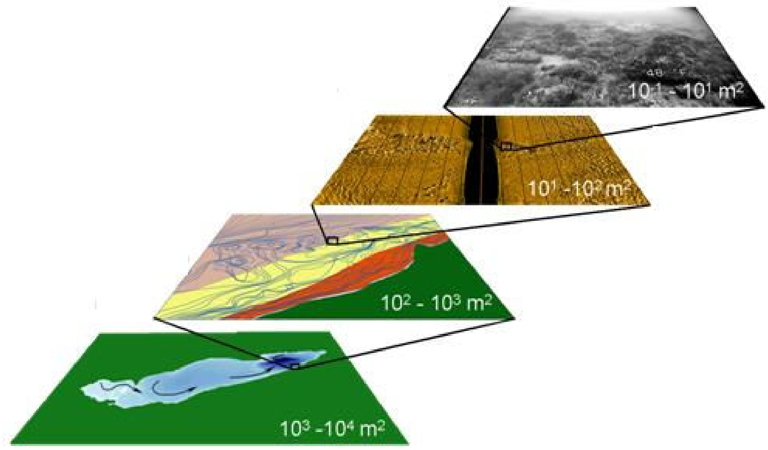
Report of the
Lake Erie Habitat Task Group
2011



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

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Presented to:

Standing Technical Committee, Lake Erie Committee
Great Lakes Fishery Commission
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Section 1. Charges to the Habitat Task Group 2010-2011

1. Document habitat related projects. Identify and prioritize relevant projects to take advantage of funding opportunities

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3. Assist the Coldwater Task Group with the lake trout habitat assessment initiative

4. Develop compilation of fish habitat related metrics.
    a. With the assistance of the Walleye Task Group, identify metrics related to walleye habitat for the purpose of re-examining the extent of suitable adult walleye habitat in Lake Erie

5. Develop a strategic research direction for the Lake Erie Environmental Objectives.

Section 2. Document Habitat Related Projects

A.M. Gorman, T. MacDougall

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”. This modification forced us to re-evaluate the objectives of this charge. From the perspective of a researcher, it is essential to provide a tool that promotes collaboration and prevents duplication of effort. For a funding officer, it would be valuable to provide information to help identify research gaps and prioritize projects within the framework of the Environmental Objectives.

We continue to work towards the integration of our table of habitat-related projects into a pre-existing query-able database. Although there are several such databases currently in use by external agencies, our primary focus is finding one that is permanently-funded, includes similar information around the basin, and is readily-available for resource managers and researchers seeking collaboration.

Our ability to prioritize projects will be facilitated in coming years by the development of the Environmental Objectives – focused Research Strategy, detailed in Section 6 (below). 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 Huron Erie Corridor

E. Roseman, J. Boase

Artificial spawning reefs were constructed at the head of Fighting Island in the Detroit River during fall 2008 (Figure 2a-1). The reef was placed in waters deeper than 6m. Four reef material treatments were used to construct 12 individual reefs of about 11 by 20 m each. Materials included four inch diameter fractured limestone, four inch diameter round field stone, variable sized fractured limestone, and a mixture of all materials. Total reef size is about 3,300 m^2.

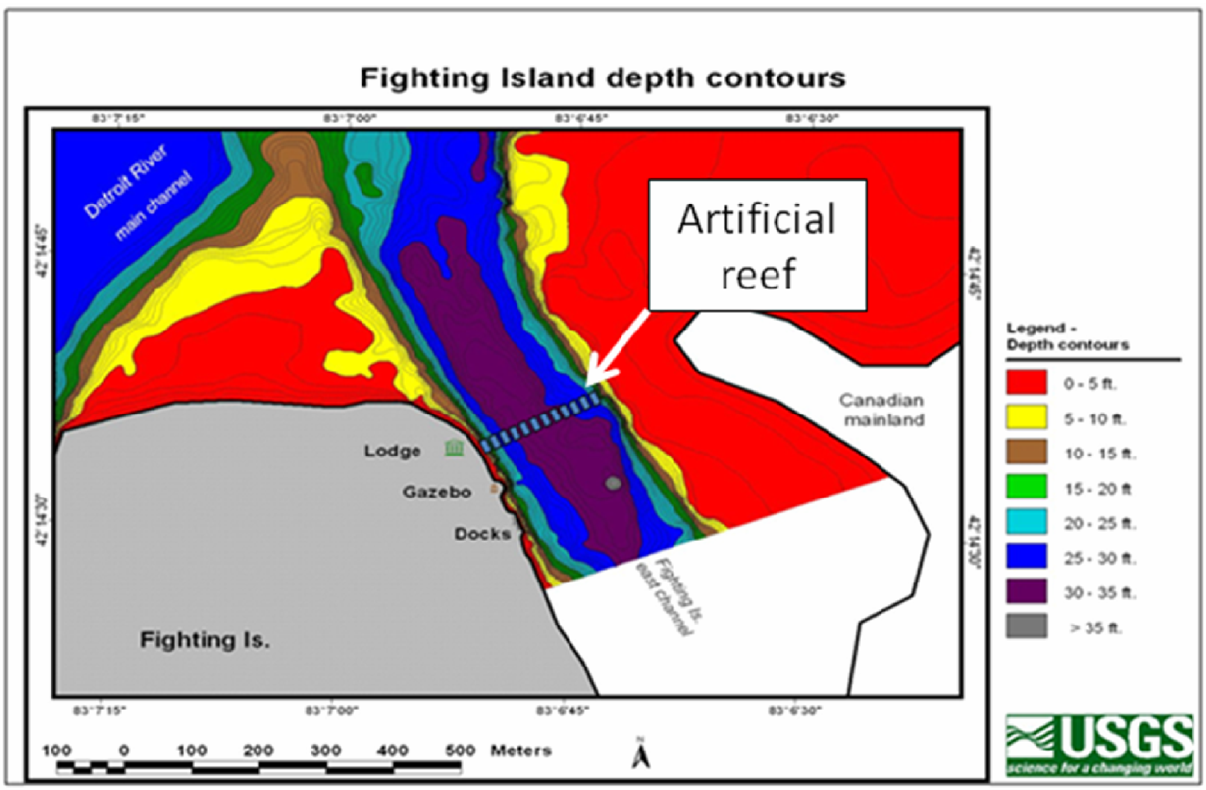

Figure 2a-1. Location of the artificial reef constructed at the head of Fighting Island in the Detroit River in 2008.

Assessment of fish use of the newly constructed habitat showed an immediate response by fish. Tables 2a-1 and 2a-2 summarize the egg data gathered at the Fighting Island fish habitat restoration site, east Fighting Island channel, Detroit River, during the spring and fall sampling seasons of 2009. Table 2a-1 contains general sampling information relative to the sampling characteristics undertaken during each (spring and fall) sample period. Table 2a-2 contains actual egg collection numbers; both total actual eggs collected, and extrapolated egg deposition rates (numbers/m²). In addition to total overall egg collections / egg density, eggs collections were combined into two groups: On-reef gangs and off-reef gangs, for all 4 fish species sampled. Egg mats were sampled for 50 days in spring, and 48 days in the fall, sampling egg deposition for walleye (spring), several sucker species (spring), lake sturgeon (spring), and lake whitefish (fall). A total of 19 and 22 gangs (3 mats per gang) were sampled weekly during the sample period during the spring and fall, respectively. Twelve gangs were sampled on the newly (fall 2008) constructed fish spawning reefs (one gang per reef) during both spring and fall, with the remaining gangs (7 in spring, 10 in fall) sampling natural habitat within a 1.5 km stretch upstream and downstream of the reefs. Total sample area for each gang equaled 0.2793 m², and represented only 0.1% of the total reef area for each reef.

At the time of collection, roughly 5 egg groups can be identified according to the morphology; walleye, “suckers”, lake sturgeon, lake whitefish, and ‘others’. The ‘others’ category is generally very small in number, and at this time, mostly unknown as to the species (poor hatch success). Fish species is not confirmed until successful hatch at the USGS Great Lakes Science Center (GLSC). About 90% of all the eggs collected during both sample seasons in 2009 were walleye, followed distantly by lake whitefish, various sucker species, and lake sturgeon. Suckers and sturgeon spawned primarily on the reefs (about 85% and 99% respectively), whereas the majority of walleye and lake whitefish were collected on natural habitat/substrates up and downstream of the reefs. For lake sturgeon in particular, spawning was not only closely tied to the spawning reefs, but to the 4 reefs (“A” – “D”) closest to the Island side of the channel. Sturgeon egg distribution was highest on the sorted limestone (4” diameter) reef, but it has not been established if it is a significant difference. Based on the one year’s egg collections, it appeared as if the preference was more toward the Island which also had slightly better water clarity (less turbidity) throughout the spawning season (spring). Lake whitefish egg numbers continue to increase, not only in total number collected, but in study area overall average number/m². Lake whitefish eggs collections also were highest on the island side of the channel; above, below, and on the reefs.

Based on sample area of the egg mats, egg deposition rates of lake sturgeon on the fish spawning reefs (107/m² - 3,300 m² total reef area) can be extrapolated over the entire reef to estimate total egg deposition of roughly 352,747 lake sturgeon eggs. This can be considered a conservative estimate as it includes all ‘0’ egg deposition rates obtained from the 8 eastern reefs. Continued sampling in successive years should help refine these numbers.

Table 2a-1. General sample information for the 2009 egg collections, Fighting Island habitat restoration site.

Sampling variables	Spring Seasonal Total	Spring (range)	Fall Seasonal Total	Fall (range)
Date:				
Start	7-Apr		22-Oct	
End	26-May	(50 days)	8-Dec	(48 days)
Water Temp				
Start (°C)	4.6		10.3	
End (°C)	15.6	(+11.0°C)	3.8	(-6.5°C)
# of gangs	19		22	
On-reef	12	63.2%	12	54.5%
off-reef	7	36.8%	10	45.5%
Total sample area (m^2)	5.31		6.14	
off-reef (m^2)	1.96		2.79	
on-reef total (m^2)	3.35		3.35	
% of reef sampled	0.10%		0.10%	

Table 2a-2. Egg collections for the sample year 2009, Fighting Island habitat restoration site.

Egg Collection variables	Walleye	Spring Sucker spp.	Lk. Sturgeon	Fall Lk. Whitefish
Overall (all gangs)				
Total eggs collected	13953	562	346	664
(% of total)	89.9%	3.6%	2.2%	4.3%
Egg deposition (#/m^2)	2,888	106	72	108
range (#/m^2)	0 - 13247	0 - 301	0 - 383	0 - 437
On-reef Gangs				
Total eggs collected	5259	478	343	138
(% of total)	37.7%	85.1%	99.1%	20.8%
Egg deposition (#/m^2)	1,616	142	107	41
range (#/m^2)	0 - 8031	0 - 301	0 - 383	0 - 75
Off-reef Gangs				
Total eggs collected	8,694	84	3	526
(% of total)	62.3%	14.9%	0.9%	79.2%
Egg deposition (#/m^2)	4,973	44	2	168
range (#/m^2)	0-5170	0 - 154	0 - 7	0 - 437

In 2010, egg mat sampling was conducted at Fighting Island reef in the Detroit River and at various sites in the St. Clair River. Egg mat sampling began in early April, 2010 and continued through June. Egg mats were lifted once per week and all eggs removed for incubation at the GLSC. In the Detroit River we collected 3,444 walleye eggs, 284 sucker eggs, 40 lake sturgeon eggs, and 503 lake whitefish eggs. In the St. Clair River we found 30 walleye eggs, 62 sucker eggs, and 137 lake sturgeon eggs.

