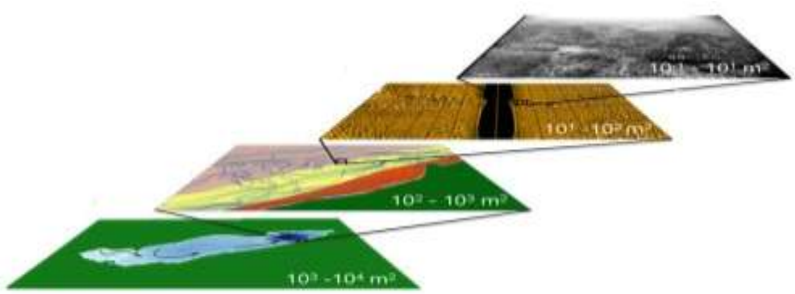
Report of the

Lake Erie Habitat Task Group 2012



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

Prepared by members:

Eric Weimer	*Ohio Department of Natural Resources (co-chair)*
Chris Castiglione	*US Fish and Wildlife Service (co-chair)*
Ann Marie Gorman	*Ohio Department of Natural Resources*
Tom MacDougall	*Ontario Ministry of Natural Resources*
Ken Anderson	*Pennsylvania Fish and Boat Commission*
Jim Boase	*US Fish and Wildlife Service*
Carey Knight	*Ohio Department of Natural Resources*
Richard Kraus	*US Geological Survey –L.E. Biological Station*
Scudder Mackey	*University of Windsor*
Jim Markham	*New York Department of Environmental Conservation*
Ed Roseman	*US Geological Survey – Great Lakes Science Center*
Ed Rutherford	*NOAA Great Lakes Environmental Research Laboratory*
Mike Thomas	*Michigan Department of Natural Resources*
Yingming Zhao	*Ontario Ministry of Natural Resources*

And non-members:

Lacey Mason	*Great Lakes GIS*
Catherine Riseng	*Great Lakes GIS*
Shubha Pandit	*University of Windsor*
Patrick Kocovsky	*US Geological Survey –L.E. Biological Station*
Christine Mayer	*University of Toledo*
Jason Ross	*University of Toledo*
Greg Kennedy	*US Geological Survey – Great lakes Science Center*
Jaquie Craig	*US Geological Survey – Great lakes Science Center*
Justin Chiotti	*US Fish and Wildlife Service*
Stacey Ireland	*US Geological Survey – Great lakes Science Center*

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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

2. Support Lake Erie GIS development and deployment

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

C. Castiglione, E. Weimer

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 projects identified by task group members and need to expand the inventory beyond the task group member knowledge. Building on the development of the Environmental Objectives detailed in Section 6 (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 Huron Erie Corridor

Greg Kennedy, Jaquie Craig, Ed Roseman, James Boase, Justin Chiotti, Stacey Ireland

Egg Deposition Studies in the St. Clair-Detroit River System

Assessment of the community composition, phenology, and spatial extent of egg deposition by lithophylic broadcast spawning fishes in the St. Clair River (SCR) and Detroit (DR) rivers occurred between 2007 and 2011. Intensive longitudinal studies of fish egg deposition occurred in the Detroit River (2007-08, 2011) and in the St. Clair River (2010, 2011). Multiple habitat types were sampled in each river including main channels, channel fringes, shallow island margins, river mouths, and open lake areas. Additional sampling occurred to document egg viability for lake sturgeon by assessing larval lake sturgeon produced at the constructed Fighting Island reef and in the North Channel of the SCR during 2010 and 2011, and at the Algonac reef site in 2011.

The first direct seasonal comparison of egg deposition by lithophylic broadcast spawning fishes was conducted throughout the SCR and DR systems during the spring 2011 sampling season. Furnace filter egg mats were used (25 sites within the SCR, and 28 sites within the DR) to collect eggs as they were deposited on the substrates, and the mats were retrieved weekly to collect eggs which were reared at the GLSC for species identification. While many of the same native and invasive species were found in both systems, the DR had about an order of magnitude greater overall egg deposition rates than the SCR. System-wide egg deposition (all species combined) averaged 151 eggs/m^2 in the SCR, whereas egg deposition in the DR averaged 3,809 eggs/m^2.

In the SCR, species composition was roughly distributed evenly by walleye, lake sturgeon, and suckers (Catostomidae; most likely white suckers, quillbacks, and redhorse species), however walleye were found more commonly throughout the SCR, but in lower numbers. Lake sturgeon eggs (1,726 eggs/m^2) were only found on a small incidental spawning habitat (Algonac reef site), whereas the sucker eggs (1,174 eggs/m^2) were most commonly found at the western most sample site in the North Channel, near the opening to Lake St. Clair.

In the DR, egg deposition by walleye accounted for roughly 99% of all eggs collected throughout the river in 2011. Eggs were collected at all 28 sites within the river. For most sites, walleye egg density averaged about 1,000 eggs/m^2, however three sites stood out with exceptionally high egg deposition; the head of Grassy Island (near Wyandotte, MI) produced 9,564 eggs/m^2, the ‘fieldstone’ reef off of Belle Isle (artificial reef – constructed habitat) produced 12,746 eggs/m^2, and the 'Hole-in-the-Wall' site to the west of the Livingstone channel at the break in the channel produced 27,759 eggs/m². This density is the highest recorded in the Huron-Erie Corridor over the past 5 years of sampling. Artificial reef sites (Belle Isle and Fighting Island) showed egg deposition rates either equal to or greater than the average deposition rates observed at other sites throughout the river. Sucker egg deposition was spotty among sample sites in the DR, but was consistent with sampling from previous years. Sucker density was highest at the Fighting Island spawning reefs, with 390 eggs/m² collected at reef 'B'. No lake sturgeon eggs were collected at the Fighting Island reefs (or anywhere else within the DR) in 2011, marking the first year without evidence of lake sturgeon spawning at the Fighting Island reefs since they were constructed in 2008.

Sampling for fall spawning fishes (primarily lake whitefish) was conducted for the second consecutive year at sites within the SCR For the second year, no (0) eggs were collected at any of the sample sites (19 sites). Egg sampling was conducted at the Fighting Island reef area in the DR to identify egg deposition by lake whitefish on the constructed reef, and to provide evidence of egg deposition within the Huron-Erie Corridor and verify the peak spawning period for sampling efforts within the SCR. Lake whitefish eggs were collected on the Fighting Island spawning reefs, and at control sites upstream and downstream of the reefs. Lake whitefish egg density averaged about 175 eggs/m² within the Fighting Island area.

Reduced egg sampling will occur in both rivers during 2012-13 with an emphasis on habitat characterization assessment (using side-scan sonar and underwater video) of sites showing higher than normal egg deposition, and pre- and post-construction assessments of planned or future constructed habitat sites. In the DR, intensive habitat characterization will occur at multiple sites throughout the DR including the Trenton channel, Sugar Is/Hole in the Wall area, the eastern Fighting Island channel, the head of Grassy Island, and the main shipping channel near Zug Island, Belle Isle, and Peche Island. Egg deposition sampling in the DR will be specifically targeted at lake sturgeon spawning at the Fighting Island reefs during May through June.

Habitat characterization of the SCR will include several sites throughout the main channel and delta areas including areas near Port Huron, St. Clair/Stag Is., Marine city/Fawn Is, Algonac at the North Channel split, mid-channel, and Chanel a Bout Rond. Egg sampling will target spawning at selected sites, including lake sturgeon at Algonac reef, pre- and post- construction assessment at the mid-channel reef site, as well as other selected sites for possible future construction.

Investigator: G.Kennedy, J. Craig, E. Roseman (GLSC)

Detroit and St. Clair River Juvenile Lake Sturgeon Trawling Assessments. Previous sampling efforts have indicated that age one and older lake sturgeon reside in the connecting channels year round. With the capture of young of year lake sturgeon in both the Detroit and St Clair rivers, our results indicate that for at least a portion of the population, all early life history requirements are being met within the connecting waterways.

