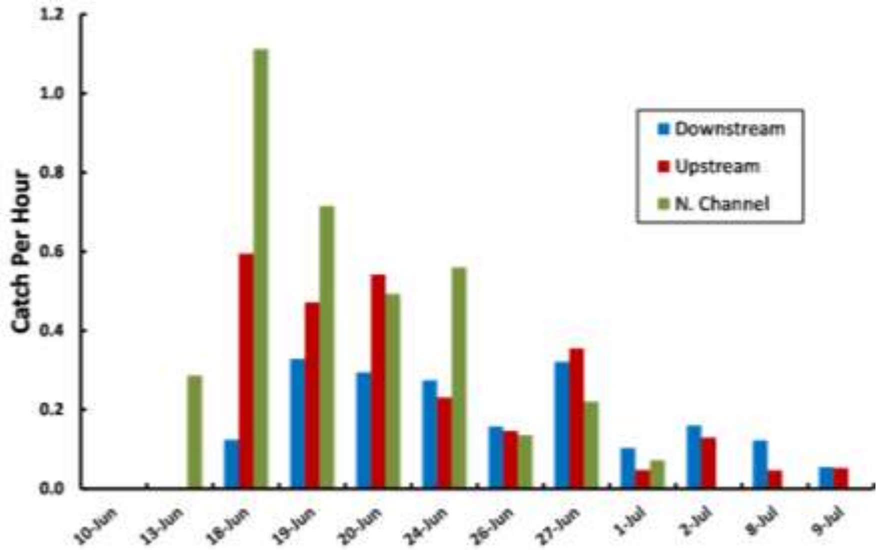

Figure 2a-3. Catch per unit effort (No./hr.) of larval lake sturgeon from sites above and below the constructed Middle Channel reef, and at a control site in the North Channel of the St. Clair River, 2013 based on collections with nighttime benthic D-frame nets.

Figure 2a-4. The St. Clair-Detroit rivers system showing completed and proposed artificial reef construction sites.

Fish Spawning and Larval Sampling

To assess the extent and magnitude of lithophilic fish spawning, egg mats were fished throughout the spring and fall spawning seasons, typically from mid-March through June and again in late October through early December in each year. Fish egg deposition was determined by placing furnace-filter egg mats on the river bottom following methods described by Roseman et al. (2011) using a small research vessel (7 – 8.5 m hull length) outfitted with a global positioning navigation system (GPS). Each egg mat consisted of a rectangle (38 x 50 x 2.5 cm) of furnace filter material wrapped around a metal frame (38 x 24 x 0.5 cm) and secured with four document clamps. Three to five such egg mats linked together, end to end, with 3 m lengths of 0.95 cm diameter braided nylon line formed a gang of egg mats. The egg mat gangs were typically set in the river for 8 – 10 weeks, and were retrieved once per week for inspection and removal of eggs.

Egg sampling in the Detroit River has been conducted from 2004 to 2013. Egg sampling in the St. Clair River has been conducted from 2010 to 2013 (Fig. 2a-1). Effort and locations of egg sampling have varied among years. Effort was low in 2006 (4 sites, only in the Detroit River) and 2007 (13 sites, only in the Detroit River) but has increased in recent study years to include >20 sites in the Detroit River and >30 sites in the St. Clair River (Fig. 2a-1).

Larval fishes were sampled to assess the timing, spatial extent, production, and transport of fishes through the connecting channel. Larval fish sampling typically began in the Detroit River in mid-March and in the St. Clair River in early April (Fig. 2a-1). Collections continued weekly, typically until June, July or August. For these weekly collections, we used a paired bongo sampler weighted with a 22.7 kg oceanographic depressor plate and fitted with two 60 cm diameter by 3.3 m long nets with 500 µm mesh size.

Egg and larval fish collections will continue in 2014 to assess spawning reef restoration as well as provide an annual index of the magnitude of fish spawning and larval production.

Shorezone Seining

In 2013, we selected nine sites in the St. Clair and Detroit rivers to sample nearshore fish and macrophyte communities (Fig. 2a-5) during late summer (late August – early September). Four sites were located in the St. Clair River, three sites were located in the Detroit River, and one site was sampled in each Lake Erie and Lake Huron. Sites were selected to allow access by vehicle with the exception of the site 'Tiki Bob' which required a boat for access. Sites were also selected to be on public land and had minimal amounts of boulders, riprap, or logs that may cause hang-ups and reduce sampling efficiency.

Shore zone sampling methodology followed Henning et al. (2014). Seining was conducted with a 1.83 m x 9.14 m bag seine constructed of 1.6 mm Delta nylon mesh. When permitted, seining was performed with four consecutive 15.25 m hauls parallel to the shoreline; equaling 6 m of shoreline sampled. Sites with smaller shorelines were sampled to the greatest extent possible and distance was recorded. The seine was pulled in an upstream direction to allow the net to stay open during sampling. Following each haul, fish were sorted into species, counted, and released away from the next seining location. When necessary, fish were vouchered for validation of species identification. The macrophyte community characteristics (density, percent cover, species, and height) were assessed by visually approximating the proportion of sites occupied by species. Species identifications were validated in the laboratory. In-situ proportions were validated by assessing underwater videos taken with a GoPro HERO 3 Black Edition. We also recorded important habitat features such as water temperature and bottom substrate types. Seining will be conducted in 2014.

Zooplankton Sampling

Seasonal numeric densities of zooplankton were estimated from 153 µm mesh zooplankton net samples collected from sites in Lake Huron, St. Clair River, Lake St. Clair, and Detroit River (Fig. 2a-6). Crustacean zooplankton were sampled with vertical hauls using a 0.5-m-diameter zooplankton net retrieved at a speed of 0.5 m/s.

Habitat Mapping

Side-scan sonar (EdgeTech) and under-water TV for habitat mapping was conducted in the SCR in the spring/summer of 2013. Sites focused on areas that have been determined to be potential areas for future reef construction or restoration sites (Figure 2a-4). Data collection is complete at Hart's Light and Algonac, which are priority sites that were picked for "enhancement" in 2013. Data processing is 70% complete for Hart's Light, and just beginning on Algonac N. Channel Split. Other sites where we are still collecting data are Marysville, Mid-Channel, Chenal A Bout Rond, and Marine City.

To assess a candidate location of an artificial spawning reef project, water depths and velocities in the Detroit River northeast of Grassy Island (NEGI) were measured with a Sontek M9 acoustic Doppler current profiler (ADCP) mounted to the gunwale of a boat. Measurements were made along fourteen transects at NEGI on 9 and 29 August, 21 November, and 4 December 2013. All transects were perpendicular to flow, with measurements starting at the right bank (banks designed while looking downstream) and moving toward the left bank.

Plans for habitat mapping in 2014 include finishing data collection and processing for the SCR sites listed above, as well as begin data collection and processing at DR sites Fort Wayne, Belle Isle, and Grassy Island. Additional ADCP assessments will also occur at these same sites.

References

Henning, B.F., K.L. Kapuscinski, and J.M. Farrell. 2014. Nearshore fish assemblage structure and habitat relationships in protected and open habitats in the upper St. Lawrence River. Journal of Great Lakes Research. In press.

Roseman, E.F., B.A. Manny, J. Boase, G. Kennedy, M. Child, J. Craig, K. Soper, and R. Drouin. 2011a. Lake Sturgeon response to a spawning reef constructed in the Detroit River. Journal of Applied Ichthyology 27(Suppl 2):66-76.

Roseman, E.F., J. Boase, G.W. Kennedy, and J. Craig. 2011b. Adaptation of two techniques for sampling fish eggs and larvae in deep rivers. Journal of Applied Ichthyology 27(Suppl 2):89-92.

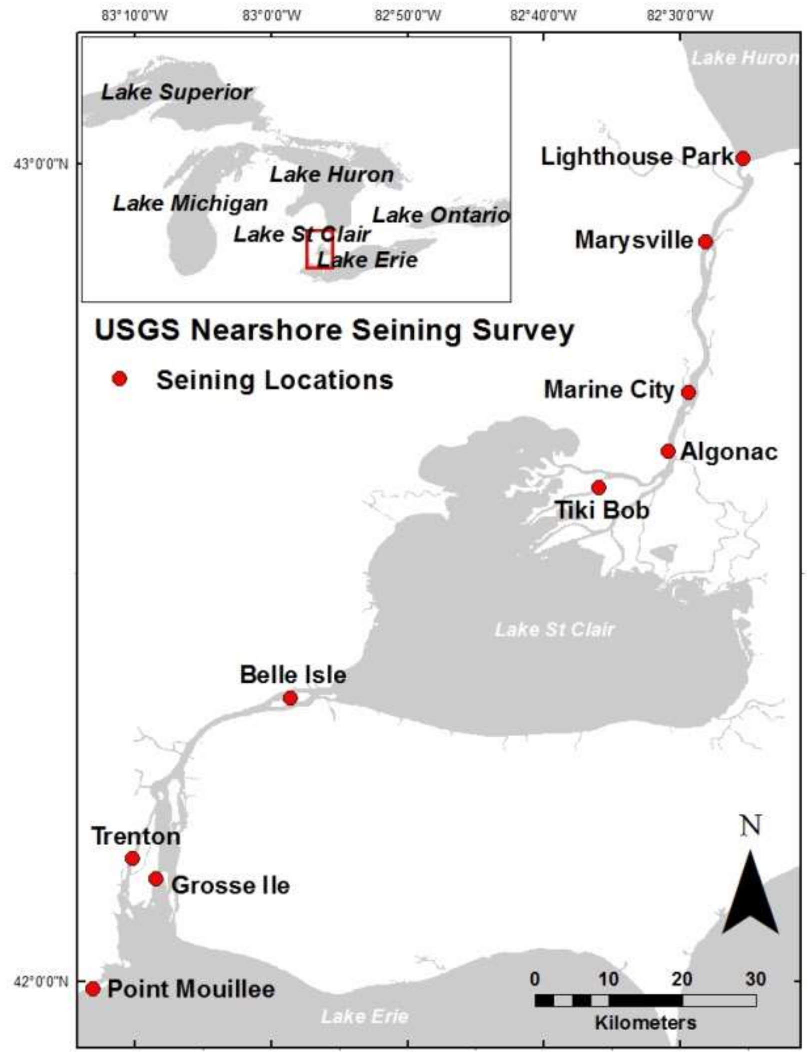

Figure 2a-5. Locations of nearshore seining in the St. Clair and Detroit Rivers during 2013.