Fish Data

Adult lake sturgeon were captured during the spring of 2009 in the Detroit River in the vicinity of the Fighting Island spawning reef. Setlines were used to collect lake sturgeon and were fished from April 8 – May 28 totaling 78 overnight sets or 38,394 hook hours of effort. We used a correction to account for setlines that were lifted with empty hooks; this is reflected in the effort listed. Thirteen lake sturgeon were captured in the Detroit River; three of these were recaptures. Fish ranged in size from 1,093mm (6.5kg) to 1,852 mm (33.9kg). We captured one ripe female and three ripe males. Sex was undetermined for the remaining nine fish. All fish were tagged externally with Floy tags and internally with P.I.T. tags and then released. Given the number of recaptured lake sturgeon that we have to date it should be possible to determine a population estimate for the Detroit River stock. Water temperatures during the sampling period ranged from 4.5^{o}C to 18.0^{o}C.

Attached to each setline were three minnow traps which were used to collect small benthic species of fish. A total of seven northern madtoms were captured during the spring sampling period at the Fighting Island spawning reef. These collections represent newly identified locations where the northern madtom has been found in Ontario waters of the Great Lakes.

During the spring of 2009 experimental gillnets were fished once a week from April 15 – May 12 near the Fighting Island spawning reef. Nets were composed of seven panels each measuring 7.62m in length by 1.83m tall. Net mesh sizes (stretch) included 75mm, 88mm, 100mm, 113mm, 125mm, 138mm, and 150mm. Fish species collected included walleye, northern pike, gizzard shad, white bass, white perch, rock bass, silver redhorse, golden redhorse, and northern hogsucker. Water temperatures during the sampling period ranged from 6.5^{o}C to 11.8^{o}C.

During the fall of 2009, experimental gillnets were fished once a week from October 21 – November 16 at the mouth of the Detroit River near Bar Point, ON. Nets were composed of six panels each measuring 7.62m in length by 1.83m tall. Net mesh sizes (stretch) included 88mm, 100mm, 113mm, 125mm, 138mm, and 150mm. Fish species collected included lake whitefish, walleye, freshwater drum, rock bass, and silver redhorse. Only one lake whitefish was collected during the period. It measured 532mm and was a ripe male. Sampling ended a week after whitefish eggs were collected at the Fighting Island Spawning Reef. Water temperatures ranged from 11.5^{o}C to 9.3^{o}C during the period.

A total of seven lake sturgeon larvae were collected at the Fighting Island reef using D-frame ichthyoplankton nets in 2009. Ichthyoplankton nets were generally fished from dusk to midnight with effort restricted to reefs A, B, C, and D (where lake sturgeon eggs had been collected during the previous 2 weeks).

Sampling dates included May 19, 20, 21, 26 and 27. Larvae ranged in size from 13mm (sac fry stage) to 20mm (post-sac fry stage).

In 2010, weekly samples were collected with paired bongo conical nets from late March through mid August, 2010. There were 330 samples collected from the main channel of the Detroit River and 9,006 larvae were captured. From the St. Clair River, we collected 943 samples and captured 1,492 larvae. Unique ecological signatures were observed at tributary mouths such as the Belle and Black rivers joining the St. Clair River (different species, densities, thermal, and secchi disk measurements). Higher larval fish densities were measured in the Detroit River than in the St. Clair River and higher diversity was also observed in the Detroit River. Evidence for transport of deepwater sculpins, cisco, and lake whitefish larvae from Lake Huron through the Huron-Erie corridor was observed.

Light trap, seine, and conical net larval collections were made in the St. Clair River delta from May 1–27 July 2010; 675 samples captured 1,060 larvae. Water chemistry and physical limnology samples were also collected. Localized water movements appear as important as connection to main channel for connectivity and retention of larvae in nursery habitats.

Lastly, D-frame drift nets were fished on bottom at “Mazlinkas” reef in the north channel of the St. Clair River at Algonac, MI, to assess night drift of larval lake sturgeon. We captured 12 larvae in one night of experimental sampling. We found larvae coming off the spawning reef as well as in the main channel away from the reef suggesting additional spawning areas upstream of our study location.

Investigators: E.F. Roseman, G. Kennedy, B. Manny, J. Craig, J. Allen, G. Black (GLSC), and J. Boase (USFWS Alpena FWCO)

2b. Nearshore Fish Community

E. Weimer

Historically, the fish community of the Lake Erie western basin nearshore 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 1900’s until the 1970’s, 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 has generally improved, especially clarity as influenced by reductions in phosphorus and, later, the introduction of exotic Dreissenid mussels (Charlton et al. 1999). This 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 in sampling in shallow water caused by debris. Since 2009, daytime electrofishing has been used, providing better access to nearshore areas and sampling more fish.

In 2010, twelve sites in the western basin were sampled (Figure 2b-1), consisting of 4 beach, 3 wetland, 3 bedrock, and 2 bluff-bank sites. Five of the sites had been physically altered by human activity, such as bank stabilization. Sampling took place on August 2nd and 3rd. A single, 5-minute electrofishing pass was made at each site in 1-2 meters of water. Low range (50-500 volts), DC settings were used on the Smith-Root control box, and every effort was made to maintain 6 amps of current. Two netters were placed on the front of the electrofishing boat, one using a fine mesh dip net to allow the collection of young-of-year (YOY) fish, particularly gizzard shad and various species of shiners. Netted fish were placed in an aerated holding tank until the run was completed, and fish were processed immediately following the electrofishing run. Fish were sorted and enumerated by species and age classification, and total lengths (mm) were recorded for up to 30 individuals.

In total, 459 individuals from 26 species were collected during the 2010 electrofishing survey. An Index of Biotic Integrity (IBI) adapted from a Great Lakes littoral zone IBI developed by Minns et al. (1994) was calculated for each site. Overall, the nearshore fish community in western Lake Erie had an IBI score of 52.8 ± 8.7, which is down slightly from 2009 (61.9 ± 12). Examining 2010 IBI scores by site geomorphology, we find that fish communities within beach (45.7) and bluff-bank (46.3) shoreline habitats continue to have lower mean IBI scores than those in bedrock (56.2) and wetland (63.0) habitats (Figure 2). However, unlike 2009, no significant differences between different site geomorphologies were present in 2010 ($p = 0.5042$). Shoreline development had no effect on IBI scores in 2010 ($p = 0.9981$; Figure 2b-2). The difference between years are likely due to adding bedrock and wetland sites in 2010; these habitats were represented by only one site each in 2009.

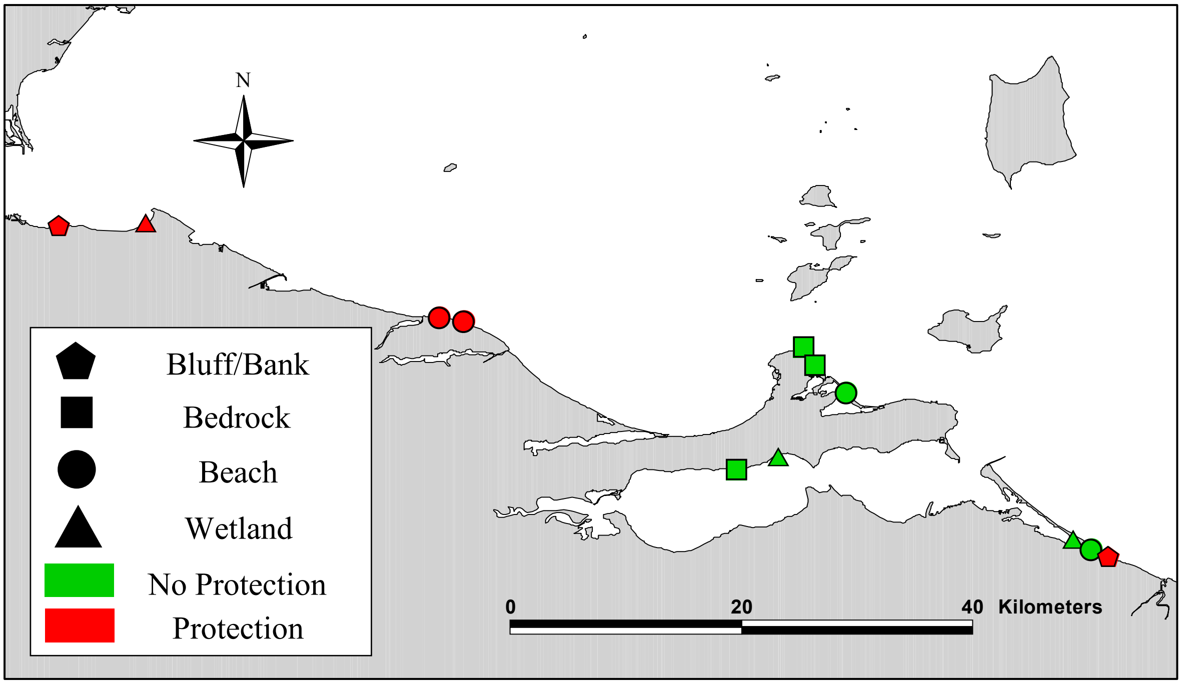

Figure 2b-1. Nearshore fish community assessment survey sites sampled

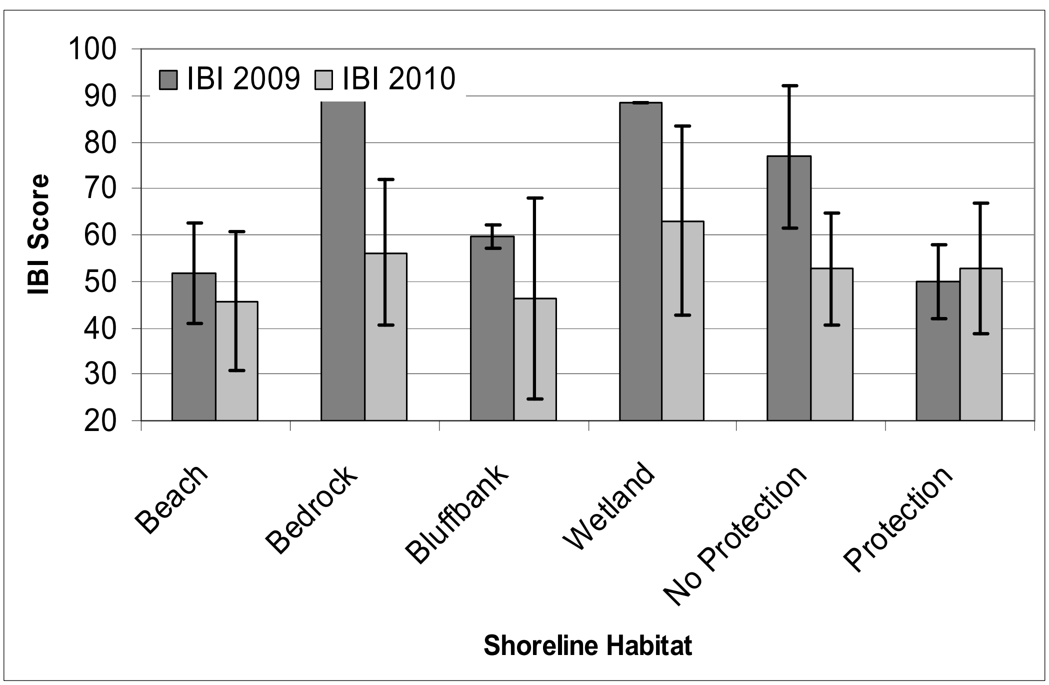

Figure 2b-2. Comparison of Index of Biotic Integrity (IBI) scores for nearshore fish communities in different shoreline habitats and levels of shoreline protection. Scale bars are 95%

Investigator: E. Weimer (ODNR)

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Casselman, J. M., and C. A. Lewis. 1996. Habitat requirements of northern pike (Esox lucius). Canadian Journal of Fisheries and Aquatic Sciences 53: 161-174.