In the Detroit River in 2011, bottom trawl assessments focused along the east side of Fighting Island because three young-of-year lake sturgeon were captured in this area in 2010. Forty five bottom trawls were conducted for a total of 215 minutes of effort. Using a Humminbird 1190 series side scan sonar imaging system, images were taken to characterize bottom substrate composition. No juvenile lake sturgeon were captured in 2011. The most common species captured were smallmouth bass, yellow perch, white perch, and silver redhorse (Table 2a-1).

In the St Clair River, bottom trawl assessments focused in the Lower St. Clair River, in the North and Middle Channels. Fifty eight bottom trawls were conducted for a total of 328 minutes of effort. A total of four juvenile lake sturgeon were captured, including two young-of-year (TL's = 134, 162, 476, 765 mm). Juvenile lake sturgeon were collected primarily over sand and gravel substrate. Other commonly encountered fish species included spottail shiner, logperch, and rainbow smelt (Table 2a-2).

Assessments for juvenile lake sturgeon are scheduled to begin in late summer. The Detroit and St. Clair Rivers will be targeted however bottom trawling will also be conducted in Southern Lake Huron near the St. Clair River and in Lake Erie near the mouth of the Detroit River. Effort will be dispersed evenly throughout each river to gain a better understanding of distribution. In addition to bottom trawling, small mesh gill nets and minnow traps will be set to assess the ability of these gears to capture juvenile sturgeon.

Investigator: J. Boase, J. Chiotti (USFWS)

Table 2a-1. Fish species captured during trawling in the Detroit River in 2011

Species	Number Captured	Species	Number Captured
Bluegill	1	Round goby	3
Carp	1	Shorthead redhorse	3
Channel cat	2	Silver redhorse	10
Freshwater drum	3	Smallmouth bass	24
Gizzard Shad	1	Spottail shiner	7
Lake sturgeon	4	Tubenose goby	1
Logperch	2	White perch	10
Northern Hogsucker	1	White bass	1
Rock bass	7	Yellow perch	20

Table 2a-2. Fish species captured during trawling in the St. Clair River in 2011

Species	Number Captured	Species	Number Captured
Carp	1	Round goby	43
Channel cat	1	Sand shiner	49
Emerald shiner	36	Shorthead redhorse	11
Gizzard Shad	1	Silver redhorse	2
Lake sturgeon	10	Smallmouth bass	19
Logperch	75	Spottail shiner	302
Northern Hogsucker	1	Trout perch	12
Rainbow smelt	69	White perch	7
Rock bass	46	Yellow perch	8

Larval Fish Studies in the St. Clair-Detroit River System

Assessment of the community composition, phenology, species abundances, spatial extent, movement, and production of larval fishes in and transported through the St. Clair-Detroit River system occurred between 2005 and 2011. Intensive longitudinal studies of larval fish were completed in the St. Clair River (2010, 2011) and in the Detroit River (2005, 2006, and 2011) with smaller spatial scope collections in the Detroit River (2007- 10). Multiple habitat types were sampled in each river including main channels, channel fringes, deltaic wetlands, river mouths, and open lake (Figure 2a-1 and 2a-2). Additional sampling occurred to assess larval lake sturgeon produced at the constructed Fighting Island reef and in the North Channel of the SCR.

While many of the same native and invasive species were found in both systems, the DR had about an order of magnitude more larval fish than the SCR and the phenology of fish early life history events was delayed in the SCR compared to the DR, likely due to water warming rates being slower in the SCR. In the DR, we found lake whitefish, walleye, yellow perch, Morone (white bass/white perch), suckers, lake sturgeon, and several native forage fish species to be relatively abundant in middle and lower river as well as at sites in Lake Erie near the river mouth. In the SCR, walleye, yellow perch, and suckers were found in lower abundances than in the DR. Transient coldwater fishes such as deepwater sculpin, rainbow smelt, cisco, and lake whitefish were found in both rivers in low abundances. Invasive species were found in both rivers and included rainbow smelt, round gobies, tubenose gobies, white perch, and common carp. Lake sturgeon were collected in the DR immediately below the Fighting Island reef and in the North Channel of the SCR. Collections of larval and juvenile native lampreys (Ichthyomyzon and Lampetra species) were collected in the North Channel of the SCR concurrent with collections of lake sturgeon.

Reduced sampling will occur in both rivers during 2012-13 with an emphasis on pre- and post-construction assessments of constructed habitats. In the lower DR and river mouth area, intensive collections will occur to satisfy data needs for collaborative bio-physical modeling efforts, genetics, and micro-element analyses. Sampling for larval lake sturgeon is scheduled to occur in the DR at Fighting Island and in the North Channel of the SCR in 2012. Intensive longitudinal exploratory assessments for lake sturgeon larvae will also occur in the SCR during 2012 to provide preliminary data for development of a large-scale project proposal aimed at identifying spawning sites and estimating larval production.

Investigator: E. Roseman, S. Ireland (GLSC)

Figure 2a-1. Egg and larval sampling sites in the St Clair River

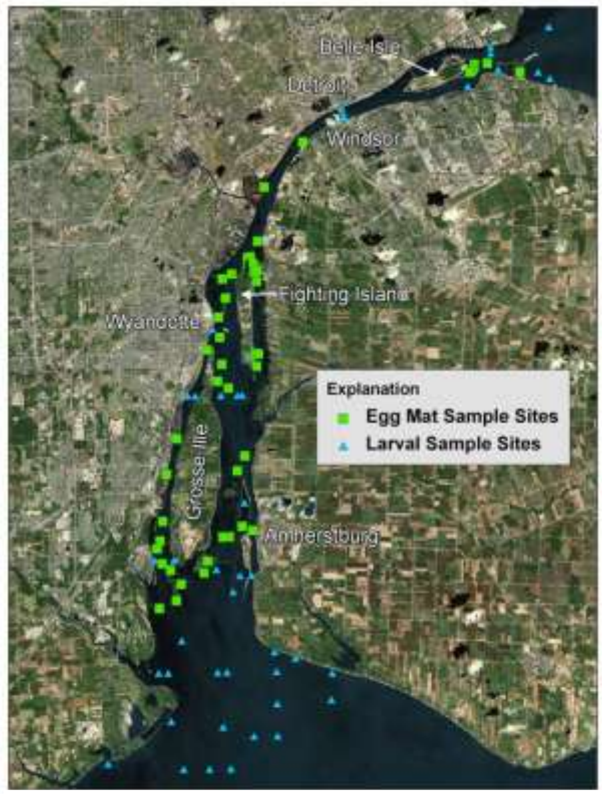

Figure 2a-2. Egg and larval sampling sites in the Detroit River

2b. Assessment of the Nearshore Fish Community

E. Weimer, C. Mayer, J. Ross

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.

During 2011, 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 a sampling design for the nearshore fish community of western Lake Erie. Specific objectives include: 1) Determination of an optimal sampling method (night and day electrofishing and overnight trapnets) based on both abundance and diversity 2) Determine optimal sampling frequency, duration of sampling, and number of locations 3) Describe relationships between the nearshore fish community and limnological and physical parameters (TP, chl-*a*, zooplankton, benthic invertebrates, nearshore substrate, shoreline features).

A total of 24 sites between Toledo and Cleveland sampled in the summer of 2011 (Figure 2b-1). Sites were selected based on geomorphic shoreline features and plume zones. The geomorphic shoreline features as categorized by the USACE include clay, bedrock, bluff bank, sand, and wetlands. Plume zones were generated based on the similarities of dominant summer flow, dissolved oxygen, temperature, and secchi depths. The four most westerly sites were sampled by OH EPA in 2011. Twenty sites were sampled by University of Toledo and Division of Wildlife personnel. Daytime electrofishing was conducted once at eleven sites and twice at nine sites. Night electrofishing was conducted once at fifteen sites and twice at four sites. Six sites included overnight trapnet sets.