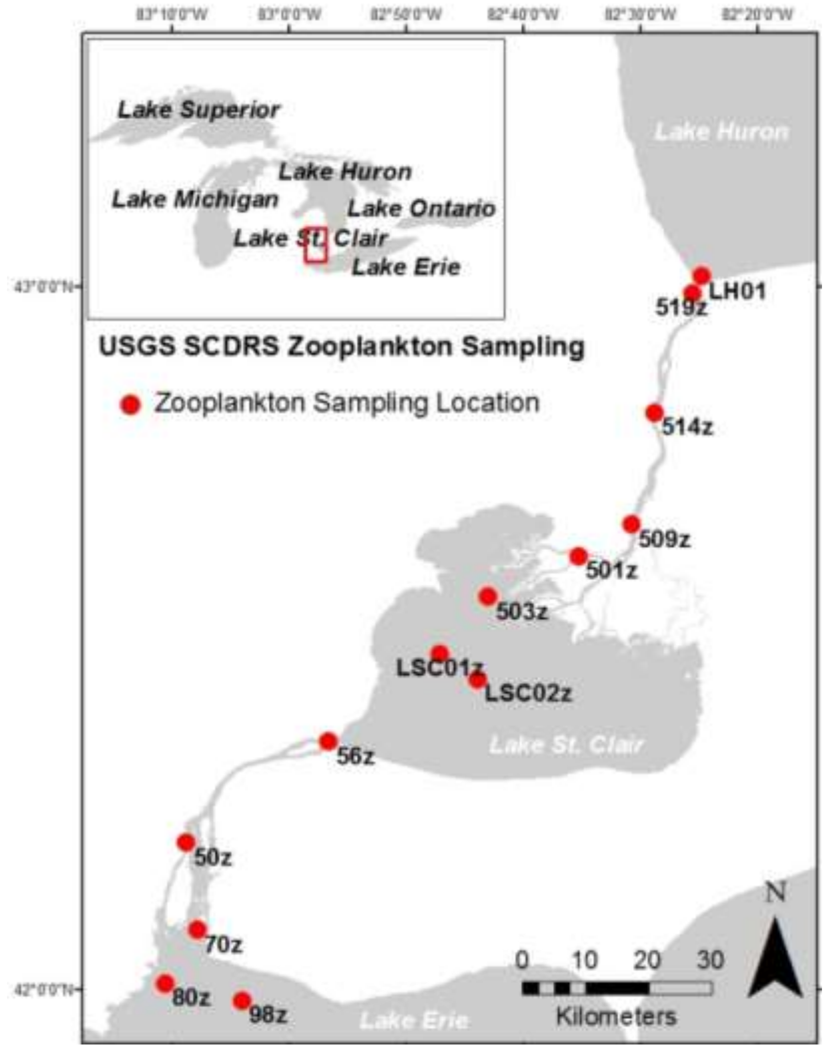

Figure 2a-6. Zooplankton sampling locations within the St. Clair-Detroit River System, 2012-13.

Adult Lake Sturgeon Setline Assessments

<u>2013 Progress</u>

Detroit River - The U.S. Fish and Wildlife Service (Service) has been conducting setline assessments in the Detroit River annually beginning in 2002 to obtain information on adult and subadult lake sturgeon. This data is used to obtain growth information, genetics, distribution, potential spawning sites, and population demographic information. To date, 282 sturgeon have been tagged. Using this mark-recapture data, the estimated population size of adult and subadult lake sturgeon in the Detroit River is near 4,000 individuals (95% CI = . In the spring of 2013, setline assessments began on April 4th,and continued until July 1st. Water temperature during this time period ranged from 2.2 – 21.2°C. A total of 41 lake sturgeon were captured during setline assessments. Twenty-five of these fish were implanted with transmitters to monitor movement throughout the St. Clair-Detroit River System as part of a larger project funded by the Great Lakes Fishery Trust. Since 2012, 36 lake sturgeon captured in the Detroit River have received transmitters as part of this project. Setllines were also deployed at a candidate reef construction site (Fort Wayne Reef) to monitor adult lake sturgeon use at this site prior to reef construction.

Southern Lake Huron/Upper St. Clair River - Beginning in 2012 the Service began deploying setlines in southern Lake Huron and upper St. Clair River near Port Huron, MI to collect lake sturgeon as part of the Great Lakes Fishery Trust lake sturgeon movement project. In the spring of 2013, setline assessments began on May 22nd and continued until June 4th. Water temperature during this time period ranged from 9.0 – 12.0°C. A total of 54 lake sturgeon were captured during setline assessments. Since 2012, 92 adult lake sturgeon have been captured during setline assessments and 64 have received transmitters as part of this project. Setlines were also deployed in the St. Clair River near the Hart's Light candidate spawning reef construction site. Two lake sturgeon were captured at this site, one a male in spawning condition.

Ultrasound - An ultrasound unit was purchased by the Service in 2012 to evaluate the utility of this gear to determine sex and maturity status of lake sturgeon in the field. The Great Lakes Fishery Trust Lake Sturgeon movement project provided us with the opportunity to test the ultrasound on fish of known sex since a small incision would be needed to insert transmitters. In 2013, ultrasound images were taken of 64 lake sturgeon. Since 2012, ultrasound images have been collected from 124 adult lake sturgeon in the St. Clair-Detroit River System.

Genetics - Blood samples and morphological pictures of lake sturgeon were collected from fish that received transmitters in southern Lake Huron. The blood samples and pictures will be used to determine if a distinction can be made between river and lake resident sturgeon by graduate students at West Virginia University.

2014 Plans

Detroit River - Lake sturgeon tagging will continue in the Detroit River to obtain population demographic (ex. stock size, survival, and movement) information. This will mark the 12th year of subadult and adult lake sturgeon assessments. A subsample of fish captured will receive transmitters as part of the lake sturgeon migration project.

Southern Lake Huron – Lake sturgeon setline assessments will continue in southern Lake Huron and in the Upper St. Clair River to capture sturgeon as part of the lake sturgeon migration project. In a cooperative project with the Ontario Ministry of Natural Resources and Purdy Fisheries Commercial Fishery, lake sturgeon captured in commercial trap nets will be tagged in order to obtain population demographic information in southern Lake Huron.

Upper St. Clair River – Setlines will be deployed during the spring spawning season at the Hart's Light proposed reef locations to monitor use of this area by adult lake sturgeon prior to reef construction.

Ultrasound images will be taken of all fish that receive a transmitter as part of the lake sturgeon migration project. Genetic and blood samples will continue to be collected.

This work is conducted in cooperation with the USGS Great Lakes Science Center, Michigan Department of Natural Resources, Great Lakes Fish Commission, Ontario Ministry of Natural Resources, and West Virginia University.

Juvenile Lake Sturgeon Assessments

2013 Progress

The Service has been conducting juvenile lake sturgeon assessments in the St. Clair-Detroit River System (SCDRS) since 2010 evaluating habitat restoration efforts and gaining a better understanding of juvenile distribution and abundance in this system. Juvenile lake sturgeon have been targeted using otter trawls and monofilament gill nets.

In 2013, juvenile lake sturgeon assessments were conducted in Southern Lake Huron and Western Lake Erie (Detroit River mouth) using a basin-wide protocol developed by the Lake Superior Lake Sturgeon Task Group. These assessments are designed to target juvenile sturgeon 3-15 years of age. Gill nets were 305 m in length and panels consisted of 183 m of 114 mm mesh, 62 m of 203 mm mesh, and 62 m of 254 mm mesh. Nets were placed at random locations in three different zones (0-2, 2-5, and 5-10 km) originating from the headwaters of the St. Clair River and mouth of Detroit River. Fifty percent of effort was allocated in the 0-2 km zone while 25% in the other two zones. This technique has proven to be successful in other areas of the Great Lakes to capture juvenile lake sturgeon. In Southern Lake Huron, 16 nets were set on August 5th – 7th, water temperatures ranged between 19.5 – 20.3°C. One juvenile lake sturgeon was captured (601mm total length) in the 114 mm mesh. Catch and catch per unit effort (CPUE = number/ gill net night) can be seen in Table 2a-1. In Western Lake Erie, 16 nets were set on August 13th – 20th, water temperatures ranged between 20.7 – 22.7°C. Seven juvenile lake sturgeon were captured (573 – 787 mm total length). Six of these fish were captured in the 114 mm mesh, while one was captured in the 203 mm mesh (721 mm total length). All lake sturgeon were captured in the same net on the same day. CPUE can be seen in Table 2a-1.

The sampling design described above was also employed using smaller mesh gill nets in the fall of 2013 targeting younger age classes (age 0-1) of sturgeon. Gill nets were 91 m in length and panels consisted of 30 m of 25 mm, 30 m of 38 mm, and 30 m of 51 mm mesh. This technique has proven to be successful in other areas to capture juvenile lake sturgeon (Barth et al. 2009). In Southern Lake Huron, 16 nets were set on September 23rd and 24th, water temperatures ranged between 17.2 – 17.7°C. No lake sturgeon were captured. CPUE can be seen in Table 2a-1. In Western Lake Erie, 27 nets were set on August 26th – September 4th, water temperatures ranged between 22.3 – 24.3°C. No lake sturgeon were captured. CPUE can be seen in Table 2a-1.

Small-mesh gill nets were also deployed in the Detroit and St. Clair Rivers to capture age-0 and age-1 juvenile lake sturgeon. Set locations were determined by placing a 500 m x 500 m grid over each river. Grids were then randomly chosen for set locations. Deep areas (> 15 m in depth) in each river were also targeted for sampling. Assessments were conducted on September 10th – September 18th, water temperature ranged between 18.0 – 22.1°C. Thirteen gill nets were set in the Detroit River and 21 in the St. Clair River. No lake sturgeon were captured in the Detroit River. Three juvenile lake sturgeon were captured in the St. Clair River (325 mm, 409 mm, and 702 mm in total length). CPUE can be seen in Table 2a-1.