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Minns, C.K., V.W. Cairns, R.G.Randall, and J.E.Moore. 1994. An Index of Biotic Integrity (IBI) for fish assemblages in the littoral zone of Great Lakes' Areas of Concern. Can. J. Fish. Aquat. Sci. 51:1804-1822.

2c. Central Basin Hypoxia and Yellow Perch

C. Knight, A.M. Gorman

Historically, lake stratification leads to hypoxic and even anoxic conditions in the hypolimnion by the end of August in the central basin of Lake Erie. The spatial and temporal extent of the hypoxic zone is dynamic and changes annually. Studies suggest both lateral and vertical movements of fish in response to this suboptimal habitat (Kreiger et al. 2009). Below certain thresholds, fish exhibit avoidance behavior and may aggregate on the edges of the hypoxic zone (Edwards et al. 2005). In 2010, we examined threshold limits of many fish species with an emphasis on yellow perch. We also identified levels of high and low hypoxic years based on the longevity of hypoxic days (Dan Rucinski pers. comm. 2010).

In this project, we are specifically examining the effect of hypoxic conditions on the distribution of yellow perch and how this may affect bottom trawl surveys. Yellow perch population assessments are conducted seasonally using a stratified random design, which is established *a priori* to encompass various depths and habitats. It is the assumption of this design that habitat at all sites is suitable and that there is an equal chance of occurrence of yellow perch at each site. These assumptions may be invalid when hypoxic water extends into sample areas (Figure 2c-1).

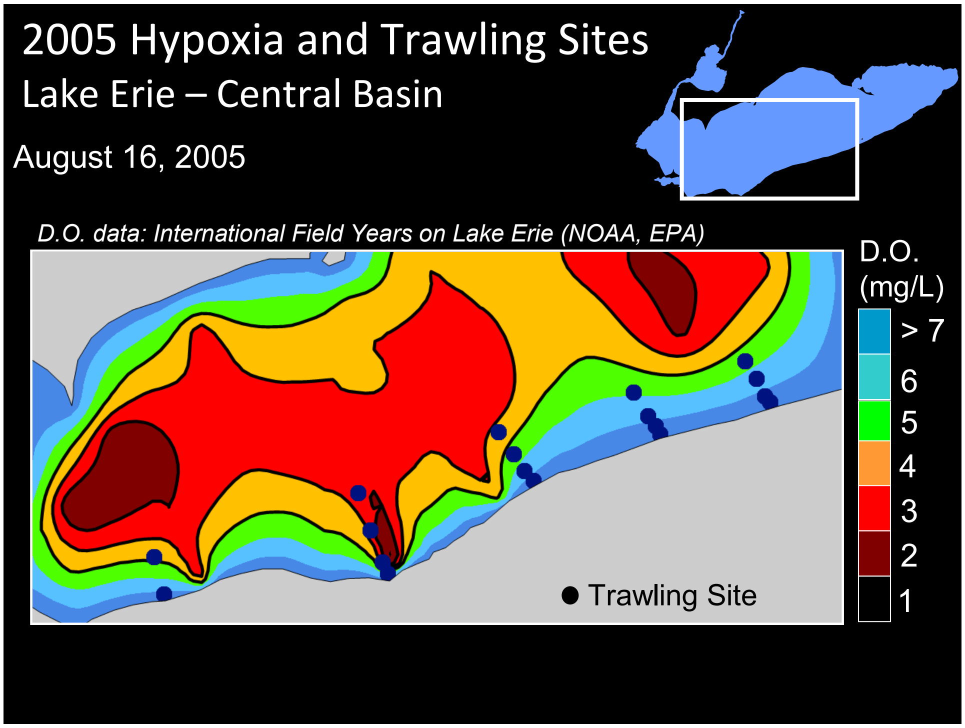

Figure 2c-1. The spatial configuration of the hypoxic zone on August 16, 2005, collected during the International Field Year on Lake Erie. The trawl point overlay demonstrates that yellow perch sampling occurred over a wide range of oxygen conditions.

It is possible that these hypoxic zones may be uninhabitable and avoided by yellow perch. Findings in 2010 indicated both 1) the absence of young-of-year yellow perch in low dissolved oxygen events, and 2) high variability in catch rates because of aggregations occurring at the edge of hypoxic zones. Such aggregations have resulted in outliers in trawl data sets and have affected the population estimates of yellow perch (Figure 2c-2). This is also likely to be true for other species. Some preliminary findings show that not sampling low dissolved oxygen areas could result in elevated yellow perch indices. We found that sampling in a low hypoxic (fewer days of hypoxia) year could result in under-estimation of age-2 yellow perch while an over-estimation is possible in a high hypoxic year. When year classes are strong, the effect of hypoxia can have substantial effects on estimated population size. This was likely the case in 1996, when 52% of the age-2 estimate in the Yellow Perch Task Group's Recommended Allowable Harvest was estimated from surveys.

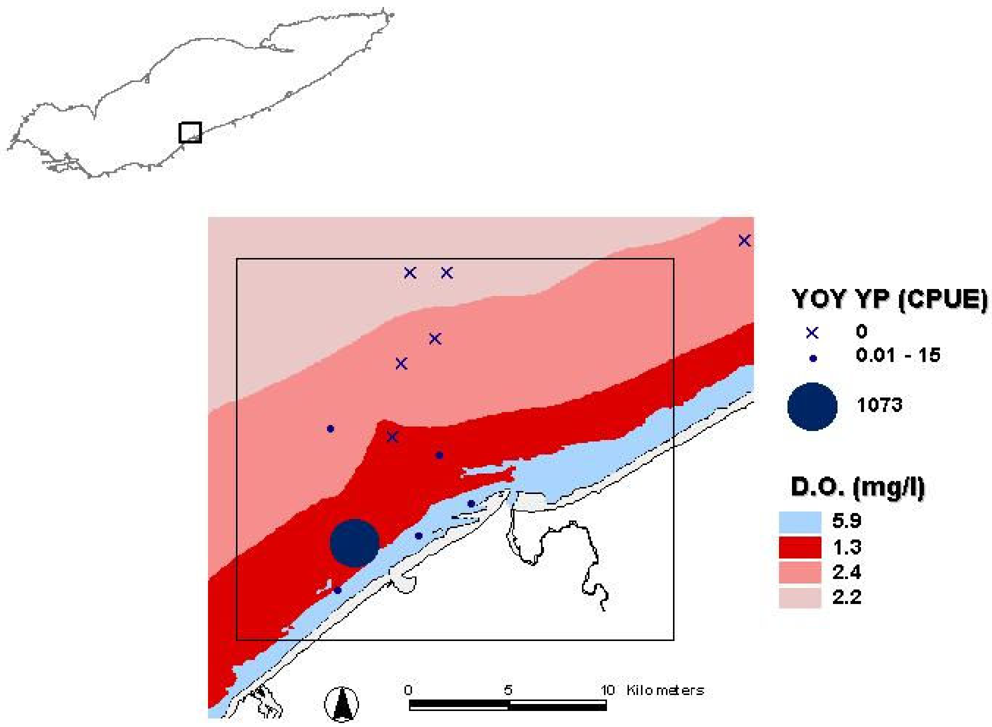

Figure 2c-2. Inset shows trawl catch rates (CPUE) of age-0 yellow perch with respect to dissolved oxygen levels. The highest catch (CPUE=1,073, total catch=10,739) represents the highest yellow perch catch in the ODNR Fairport station's history. Data supports that fish may be aggregating near the edge of the hypoxic zone.

Investigators: Troy Farmer, Ann Marie Gorman, Carey Knight, Stuart Ludsin, and Kevin Pangle

References

Kreiger A. Kenneth, Michael T. Bur and Edwin J. Hammett. 2009. Nearshore hypoxia as a new lake metric. Lake Erie Protection Fund, Project SG 334-07. 38 pp.

William J. Edwards, Joseph D. Conroy and David A. Culver. 2005. Hypolimnetic oxygen depletion dynamics in the Central Basin of Lake Erie. Journal of Great Lakes Research 31(2): 262-271.

2d. Grand River (ON) Habitat Rehabilitation

T. MacDougall

Current habitat rehabilitation in the lower reaches of the Grand River (ON) is guided by the conclusions reached after 5 years of assessment in the early 2000s. In 2010, progress was made on two ongoing efforts focused on habitat fragmentation, impoundments, migratory fish and ecosystem connectivity (see below). Concurrently, the Grand River Conservation Authority (GRCA) began the process of revisiting its watershed management plan. Moving beyond simple flood control and drinking water management, this initiative acknowledges ecological flow needs and the connectivity between the watershed and Lake Erie. Development and implementation of this plan represents first steps in systematically addressing Grand River habitat rehabilitation from a water quality perspective.

Pike Creek - Pike Creek is a subwatershed of the Grand River that drains to the main channel approximately 30 kilometers upstream from Lake Erie. In the recent past, the last kilometer of the tributary has been altered by tile drain to facilitate farming of the floodplain. This created a situation where migratory species such as northern pike, were only able to access the creek on rare occasions of extreme spring flooding. Plans to re-establish the connection using natural channel design were initiated in 2008. In 2009 elevation surveys were conducted in order to ascertain the best approach and engineering designs were prepared. Fisheries surveys were conducted upstream of the project site to establish fish community composition and diversity to use as a baseline for later comparisons. All necessary regulatory requirements, consultations with affected stakeholders and sourcing of bio-engineering materials were completed in 2010. Construction is set to begin in early 2011.

Partners: OMNR, Haldimand Stewardship Council; Canada-Ontario Agreement: Respecting the Great Lakes Basin Ecosystem.