Electrofishing consisted of five 100-m shoreline transects at each site using equipment and methods in accordance with Ohio EPA standards (Thoma 1999). Fish were processed every 100-m in order to develop species accumulation curves. Night electrofishing resulted in significantly more species being caught than daytime electrofishing (paired t-test p=0.0009; Figure 2b-2). Night species richness was higher at almost every site, and there were no species caught during the day that were not also caught at night, suggesting that electrofishing at night better describes the nearshore fish community than during daytime. Nighttime electrofishing captured significantly more species than trapnets at corresponding sites (paired t-test, p=0.04; Figure 2b-3). Furthermore, electrofishing took less time than trapnetting, making electrofishing more efficient.

Fish at each site were enumerated and identified by transect, and species accumulation curves were calculated. At sites where all 5 transects were sampled (n=14) the cumulative number of species caught increased with the number of transects sampled, although there is evidence of diminishing return on sampling effort (Figure 2b-4).

We classified shorelines as being: 1) disturbed (little or no vegetation, n=10), 2) in process of recovery (with various amounts of vegetation recolonizing, n=8) and 3) unaltered (n=2). Unaltered sites also had little or no vegetation because the only sites without substantial human alteration are bedrock walls. Disturbed sites had the fewest number of species captured by a combination of day and night electrofishing (Figure 2b-5). We compared disturbed sites to recovering sites using a t-test that does not assume equal variance, and found that recovering sites had significantly more species captured (t-test p=0.0004). We did not include unaltered sites in this comparison because of the small number of sites.

Staff from the Division of Wildlife also collected substrate data at each sample site. Substrate information was collected with a seabed mapping system made by Quester Tangent, which uses acoustic signals to identify differences in substrate type, and map the extent of each substrate type at each sample site. Substrate data were collected during August and September, 2011, from the 1-m water depth out to 3-m of water depth along each 500-m transect. Data collection was limited to shallower water in areas where the gradient of the lake placed the 3-m depth too far from the fish community sampling area. Data was collected in a grid pattern, and saved for future processing and groundtruthing. Division of Wildlife staff attended training in November at the Quester Tangent company headquarters to learn how to post-process the raw data. Sampling of both the nearshore fish community and the nearshore habitat will continue in 2012.

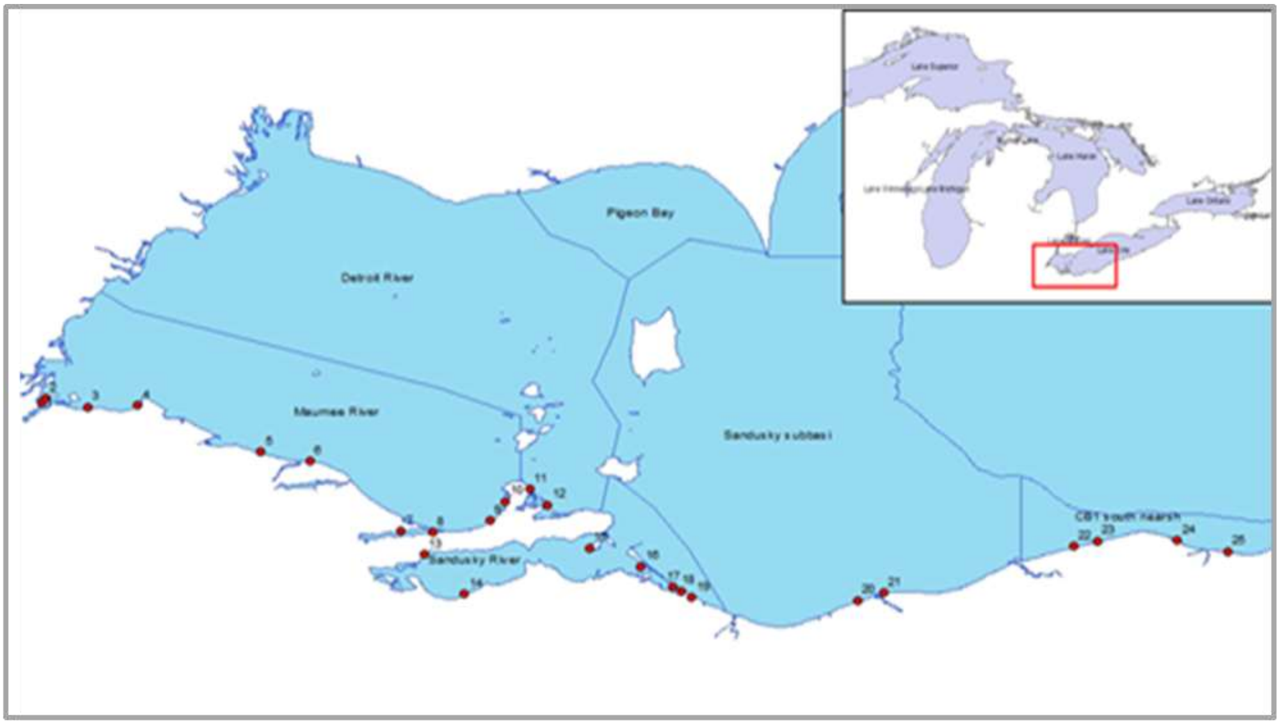

Figure 2b-1. Distribution of nearshore sampling sites across plume zones in the western basin of Lake Erie.

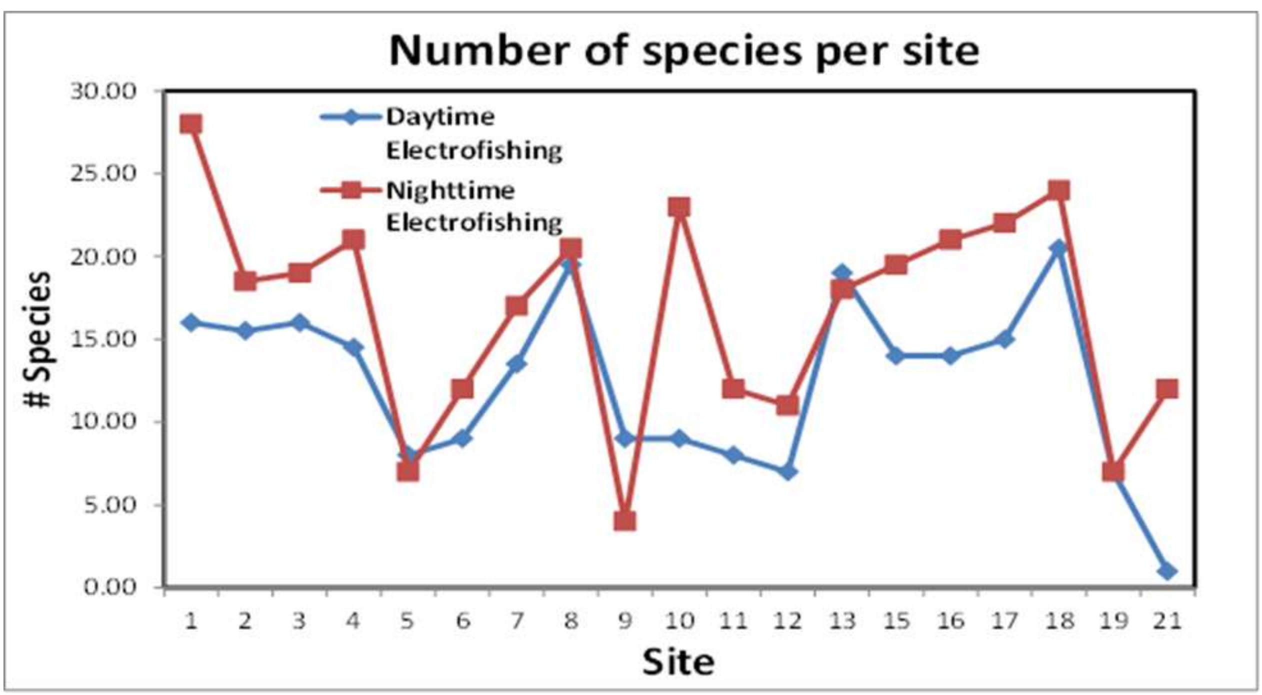

Figure 2b-2. Number of fish species captured during day and night electrofishing at 19 sites.

