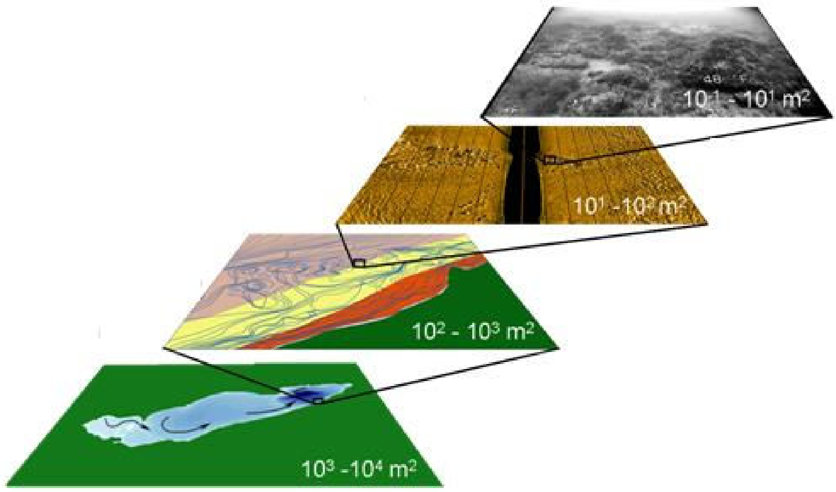
Report of the

Lake Erie Habitat Task Group
2010



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 2009-2010

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. 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 strategic research direction for Environmental Objectives.

In 2009, the HTG focused most its efforts on charge number three and four. The only change to HTG charges from the previous year involved simplifying the wording associated with charge four. While the current focus of this charge is now specifically walleye habitat, the metrics and methods derived will be applicable to other species in future exercises. Charges number one and two continue to be addressed opportunistically as new projects arise. We present updates on habitat projects the current status of the LEGIS and the EO strategic direction.

Section 2. Document Habitat Related Projects

AM. Gorman, C. Castiglione

The first charge to the HTG involves the documentation of habitat projects occurring throughout 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.

As noted here previously the habitat listing, presented as a spatial inventory, and discoverable using 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.

One example of a toolset that would address these objectives is used by the U.S. Fish & Wildlife Service's Fishery Information System (FIS). FIS tracks the progress of restoration and recovery tasks in the context of planning documents and the status of populations in the wild. FIS is a component of the Environmental Conservation Online System (ECOS, http://ecos.fws.gov/ecos/indexPublic.do) and includes the Fisheries Operational Needs System (FONS). FONS is one of the tools for the U.S. Fish & Wildlife Service's Fisheries Program for communicating planning and performance activities considered in funding and management decisions. All FONS projects are required to reference a planning document to demonstrate the broader fishery management objective and provide relevance to partner and stakeholder support. The Lake Erie Committee's Fish Community Goals and Objectives have been included in the FIS system with a number of projects identifying this document as an important reference. Some of these projects needs include:

- Develop a method for prioritizing fish habitat restoration projects
- Lake Erie Lake Trout Rehabilitation Program
- Stream Habitat Restoration and Fish Passage Projects
- Lake Erie and Lake Ontario Post Stocking Survival Assessment of Lake Trout
- Development of a Fish Mass Marking Center for the Great Lakes

The Great Lakes Commission has also developed the Great Lakes Habitat Restoration Initiative (GLHRI) Database Query (http://gis.glin.net/glhi/query.php). Similar to FONS, researchers can provide information about planned or existing projects (including financial requirements, areas and species impacted, etc.) and store it into this database. The benefit of this toolset is that anyone can access the information, including funding officers, unlike FONS, which is used exclusively by the USFWS and its funding program.

Over the next year, our intent to integrate our table of habitat-related projects into a query-able database similar to FONS or GLHRI. 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. Nearshore Aquatic Habitat Classification – GL Aquatic GAP Analysis

C. Castiglione

Near-shore habitats are critical to Great Lakes fish populations and aquatic biodiversity. The coastal zone is an important buffer and link between open water and inland ecosystems and is used by more than 120 native or established fish species for spawning and nursery grounds. Increased degradation pressures on these aquatic habitats are creating a critical need for assessment tools, including classification of these areas.