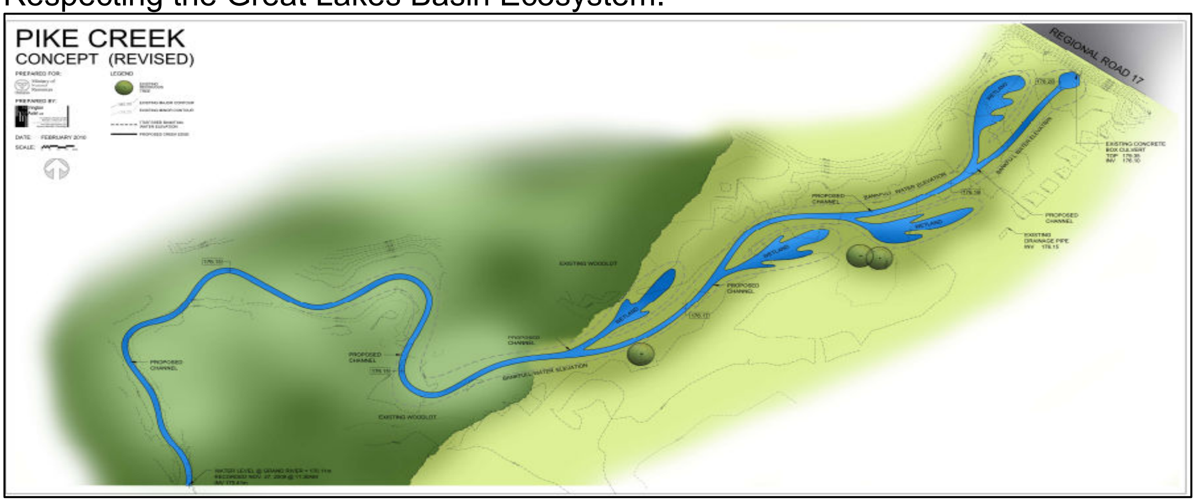

Figure 2d-1.Pike Creek. Partners: OMNR, Haldimand Stewardship Council, Habitat Haldimand, *Dunnville Dam -* The low-head barrier dam at the town of Dunnville negatively impacts the aquatic ecosystem of the Grand River in a variety of ways which include not only blocked fish passage but also wetland health and water quality. The process to address this major habitat impediment is expected to take several years due to the complexity of the issue, not only from an ecological and hydrological perspective but from a social and historical perspective. In recognizing that major changes to the hydrology are necessary to realize improvements, a detailed assessment of river bathymetry and riparian elevations was conducted in 2009. This information was used to inform the creation of a 1:50,000 scale physical model of the river, which encompasses a 7km section of river above and below the dam and impoundment. This model is being used to explore a several rehabilitation scenarios, which include dam removal (full to partial) and the creation of a rocky-ramp bypass channel. Information gained (e.g. resulting changes to channel morphology, changed flood risk, sediment transport) will be used to help make decisions regarding next steps. A LiDAR areal survey of the area early in 2010 was used to create a fine scale digital elevation model of the lower river reach. Information gathered is currently being used to inform a groundwater-surface water model that will be used to predict wetland migrations and groundwater consequences following a hydrological habitat alteration. Discussions around rebuilding a fishway vs. forms of dam removal are ongoing. In the interim to active habitat restoration on this issue, work to catch and move portions of a large walleye spawning migration, currently isolated from their spawning habitat, continues each spring.

Partners: OMNR, Dr. B. Annable/ University of Waterloo, GRCA, MOE, DFO, EC, SGR working group; Canada-Ontario Agreement: Respecting the Great Lakes Basin Ecosystem.

2e. Other Notable Habitat Projects in Brief

K. Anderson, J. Markham

- *Fish Passage Project, Chautauqua Creek (NY).* This project involves creating fish passage for steelhead and other native fishes past two water supply dams, opening up an additional 10 miles of high quality habitat. The design involves notching the lower dam and construction of a rock ramp on the upper dam in order to facilitate passage. Funding issues that have delayed this project for several years have been resolved and the project is scheduled for completion by Fall 2011. (NYSDEC, USACE). This project is funded through the GLFER program.

- *Springville Dam Fish Passage Project, Cattaraugus Creek (NY).* The Springville Dam is located approximately 34 miles upstream of Lake Erie on Cattaraugus Creek. The dam, built in 1921, was used as a source of hydroelectric power to the local community but has been out of operation since the late 1990s. Fish passage around this dam would allow access to over 70 miles of high quality spawning areas for steelhead and other stream fishes. A feasibility study is currently underway to determine the structural integrity of the dam, hydrodynamics of the watershed, and degree of sediment contamination in the sediments upstream of the structure. The feasibility study is scheduled to be completed in 2011, and future plans for the project will be developed based on these results. (NYSDEC, USACE, Erie County). This project is funded through the GLFER program.

- *Preliminary Restoration Plan (PRP), East Branch of Conneaut Creek Impoundments (PA).* The PRP has been completed for this project and the project has advanced to the feasibility, design phase. The project involves improving fish passage to a reach of East Branch of Conneaut Creek by the removal of two dams near Albion, PA, restoration of the stream reach impacted by the dam, and the construction of a sea lamprey control barrier. Results of this feasibility and design phase will determine future direction of this project (PAFBC, USACE, Albion Sportsmen's Club)

- *Preliminary Restoration Plan (PRP), Elk Creek McKean Reach (PA).* The PRP is scheduled for completion in March of 2011. The project hopes to advance approximately 800 linear feet of stream restoration with various habitat improvement features intended to correct stream bank erosion and maintain quality pool which serves as a seasonal refuge of resident fish as well as a fishing destination for Pennsylvania's Steelhead fishery. The PRP will document the costs and benefits to determine future direction of this project (PAFBC, USACE)

- *Fish Passage Project, Fourmile Creek (PA).* The project completed construction of the fish passage at a low head dam by erecting an Alaskan Steep-pass Fish-way in the summer of 2010 which provided passage of fall and winter runs of steelhead and will allow for the seasonal control of sea lamprey passage. The second phase will reestablish fish passage at a natural falls, which became a barrier due to head cutting and channel degradation from urban runoff. The work is scheduled for the summer of 2011 (PFBC, PA Sea Grant, Lawrence Park Township, Lawrence Park Golf Course, PA Steelhead Association)

- The following are habitat improvement efforts for steelhead and other resident aquatic community components: *Cassidy Park Fish Habitat and Hyporheic Zone Improvement Project* (PAFBC, Millcreek Township, PA Steelhead Association, S.O.N. of Lake Erie), *Crooked Creek Holliday Site Stream Enhancement Project* (PAFBC, NRCS, Property Owner), *Elk Creek, Folly's End Stream Enhancement Project* (PAFBC, NRCS, Property Owner), and *East Branch of Conneaut Creek Albion Park Stream Enhancement* (completed in 2010; PAFBC, Albion Sportsmen's Club).

Section 3. Lake Erie GIS Status

E. Rutherford, L. Mason

The Great Lakes GIS, including the Lake Erie GIS, was created in order to facilitate the sharing of data and holistic management of the Great Lakes basin as described in the Joint Strategic Plan for Management of Great Lakes Fisheries. The project includes map-delineated spatial units and associated habitat and biological attribute data for terrestrial, tributary rivers, nearshore, and offshore ecosystems. Funding for development was provided by the Michigan Department of Natural Resources, the U.S. Environmental Projection Agency, the U.S. Fish and Wildlife Service, and the Great Lakes Fishery Commission. As reported last year, funding for the development of the Great Lakes GIS concluded on December 31, 2007.

The project was partially supported by grants from the Michigan Department of Natural Resources (MDNR) that extends through September 2011. Previously, the MDNR work involved acquiring and mapping data on habitat and habitat suitability of non-game species within Michigan's waters of the Great Lakes. Currently, the MDNR work is supporting the progress of the Great Lakes GIS project's Internet website design and implementation. The new Great Lakes GIS website will contain an online data viewer and data download portal. Charge two to the HTG involves continuing to support the Lake Erie GIS initiative. While there is currently no funding designated for maintenance, upkeep or data updates, several side initiatives are progressing with the expectation that they will eventually be incorporated into the LEGIS. In particular, this includes substrate and habitat mapping, which has mostly been completed and will be incorporated into the LEGIS in 2011. Additionally, cooperative ecosystem and food web modeling work initiated by scientists at University of Michigan, NOAA GLERL, and several other regional resource agencies and universities are being conducted with the recognition that generated information can be incorporated into the LEGIS product.

The HTG recognized the need for more regular updates to the lower trophic level and fisheries data components of the LEGIS and will be investigating ways of annually integrating data from LEC member agencies. The current plan is share a data table template with the LEC agencies. The data can then be submitted to the LEGIS Project Coordinator annually. The data table template should allow for easy data preparation by agencies and quick incorporation into the LEGIS.

Information about LEGIS, and the overall Great Lakes GIS initiative, can be found at: http://ifrgis.snre.umich.edu/projects/GLGIS/index.htm

Section 4. Identification of potential lake trout spawning habitat in Lake Erie

T. MacDougall, S.D. Mackey, A.M. Gorman, J. Markham, and P. Kocovsky

In 2005, at the request of the Coldwater Task Group (CWTG), the HTG was assigned the task of identifying potential lake trout spawning habitat in Lake Erie. This would assist the CWTG with their charge of restoring a viable population of lake trout in Lake Erie as outlined in the recently finalized "Strategic Plan for the Rehabilitation of Lake Trout in Lake Erie, 2008-2020" (http://glfc.org/pubs/SpecialPubs/2008-02.pdf).

The task group's approach to addressing this charge has evolved along with our understanding of the current ecosystem, the limitations of best available datasets, the relatively small and localized scale of target substrate, the confounding presence of invasive species and the location and behaviour of lake trout during spawning time. Detailed descriptions of methods and field work accomplished since 2006 can be found in previous HTG annual reports (2007-2010; http://glfc.org/lakecom/lec/HTG.htm). In brief, the project used a multi-tiered approach that included: 1) identification of key environmental characteristics of lake trout habitat based on published records from other Great Lakes including bathymetry, substrate, slope, water depth, and proximity to deeper water nursery areas; 2) substrate mapping and bottom typing using side-scan sonar, Roxann classification and underwater video; and 3) an assessment of linkages and connectivity between potential spawning and juvenile rearing areas.

With primary fieldwork completed in 2009, actions on this charge in 2010 were focussed on data validation, the completion of north shore substrate interpretation, the standardization of substrate and habitat classifications, and the development of a method for comparing sites. In addition to characterizing areas based on areal coverage of substrate types, analyses including *minimum bounding regions* (MBR) and nearest neighbour calculations were tested on south shore and PA ridge sites. As well, a comparison of Sidescan and Roxann interpretations at Brocton Shoal, PA ridge, and Clear Creek/Long Point Ridge was completed. Video interpretation and classification by Joshua Morse was expanded in 2010 by considering video additional to that collected during this project (Environment Canada archives). Use of preliminary findings continued to inform stocking in Ontario waters and fall gillnet assessment in NY and PA waters. Similarly, trial gillnetting on Nanticoke Shoal was conducted in November 2010.