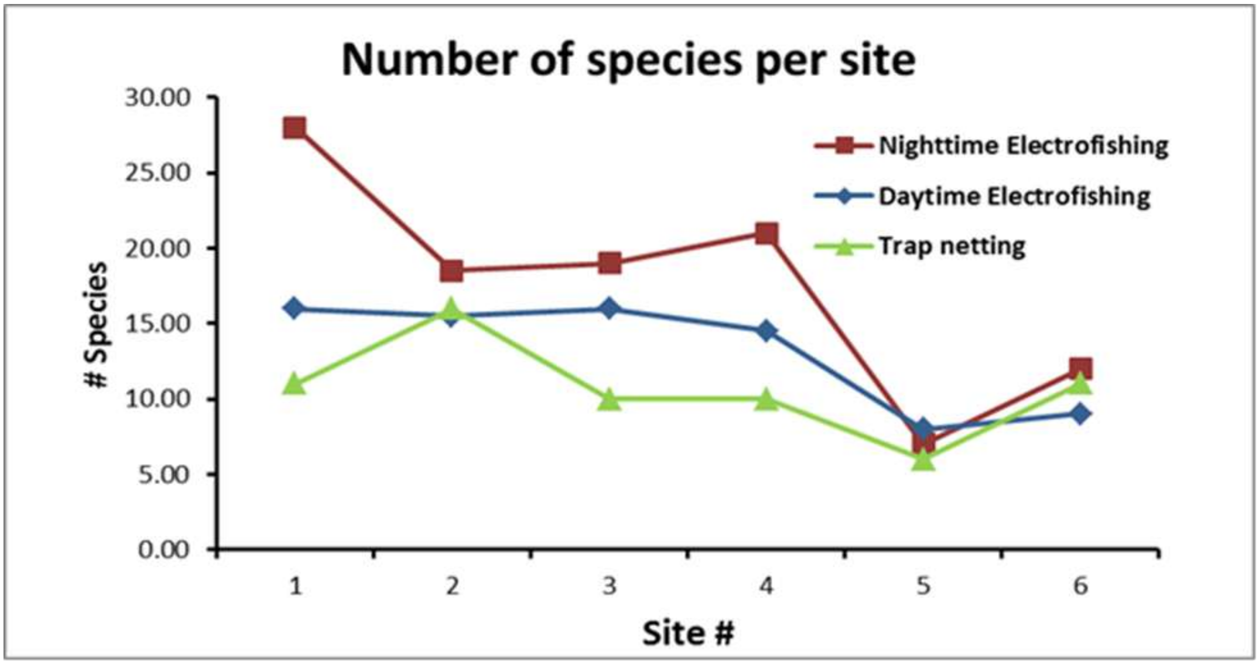

Figure 2b-3. Number of fish species captured with day and night electrofishing and trapnets at 6 sites.

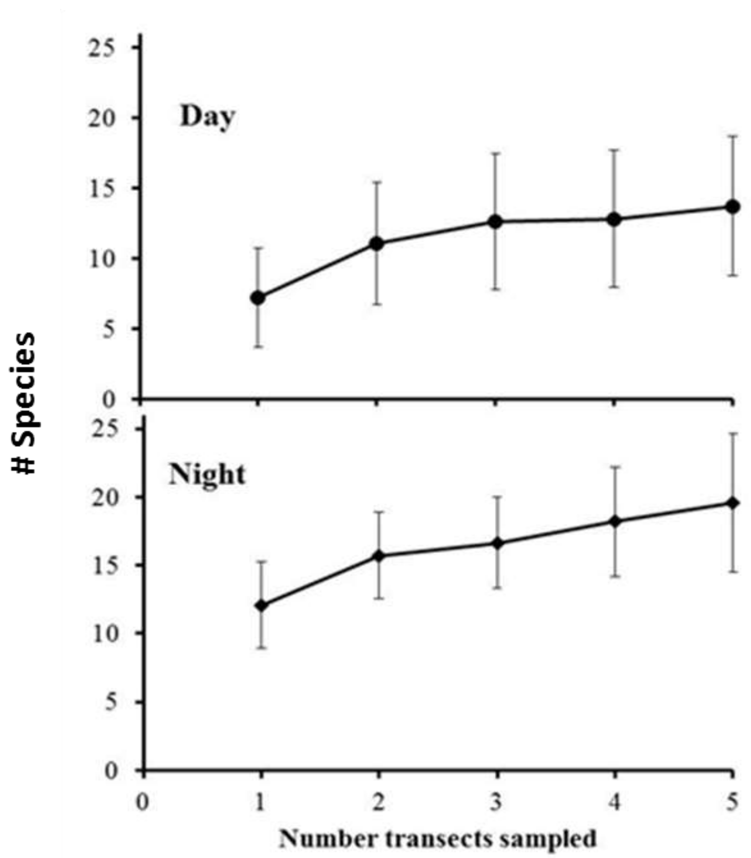

Figure 2b-4. Mean number of species captured day and night electrofishing at 14 sites as the number of 100m transects sampled at each site increases.

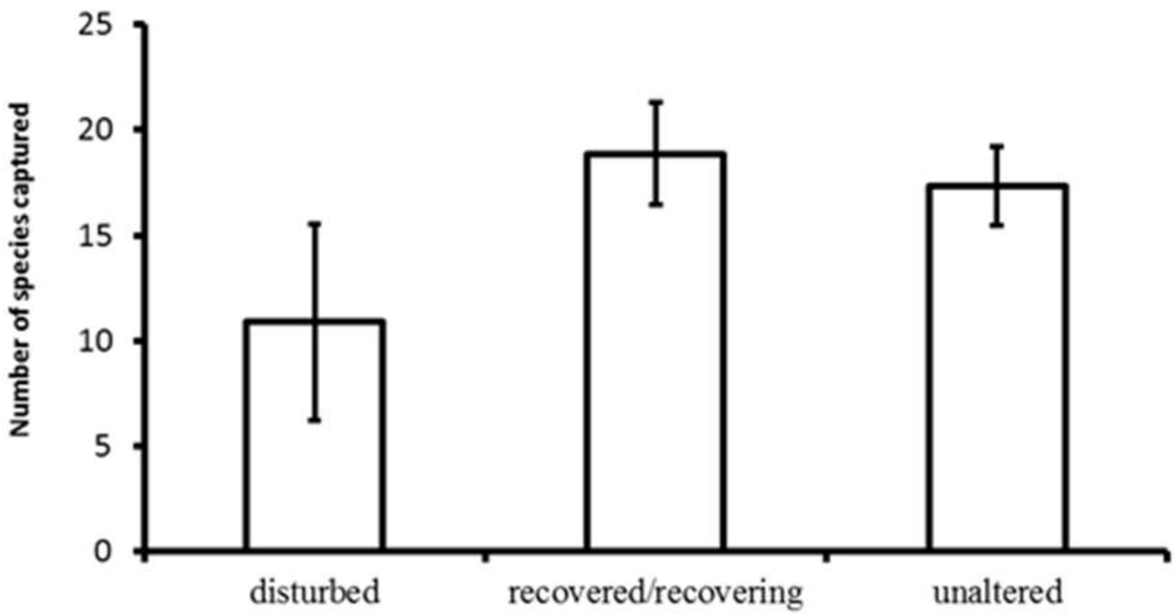

Figure 2b-5. Mean number of species captured during day and night electrofishing at 20 sites grouped by anthropogenic impact on the shoreline in western Lake Erie. Shoreline habitat is classified as disturbed, recovered/recovering, and unaltered.