The Great Lakes Regional Aquatic Coastal Gap Analysis Project has developed an objective, flexible, multi-scale framework for nearshore habitat and biotic classifications. This classification framework consists of spatial units at six scales ranging from the landscape level of the Great Lakes Region to the 90 meter spatial cell. These scales include: 1) Great Lakes basin; 2) Individual great lake; 3) Aquatic Lake Unit-ALU (broad circulation basin); 4) Coastal or Open Water Zones–COZ (subdivision of ALU); 5) Aquatic Habitat Areas – AHA (subdivision of COZ's) and 6) local sites (90m spatial cell).

Over 30 habitat characteristics and 32 fish species were analyzed for the western Lake Erie pilot area using a sequence of multivariate techniques by grouping species assemblages (e.g., cluster analysis), identifying influential habitat variables (e.g., ordination), constructing predictive species-habitat models (neural networks), and implementing a habitat classification framework throughout the study area. Characterization of spatial units based on the predicted fish abundances provides a fish-guided classification of aquatic areas at each spatial scale and demonstrates how classifications may be generated from this framework. This approach extends our ability to address scale-sensitive spatial issues, characterize aquatic communities, estimate abundances of common species and their centers of distribution, and provide benchmarks for target species assemblages.

Data and Model Development

Habitat data used were georeferenced spatial datasets that covered all of western Lake Erie and included depth, substrate, distance and direction to wetlands, distance and direction to major rivers, sub aquatic vegetation, shoreline geomorphology, shoreline protections, shoreline sinuosity, bottom slope, and water temperature. Biological surveys were the basis of this study and two excellent data sets were made available for this work; electrofishing collections at sites along the Ohio shore of Lake Erie (OH EPA 2002) and trawl collections throughout much of the US waters of the western Lake Erie basin (OH DNR 2002). Electrofishing samples (>200) were collected from 1982-2002 at 49 sites within the pilot area. Trawl samples (>3,000) were collected from

1969-2002 within 62 sampling grid cells. These data sets were analyzed separately and standardized (electrofishing: catch/km; trawling: catch/hr) before analysis and then classified on a logarithmic abundance scale.

Identification of influential habitat variables

Canonical Correspondence Analysis (CCA) was used to identify gradients within the data and the most influential habitat variables affecting fish (Figure 2a-1). These variables are likely to be effective fish abundance predictors (Table 2a-1) and were used as neural networks inputs.