To date, this work has focussed on target areas in the eastern basin of the lake; although locations in the western basin, associated with historic coregonine spawning, have been discussed with regard to future investigation. In total, 128 km^2 of eastern basin and Pennsylvania ridge-associated lakebed were surveyed with Sidescan Sonar as well as 121 km^2 using Roxann classification (Figure 4-1).

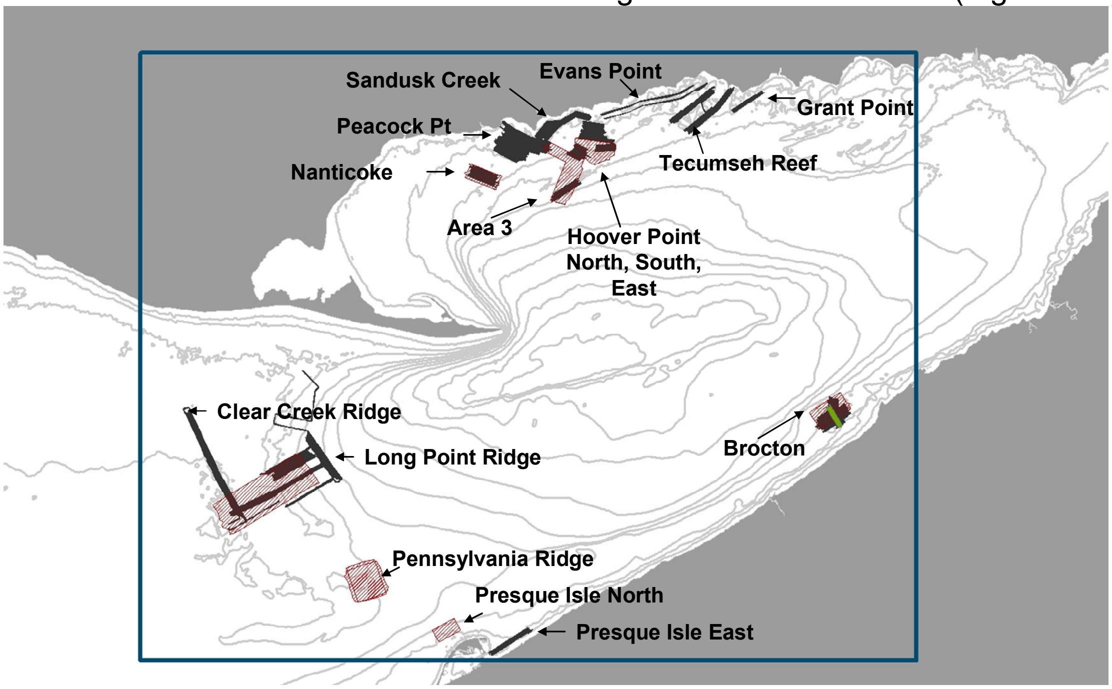

Figure 4-1. Areas of the east and east-central basin of Lake Erie surveyed with Sidescan and Roxann technologies between 2006 and 2009. Solid areas represent coverage by Sidescan sonar; Red, hatched areas represent coverage by Roxann.

Data interpretations of the two techniques are based on different classification categories. Regardless, initial comparisons in areas where coverage overlapped, has demonstrated some correspondence between the broad category bottom types classified using the coarser scale Roxann and desirable substrate identified on the finer scales associated with Sidescan sonar surveys. This is most evident at Brocton Shoal (Figure 4-2), where over 98% of potential habitat (Sidescan) was found over the cobble sand-silt mix classification (RoxAnn).

North Shore Shoals

Completion of sidescan sonar interpretations for all north shore sites in 2010 (Nanticoke Shoal, Peacock Point, Hoover Point North, South and East, and Tecumseh Reef) provided some confirmation of initial impressions about substrate suitability in this area of the eastern basin. Nanticoke Shoal continued to stand out as a very promising site due both to its substrate and its proximity to deeper-water areas that may serve as lake trout nursery habitat. Fine scale bathymetry of this shoal, collected during a multibeam survey by the Canadian Hydrographic Service in 2010, will be used to examine cobble substrate relative to small, local, steep slopes. Peacock Point, upon closer examination, appears to have more potential than first impressions indicated. Boulder-cobble piles and scarp debris have been identified in shallow waters (<6m) along the northwest flank.

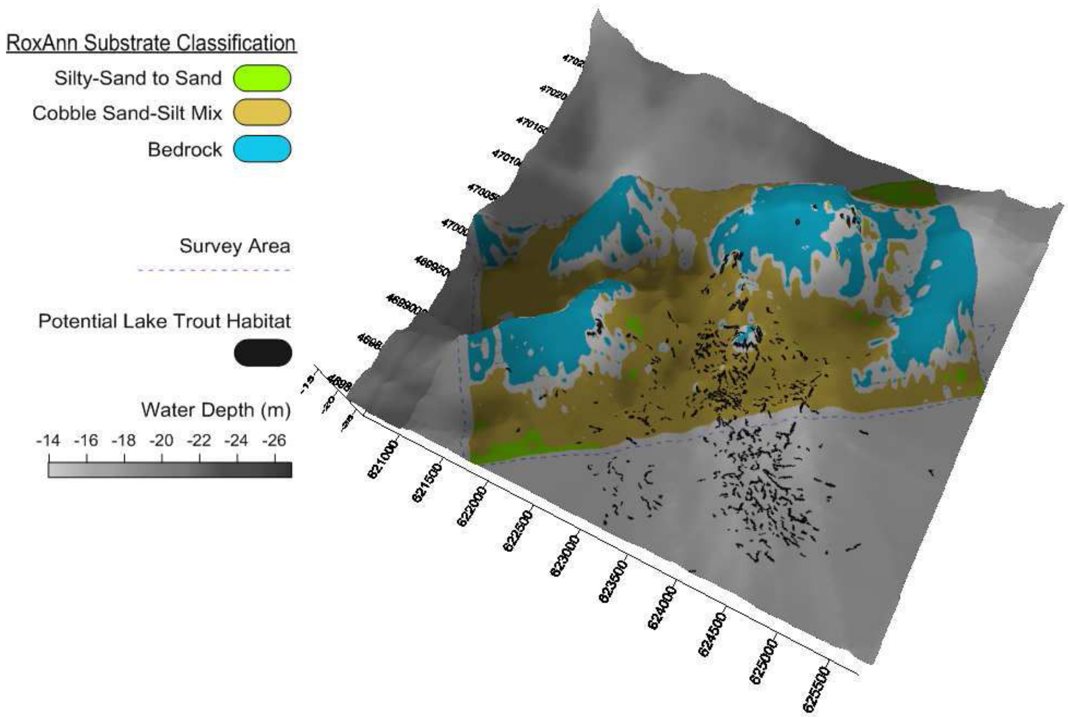

Figure 4-2. A 3-dimensional depiction of Roxann substrate classification overlaid with potential lake trout features as defined by Sidescan sonar interpretation at Brocton Shoal, NY.

The complexity of the sidescan data in this area, as well as areas to immediate east, has prompted us to revisit the current interpretation. Additional suitable substrate may exist on smaller scales. Desired expansion of sidescan sonar coverage on the eastern portion of Hoover Point, as recommended in last year's report, did not occur in 2010. Regardless, the area continues to hold potential due to the presence of cobble, cobble/scarp, and fractured blocky bedrock covering a larger area than observed at Nanticoke Shoal. While suitable substrate was present, in much smaller quantities at the remaining north shore sites (Hoover North, South, and Tecumseh Reef), the north shore as a whole continues to hold potential based on its lower incidence of fouling (see Video interpretation; below) and the possibility that lake trout in eastern Lake Erie are making use of non-traditional, shallow water, habitats (see Presque Isle, PA; below).

Historic Spawning site at Brocton Shoal as a reference site

As described previously, extensive reconnaissance surveys were conducted between 2007 and 2009 before large areas of suitable cobble were discovered inshore of the original target areas first described by Thomas Edsall in 1987. High resolution sidescan sonar data were subsequently collected over the area of best potential habitat. Although underwater video data revealed that boulder-cobble ridge substrates may not be suitable as lake trout spawning habitat (due to sediment-filled interstitial spaces and extensive mussel and algae coverage) (see video images below), an analysis of the substrate characteristics was conducted for comparison across sites. This physical description of the only known historic Lake Erie spawning site is important despite its current fouled state. Brocton Shoal has a large number (>250) of discrete boulder-cobble ridges (Figure 4-3) located within the bathymetric saddle between bedrock highs (Figures 4-2 and 4-3).

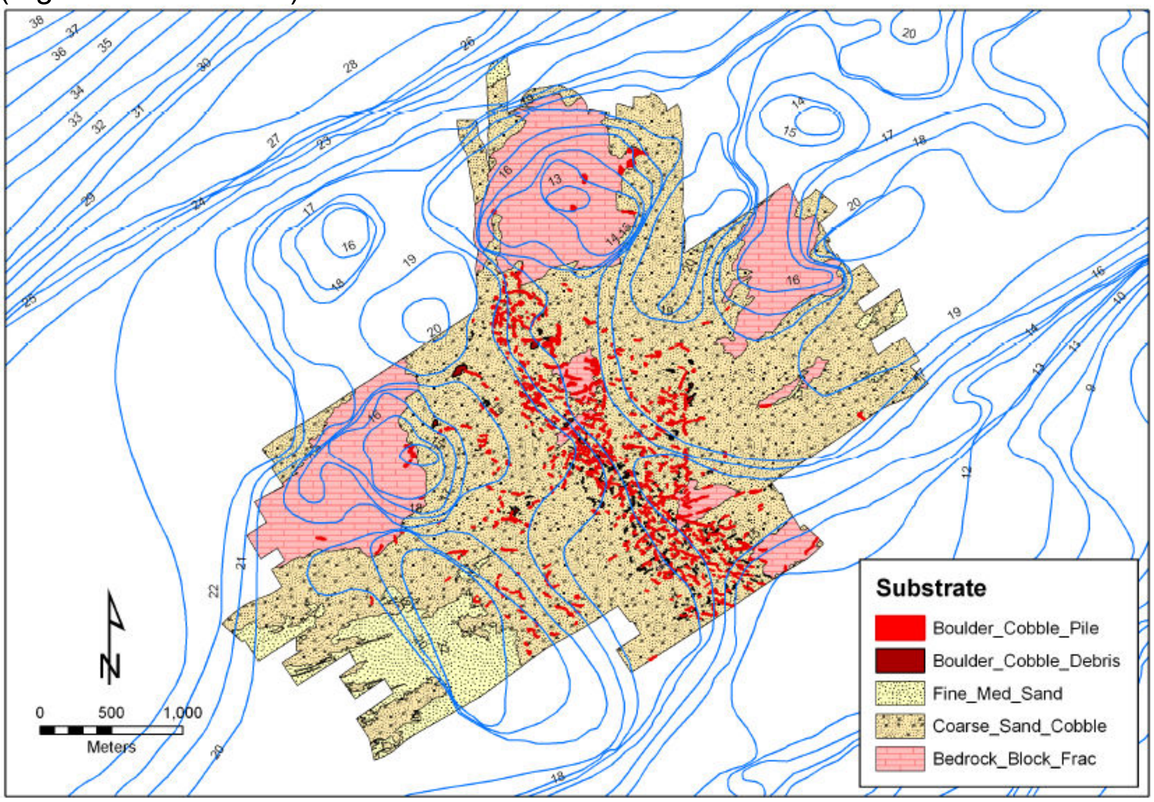

Figure 4-3. Substrate and habitat interpretations from sidescan sonar surveys at Brocton Shoal, NY.