Investigator: E. Weimer (ODNR), C. Mayer and J. Ross (UToledo)

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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 (DO). 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 of 10,000 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 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 DO 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) in the Central Basin in 2011. We quantified the epi- and hypo-limnetic spatial distribution of fishes across a depth gradient and associated ecotone of hypoxia in the central basin of Lake Erie. We used a combination of hydroacoustic surveys, bottom trawls, and mid-water trawls to characterize spatial patterns for individual species, fish assemblage structure, and total fish biomass. We examined diel migration effects with paired daytime-nighttime surveys in both August (during hypoxic bottom conditions) and September (during normoxic bottom conditions) (Figure 2c-1).

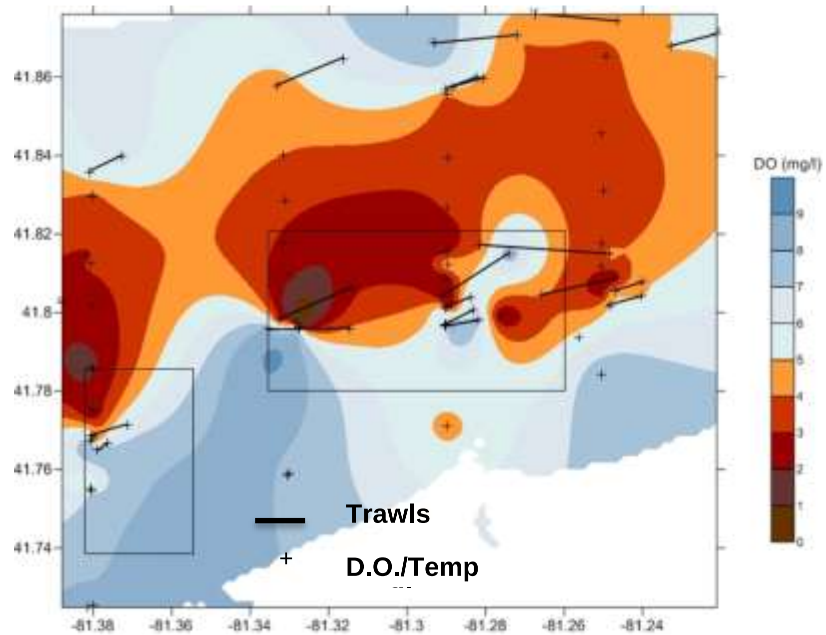

Figure 2c-1. Our sample design for studying hypoxia over a diel period on August 16-17, 2011 with bottom and midwater trawls across continuous temperature and DO monitoring locations. The longer lines indicate midwater trawls.

Although the biotic data are still being analyzed, we found high variability in dissolved oxygen at small spatial and short temporal scales. For example, DO may be normoxic (i.e. >7 mg/l) at the beginning of a trawl and hypoxic (i.e. <2 mg/l) at the end, or the opening of the trawl net (2m high) may span a similar gradient of DO. In addition, on short time scales (< 7 hrs) bottom DO can change from normoxic to hypoxic at a single location. These findings highlight difficulties in characterizing a single trawl sample as hypoxic or normoxic, which has implications for current Task Group proposals to omit trawl samples with low DO (<2mg/L) from the calculation of percid recruitment indices. We recommend that future assessment sampling include temperature and DO profiles at the beginning and end of each tow in order to support the development of a scientifically-based decision rule.

2d. Grand River (ON) Habitat Rehabilitation

T. MacDougall

Current habitat rehabilitation in the lower reaches of the Grand River (ON) is guided by conclusions reached after 5 years of assessment in the early 2000s. In 2011, habitat rehabilitation continued to focus on habitat fragmentation, impoundments, migratory fish and ecosystem connectivity. Concurrently, important steps were taken in linking water quality habitat needs in the lake nearshore with the actions of water quality regulators on the landscape. The Grand River Conservation Authority (GRCA) continued the process of updating its water management plan (GRWMP). Moving beyond simply 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 and quantity perspective. A Lake Erie-Grand River working group, formed in 2011, utilized both Lake Erie's Fish Community Goals and Objectives and Environmental Objectives in developing GRWMP objectives and targets thereby tying land based actions to estuary and lake habitat needs. This work will ultimately result in the consideration of lake needs when planning habitat rehabilitation higher in the watershed.

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. Following extensive consultation, planning, surveying, designing, and permitting (2008-2010), construction of a new channel was carried out in two phases during June and August of 2011 (Figure 2d-1). This work included the breaking of the agricultural tile drain and the creating of wetland cells to buffer runoff from the farm fields. The resulting channel has proven effective (retained water connectivity through remainder of the year) and there have been qualitative observations of use by species including northern pike (adult and juvenile), long nosed gar, sunfish and a variety of minnow species. Fisheries assessment and monitoring will commence in 2012.

Partners / Funding Sources: OMNR, Haldimand Stewardship Council, Grand River Conservation Authority, Niagara College, Six-Nations Ecocentre / Canada-Ontario Agreement: Respecting the Great Lakes Basin Ecosystem, Ontario Trillium Foundation.

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 recent years the topography, geology and hydrology and of the system has been surveyed at a fine scale and modeled (both physical and computer models) in order to guide decisions around a complete restoration (dam removal) and/or single issue habitat fixes (e.g. alternate fish passage facilitation). The development of a groundwater-surface water model to be used to predict wetland migrations and groundwater consequences following a hydrological habitat restoration, continued in 2011.

Several environmental reporting exercises (federal and provincial), including parts of the GRWMP have succinctly outlined the major issues and have offered guidance for managers related to habitat restoration, targets and monitoring at this location. Also in 2011, the denil fishway in the dam structure, previously identified as underperforming but currently the only method of unassisted fish passage beyond the 7km upstream point, was found to be in disrepair and non-functional. This failure of a critical fisheries component of the dam structure was seen as an opportunity to rationalize moving forward with some of the proposed restoration measures. The interim plan is to solicit an engineering assessment of the fishway structure and pursue funding to repair it in order to re-establish some habitat connectivity.

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

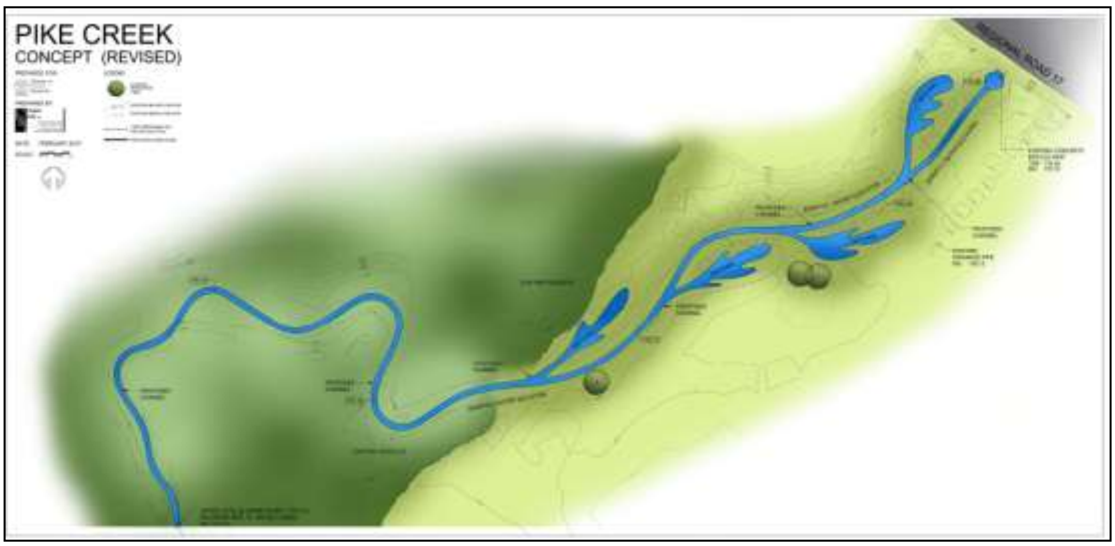

Figure 2d-1. New channel construction of Pike Creek

2e. Other Notable Habitat Projects in Brief

K. Anderson, E. Weimer

- *Coastal Wetland Re-connection, Middle Harbor (OH) and Erie Marsh (MI).* Work began in late-2011 to reestablish connectivity between these two coastal wetlands and Lake Erie by installing large culverts in dikes to allow natural water exchange and fish passage. Pre- and post-restoration fish and plant community monitoring is being undertaken, and in Middle Harbor, a planned drawdown and seeding is planned to avoid colonization by invasive macrophytes. This work is scheduled to be completed in 2012. (Ducks Unlimited, The Nature Conservancy, ODNR-DOW, Ohio State Parks)