Table 2a-1. Catch per unit effort (CPUE = number/gill net night) of fish species captured during basin-wide and small-mesh juvenile lake sturgeon assessments in Southern Lake Huron and Western Lake Erie.

	Basin-wide gillnets		Small-mesh gillnets			
Species	Western Lake Erie	Southern Lake Huron	Western Lake Erie	Southern Lake Huron	Detroit River	St. Clair River
Black redhorse	-	-	-	-	-	0.05
Bowfin	0.06	-	-	-	-	-
Channel catfish	2.00	0.13	0.07	-	0.08	-
Common carp	1.00	0.25	-	-	-	-
Freshwater drum	1.69	0.31	0.04	-	-	-
Gizzard shad	13.81	0.13	0.11	-	-	-
Golden redhorse	0.06	-	0.04	-	-	0.15
Goldfish	0.06	-	-	-	-	-
Lake sturgeon	0.44	0.06	-	-	-	0.15
Largemouth bass	0.19	-	0.07	-	-	0.05
Longnose gar	0.06	-	-	-	0.08	-
Muskellunge	-	-	0.04	-	-	-
Northern hog sucker	-	-	0.04	-	0.08	-
Northern madtom	-	-	-	-	-	0.05
Pumpkinseed	-	-	0.04	-	0.08	-
Quillback	0.06	-	-	-	-	-
Rock bass	-	-	1.15	0.06	0.62	0.10
Round goby	-	-	0.04	0.31	-	0.05
Shorthead redhorse	0.13	0.56	-	-	-	0.05
Silver chub	-	-	-	-	-	0.10
Silver redhorse	0..25	0.50	-	-	-	-
Smallmouth bass	4.06	1.00	2.04	0.06	0.77	0.10
Spottail shiner	-	-	0.07	0.25	-	0.15
Spotted sucker	-	0.06	-	-	-	-
Stonecat	0.06	-	0.11	-	0.31	0.30
Trout perch	-	-	-	-	-	0.10
Walleye	0.38	0.31	0.15	0.38	0.15	0.30
White bass	0.06	-	0.04	0.06	-	0.05
White perch	-	-	5.78	0.25	0.69	-
White sucker	-	-	-	-	-	3.20
Yellow bullhead	-	-	0.07	-	-	-
Yellow perch	-	-	6.15	0.13	0.08	0.25

2014 Plans

St. Clair River – Small-mesh gill nets will be deployed in the lower St. Clair River targeting age-0 and age-1 juvenile lake sturgeon. Assessments will focus in areas below habitat enhancement projects (Middle Channel reef, Hart's Light reef, and Pointe Aux Chenes reef), and deep areas (> 15 m in depth) throughout the lower river. Sites will be determined by placing a 500 m x 500 m grid over the river and randomly selecting grids for set locations.

Detroit River/Western Lake Erie – Setlines will be deployed in the lower Detroit River and Western Lake Erie targeting juvenile lake sturgeon. Sites will be determined by placing a 500 m x 500 m grid over the area and randomly selecting grids for set locations. Deep areas will also be targeted.

Lake Erie – Thirteen locations will be sampled in Lake Erie to assess the abundance of juvenile lake sturgeon. This basin-wide effort is a collaborative project with the U.S. Fish and Wildlife Service, Ohio Department of Natural Resources, Ontario Ministry of Natural Resources, Michigan Department of Natural Resources, and Pennsylvania Fish and Boat Commission. Gill nets will be 152 m in length and panels will consist of 91 m of 114 mm mesh, 30 m of 203 mm mesh, and 30 m of 254 mm mesh. Nets will be placed at random locations in three different zones (0-2, 2-5, and 5-10 km) originating from the mouths of tributaries which historically supported or are believed to support lake sturgeon populations. Fifty percent of effort will be allocated in the 0-2 km zone while 25% in the other two zones.

References

Barth, C.C., S.J. Peake, P.J. Allen, and W.G. Anderson. 2009. Habitat utilization of juvenile lake sturgeon, *Acipenser fulvescens*, in a large Canadian river. J. Appl. Ichthyol. 25 (Suppl. 2) 18-26.

Adult Fish Community Assessments Associated with Habitat Enhancement Projects

<u>2013 Progress</u>
The Service has been deploying gill nets to monitor the adult fish community before and after the construction of reefs within the St. Clair-Detroit River System. Experimental gill nets have been fished once per week in the spring and early summer (April through June) and fall (November, December) at several locations in the St. Clair and Detroit Rivers. Locations in the St. Clair River include: the Middle Channel Reef, North Channel Control Site, Hart’s Light Reef, and Pointe Aux Chenes Reef. Locations in the Detroit River include the Fort Wayne Reef. An overview of assessment effort can be viewed in Table 2a-2. Two to three gill nets were set at each location. Gill nets consisted of mesh sizes ranging from 75 to 150 mm in 12.5 mm increments with each net having 14 panels (2 of each mesh size). Nets dimensions were 2 m tall x 7.6 m panels x 14 panels (with randomly placed mesh sizes) for a total length of 106 m. Common biological metrics were collected from each fish species along with genetic samples and aging structures from select sport fish.

Table 2a-2 Gill net assessment effort associated with the reef construction projects. Effort is reported in hours, number of weeks assessments occurred in parentheses.

Year	Season	Fort Wayne Reef	Pointe Aux Chenes Reef	Hart's Light Reef	Middle Channel Reef	North Channel Control Site
2010	Spring	-	-	-	184 (6 weeks)	-
	Fall	-	-	-	-	-
2011	Spring	-	-	-	445 (7 weeks)	266 (5 weeks)
	Fall	-	-	-	135 (2 weeks)	91 2 (weeks)
2012	Spring	-	-	-	113 (2 weeks)	143 (2 weeks)
	Fall	191 (4 weeks)	-	-	219 (4 weeks)	194 (4 weeks)
2013	Spring	304 (10 weeks)	370 (8 weeks)	298 (7 weeks)	403 (8 weeks)	383 (8 weeks)
	Fall	-	237 (5 weeks)	222 (5 weeks)	263 (5 weeks)	249 (5 weeks)

St. Clair River Spring Gill Net Sampling - Spring gill net catch per unit effort (CPUE) in hours, total number of fish captured, sampling dates, and water temperature at each reef location can be viewed in Table 2a-3. Species richness was highest at the Middle Channel Reef site (20), followed by North Channel Control (17), Pointe Aux Chenes (13), and Hart's Light Reef (11). Species richness was likely lower at the Pointe Aux Chenes and Hart's Light sites because sampling just began at these sites in 2013, while the other sites have been sampled for several seasons. Lake sturgeon have been captured at the North Channel Control site, Middle Channel Reef, and Pointe Aux Chenes sites, however CPUE was greatest at the North Channel Control site. At the North Channel Control site 11 lake sturgeon have been captured with the majority of these fish being juveniles. Northern madtom have been captured at the North Channel Control site, Middle Channel Reef site, and Pointe Aux Chenes site. However, it should be noted that the gill nets used in these assessments are not effective at sampling northern madtom. Walleye have been captured at all sites, with the highest CPUE at Hart's Light (0.141 fish/hr), which was twice as high as any other site during all years. White sucker have also been collected at every site with similar CPUE values. Information regarding other fish species can be found in Table 2a-3.

Detroit River Spring Gill Net Sampling - Eleven fish species were captured at the Fort Wayne Reef site in the Detroit River in the spring of 2013. No lake sturgeon or northern madtom were captured in gill nets at this site. Walleye CPUE was 0.658 fish/hr, nearly five times higher than the highest walleye CPUE observed in the St. Clair River. Information regarding other fish species can be found in Table 2a-3.

Table 2a-3. Spring gill net catch per unit effort (CPUE), total number of fish captured, sampling dates, and water temperature at each reef location in the St. Clair and Detroit Rivers.

SPRING GILL NET	St. Clair River									Detroit River
	North Channel (Control)			Middle Channel				Hart's Light	Algonac	Fort Wayne
Year	2011	2012	2013	2010	2011	2012	2013	2013	2013	2013
Common carp	0.004	-	-	-	-	-	-	-	-	-
Channel catfish	-	-	-	-	-	-	-	0.003	0.003	0.003
Chinook salmon	-	-	-	-	0.007	-	-	-	-	-
Freshwater drum	-	-	-	0.005	-	-	-	-	-	-
Gizzard shad	-	-	0.004	-	-	0.009	-	-	-	0.007
Golden redhorse	0.004	-	0.004	-	-	0.009	0.012	0.010	0.014	0.003
Lake sturgeon	0.008	0.021	0.016	-	0.002	-	-	-	0.005	-
Lake whitefish	-	-	-	-	-	-	-	-	-	-
Largemouth bass	0.004	-	-	-	-	-	-	-	-	-
Logperch	-	-	-	-	-	-	-	-	-	-
Nothern hogsucker	0.015	-	-	0.016	-	0.009	-	0.007	0.014	-
Northern madtom	0.004	-	-	-	0.002	-	-	-	0.003	-
Northern pike	-	0.007	-	0.021	0.010	0.009	-	-	-	-
Rainbow trout	-	-	-	-	0.002	-	-	-	-	-
Rock bass	0.030	-	0.013	0.026	0.020	-	0.027	0.003	0.024	0.020
Round goby	-	-	-	-	0.002	-	-	-	-	-
Shorthead redhorse	0.004	-	0.004	0.016	0.005	-	0.016	0.034	0.005	0.026
Silver lamprey	-	-	-	-	-	-	-	-	-	-
Silver redhorse	0.019	-	0.004	0.037	0.022	-	0.008	0.003	0.014	0.026
Smallmouth bass	-	-	-	-	0.002	-	-	-	-	0.026
Spottail shiner	-	-	-	-	-	-	-	-	-	-
Spotted sucker	-	-	0.004	-	-	-	-	-	-	-
Stonecat	0.015	-	0.013	-	0.018	-	0.016	0.003	0.030	-
Walleye	0.034	0.028	0.029	0.037	0.030	0.044	0.070	0.141	0.043	0.658
White bass	0.038	-	0.038	0.032	0.065	-	0.019	0.007	0.011	0.322
White perch	-	-	-	0.005	0.002	-	-	0.010	0.003	0.115
White sucker	0.083	0.153	0.113	0.042	0.023	0.096	0.132	0.148	0.165	0.023
Yellow perch	-	0.007	-	-	0.007	-	-	-	-	-
Total Fish Captured	69	31	60	45	151	20	77	110	123	374
Dates Sampled	5/11 - 6/21	4/13 - 4/26	4/1 - 6/18	4/19 - 6/8	4/13 - 6/21	4/13 - 4/26	4/1 - 6/18	4/8 - 6/17	4/1 - 6/17	4/2 - 7/1
Water Temperature	9.5 - 16.9	5.8 - 8.3	2.0 - 14.8	8.1 - 18.7	4.9 - 17.4	5.8 - 8.3	1.7 - 14.8	2.0 - 14.8	2.0 - 15.1	3.6 - 21.1