<u>Long Point, Clear Creek, and Pennsylvania Ridge Complex</u>

A preliminary interpretation of the Roxann data from this area in 2009 were that no suitable lake trout spawning substrate was evident. An analysis using higher-resolutions sidescan sonar data in 2010 revealed limited areas of boulder-cobble substrates at the southern portion of Clear Creek Ridge (Figure 4-4); these areas may be suitable for spawning lake trout. Most of the Clear Creek and Long Point Ridges are composed of highly mobile sand and fine gravel substrates (both Roxann and sidescan conclusions). Additionally, sidescan data from the eastern flank of the Long Point Ridge (increasing downslope to the east) revealed exposed cohesive materials (possibly clay till) overlain by coarse sand and gravel-cobble lag deposits. Although probably not suitable for lake trout spawning, these data provide a better understanding of Lake Erie substrates and will be used to update regional Lake Erie substrate coverages (e.g. in the LE GIS project; see Section 3).

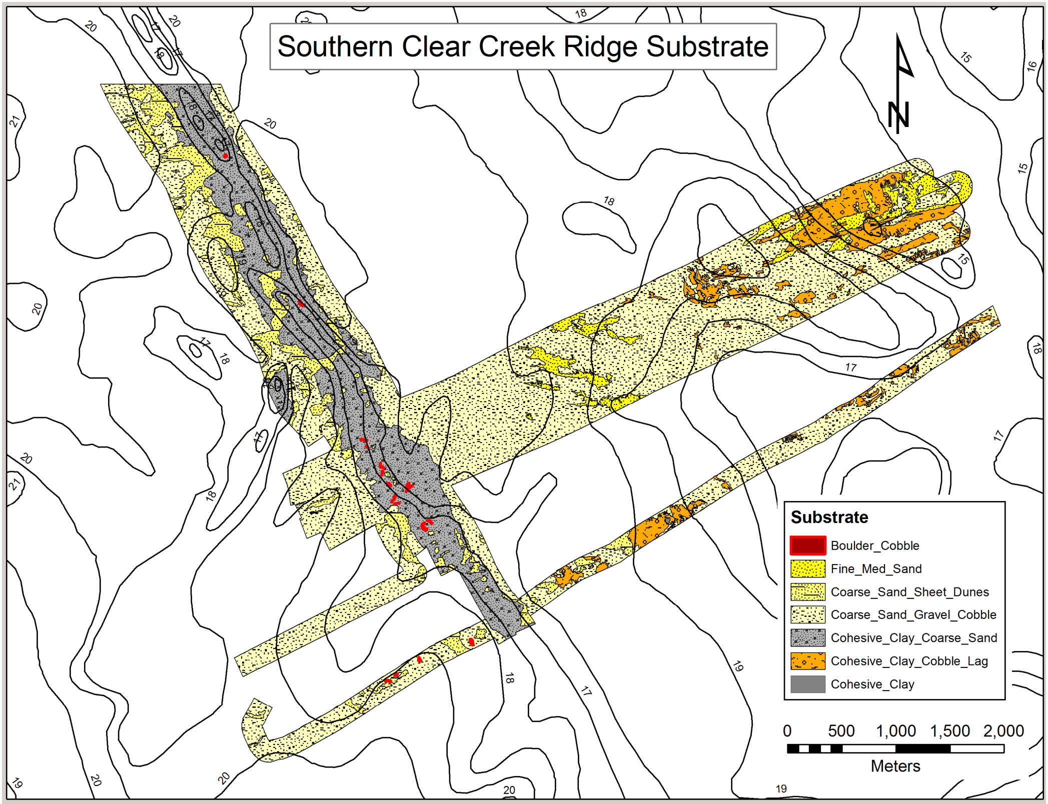

Figure 4-4. Substrate and habitat interpretations from sidescan sonar surveys at Clear Creek Ridge.

New, Alternate Reference Site at Presque Isle, PA

As reported previously, a sidescan survey south and east of the Presque Isle channel entrance was conducted in late November 2009 based on new information regarding the location of annual collections of spawn-ready lake trout (Jim Grazio, PADEP). While this area was relatively shallow (5-10m) and did not have the steep slopes previously targeted, extensive areas of highly fractured bedrock, and associated rock debris could theoretically be used by lake trout as spawning habitat.

Some limited boulder-cobble habitat was found to exist where LT are reliably caught each year. Underwater video data show areas of relatively clean boulder-cobble habitat; however these “clean” areas are limited in size and extent. These areas, along with the shallow fractured bedrock need to be further assessed to determine the availability of interstitial spaces (see Fisheries management action; below). Surprisingly, fall sampling in 2010 revealed that lake trout were congregating over coarse materials associated with the Erie, PA sewer outfall pipe that is located near the natural boulder-cobble habitat.

If these substrates are indeed shown to be used by lake trout as spawning habitat, this may prompt a re-consideration of nearshore, shallow water, highly fractured bedrock areas in other parts of the lake as potential spawning habitat for lake trout (e.g. Tecumseh Reef on the north shore). Even if used by lake trout, their appropriateness as habitat for *successful* reproduction may be limiting if the higher energy of these areas negatively impact incubation, hatching and /or larval dispersal, or if local currents do not provide connectivity to appropriate nursery habitat.

Comparing Brocton, Presque Isle East, Long Point Ridge Clear Creek Ridge

Detailed characterizations of substrate as well as proportional cobble area and MBR and nearest neighbour analyses for these areas have been reported elsewhere (see http://glfc.org/lakecom/lec/HTG.htm for "Identifying potential lake trout spawning habitat in Lake Erie" Final Report, GLFWRA).

Briefly, all sites were predominantly comprised of sand substrates. At Brocton and Presque Isle East, the secondary substrate was bedrock and there was more spawning substrate than at the Ridge locations. According to the Roxann surveys, spawning substrate was most atop a sand-silt cobble mix at Brocton and over a sand, gravel, and shell mix on the Ridge. Although structures were largest in size at Presque Isle (average = 1,144 m^2), Brocton had considerably more spawning structures (577 compared to 7 structures at Presque Isle East and 16 structures at the Ridge). Overall, the Ridge locations had the least amount of spawning substrate, but in the portion of this site where potential habitat was present, these structures were denser per unit area than at the other sites. Depths of suitable substrate were comparable amongst sites except for Presque Isle East, which was shallower than the others (8 m compared to 18 m).

Biotic Factors affecting potential of identified Habitats and Structures

It has become apparent that traditional habitat metrics for describing lake trout spawning requirements (slope, cobble size, depth) may no longer be entirely appropriate for defining the potential of an area. Where suitable cobble and slope are found the additional presence of lithophilic species such as *Dreissenid* mussels and attached filamentous algae (e.g. *Cladophora* sp.) may obstruct or reduce their function as spawning habitat. The very presence of mussels or algae may alter currents sufficiently to promote sedimentation, occluding any interstitial spaces that do exist. Large quantities of dying algal biomass in the Fall may result in an oxygen demand that prevents acceptable incubation of fertilized eggs.

The identification of potential of sites based solely on the proportion of cobble, slope, and water depth may be meaningless in light of yet to be quantified impacts of habitat fouling by mussels, algae, and/or silt. A relatively small area of cobble or fractured rock experiencing sufficient energy to preclude fouling by lithophilic species, may prove much more productive and thus have a higher potential than large areas of cobble covered in mussels and algae.

Examination of the video information has shown that the extent of *Dreissenid* mussel coverage on a given type of substrate (e.g. bedrock/cobble) can vary considerably across the survey area (Figure 4-5).

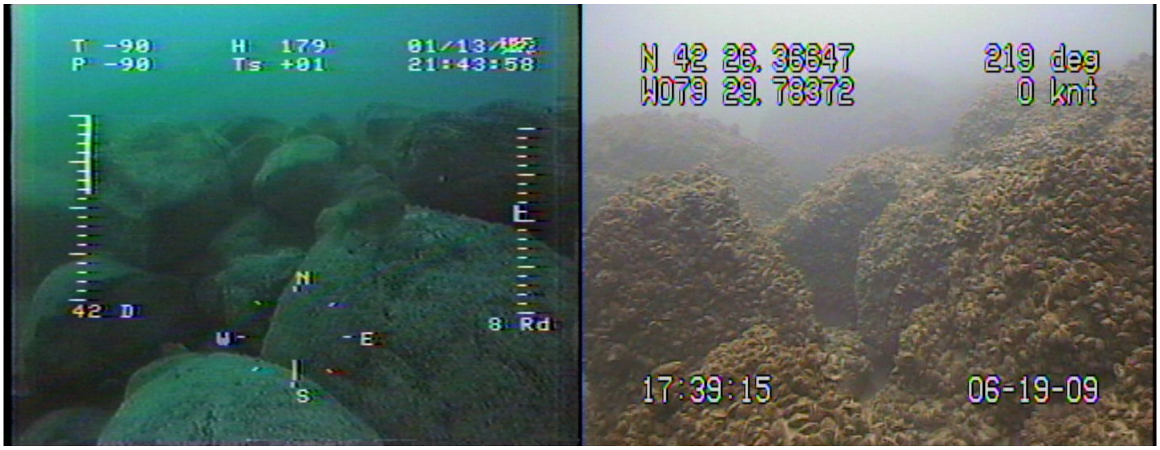

Figure 4-5. Images of Brocton Shoal pre- dreissenid invasion (left; 1987, Edsall) and post dreissenid invasion (right; 2009 current study).

The underwater video, originally collected primarily as a source of ground-truthing for the sonar techniques, has shown promise as effective assessment tool in its own right. Together with a classification scheme developed to guide and catalogue the subjective interpretation of images, the underwater video has allowed for the incorporation of biotic components (particularly attached invasive species) into the overall description and assessment of lake trout habitat. In 2010, Joshua Morse (Oberlin College, OH) expanded his 2009 interpretation of east basin substrate to include older video images collected over a broader time and spatial scale (some central basin north shore sites) than the current project (Environment Canada archives). His conclusions to date favour the north shore sites when compared to historic Brocton shoal (Figure 4-6), particularly Nanticoke Shoal and the nearshore in association with Hoover Pt.-East.