- *Fish Passage Project, Fourmile Creek (PA)*. The project is completed with the construction of a bypass fish-way in the fall of 2011 at a natural waterfall, which provided passage of fall and winter runs of steelhead and will allow for the seasonal control of sea lamprey passage. The fall became a barrier due to head cutting and channel degradation from urban runoff. (PFBC, PA Sea Grant, Lawrence Park Township, Lawrence Park Golf Course, PA Steelhead Association)

Section 3. Lake Erie GIS Status

E. Rutherford, L. Mason, C. Riseng, E. Weimer

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 extended 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 and walleye and yellow perch harvest by grid data, which will be incorporated into the LEGIS by early 2012. In 2012, the Forage Task Group will be providing data from their Lower Trophic Level Assessment program, which initially will include a subset of years to determine how best to incorporate these data into the LEGIS. 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 recognizes 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

In other news, the Lake Erie GIS will be 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. Using coastal and offshore spatial processing zones, a gridded network of cells with attributed data-building blocks are being developed to define ecological habitat units, support classification and assessment, and facilitate linking of offshore, coastal and terrestrial process at multiple spatial and temporal scales. Data from the Great Lakes GIS is being incorporated into the GLAHF, and the HTG will find ways to provide new and updated data to this project.

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 (2007-2011); http://glfc.org/lakecom/lec/HTG.htm .

With the completion of primary fieldwork in 2009, actions on this charge in 2010 and 2011 were focused on validation of substrate condition and interpretation using underwater video, acquisition and interpretation of additional north shore sidescan sonar data, standardization of substrate and habitat classifications, and the development of a method for comparing sites.

In 2011, key activities related to this charge included:

Lake Trout Stocking and Assessment

Substrate and potential habitat information continued to guide stocking activity in Ontario waters; the full Ontario contribution (5,600) being boat stocked over Nanticoke Shoal in 2011. Standardized gillnet assessments were conducted in November on Nanticoke Shoal in Ontario waters and at a variety of locations in NY waters.

Underwater video surveys conducted in July, 2011 revealed a potential high quality lake trout spawning area off 18 Mile Creek in NY. This nearshore site is relatively large and appears to possess many of the necessary attributes that lake trout need for successful reproduction, including cobble sized rock piles, a substrate relatively clean of silt, and large interstitial spaces (Figure 4-1).

Furthermore, the rocks did not appear to be as heavily encrusted with dreissenids as areas on Brocton Shoal (Figure 4-2). The only negative attribute of this site, which is also true of all other sites on New York's Lake Erie coastline, is that it is subject to the strong westerly winds and waves that buffet the area during fall and winter months. However, because this site is shallower and closer to the eastern end of the lake, it often becomes ice covered during winter, thus diminishing some of these effects. Fall gillnetting found that lake trout were utilizing this site. Although the numbers of lake trout caught were not as high as on other nearshore sites sampled in recent years, the sampling did confirm that lake trout did find this habitat and were utilizing it despite its considerable distance from stocking locations (25 miles). To date, this site appears to have the best quality habitat for spawning lake trout that we have surveyed in the New York waters of Lake Erie.

A site-over-time video investigation of the shallow cobble ridge on Nanticoke Shoal failed to discover use by lake trout however a dynamic aspect of the issue of fouling of cobble was made apparent.

North Shore Shoals

Completion of sidescan sonar data collection and interpretation for Hoover Point East in 2011 (Figure 4-3) confirmed the presence of additional potential substrates in this area of the eastern basin. The area continues to hold considerable habitat potential due to the presence of cobble, cobble/scarp, and fractured blocky bedrock covering a larger area than observed at Nanticoke Shoal. Nanticoke Shoal continues 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. This represents the completion of the shoals originally targeted in 2008-2010 (Figure 4-4)

Maitland Ridge

A large bathymetric feature situated east of the previously investigated shoal areas was targeted for a reconnaissance survey in November 2011 (Figure 4-5). Known as the Maitland Ridge, substrates on this large feature were originally mapped as cohesive glacial till. The Ridge has been noted as a potential location of interest outside of the bedrock shoals to the west. Due to the sheer scale of the feature (15km x 25km) and the supposition that it may be comprised mainly of sand, a reconnaissance survey was designed to ascertain if and where to target more comprehensive surveys. Recent reconnaissance lines, spaced 1km apart with a 400m swath width, indicate that much of the Ridge may be covered by a sandy substrate. Poor November weather prevented the completion of planned survey. There are plans to revisit and complete the preliminary survey in 2012.

Western Basin

Following on the “future directions” presented in the 2011 HTG report, a research strategy was developed to investigate potential spawning habitat in the western basin of the lake. This work would target the objectives similar to those devised for the eastern basin, namely 1) conduct a multi-scale habitat assessment in select West Basin reefs to prioritize suitability for native fish populations (including: cisco, lake whitefish, lake trout, etc.) with respect to physical processes influencing recruitment success; and 2) Initiate informed stocking on West Basin reef structures using hatchery-reared, tagged lake trout and assess annual movement, homing response, and return rates correlated to stocking site locations. Members of the HTG together with additional collaborators are currently pursuing the funding needed to realize this initiative.

Seasonal Monitoring of fouling by algae

Regular video monitoring at 11 sites (stratified by degree of cobble and depth) on Nanticoke Shoal was conducted between May and November, 2011 using a drop camera. This exercise gave an indication of the timing of growth and degree of coverage by filamentous attached algae, particularly at sites otherwise deemed suitable for lake trout spawning. Although a large biomass of algae was apparent by mid-summer, most had apparently died back and been dispersed by wave action and currents by early November, concurrent with the probable timing of lake trout spawning. Review of additional video images, collected at a single location over a number of days (for the purposes of documenting fish use of the substrate), revealed that much of this material may have died and broken down but may not have been moved much beyond its origin. Quantities of easily suspended flocculent material, presumably dead or dying algae were introduced into the water column during high energy storm events and settled out under calmer conditions. This has given rise to further concern about the ability of otherwise clean cobble substrate to support the incubation of lake trout eggs. Shallow waters may provide for wave energy sufficient to keep substrate free from dreissenid coverage but this same energy may result in the continued re-introduction of, and smothering by, organic material.

FIGURE 4-1. Location of 18 Mile Creek Shoal sampled for spawning lake trout, November 2011.

FIGURE 4-2. Underwater photo of bottom habitat off 18 Mile Creek in Lake Erie, July 2011.