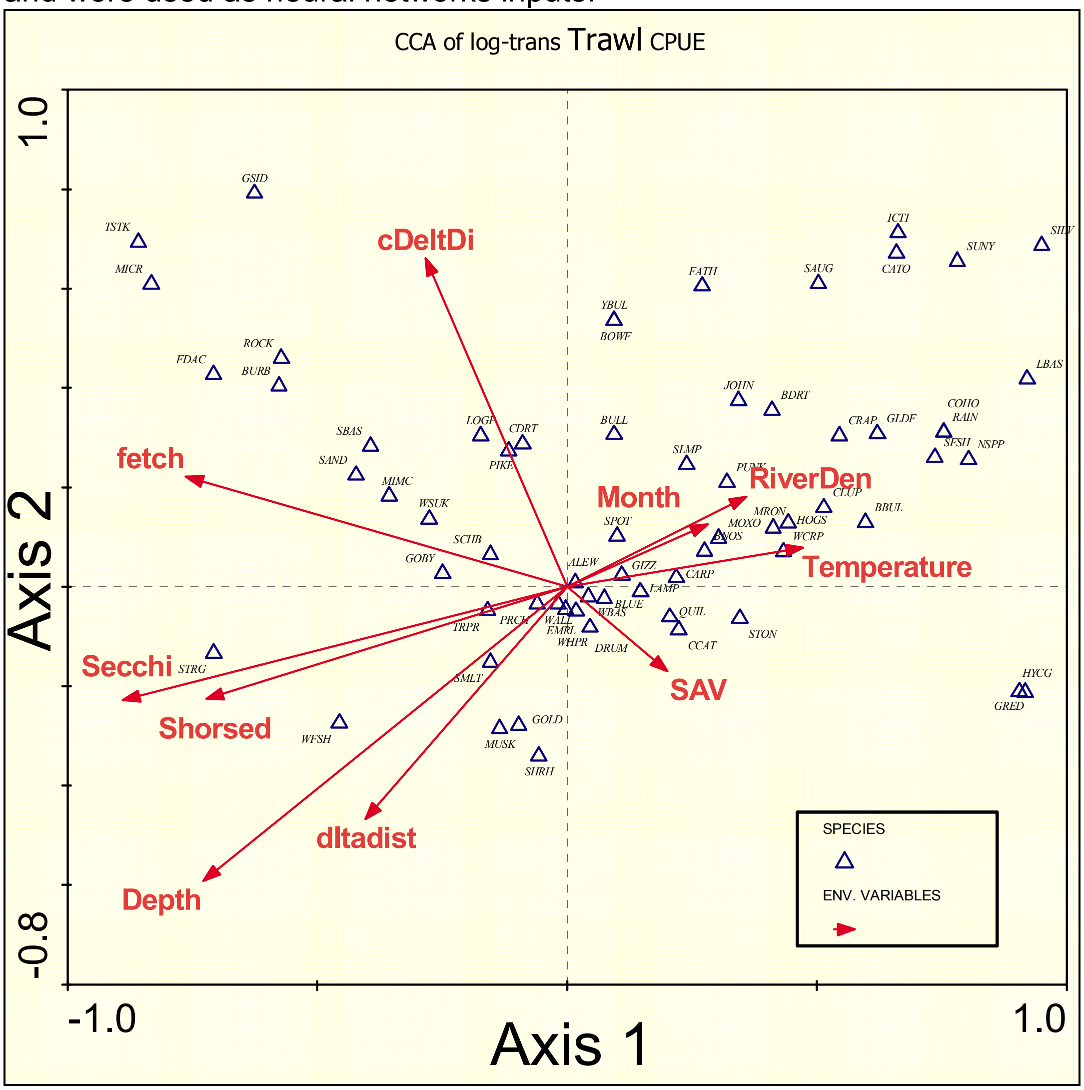

Figure 2a-1. Direct gradient analysis using the CANOCO program to perform Canonical Correspondence Analysis on the ODNR trawling dataset. Red arrows indicate habitat variable gradients. Blue triangles are the optimum environmental conditions for each species. The axes represent weighted composite variables that explain most data variability.

Table 2a-1. Influential habitat variables based on CCA of each dataset

Influential Habitat Variable	
EPA	DNR
Secchi depth	Secchi depth
Fetch	Fetch
Sub Aquatic vegetation	Sub Aquatic Vegetation
Distance to open wetland	Distance to delta wetland
Sinuosity of shoreline	Cosine of direction to nearest delta wetland
Coefficient of Variation of temperature	Temperature
Distance to major river	Density of Major Rivers within 10km
Cosine of direction to nearest major river	Water depth
Shoreline Sediment type	Shoreline sediment type
Shoreline protection	
Shoreline geomorphology	

Explanation of Neural Networks for Great Lakes Aquatic Coastal GAP
Neural Networks (NN) are very complex non-linear modeling equations developed by an iterative fitting process. This process generated the best mathematical model that matches patterns of habitat variables to observed fish abundance (or some other variable to be predicted). Like regression models, NN models work with independent variables or inputs (e.g., habitat variables) and a dependent variable or output (e.g., fish abundance). In developing the modeling equation, the NN uses the inputs (habitat variables) and applies a weight to these variables then passes this value to each node (neuron) of a hidden layer of neurons. Each neuron adjusts the weight according to a function and passes that to the next neuron of the next hidden layer. The last neuron of these hidden layers passes the modified value to the output neuron where all values are combined to produce a single output value (predicted fish abundance class). This process is repeated for each observation in the training data set. These results (predicted fish abundance class) are compared to the original observations (fish survey) to determine the error. This is ONE iteration and the whole process is repeated many times, each time adjusting input variable weights and re-testing for error. The process continues as long as the error

decreases (i.e., correlations are maximized and the mean square error is minimized). This iterative adjustment process allows the NN to learn the patterns of the data set. A subset of the data (20% in this case) is held out of the training (e.g., fitting) to validate the model and prevent overlearning. The resulting equation can be used to predict fish abundance values for all areas, using the existing habitat values at those spatial locations as inputs into the NN model equation. The resulting output is the predicted fish abundance class at any particular spatial location (Figures 2a-2 and 2a-3).