Using New Information to Direct Fisheries Management Action

Using estimates of habitat potential based purely on substrate areas at Brocton Shoal, several sites were chosen to conduct fall gillnet surveys and to deploy egg traps in 2008 and 2009. Previously, there had been no evidence to indicate that these areas are being used by lake trout for spawning. In 2010, continuation of the NY surveys, and expansion of the coverage to include Presque Isle East revealed the stocking origins of LT aggregating in the PA nearshore. While predominantly PA-stocked fish were found, some NY-stocked fish were at this site suggesting that some behavioural factors may over-ride stocking site imprinting. The November deployment of egg traps over identified habitat was inconclusive due to early ice cover and equipment loss. For details see the LEC, CWTG report 2011 (http://glfc.org/lakecom/lec/CWTG.htm).

Stocking of lake trout in Ontario waters (thus expanding the spatial distribution of stocking as recommended in the Lake Trout Management Plan) was conducted in 2008 through 2010 over identified cobble areas on Nanticoke Shoal. The subsequent recapture of some individuals indicates that some level of survival and dispersal is occurring. However it will be several years before sufficient numbers are stocked and reach maturity for an assessment of whether they will return and attempt to reproduce at this location. Annual stocking in Ontario waters will continue to compliment ongoing stocking in NY and PA waters. Limited gillnetting on Nanticoke Shoal on November 15, 2010 (24 hour set) did not capture any lake trout.

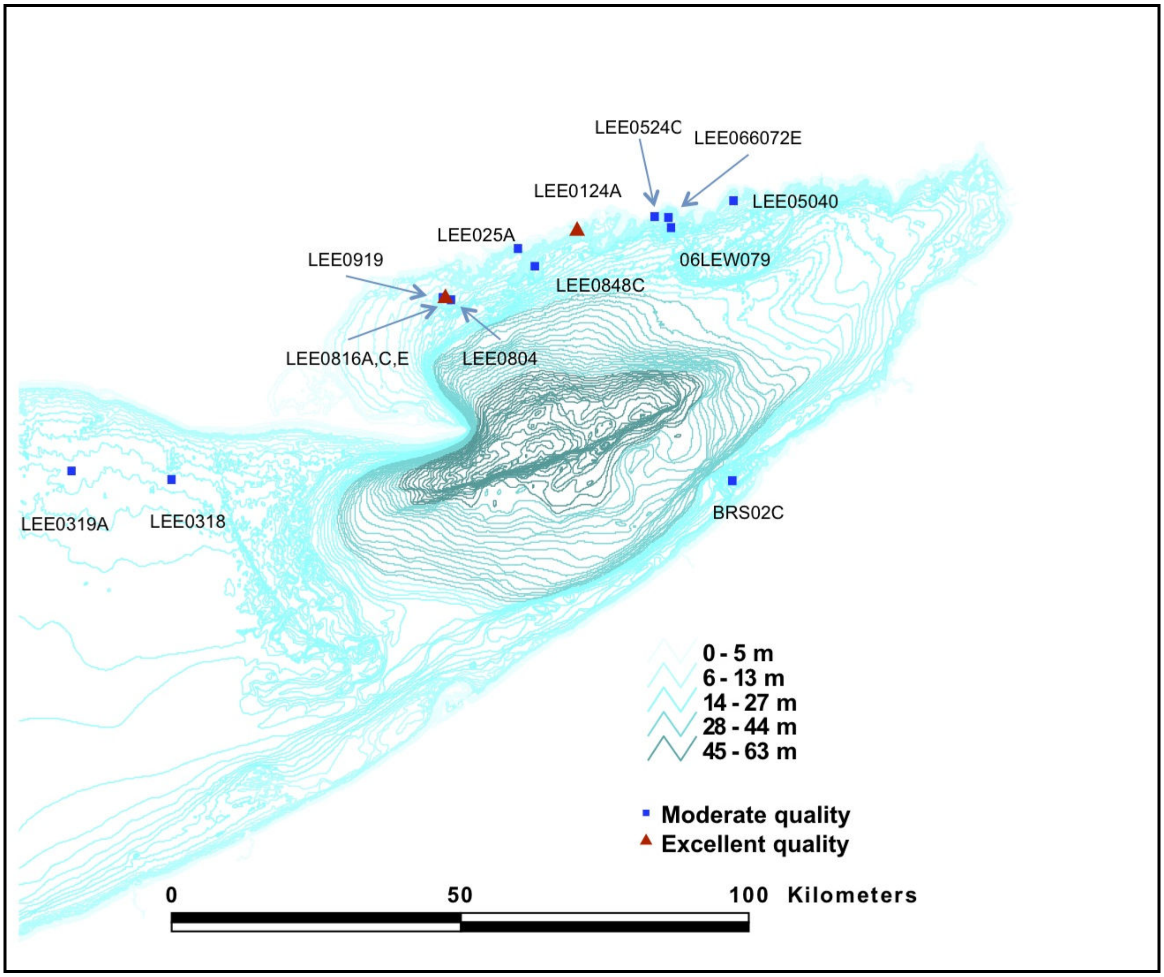

Figure 4-6. Lake trout spawning potential based on interpretation of underwater video focussing on substrate, interstitial space occlusion and fouling by biotic invasives (from Morse 2010).

Over the long term, evidence of successful lake trout reproduction in a particular area will determine its actual potential. It is entirely possible that lake trout behaviourally driven to choose non-traditional spawning areas may successfully spawn, but successful incubation of eggs may be compromised by additional factors such as wave action, exposure to predation, low DO, or siltation.

Conclusions to date: Summary

1. Areas of substrate suitable for lake trout spawning in Lake Erie, beyond the known historic spawning location at Brocton Shoal, do exist.

- Identifying these areas was more involved than originally anticipated (and the current list is not comprehensive) due to the inadequacy of existing datasets. There are significant data gaps or inaccuracies in existing datasets (e.g. substrate) which can compromise investigations into fish/habitat interactions.

- Where accurate, the resolution of many datasets (e.g. bathymetry and substrate) is too coarse given the limited size and extent of most identified areas. Many of these habitat areas are discrete.

- Surveys must be designed to be flexible / iterative: the spatial resolution of survey grids have to be adjusted based on habitat attributes (limited size and extent)

2. Historically suitable substrate may not currently be *functional* due to the unforeseen impacts of invasive species on habitat, both directly and indirectly (long-term sedimentation impacts)

- At these sites do LT: 1) aggregate 2) spawn 3) realize protection from egg predation; 4) realize successful incubation; 5) realize hatchling transport to nursery areas?

- It would be desirable to acquire similar data from active spawning sites in Lake Ontario for comparison with habitat conditions in Lake Erie. If not precluding reproduction, are invasive species impacts limiting?

- This points to possible habitat restoration opportunities (e.g. removal of sediments/invasives)

3. Links between habitat and lake trout need to be better established.

- It may be strategic to have fish lead us to potential spawning/nursery habitats (New Combined Approach/Strategy)

- There is very limited fall data available regarding where lake trout choose to be during spawning time (late fall): historic deeper cobble vs. alternate (e.g. shallow, clean, fractured bedrock)

- Some LT choose shallow-water habitat far removed from site of stocking (e.g. NY-stocked LT in PA nearshore). Questions remain as to the degree to which lake trout seek suitable spawning habitat relative to homing to site of stocking.

- Poor Understanding of Critical Habitat Attributes for these Fish. Can Fish Show Us What They Need?

Direction for 2011 and beyond

In 2011, some follow up underwater video characterization at key sites will occur (e.g. Peacock Pt., Presque Isle East, Brocton Shoal, Hoover Pt East.)

The HTG expects to have a complete package of characterizations and interpretations of spawning potential, for each area investigated to date, by the end of 2011. This can be used by the CWTG to inform agency assessments and identify new stocking locations.

The discovery of potential shallow-water habitat near Presque Isle, PA was linked to long-term sampling of lake trout by Jim Grazio (PADEP) at these sites. This suggests an alternative approach whereby we would let the fish guide us to where they want to be and then characterize the substrate and habitat features at that site. Whereas this is difficult for a struggling Lake Erie species such as lake trout, it is more practical for other, more abundant and thus less cryptic species.

Expansion of fall gillnetting to survey shoals, identified by substrate and video interpretation but not currently fished, is desirable but logistically difficult given weather conditions during spawning time. An alternative to gillnetting might include video monitoring (suggested last year but not implemented). Distance from current stocking locations may affect the use of an area deemed of high potential until lake trout numbers expand to a point where dispersal may increase.

Investigations into the rate at which cleaned substrate are fouled by sediment, mussels and/or algae would allow for the consideration of the potential of this type of restoration. It would additionally be important to assess the visual condition of mussel infested shoals currently successfully used for reproduction in Lake Ontario in order to more accurately gauge the ability of invasive species to detrimentally modify substrate.

The potential of western basin locations for lake trout spawning should be assessed.

HTG Investigators - A. Gorman (ODNR), S.D. Mackey (Habitat Solutions), T. MacDougall (OMNR), and J. Markham (NYSDEC)

Collaborators
H. Biberhofer (EC) - principle investigator with the HTG team.
P. Kocovsky (USGS) – previous HTG member and investigator with HTG
Joshua Morse, Oberlin College (OH) - video classification and interpretation.
Jim Grazio (PADEP) – investigations of PA shoreline and linking habitat to LT.

Funding Sources

- Canada Ontario Agreement; Respecting the Great Lakes Basin Ecosystem
- Great Lakes Fish and Wildlife Restoration Act Grant # 30181-8-G021

Section 5. Identify metrics related to walleye habitat

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

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. Presently, quotas are allocated proportionally based on surface area of waters less than or equal to 13 m deep by jurisdiction (Figure 5-1). This version of the strategy (STC 2007), adopted in 2008, 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 any attempt to further improve estimates of suitable walleye habitat through an expanded definition of habitat based recent literature, geospatial analyses and historic datasets.

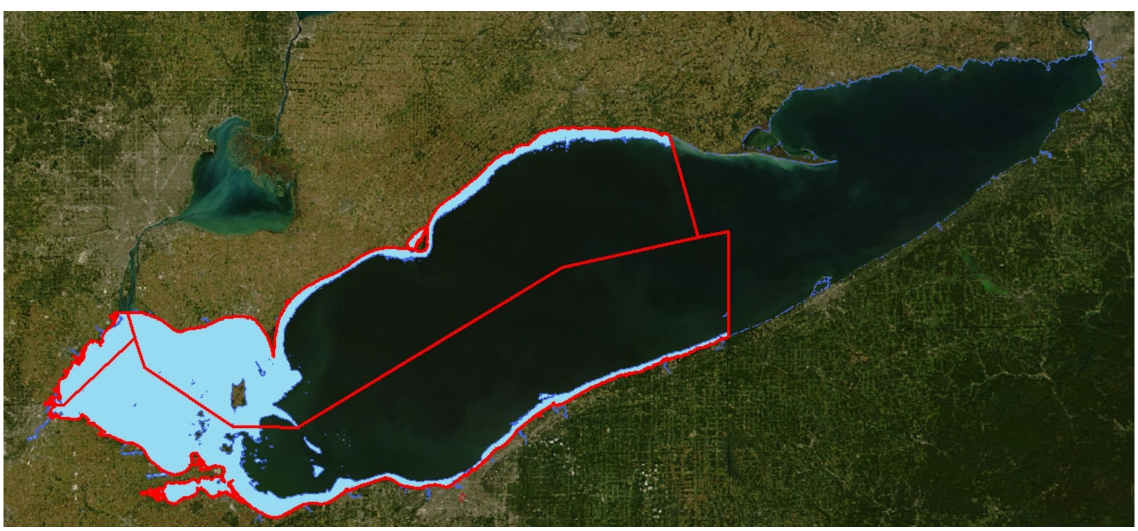

Figure 5-1. This map represents the present quota sharing allocation, which is proportionally based on surface area of waters less than or equal to 13 m deep (area in light blue) by jurisdiction for Ohio, Ontario and Michigan (outlined in red).