St. Clair River Fall Gill Net Sampling - Fall gill net (CPUE) in hours, total number of fish captured, sampling dates, and water temperature at each reef location can be viewed in Table 2a-4. Species richness was highest at the North Channel Control site (20), followed by the Middle Channel Reef site (17), Pointe Aux Chenes site (8), and Hart's Light Reef site (5). Species richness was likely lower at the Pointe Aux Chenes and Hart's Light sites because sampling just began at these sites in 2013, while the other sites have been sampled for several seasons. Lake sturgeon have been captured at the North Channel Control site and at the Middle Channel Reef site, however CPUE was greatest at the North Channel Control site. At the North Channel Control site, nine lake sturgeon have been captured with the majority of these fish being juveniles. Northern madtom have been captured at the North Channel site and Middle Channel Reef site. However, it should be noted that the gill nets used in these assessments are not effective at sampling northern madtom. Walleye and white sucker have been captured at all sites with similar CPUE values during all years. Information regarding other fish species can be found in Table 2a-4.

Table 2a-4. Fall gill net catch per unit effort (CPUE), total number of fish captured, sampling dates, and water temperature at each reef location in the St. Clair and Detroit Rivers.

FALL GILL NET	**St. Clair River**								**Detroit River**
	North Channel (Control)			Middle Channel			Hart's Light	Algonac	Fort Wayne
Year	2011	2012	2013	2011	2012	2013	2013	2013	2012
Common carp	-	-	0.004	-	-	-	-	-	-
Channel catfish	-	-	-	-	0.002	-	-	-	-
Chinook salmon	-	-	-	-	-	-	-	-	-
Freshwater drum	-	-	-	-	-	-	-	-	-
Gizzard shad	-	0.010	0.016	0.006	0.009	-	-	-	0.073
Golden redhorse	0.011	0.004	0.004	0.006	-	0.004	0.010	0.008	-
Lake sturgeon	0.011	0.010	0.024	-	-	0.004	-	-	-
Lake whitefish	-	-	-	-	-	-	-	-	0.005
Largemouth bass	-	-	-	-	-	-	-	-	-
Logperch	-	0.002	-	-	0.002	-	-	-	-
Nothern hogsucker	0.011	0.002	-	0.006	-	-	-	0.013	0.005
Northern madtom	-	0.006	-	-	0.004	-	-	-	0.005
Northern pike	0.011	0.006	-	0.039	0.007	-	-	-	-
Rainbow trout	-	0.002	-	-	-	-	-	-	-
Rock bass	-	0.014	0.004	0.006	0.024	0.011	-	0.013	-
Round goby	-	0.002	-	-	0.002	-	-	0.004	-
Shorthead redhorse	0.011	0.016	0.040	0.006	-	0.023	0.041	0.008	0.020
Silver lamprey	-	0.002	-	-	-	-	-	-	-
Silver redhorse	0.011	0.008	0.004	0.013	-	-	0.005	-	-
Smallmouth bass	-	-	-	0.013	-	-	-	0.017	0.037
Spottail shiner	-	0.002	-	-	-	-	-	-	-
Spotted sucker	-	-	-	-	-	-	-	-	-
Stonecat	-	0.006	-	-	0.004	-	-	-	-
Walleye	0.022	0.008	0.012	0.026	0.046	0.011	0.045	0.038	0.105
White bass	-	-	0.004	-	-	-	-	-	-
White perch	-	0.027	-	-	0.004	-	-	-	-
White sucker	-	0.002	0.004	0.013	0.004	0.011	0.005	0.008	0.010
Yellow perch	-	0.002	-	-	-	-	-	-	-
Total Fish Captured	8	65	29	21	52	15	23	26	50
Dates Sampled	11/14 - 11/30	10/11 - 12/6	10/22 - 11/19	11/14 - 11/30	10/17 - 12/6	10/22 - 11/19	10/22 - 11/19	10/22 - 11/19	11/6 - 12/6
Water Temperature	6.0 - 10.0	5.8 - 14.2	7.3 - 13.5	6.0 - 10.0	3.7 - 13.7	7.4 - 13.6	6.7 - 13.5	7.4 - 13.5	5.1 - 6.4

Pre/Post Reef Gill Net Comparisons - Comparisons pre and post reef construction can only be made at the Middle Channel Reef site. Prior to reef construction, 20 fish species were documented at the reef construction site. Since construction two additional fish species have been documented at this site, channel catfish and logperch. Target species, walleye, white sucker, and redhorse sucker (golden redhorse, shorthead redhorse, and silver redhorse) CPUE in the spring of 2013 (first spring post-construction) remained similar to 2010, 2011, and 2012 (pre-construction) (Figure 2a-7). CPUE values comparing other fish species pre and post-construction remained fairly stable. Data collection during the spring of 2014 will provide more insight regarding pre and post-construction comparisons.

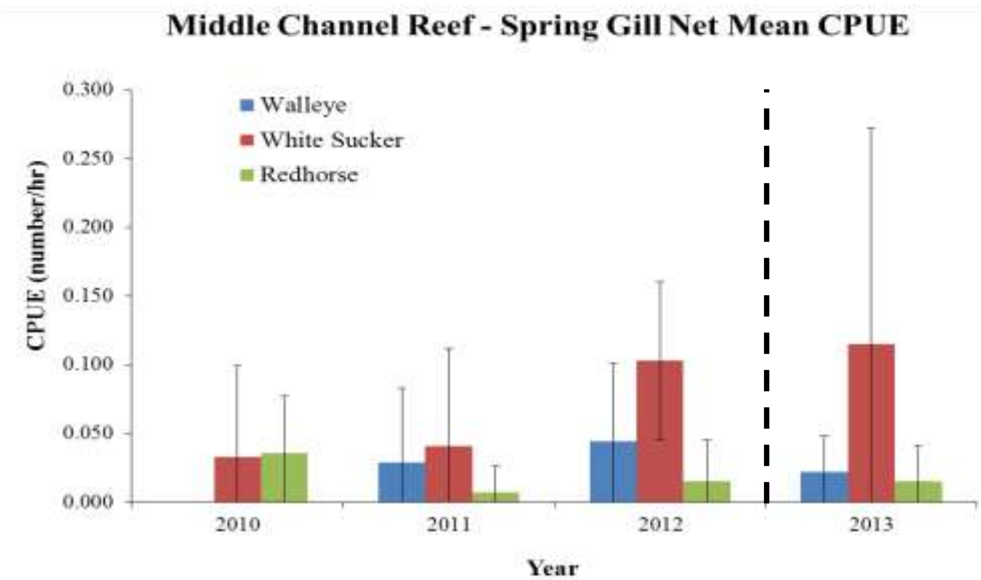

Figure 2a-7. Walleye, white sucker, and redhorse sucker spring gill net CPUE at the Middle Channel Reef site. Vertical dashed line represents pre and post reef construction periods. Data was standardized (4.9 – 14.8 C) to include water temperature ranges sampled during all years

Juvenile Lake Sturgeon at the North Channel Control Site - The North Channel control site near the head of Russel Island and Pointe Aux Chene seems to be an important area for juvenile lake sturgeon. Between 2011 and 2013 a total of 22 juvenile lake sturgeon (0.020 fish/hr) have been captured at this location ranging in size from 335 – 1122 mm.

<u>2014 Plans</u>

St. Clair River - The Service plans to deploy two gill nets weekly during the spring (April-late June) and fall (middle November – middle December) at the Hart's Light, Pointe Aux Chenes, and North Channel control site in the St. Clair River. Gill net sampling at the Middle Channel reef will only be conducted during the spring. Two Gee minnow traps will also be attached to gill nets to monitor the benthic fish community at these locations.

Detroit River – Gill nets will be deployed weekly during the spring (April – late June) and fall (middle November – middle December) at Fort Wayne and a candidate reef site near Grassy Island. Two Gee minnow traps will also be attached to gill nets to monitor the benthic fish community.

2b. Assessment of the Nearshore Fish Community

E. Weimer

The fish community of the Lake Erie western basin nearshore historically contained many common phytophilic fish species (e.g., centrarchids, esocids), and even provided a valuable component to the commercial fishery (Baldwin et al. 1995). From the early 1900s until the 1970s, these species have suffered the impacts of increased anthropogenic activity (shoreline development, wetland loss and reduced water quality and clarity) in the Lake Erie watershed (Casselman and Lewis 1996), leading to a severe community decline in the lake. Following the 1972 signing of the Great Lakes Water Quality Agreement, water quality in Lake Erie generally improved, especially clarity as influenced by reductions in phosphorus and, later, the introduction of exotic Dreissenid mussels (Charlton et al. 1999). Improved water clarity and recent low water levels have stimulated an increase in the production of aquatic macrophytes along the shoreline of the western basin. This has led to increases in the occurrence of phytophilic fish species in ODNR trawling catches at some standardized sites (Division of Wildlife, unpublished data). However, the design of the current trawling program is not extensive enough in nearshore habitat to properly assess this community. In 2007, Division of Wildlife personnel from the Sandusky office began an annual survey in the western basin to assess the composition and abundance of the fish community in the nearshore habitats of Lake Erie. Twelve sites that represent a gradient of geomorphologic and anthropogenic influences to nearshore Lake Erie were selected using the Lake Erie GIS. Trawling was used in 2007 and 2008, but was abandoned due to difficulty caused by sampling in shallow water with debris. During 2009 and 2010, daytime electrofishing was used to gain better access to nearshore areas and to sample more fish.