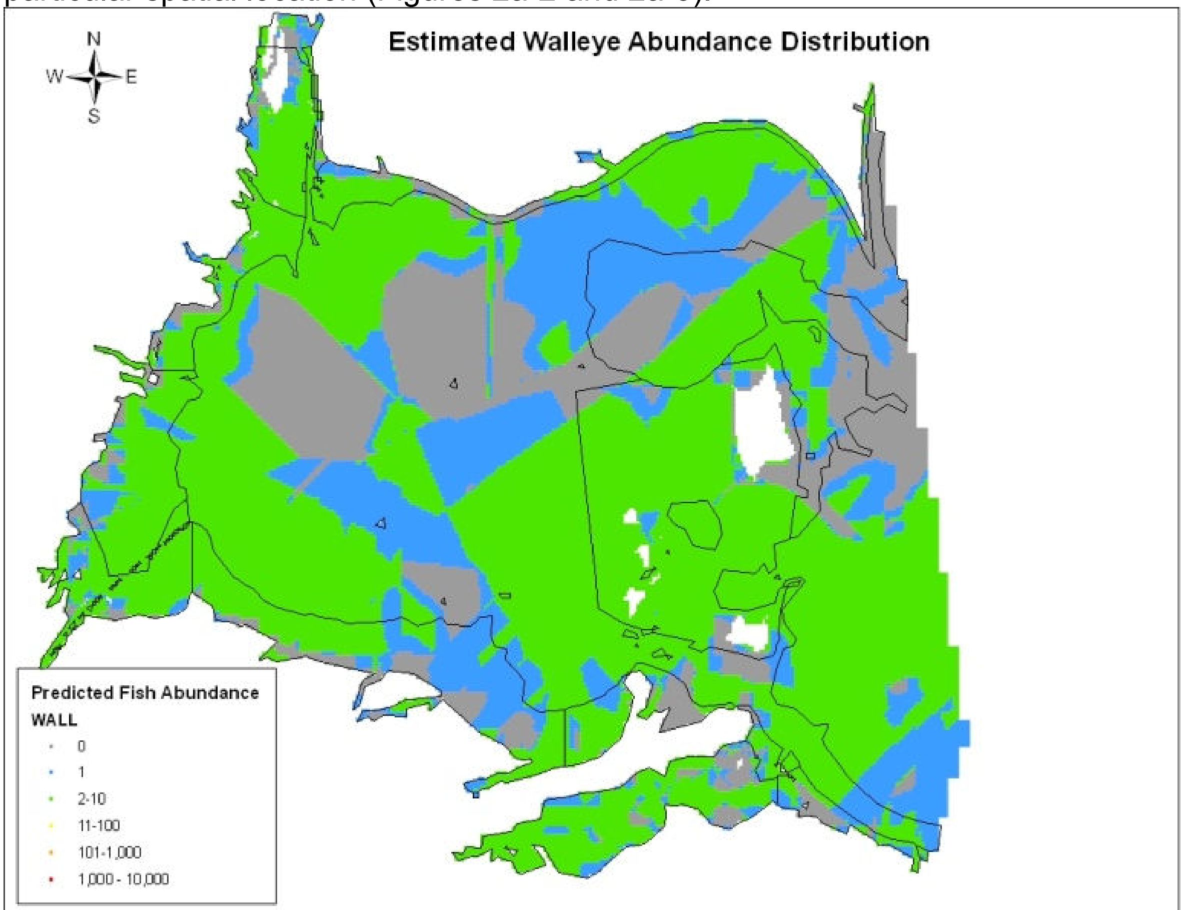

Figure 2a-2. Broad categories of estimated Walleye abundance (number/1000m^2) in the western basin of Lake Erie. Categories: Grey = 0, Blue = 1, Green = 2-10, Yellow = 11-100, Orange = 101 – 1000, Red = greater than 1000.