A sub-group consisting of HTG and WTG members was established to define a set of metrics of environmental variables and to develop a statistical relationship between the variables and suitability of adult walleye habitat. As a management tool, the model should be able to estimate the quantity of walleye habitat for each jurisdiction in Lake Erie. Through several meetings and discussions, a set of habitat variables was tested and selected. Selection of the variables was not only judged based on the understanding of walleye ecology and behaviour but also on the existence and spatial coverage of the available datasets.

Two modeling approaches were used to assess the relative roles of environmental conditions on the distribution of walleye. First, Pandit et al. (in preparation) used an ecological niche concept (Guisan and Thuiller 2005, Thuiller et al. 2010) in developing habitat suitability models by relating observed species presence/absence to environmental variables. Predictions from these habitat models are generally considered to be good indicators of habitat suitability, and thus species performance. The basic assumption is that, among habitats occupied by the species, the more suitable habitats attract more frequent visits by the given species (Albert and Thuiller 2008). Pandit et al. (in preparation) used empirical information to develop a habitat suitability model that can be used to estimate the probability of walleye occurrence, a proxy of habitat quality. The model was developed through a logistic regression analysis of the relationship between walleye occurrence and several environmental variables, as follows

$$\log(p/1-p) = \beta_0 + \alpha_1 X_1 + \ldots\ldots\ldots \alpha_n X_n$$

Where: *p* is the probability of walleye presence, β is the intercept constant; α is the coefficient parameter; and X represents the environmental variables. Previous studies (Christie and Regier 1988, Lester et al. 2004) suggested that temperature, dissolved oxygen, light attenuation (Secchi depth) and depth within the water column are important factors influencing walleye habitat and should be included in the model selection. An AIC-based model selection procedure was adopted to select among the variables. The selected model was developed using 75% of a 20 year time-series of walleye catches from an OMNR Partnership Gill net survey (August-November, 1989-2008) based on OMNR harvest for developing models. The model was validated using the remaining 25% of the OMNR data and a fall gill net survey from ODNR (late-September through early-November 1990-2009) based on an independent sample protocol. The data on abiotic conditions were collected concurrent with the surveys. Accuracy assessment showed that the model predicted walleye occurrence by an accuracy rate of greater than 75%.

The second modelling approach tested by ODNR (Fairport) was to determine if abundance could be modeled from the same environmental factors using the ODNR dataset. Overall, these findings support the literature (e.g. Lester et al. 2004) that there is a greater probability of finding walleye in shallower, warmer, more turbid waters. D.O. was not a good determinant is this modeling exercise. This is likely because few samples were taken below what is considered a critical threshold for walleye (~3 mg/l).

Pandit et al. created a series of a continuous, rasterized (interpolated) maps for each selected environmental variables (~ 50 m cell resolution) for the Ontario waters of the east and west basins of Lake Erie from which the walleye suitability index (0 to 1) was calculated for each cell using the selected model and the total area of weighted walleye habitat for each region was derived. This exercise was only conducted with abiotic data from late-August through early September in 2006-2008. Then, Pandit et al. compared weighted suitable habitat between the basins and different depths (i.e. near the surface and at the bottom of the lake). They found more suitable habitat in the surface than near the bottom of the east basin, while little difference was detected between surface and bottom in the west basin. This is mainly because the eastern basin is much deeper than the west and thermally-stratifies for much of the sample period. In general, the west basin had much more suitable habitat than the east basin (Figure 5-2). This was true for both adults and for juveniles. The central basin was not assessed for comparison because limited abiotic data was available for the time period during which this analysis was conducted (i.e. 2006-2008, late-August through early September). Inter-annual differences were not significant over this time period; however, it is likely that portions of the west basin would likely be unsuitable for walleye if June and July models were used. This is because a portion of walleye tend to migrate to the east basin to avoid elevated summer temperatures in the west. There is evidence that walleye migrate farther east in warmer years (Knight and Gorman, unpublished data).

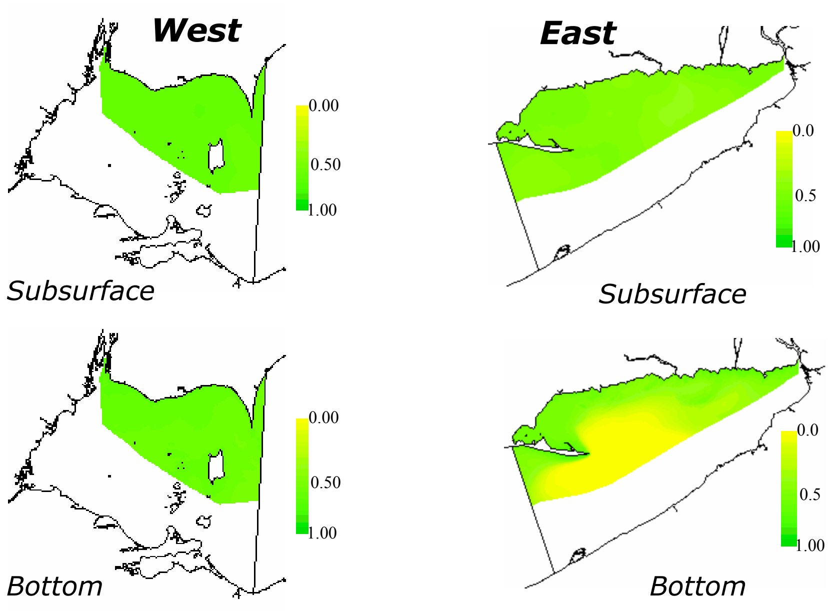

Figure 5-2.Habitat Suitability Index (HSI) maps derived from the species-habitat model for adult walleye in Lake Erie at the subsurface (i.e. at 6 m below the water surface) and the bottom in Ontario waters of the West and East basins. The maps represent the average value of HSI index over three years (2006-2008). Indices range from 0 (unsuitable) to 1 (suitable). (Pandit et al., unpublished)

The lakewide implementation of the model developed by Pandit et al. encountered difficulties due to data limitation. At present, a comprehensive lakewide abiotic dataset with sufficient spatial and temporal coverage is not available. Such data deficiency reduces the model utility and prevents further investigations on the spatial and temporal variations of the habitat and assessment of the habitat quantity and quality for Lake Erie walleye. The task group suggests that more lakewide assessments (including the central basin and U.S. waters) with significantly increased spatial and temporal coverage needs to be conducted. The data can also be used for the species-habitat model to assess changes in the amount of suitable habitat (i.e. walleye probability) due to some drastic environmental changes such as rapidly- and greatly-increased temperature, earlier and/or extended stratification (i.e. larger hypoxic zone), and heavy precipitation in a short period time (i.e. light conditions). In turn, we could better understand potential changes in quota allocation if this new definition of walleye habitat were employed.

We intend to present a number of options by which managers can use “walleye habitat” to justify a proportional allocation of the walleye harvest. With this in mind, we may also evaluate amount of suitable walleye habitat based on traditional habitat suitability models (e.g. McMahon et al. 1984), and also analyze metrics of walleye productivity (i.e. which jurisdiction has more (or more productive) spawning or nursery habitat). For each approach we will provide information about the variability around model predictions and the resulting (predicted) dynamics of the proportion of potential walleye habitat by jurisdiction.

Investigators: S. Pandit and J. Ciborowski (U of Windsor), Y. Zhao (OMNR), C. Knight and A.M. Gorman (ODNR)

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Section 6. Strategic Research Direction for the Environmental Objectives

S.D. Mackey

Environmental Objectives are intended to identify habitat conditions that are necessary to achieve the Lake Erie Committee's stated FCGOs. In Lake Erie, ten Environmental Objectives have been identified to support achievement of the thirteen FCGOs.

They include those that are necessary to protect and restore physical processes:

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,

those that address the recovery and restoration of fish communities:

1. Re-establish open water transparency consistent with mesotrophic conditions that are favorable to walleye in the central basin and areas of the eastern basin,
2. Maintain dissolved oxygen conditions necessary to complete all life history stages of fishes and aquatic invertebrates,
3. Restore submerged aquatic macrophyte communities in estuaries, embayments, and protected nearshore areas, and
4. Minimize the presence of contaminants in the aquatic environment such that the uptake of contaminants by fishes is significantly reduced,

and those designed to eliminate continued habitat degradation:

1. Halt cumulative incremental loss and degradation of fish habitat and reverse, where possible, loss and degradation of fish habitat,
2. Improve access to spawning and nursery habitat in rivers and coastal wetlands for native and naturalized fish species, and
3. 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.

As part of a strategic approach to habitat management, the HTG is proposing to summarize the current state, trends, and potential threats for each of the Environmental Objectives in a White Paper in order to better understand and define the types of research questions and answers that will be required by the Lake Erie Committee to achieve the Lake Erie FCGOs.

The approach will utilize a scenario process designed to systematically identify and address data gaps, lack of knowledge, and lack of understanding by evaluating current and potential future threats and trends for each of the Environmental Objectives. The white paper will examine how those threats and trends may impact the ability of Lake Erie Committee to achieve the stated Lake Erie FCGOs.

The HTG will develop *habitat change scenarios* based on fundamental drivers such as anthropogenic, climate change and invasive species stressors. These scenarios will be used to assess how threats and trends to the environmental objectives may change in the future. New threats may arise, and current trends may change (either become less important or more important under certain scenarios).

As these analyses are performed, questions will arise and data needs will surface along the way. It is anticipated that most of these questions will not have been asked before and will represent areas for future investigation. Moreover, it is probable that common data and information needs will be identified that are required to address the questions and issues that arise from the scenario analyses.

Even though it's unclear as to how often this should be done, it may be appropriate to periodically revisit the Environmental Objectives (and perhaps the FCGOs) to ensure that they are still viable. The Lake Erie Environmental Objectives were developed and published in 2005. Every 5 years or so it may be prudent to review and re-evaluate the Environmental Objectives, perhaps in associtation with the "State of Lake Erie" reporting, to assess whether they are still appropriate and are "on track". If certain Environmental Objectives can not be attained, then the related FCGOs may not be attainable either.

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

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