During 2011 and 2012, the University of Toledo's Lake Erie Center undertook a cooperative project (FSGR02) with the Sandusky office of the Ohio Division of Wildlife to develop an optimal survey design for the nearshore fish community of western Lake Erie. The project objectives included a focus on sampling method, duration and timing of sampling, and number and location of survey sites. The recommendations generated by this project have been incorporated into the Division of Wildlife nearshore survey for 2013 and beyond. The methods described below reflect these changes. More information on FSGR02 can be found at Ross (2013).

Sites were selected from the 20 sites used by Ross (2013), which includes a mix of sites sampled by the Division Of Wildlife in previous years and new sites. Ten sites were sampled in 2013; future sampling will target the same 10 sites plus 2 additional sites selected from Ross's remaining sites. These additional sites will be rotated so that all sites will be sampled every five years. Each site consists of five, 100-m shoreline transects. Sampling begins ½ hour after sunset, and no more than two sites will be sampled in any given night. Two netters using fine-mesh dip nets will be located on the bow of the electrofishing boat, and all fish are netted. Low range (50-500 volts), DC settings is used on the Smith-Root control box, and every effort is made to maintain 6 amps of current. Other equipment and methods will follow Ohio EPA standards (Thoma 1999) to allow data sharing.

Fish were processed after each 100-m transect. Catches of most species were enumerated by species and age class, and weights recorded. Centrarchids were preserved by site and transect, and transported to the laboratory. This was done in order to collect length and weight with higher precision then field conditions allow, as well as to collect otoliths for age and growth analysis. Catches of age-0 non-centrarchids were preserved and processed at the lab to reduce field time. In 2013, 10 sites between Toledo and Huron were sampled using night electrofishing between June 26 and July 18, 2013 (Figure 2b-1).

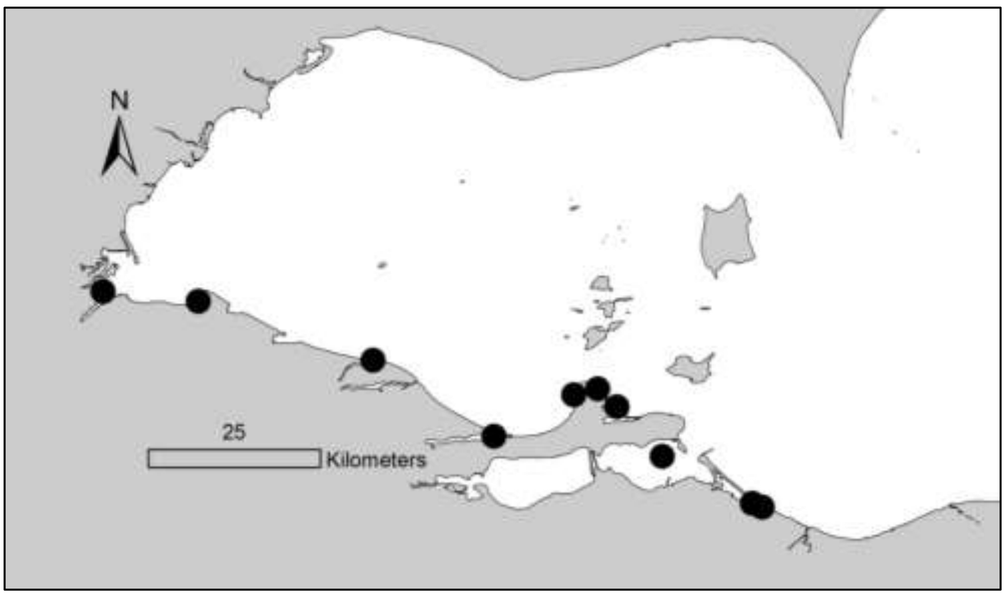

Figure 2b-1. Sites sampled during the 2013 Nearshore Fish Community Assessment Survey, Ohio waters of Lake Erie.

These sites represent our 10 base sites; additional sites were not sampled. Twenty-nine species were collected. Of the 1,840 total fish collected, 266 were centrarchids, mostly bluegills and largemouth bass (n = 128 and 114, respectively). Electrofishing catch of legal-size (14”, 355 mm) largemouth bass was 11/hour. Stock density indices were calculated for bluegills and largemouth bass (Willis et al. 1993); the relative stock density for quality length fish in the Lake Erie nearshore is 34 and 58, respectively. In addition, sixteen percent of stock-length (200 mm) largemouth bass were preferred-length (380 mm) or larger. The availability of sizable largemouth bass in the nearshore likely contributes to the increased targeted effort by recreational anglers (unpublished data).

We calculated an index of biotic integrity (IBI) developed for Great Lakes coastal areas by Minns et al. (1994) for each site. Reported on a scale from 0 to 100 (with the higher score indicating the best quality fish community), 2013 IBI scores ranged from 52.1 to 81.5 across sites, with a mean score of 70.7. The 2013 mean IBI was higher than those in 2009 (61.9) and 2010 (52.8), likely an artifact of electrofishing during day versus night.

The influence of nearshore habitat on the fish community has been documented previously (Ross 2013). Mean species richness and IBI score were calculated for differing nearshore habitats (Figure 2b-2).

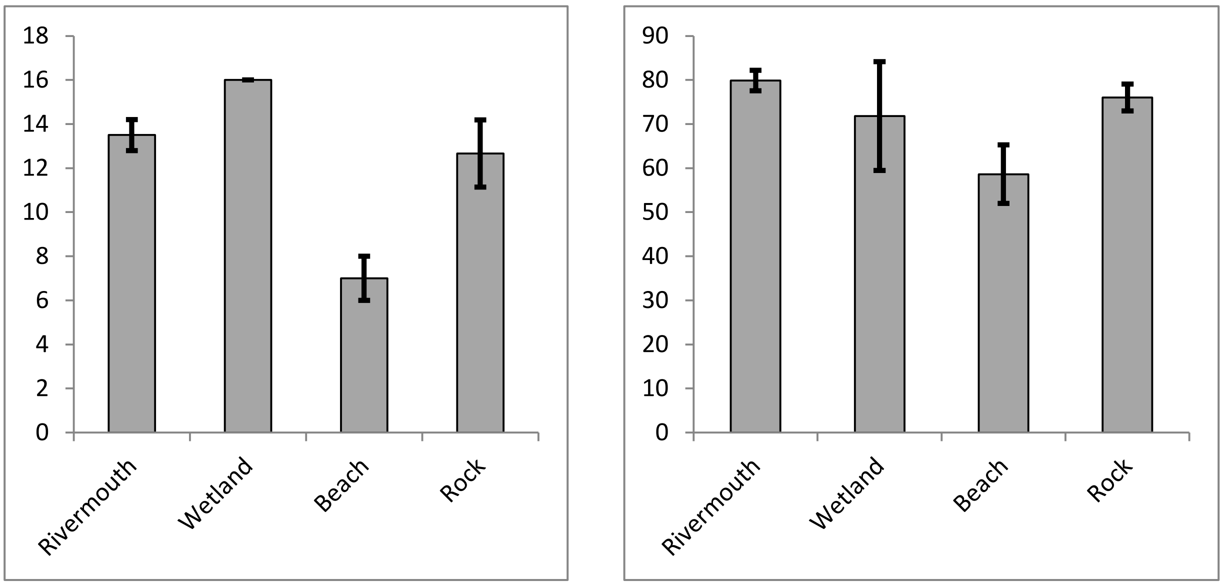

Figure 2b-2. Species richness (A) and Index of Biotic Integrity (IBI) scores (B) across four nearshore habitat types. Error bars are ± standard deviation.

Habitats were classified using general substrate characteristics (wetland, beach, and bedrock); a fourth classification (rivermouth) was used at two sites within rivermouths where the nearshore substrates were heavily modified with rip-rap. In total, rivermouth and wetland classifications contained two sites each, while beach and bedrock classes consisted of 3 sites each. In general, fewer species were collected in beach habitats than at other habitats. In addition, IBI scores were lower in beach habitats than in rivermouths and bedrock habitats. This type of information should be useful to agencies with shoreline regulatory authority, engineers, and municipalities interested in incorporating elements into nearshore modification projects that are beneficial to the fish community.

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2c. Central Basin Hypoxia and Yellow Perch

C. Knight, R. Kraus, A.M. Gorman

In systems that are seasonally affected by hypoxic bottom waters, such as Lake Erie, population assessments may be influenced by anomalous high catch rates of particular species. There is evidence that large catches are caused by an aggregation of fish in marginal habitats due to avoidance of low dissolved oxygen (D.O.). In 2008, for example, we collected 10,739 age-0 yellow perch in one 10 minute tow in normoxic waters adjacent to the hypoxic zone. All other catches at that site averaged 42 fish/tow (range 1-141), and this value was more than 200% greater than the next largest catch in the 22 years of this survey. We tracked the 2008 cohort in subsequent surveys from age-0 to age-2 and found that including this observation had a disproportionate influence on the District-2 (D2) index for that cohort. Including this datum, the 2008 cohort in D2 ranked among the top 15% of hatches in 22 years (i.e. rank of 3). Subsequent sampling of this cohort (as age-0 in the fall of 2008, as age-1 in fall of 2009, or as age-2 from the ADMB estimate in 2010) indicated that it was average (in the top 40-60% of all years). Similarly, low D.O. habitats frequently have zero catches, which may contribute to relative underestimation of year-class strength. Currently, there is no consensus on the best way to handle this sort of variability in the estimation of year-class strength for percids in Lake Erie. In part, this situation is hampered by a lack of understanding of how fish distribution changes in response to low dissolved oxygen.