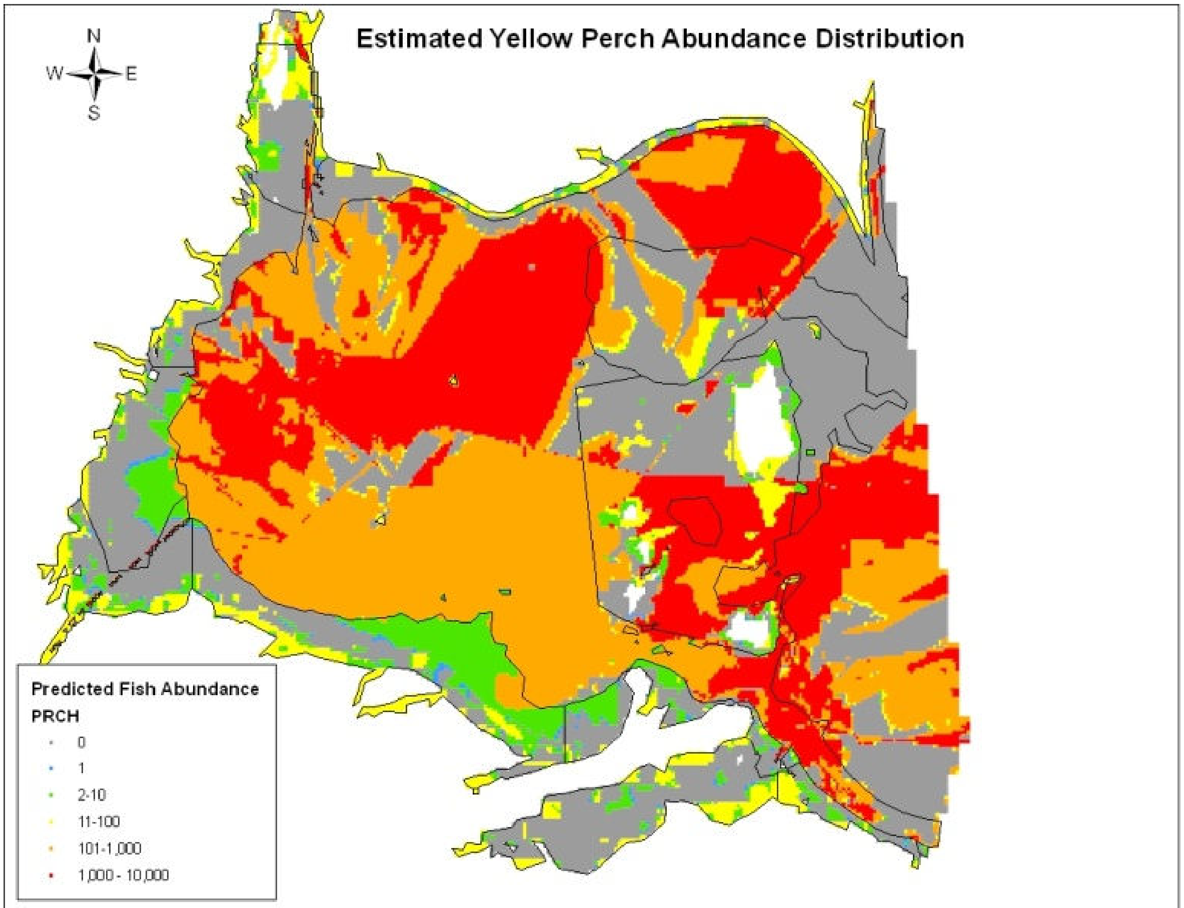

Figure 2a-3. Broad categories of estimated Yellow Perch abundance (number/1000m^2) in the western basin of Lake Erie. Categories: Grey = 0, Blue = 1, Green = 2-10, Yellow = 11-100, Orange = 101 – 1000, Red = greater than 1000

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2b. Fish Habitat Assessment and Rehabilitation in the Huron Erie Corridor

E. Roseman and J. Boase

Artificial spawning reefs were constructed at the head of Fighting Island in the Detroit River during fall 2008 (Figure 2b-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.