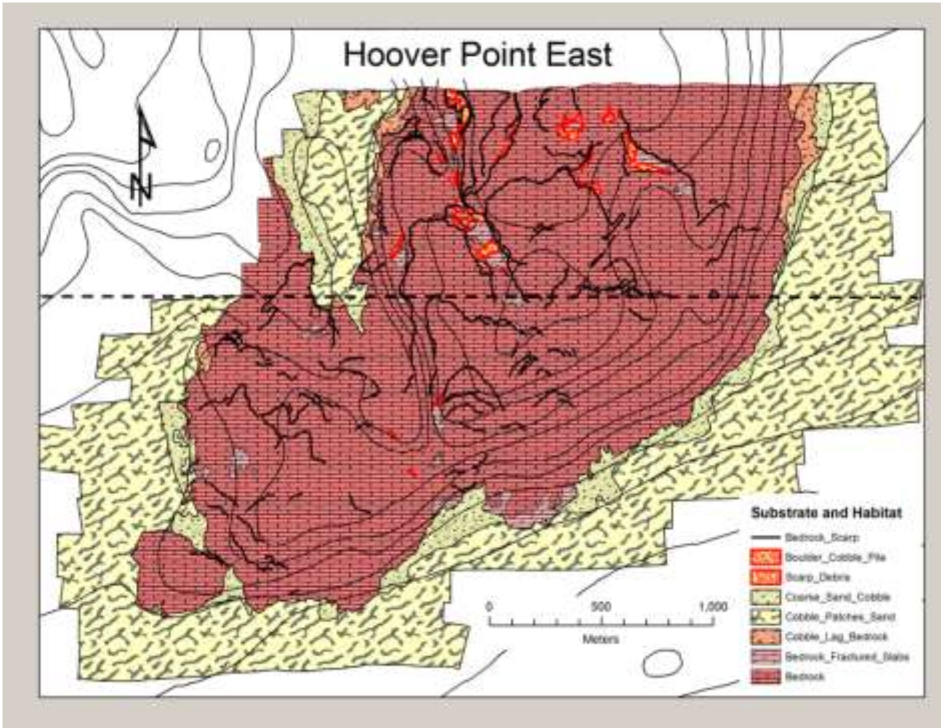

Figure 4-3. Expanded interpretation of Hoover Point East survey site. Additional sidescan sonar data were acquired below dashed black line in 2011.

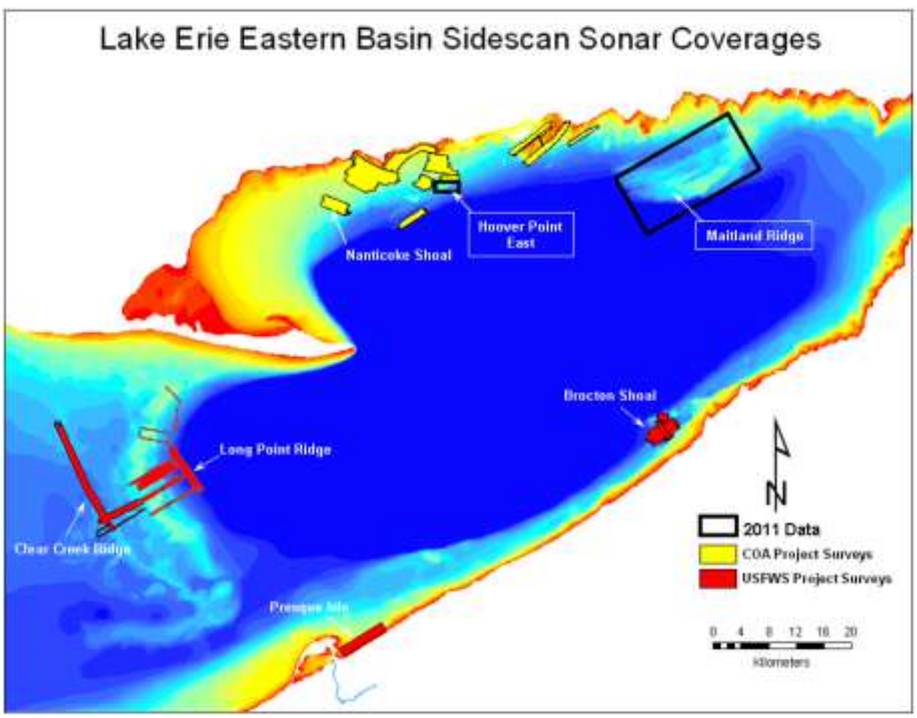

Figure 4-4 Location map showing Lake Trout survey sites. Additional sidescan sonar data were acquired at Hoover Point East and the Maitland Ridge in 2011.

Maitland Ridge Reconnaissance Lines

Figure 4-5. Reconnaissance sidescan sonar lines acquired over the Maitland Ridge fall 2011. For comparison, the rectangle in the upper right portion of the figure represents the size of the Nanticoke Shoal survey area.

HTG Investigators - A. M. 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 the HTG team
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 an 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 address this charge. Our objectives were to: 1). develop species-habitat relationships for juveniles and adults using walleye catch data, 2). generate lakewide maps of habitat suitability, and 3). compare the proportion of suitable walleye habitat by jurisdiction with those derived using the updated maps from objective 2.

Empirically-Derived Species-Habitat Relationships

We have successfully completed the first objective. The detailed model selection procedure can be found in last year's Habitat Task Group Report (HTG 2011). Overall, we determined that walleye prefer warm, turbid waters and that they may adjust their distribution horizontally (i.e., nearshore or offshore) or vertically (within the water column) to search for desired conditions. Initially the negative association with dissolved oxygen (DO) was surprising; upon closer inspection, this may be attributed to the fact that the DO levels of over 98% of the observations in our data set were above the critical threshold (~3 mg/L). The relationship between walleye occurrence and dissolved oxygen would likely have been positive if more sampling had occurred in instances of lower dissolved oxygen. Habitat preference varied by both age group (i.e. juvenile and adult) and vertical strata. Parameter estimates for significant variables and interactions can be found in Table 5-1.

Table 5-1. Estimated parameters of the best fitting generalized linear response models (Interaction) for juvenile and adult walleye. Parameters included water temperature ('Temperature'), dissolved oxygen ('DO'), light attenuation ('Secchi'), and the fishing depth of the sample gear from surface ('Depth'). Only the estimated coefficients of environmental variables that were retained in the final model are reported.

Parameters	Juvenile	Adult
Constant	2.818	2.808
Depth	-0.171	-0.322
Secchi		0.726
DO	-0.679	-0.31
Depth: DO		0.008
Secchi: DO	0.088	
DO:Temperature	0.03	0.007
Secchi:Temperature	-0.074	-0.047
Depth: Secchi		0.009
Depth:Temperature	0.008	0.007

Habitat Suitability Map Models

We developed the species-habitat models using a 20 year long term dataset of Lake Erie walleye catches (collected by OMNR and OHIO). The availability of this long term data set provides a unique opportunity to improve one's capacity to model the linkage between the environment and fish occurrence, because the available data encompass a wide range of environmental conditions. We did, however, encounter data limitations when we attempted to generate the lakewide Habitat Suitability Index (HSI) maps from the species-habitat relationships. To construct a lakewide HSI map, we first needed to create a continuous surface for each of the environmental variables. Interpolating observed environmental values is a common method for creating a continuous surface. However, in our case, annual lakewide data collection took place from May through November and covered a relatively wide range of environmental conditions (for example surface water temperature in our data set in each year spanned the range 11-21^{0}C). Thus, it restricted our ability to interpolate the observed environmental variables across the entire lake. Therefore, we limited our spatial modeling to the Canadian waters of the east and west basins from August 25 to September 11 in 2006-2008. This time-space combination was selected because it corresponded with the highest resolution abiotic data available. We developed Habitat Suitability Indices using our species-habitat model to demonstrate the differences in probability of occurrence of walleye over a short time frame (late summer) between vertical strata, age groups (juvenile and adult), basins, and years. An example of the probability maps for adult walleye can be found in Figure 5-2.