To better understand how fish distribution changes in response to seasonal hypoxia, we conducted an intensive survey at one site (Chagrin, near the Grand River) in the Ohio waters of the Central Basin in 2011, 2012, and 2013. Early in our investigation we encountered higher than expected variability in dissolved oxygen. We investigated this further with the application of temperature and dissolved oxygen loggers and modifications to trawl survey procedures. The results are still being analyzed and a manuscript is in preparation, which addresses the implications of hypoxia-based habitat compression on the vulnerability of fish to capture in survey and commercial fishing gears. Here we present some preliminary results that illustrate the dynamic temporal and fine-scale spatial variability in dissolved oxygen that influences fish distribution.

In all three years of this research, we expanded our use of temperature-dissolved oxygen loggers to quantify the temporal variability of oxygen in the hypolimnion, and contrary to traditional views of the "dead zone" in Lake Erie's central basin, we found that hypoxic episodes were frequent and often accompanied by rapid changes in temperature (Figure 2c-1).

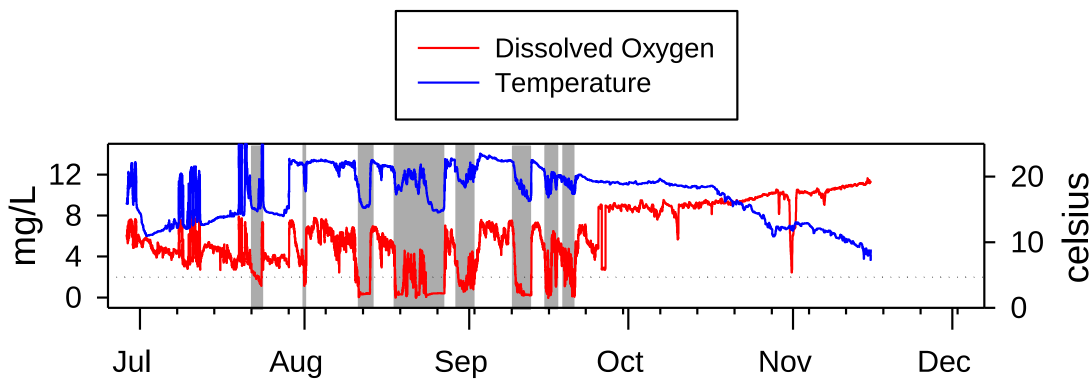

Figure 2c-1. Temperature and dissolved oxygen 2013 time series, near Fairport Harbor, central basin of Lake Erie. Water depth=14.3m. Sensor depth=13.8m. Hypoxic episodes were defined as oxygen concentration <2mg/L (gray shaded areas).

This variability occurred even at shallow depths and illustrated that changes in thermocline depth and hence internal waves were largely responsible for the variability in dissolved oxygen that we observed (Figure 2c-1). These results are being examined in conjunction with nearby commercial trap net catches, and are being used to help inform revised hypoxia monitoring by the US EPA that better addressed Great Lakes Water Quality Agreement goals.

The importance of dynamic temporal variability in dissolved oxygen at a fixed location was emphasize by the spatial variability in hypolimnetic dissolved oxygen that we observed in water quality surveys and alternative approaches to examining survey bottom trawl catches. The intensive study of the Fairport Harbor study site prompted us to measuring water quality at both the beginning and end of bottom trawls conducted during ODNR assessment surveys. As expected many of the August trawl samples were conducted in hypoxic bottom waters, and the catches were significantly lower by one- to several orders of magnitude (Figure 2c-2). Likewise, trawls conducted in normoxic conditions had higher and more variable catches (Figure 2c-2). Surprisingly, several trawls spanned a wide gradient of dissolved oxygen between the end points, complicating our ability to classify the trawls as either hypoxic or normoxic (Figure 2c-2). This high spatial variability in dissolved oxygen within the distance of a trawl sample may in part explain some of the variability in historical survey catches.

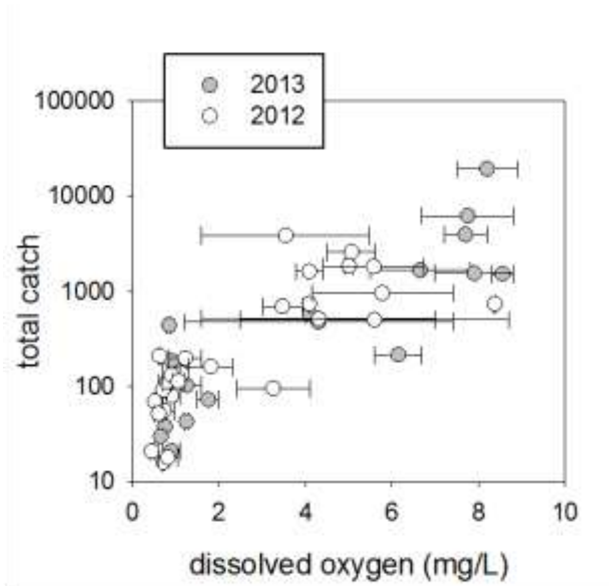

Figure 2c-2. August 2012 and 2013 survey catches, central basin of Lake Erie, Ohio. The error bars illustrate the range of bottom dissolved oxygen observed at the endpoints of the trawl sample. Note that total catch includes all species and is plotted on a log-scale.

To further understand the implications of the 2012 and 2013 results, we developed a more detailed analysis of historical trawl survey assessment results with ODNR data from 1990-2008 in which the bottom dissolved oxygen was classified based upon one water quality sample, either at the beginning or the end of the trawl. This data set was available from an OSU dissertation (T. Farmer, unpublished), which classified trawl samples as hypoxic (bottom dissolved oxygen <3mg/L) or normoxic. For site depths >5m, we identified the nearest neighboring trawl site (within 6 miles) and developed four categories based upon a comparison of each trawl sample pair (Figure 2c-3). Although variability due to small scale hypoxia could not be quantified in this data set, the results suggest that fish may be more concentrated near the edges of hypoxic zones. Hypoxic sites for which the nearest neighboring site was classified as normoxic had higher catches than those for which the nearest neighbor was hypoxic (Figure 2c-3). This provides some indication that these samples may represent cases where the trawl passed through a hypoxic zone boundary. By comparison, normoxic sites for which the nearest neighboring site was hypoxic had slightly higher catches, on average, than those for which the nearest neighbor was normoxic (Figure 2c-3). This latter result suggests that hypoxia may concentrate fish in edge areas, further influencing survey catches and stock assessments.

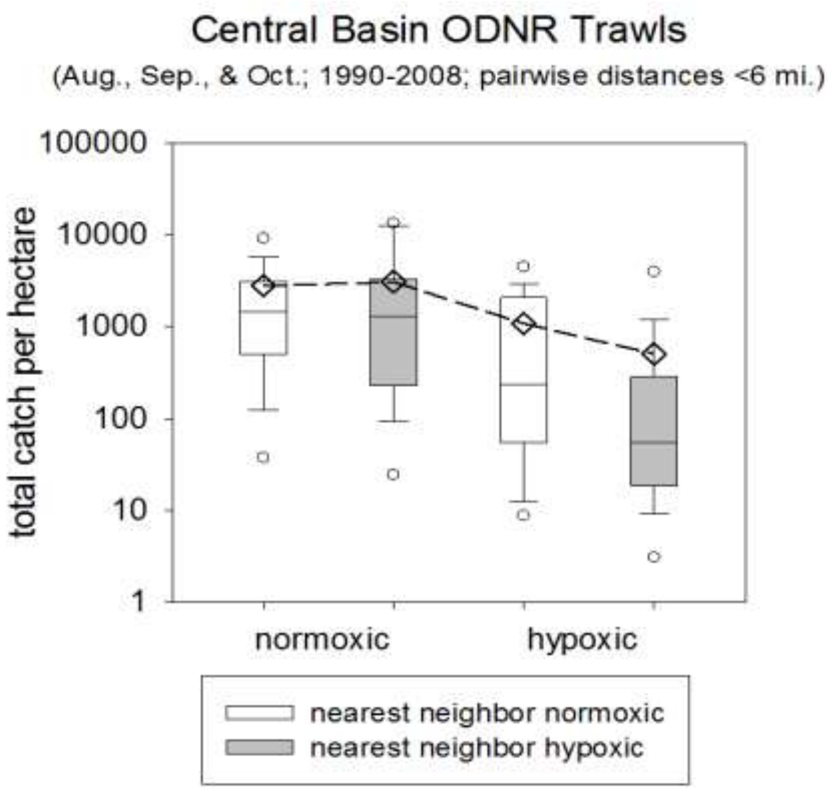

Figure 2c-3. Late summer and early fall survey catches, central basin of Lake Erie, Ohio. Classified by nearest neighboring trawl site characteristics (within 6 miles). The box and whisker plots show percentiles, circles indicate the 5th and 95th. The diamonds and dashed line illustrates the arithmetic mean. The total catch of all fish species is scaled per area (hectare) and plotted on a log scale.

These findings highlight difficulties in characterizing a single trawl sample as hypoxic or normoxic, which has implications for the current interim decision rule to omit trawl samples with low D.O. (<2mg/L) from the calculation of percid recruitment indices. Exactly how this hypoxia-based habitat compression effect influences the reliability of percid stock assessments will have to be informed with additional analysis of existing data, information on spatial variability in dissolved oxygen and catches from other trawl surveys, and simulation exercises with the current population models. The Habitat Task Group supports such efforts towards the improvement of a scientifically-based decision rule.

2d. Other Notable Habitat Projects in Brief

- *Coastal Wetland Re-connection, Middle Harbor (OH)*
  Work began in late-2011 to reestablish connectivity between this coastal wetland and Lake Erie to allow natural water exchange and fish passage. In 2012, a large culvert with water control structure, pump, and carp exclusion screen was constructed between Middle and West Harbor. Middle Harbor was partially dewatered during the fall, in preparation for final drawdown in spring 2013. Fish, invertebrate, and plant community monitoring was completed prior to restoration activities. In 2013, Middle Harbor was partially dewatered (full dewatering was planned, but was not possible due to the bathymetry in the harbor). To avoid colonization by invasive macrophytes and to provide food for migratory birds, Japanese millet was aerially seeded in June. Dewatering and seeding will continue in future years. Once plant community goals have been achieved, restoration will focus on water level management and fish community restoration. Post-reconnection fish, invertebrate, and plant community monitoring will follow. (Ducks Unlimited, The Nature Conservancy, ODNR-DOW, Ohio State Parks)

- *Status of Chautauqua Creek Fish Passage Project (New York)*
  A long awaited fish passage project on Chautauqua Creek (Chautauqua County, New York) was completed by the Army Corp of Engineers (ACOE) during July, 2012. This project was initially started in 2006 through the Great Lake Fisheries and Ecosystem Restoration (GLFER) program and was a collaboration between the ACOE, the NYSDEC (non-federal sponsor), and the Village of Westfield. The goal of the project was to provide fish access to approximately 10 miles of high quality spawning areas in the upper portion of Chautauqua Creek. The design involved two separate dams and included creating a notch in the lowermost dam and a rock ramp at the uppermost dam to promote fish passage of all species. Measures were also added to prevent the upstream migration of invasive Sea Lamprey.

  Unfortunately the project didn't have a long wait to find out if the fish passage design would hold up to a serious flooding event. A combination cold front and the remnants of Superstorm Sandy dumped approximately seven inches of rain over a 24 hour period, and ten inches over a week, in Western New York during late October 2012, causing a major flooding event on all the streams including Chautauqua Creek. The most extensive damage at the fish passage project was to the rock ramp at the uppermost dam where a major portion of the rocks were displaced. Some of the rocks measuring feet in diameter were actually moved several hundred feet downstream below the lowermost dam, an indication of the severity of the flooding event, while others traveled over three miles to the mouth of the stream in Lake Erie. While there was not any physical damage to the notch at the lowermost dam, there were several trees and a large boulder that were stuck in the notch which hindered any upstream fish passage.

In Spring 2013, the ACOE, the NYSDEC, and the Village of Westfield reviewed the status of the project and discussed the possibility of restoring the project back to its original state, and if possible incorporate modifications for withstanding future flooding events. The preferred improvements included repositioning of the stones in the rock ramp and pinning them in place, and adding additional rocks below the lower dam to raise the pool height to promote better passage of non-jumping species. The NYSDEC is currently seeking funds in conjunction with the Chautauqua County Soil and Water District to complete the modifications and restore functionality back to the project.

Figure 2d-1. Rock ramp on the uppermost dam post-construction and pre-flood, and after the Superstorm Sandy flood.

Figure 2d-2. Notching in the lower dam post-construction and pre-flood, and logs and rocks in notch after the Superstorm Sandy flood.

Section 3. Assist Member Agencies with Technology Use

3a. Sidescan Sonar Workshop

E. Weimer, C. Castiglione

The Habitat Task Group (HTG) has identified the use of sidescan technology as an increasingly popular and important tool for evaluating habitat in aquatic systems. Sidescan has been used on Lake Erie to map substrate distributions, target potential Lake Trout spawning habitat, and evaluate habitat in the nearshore. Historically, this work has required the use of specialized, stand-alone sidescan systems that have been cost prohibitive for many agencies to purchase. In recent years, manufacturers have begun to integrate sidescan technology into sonar/chartplotter systems that mount on vessel hulls. These integrated sidescan systems are relatively inexpensive, and many agencies around Lake Erie have begun using these systems to collect data. The HTG encourages these activities, but understands that integrated sidescan systems may perform differently at various depths, ranges, and frequencies compared to traditional, stand-alone systems.

Recognizing this, the HTG has begun planning an exercise that will establish guidelines for collecting, processing, and analyzing sidescan data in Lake Erie. Members of the HTG will gather in May 2014 to collect data using multiple stand-alone (Klein, Edgetech) and integrated (Lowrance, Humminbird) sidescan systems. A suite of locations with varying depths and substrates will be sampled concurrently using each system using various settings (range, frequency, speed). Data will be processed over the following months, and a HTG meeting will be planned for December 2014 to review data collection settings, quality, and processing. It is hoped that a guidance document identifying recommended sidescan systems and settings for a particular data collection need can be developed. Once this process is completed, the HTG hopes to develop a workshop for those interested in collecting sidescan data throughout the Great Lakes.

3b. Continued support of LE GIS/GLAHF development and deployment

C. Riseng, L. Mason, E. Rutherford

The Lake Erie GIS has been incorporated into a larger initiative, the Great Lakes Aquatic Habitat Framework (GLAHF). The GLAHF is a GIS database of geo-referenced data for Great Lakes coastal, large rivermouth, and open water habitats being developed by the University of Michigan, along with multiple partner researchers, universities, and agencies. The goal of the GLAHF is to develop and provide access to a Great Lakes aquatic habitat database and classification framework to provide a consistent geographic framework to integrate and track data from habitat monitoring, assessment, indicator development, ecological forecasting, and restoration activities across the Great Lakes. The project is funded for three years by the Great Lakes Fishery Trust and recently received additional funding from the UM Water Center to develop a web-accessible Decision Support Tool. Using coastal and offshore spatial processing zones and a gridded network of cells, the framework was developed and has been attributed with existing available georeferenced data including GL GIS data (Table 3b-1).

Table 3b-1: Summary of super habitat variables and associated data in the GLAHF habitat framework. These habitat variables will be used for fish habitat classification.

Topobathymetry/Slope - 3	Biological - 5
Geomorphology – 5	Rivers/Hydrology – 8
Mechanical Energy/Hydraulics - 7	Wetlands/Aquatic Vegetation - 3
Temperature/Energy - 7	Landscape Variables – 9
Water Chemistry - 16	

The GLAHF project currently is focused on identifying, acquiring, and geoprocessing biological data, especially fish community data, and data collected in recent surveys of nearshore areas (Environment Canada, U.S. EPA, state DNRs, USGS). The other ongoing effort is focused on developing an ecological habitat classification. To date, aquatic and coastal habitat zones have been defined and a task force is working to identify fine-scale ecological habitat units through multivariate analysis and clustering procedures (Figure 3b-1).

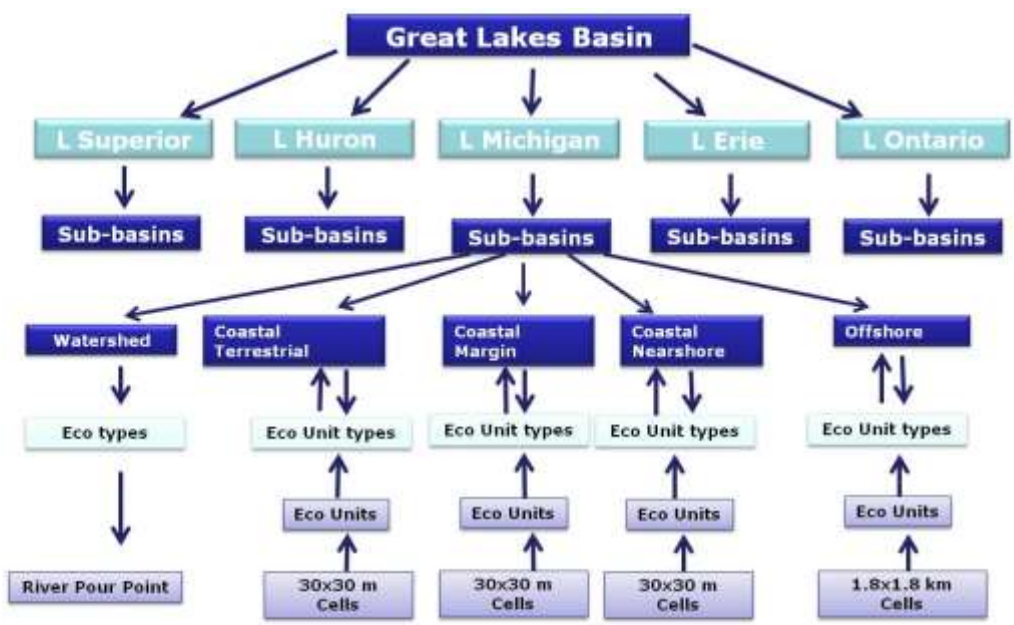

Figure 3b-1. GLAHF ecological classification framework

Charge two to the HTG involves continuing to support the Lake Erie GIS initiative, which is now GLAHF. GLAHF has received and incorporated several datasets from the LEHTG, including data on total phosphorus and chlorophyll a (2001-20011) updated substrate (Habitat Solutions, Mackey), and benthic invertebrate densities (1999-2011). Data important for fisheries management and restoration will be included in GLAHF including substrate and habitat mapping, and walleye and yellow perch harvest by grid data. In 2013, we are planning to update the walleye and yellow perch harvest by grid data and the Forage Task Group Lower Trophic Level Assessment program data. This will initially include a subset of years to determine how best to incorporate these data into the database. The HTG has been utilizing side scan sonar data to map substrate, depth, and other critical fish habitat data in an effort to meet the tasks of other charges. As this technology is becoming cheaper, easier, and more common to use, the GLAHF technical staff will work with the HTG to determine how the data can be standardized, distributed, and utilized at multiple scales.

The HTG recognizes the need for more regular updates to the lower trophic level and fisheries data components of the GLAHF and will be investigating ways of annually integrating data from LEC member agencies. The current plan is to share a data table template with the LEC agencies. The data then can be submitted to the GLAHF GIS Staff annually. The data table template should allow for easy data preparation by agencies and quick incorporation into the GLAHF. Information about GLAHF, and the overall Great Lakes GIS initiative, can be found at:
http://ifrgis.snre.umich.edu/projects/GLAHF/glahf.shtml.

3c. Mapping Spawning Substrate and Nearshore Habitat

E. Weimer

In recent years, members of the HTG have been heavily involved in mapping and classifying substrate for Lake Trout spawning and along the Lake Erie nearshore. Summaries of these efforts can be found in past HTG reports. In 2013, no additional Lake Trout spawning habitat mapping was conducted. With the completion of the Lake Trout initiatives, it is unlikely that further mapping will continue. Nearshore habitat mapping at ODNR-Wildlife nearshore fish community assessment sites is planned for the summer of 2014.