From the resulting maps, we determined that habitat suitability varies between subsurface and bottom waters, age group, and basin. Our findings indicate that Weighted Habitat Suitability Indices, WHSI, which are the combination of habitat quality and quantity, ranged from 0.70 to 0.25 for adults and 0.50 to 0.16 for juveniles for surface and bottom waters, respectively. This indicates that surface waters provide more habitat than bottom waters. We also found that the west basin has a greater probability of having adult habitat (0.71) and juvenile habitat (0.7) than the east (0.47 and 0.26, respectively). Lastly, there was no significant inter-annual difference in WHSI for the time period sampled (late August to early September, 2006-2008).

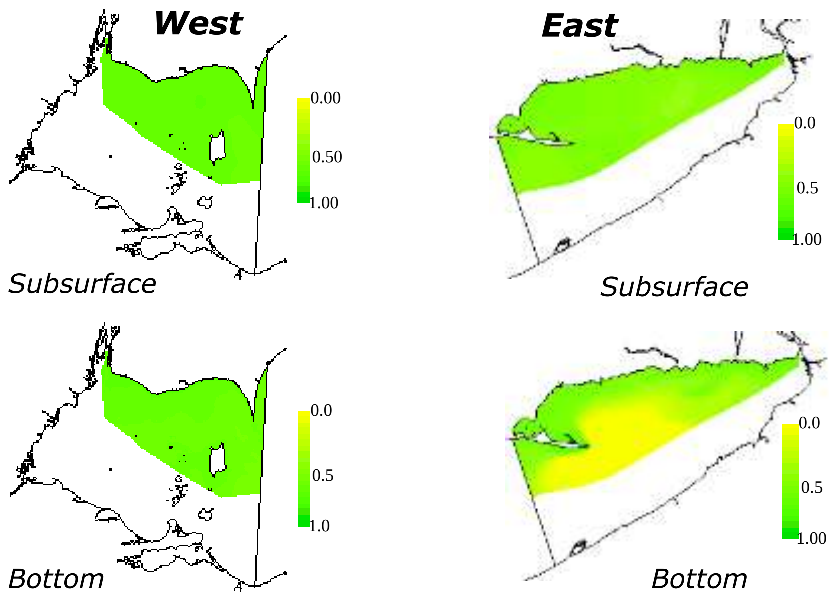

Figure 5-2. Habitat Suitability Index (HSI) of Ontario waters of the west and east basins derived from the species-habitat model for adult walleye in Lake Erie at subsurface (i.e. at 6 m below the water surface) and bottom waters. The maps represent the average value of HSI index over three years (2006-2008).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

Comparison to Current Definition of Suitable Habitat

Presently, preferred habitat is defined as the surface area of waters less than 13 m deep. Results from our study demonstrate that water depth is not the only driving factor in the species-habitat relationship; other environmental factors (and their interactions) are also essential in determining the occurrence of walleye. Our analysis has also changed the way we consider the depth component. We found that shallower depths were linked to an increased probability of encountering walleye. This appears to be similar to the current definition, which indicates that shallower areas are more suitable (closer to shore, less than 13m). We analyzed 'depth' as depth of the fishing gear and not the total water column depth. For this reason, we consider that virtually all surface waters are suitable with respect to overall water column depth, because walleye can migrate vertically in the water column to reach waters that are closer to the surface (i.e. less deep).

Although our objective was to compare the proportional distribution of habitat by jurisdiction using the present (depth-based) and new models, we cannot currently conduct this comparison for the entire area to which quota is allocated because of the data limitations mentioned. We present the following results as an example of what we intend to do once we are able to generate the lakewide probability maps with more high resolution data.

Habitat suitability indexes for Canadian waters of the east and west basins have been calculated as follows:

A. HS index (≤13m) - ratio of the area of ≤13m depth to the total surface of the selected area. This is the current definition for quota allocation).
B. HS Index weighted - ratio of weighted habitat Suitability Area, WHSA (this is the combination of the quality and quantity of the selected area). WHSA was calculated as: $WHSA = \sum_{i=1}^{n} P_i \times a$; where P_i is the probability of suitability habitat to each grid (*i*) and *a* is the area of the grid *i* (2500 m^2). Suitability index (P_i) was calculated based on our model.
C. HS Index (≥0.5) - ratio of the area containing the probability of suitability habitat which is greater than 0.5 to the total area.

The results show three different indexes of habitat suitability for three groups of walleye (Table 5-2). According to the current definition of quota allocation (A, HS index ≤13m), the west basin has 1.00 (i.e. 100%) probability of having suitable walleye habitat because all areas are less than 13m depth; in the east basin, the probability decreases to 0.20. Results from our new habitat model indicate that the current model maybe underestimating the amount of east basin habitat. Our WHSA results (B, HS Index weighted) show that the probability of encountering walleye in the east basin is 0.43 and 0.37 for adults and juveniles, respectively. The results from areas with a greater probability than 0.5 (C, HS Index ≥ 0.5) are similar but slightly less. Our findings also indicate that the current definition may overestimate the amount of west basin habitat.

Table 5-2. Comparison of the HS Indexes in Canadian waters of the east and west basins for three groups of walleye.

Basin	Total surface area	<13m	**A. HS Index (13m)**	WHSA of sub surface	WHSA of bottom	Average WHSA	**B. HS Index (Weighted)**	>=0.5 of subsurface	>=0.5 of bottom	Average	**C. HS Index (>=0.5)**
1. All walleye											
East	3651.71	726.32	**0.20**	2854.84	1730.62	2292.73	**0.63**	3651.71	1418.10	2534.91	**0.69**
West	1655.04	1651.52	**1.00**	1604.08	1550.64	1577.36	**0.95**	1655.04	1655.04	1655.04	**1.00**
2. Adult walleye											
East	3651.71	726.32	**0.20**	2017.89	1155.17	1586.53	**0.43**	1876.65	397.75	1137.20	**0.31**
West	1655.04	1651.52	**1.00**	1276.01	1264.47	1270.24	**0.77**	1276.01	1264.47	1270.24	**0.77**
3. Juvenile walleye											
East	3651.71	726.32	**0.20**	1684.80	999.85	1342.32	**0.37**	1093.93	420.43	757.18	**0.21**
West	1655.04	1651.52	**1.00**	1304.27	1274.48	1289.38	**0.78**	1304.27	1274.48	1289.38	**0.78**

Future Work and Recommendations

As the abiotic datasets become available, we intend to present a number of options by which managers can use “walleye habitat” to justify a proportional allocation of the walleye harvest. We may also evaluate amount of suitable walleye habitat based on traditional habitat suitability models (e.g. McMahon et al. 1984) and analyze metrics of walleye productivity (i.e. which jurisdiction has 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.

The data deficiency that we encountered reduces the model utility and prevents further investigations on the spatial and temporal habitat and assessment of the habitat quantity and quality for Lake Erie walleye and other important species. The task group suggests that more lakewide assessments need to be conducted (including the central basin and U.S. waters) with significantly increased spatial and temporal coverage. If the data is collected across the lake within a short period, it can be used 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 the entire lake using the model. In turn, we could better understand potential changes in the amount of available habitat by jurisdiction if this new definition of walleye habitat were employed.

Investigators

S. Pandit (Université du Québec à Montréal), 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, E. Weimer

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.

As a first step, a matrix has been distributed to HTG members that will be used to identify and rank a potential stressor's impact on the Environmental Objectives. For example, will altered precipitation patterns caused by climate change effect Environmental Objective 1 (restore natural coastal systems and nearshore hydrological processes), and how large will the effect be? Once this matrix is completed, the HTG will identify what data will be necessary to answer these questions, and future research and collections will be directed proactively. The HTG anticipates completion of this exercise by the beginning of 2013.

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 association 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

The HTG would like to thank Dr. Hans Biberhofer (NWRI, Environment Canada), for his collaboration on the lake trout habitat charge. Jim Grazio's (PADEP) knowledge of lake trout spawning in PA waters and assistance in data collection has been invaluable. Dr. Shubha Pundit's modeling work is proving to be a key component in addressing the HTG's walleye habitat charge.