Section 4. Support Other Task Grouped by Compiling Metrics of Habitat

Identify Metrics Related to Walleye Habitat

Y. Zhao, R. Kraus, C. Knight, A.M. Gorman, and S. Pandit

Presently, quotas are allocated proportionally based on surface area of waters less than or equal to 13 m deep by jurisdiction (Figure 4-1; STC 2007).In 2008, the HTG was charged with assisting the Walleye Task Group (WTG) with identifying metrics related to walleye habitat for the purpose of re-examining the extent of suitable adult walleye habitat in Lake Erie. This information may ultimately be used to quantify the amount of preferred adult walleye habitat by jurisdiction, thereby providing the Lake Erie Committee (LEC) with an alternate way to allocate fishery quota for walleye. This new strategy reflects an effort to utilize advances in spatial analysis (GIS) and newly compiled data (LEGIS) and to recognize expanding populations and changing distributions relative to the original strategy established in 1988. The LEC assigned the HTG this charge in an attempt to further improve estimates of suitable walleye habitat through an expanded definition of habitat based on recent literature, geospatial analyses, and historic datasets. Currently, the species-habitat model has been developed using fishery-dependent and fishery-independent gill net datasets. A summary on these findings is located in the 2012 HTG Report, and a manuscript has been published in the *Journal of Great Lakes Research* (Pandit et al 2013).

Figure 4-1. This map represents the present quota sharing allocation, which is proportionally based on surface area of waters less than or equal to 13 m deep (area in light blue) by jurisdiction for Ohio, Ontario and Michigan (outlined in red).

More recently, electronic tagging methods are being applied to Lake Erie walleye to define movement and spatial exploitation patterns in support of management. Acoustic array investigations may also provide insight to the gill net data based habitat model. Preliminary findings have indicated a higher proportion of detections at receiver depths >13m than expected, which further suggests the utilization of deeper offshore habitats by walleye. This research can provide new insights on walleye habitat use and the task group is supportive of efforts to further improve walleye habitat metrics through in situ behavioral study of walleye habitat selection.

References

STC. 2007. Quota Allocation Strategies. Report of the Standing Technical Committee to the Lake Erie Committee. 8pp.

Pandit, S.N., Zhao, Y., Ciborowski, J. J. H., Gorman, A.M., and Knight, C. 2013. Suitable habitat model for walleye (Sander vitreus): implications for inter-jurisdictional harvest quota allocations in Lake Erie. Journal of Great Lakes Research, Vol39: 591-601.

Section 5. Strategic Research Direction for the Environmental Objectives

S.D. Mackey

Introduction

The Lake Erie Environmental Objectives provide guidance to fishery and environmental management agencies in the form of descriptions of the various environmental conditions affecting Lake Erie fisheries resources and conditions needed to ensure that Lake Erie's FCGOs will be achieved. For Lake Erie, the Environmental Objectives sub-committee (now the Habitat Task Group or HTG) identified ten Environmental Objectives in support of the thirteen Fish Community Goals and Objectives. The rationale behind each of the Environmental Objectives was described in a white paper released in July 2005.

<u>Protect and Restore Physical Processes</u>

1. Restore natural coastal systems and nearshore hydrological processes;
2. Restore natural hydrological functions in Lake Erie rivers and estuaries; and
3. Recognize and anticipate natural water level changes and long-term effects of global climate change and incorporate these into management decisions.

<u>Recover and Restore Fish Communities</u>

4. Re-establish open water transparency consistent with mesotrophic conditions that are favorable to walleye in the central basin and areas of the eastern basin;

5. Maintain dissolved oxygen conditions necessary to complete all life history stages of fishes and aquatic invertebrates;
6. Restore submerged aquatic macrophyte communities in estuaries, embayments, and protected nearshore areas; and
7. Minimize the presence of contaminants in the aquatic environment such that the uptake of contaminants by fishes is significantly reduced.

Halt Habitat Degradation

8. Halt cumulative incremental loss and degradation of fish habitat and reverse, where possible, loss and degradation of fish habitat;
9. Improve access to spawning and nursery habitat in rivers and coastal wetlands for native and naturalized fish species; and
10. Prevent the unauthorized introduction and establishment of additional non-native biota into the Lake Erie basin, which have the capability to modify habitats in Lake Erie.

Aquatic habitats are the product of interactions between physical and biological processes. These processes contribute to the creation and maintenance of habitat through the interaction of energy with broad-scale geologic, geomorphic, and hydrologic features on the landscape over varying spatial and temporal scales. The pattern and distribution of habitats are controlled, in part, by the underlying physical characteristics of the basin and interactions between energy, water, and the landscape (e.g., Sly and Busch 1992; Higgins *et al.* 1998; Mackey and Goforth 2005; Mackey 2008). Moreover, the physical characteristics and energy conditions that define habitats are created by the interaction of climate (energy), geology (geomorphology and substrate), and hydrology (water mass characteristics and flow) – the same variables and processes that maintain physical integrity. Habitats are created when there is an intersection of a range of physical, chemical, and biological characteristics that meet the life stage requirements of an organism.

However, both anthropogenic and natural stressors (including climate change), can alter the physical characteristics and energy conditions that create and maintain Lake Erie aquatic habitats. Effective implementation strategies and actions to achieve sustainable Environmental Objectives will require anticipating and mitigating the impacts of both anthropogenic and natural stressors on aquatic habitat.

Process

The HTG continues to employ a scenario process designed to systematically identify and address data gaps, knowledge gaps, and lack of understanding by evaluating past, current, and potential future threats and trends for the Environmental Objectives, and how those threats and trends may impact the ability of Lake Erie Committee to achieve stated Lake Erie FCGOs.

The HTG reviewed three primary drivers: 1) anthropogenic stressors, 2) climate-change stressors, and 3) invasive species stressors in order to provide direction for future work. The objective was to determine what data, information, and knowledge is required to support on-the-ground (or in-the-water) habitat restoration in Lake Erie, and how best to implement strategies that achieve the Environmental Objectives.

Discussion

As a result of this analysis, there was recognition that fishery management agencies do not have the authority to directly address the physical stressors affecting attainment of FCGOs and the underlying Environmental Objectives. This is clearly evident in nearshore and coastal areas where very few in-water habitat enhancement or restoration projects have been implemented by the HTG or associated resource management agencies. The same can be said for deep water open-lake habitats as well.

Review of ongoing Great Lakes habitat restoration projects and literature reveals a paucity of techniques for in-water restoration or enhancement of rivermouth, nearshore, and coastal habitats. Thus, even if fishery management agencies had the authority to manipulate nearshore and coastal habitats, limited information is available to provide guidance as to how best to enhance or restore those habitats. Science-based information and guidance *should be a key outreach strategy* of the HTG to promote sound restoration projects and practices in riverine, coastal, and nearshore environments.

The HTG is implementing the following strategies to address these needs:

1. There is a continuing need to identify habitat knowledge gaps and research needs.
    a. Development of techniques and methods to restore fish habitat in riverine, coastal, and nearshore environments through implementation of small pilot projects and associated monitoring work to validate project results.
    b. Encourage continued regional mapping and assessment of nearshore and coastal habitat areas (promote the use of new technologies such as sidescan sonar, multibeam, and underwater video technologies).
    c. Encourage continued sampling of fish communities in shallow-water coastal and nearshore habitats.
    d. Build linkages between coastal processes, hydrology, and habitat structure to promote sustainable habitat enhancement/restoration projects.

2. Moreover, many ongoing Great Lakes habitat restoration projects are traditional large-scale projects focused on wetlands or tributaries that require substantial technical and financial resources not generally available to municipalities and private landowners. These types of projects send a message that habitat restoration projects must be large and expensive, funded directly or indirectly by public dollars through grants from Federal agencies, be technically complex, and must include multiple partners/stakeholders (Federal-State agencies and/or environmental NGO's). However, long-term degradation of Great Lakes coastal habitats occurred as a result of *cumulative impacts* caused by changes in *private* land use and shoreline modifications on a property-by-property and municipality-by-municipality scale.

   To complement larger-scale traditional approaches to restoration, the HTG will:

   a. Develop guidance materials to support and implementat nearshore and coastal habitat restoration through *existing State and Local regulatory processes* on a property-by-property and municipality-by-municipality scale.
   b. Develop mechanisms to encourage and support multiple smaller, less expensive and less complex nearshore and coastal habitat restoration projects funded by private (or limited public) dollars with only one or two partners or stakeholders.
   c. Support increased monitoring of nearshore areas to document how improvements in nearshore habitats have benefited nearshore fish communities.

3. Most habitat restoration projects are implemented by non-fishery management agencies/ programs. They are unaware that Environmental Objectives exist for Lake Erie. Insertion of Environmental Objectives into ongoing programs/authorities will provide a way for the HTG (and LEC) to influence and track projects/programs of other non-fishery management agencies in support of the Lake Erie Environmental Objectives.

   Guidance and Environmental Objectives need to be *actively* distributed to other agencies/programs for inclusion in ongoing and proposed projects, i.e. just posting the Environmental Objectives on the GLFC website is *not enough*.

Section 7. Protocol for Use of Habitat Task Group Data and Reports

- The Habitat Task Group (HTG) has used standardized methods, equipment, and protocol in generating and analyzing data; however, the data are based on surveys that have limitations due to gear, depth, time and weather constraints that vary from year to year. Any results or conclusions must be treated with respect to these limitations. Caution should be exercised by outside researchers not familiar with each agency's collection and analysis methods to avoid misinterpretation.

- The HTG strongly encourages outside researchers to contact and involve the HTG in the use of any specific data contained in this report. Coordination with the HTG can only enhance the final output or publication and benefit all parties involved.

- Any data intended for publication should be reviewed by the HTG and written permission received from the agency responsible for the data collection.

Section 8. Acknowledgements

The HTG would like to thank Dr. Shubha Pandit. The modeling work is proving to be a key component in addressing the HTG's walleye habitat charge.