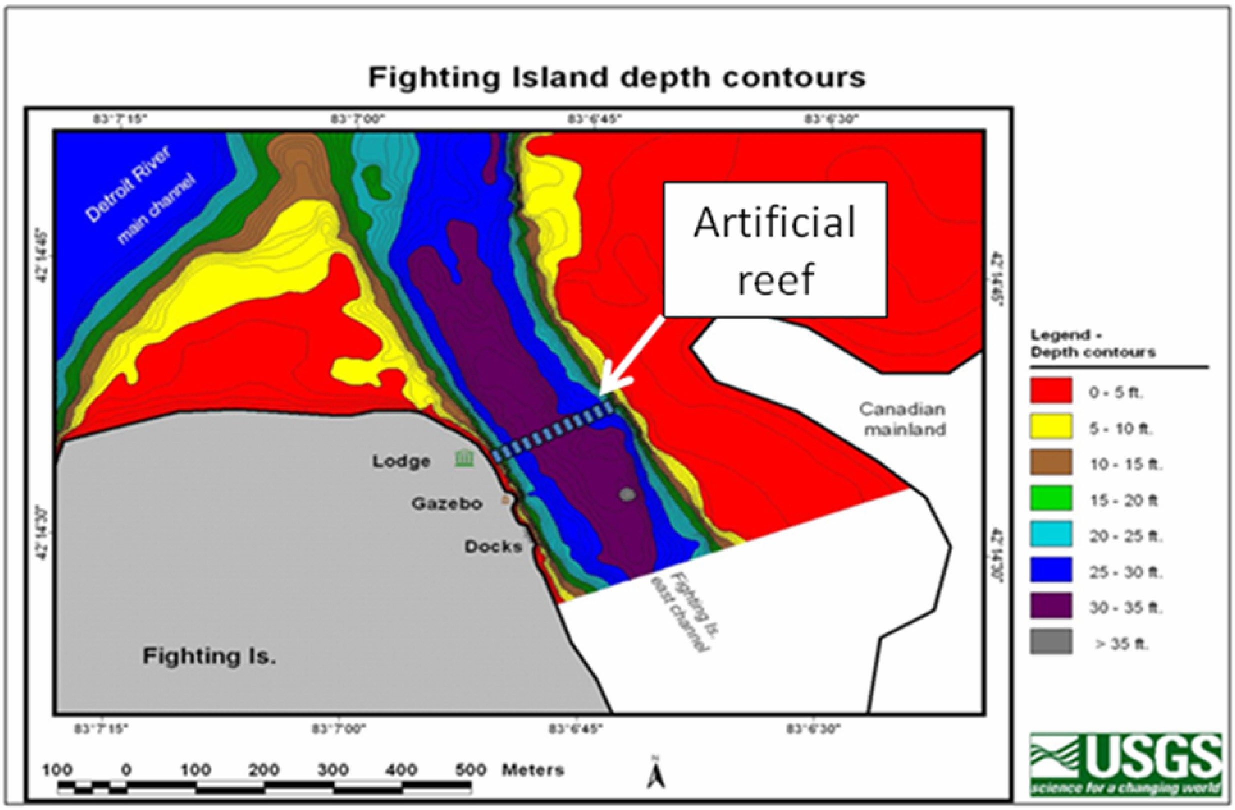

Figure 2b-1. Location of the artificial reef constructed at the head of Fighting Island in the Detroit River in 2008.

Assessment of fish use of the newly constructed habitat showed an immediate response by fish at the Fighting Island site. Tables 2b-1 and 2b-2 summarize the egg collection data gathered at the Fighting Is. fish habitat restoration site, east Fighting Is. channel, Detroit River, during the spring and fall sampling seasons of 2009. Table 1 contains general sampling information relative to the sampling characteristics undertaken during each (spring and fall) sample period. Table 2 contains actual egg collection numbers, both total actual eggs collected, and extrapolated egg deposition rates (numbers/m^2). 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 m^2, 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, and 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 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 highly 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/m^2. 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/m^2 - 3,300 m^2 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 2b-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 2b-2. Egg collections for the sample year 2009, Fighting Island habitat restoration site.

Egg Collection variables	Walleye	Spring Sucker spp.	Spring 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

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 and is reflected in the effort listed. Thirteen lake sturgeon were captured in the Detroit River, three of which 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, for the remaining nine fish sex was undetermined. 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, n. pike, gizzard shad, white bass, white perch, rock bass, silver redhorse, golden redhorse, and n. hogsucker. Water temperatures during the sampling period ranged from 6.5oC to 11.8oC.
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, and 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 11.5oC to 9.3oC during the period.

A total of seven lake sturgeon larvae were collected at the Fighting Island Reef using D-frame ichthyoplankton nets. 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).

2010 and Beyond

As part of the Great Lakes Restoration Initiative, we will expand research and management efforts to assess and rehabilitate fish spawning and nursery habitats in the HEC to enhance sustainable, native fish populations. Assessment of fish reproductive and nursery habitats will take place in the St. Clair and Detroit Rivers during 2010. To this end, our objectives include:

1. Use sound science to measure physical and biological habitat parameters within the HEC; identify locations where natural spawning and/or nursery habitat exists; and identify locations where habitat improvement projects would attract and enhance native fish populations.
2. Integrate geospatial and hydrodynamic models to estimate natural habitat attributes (geomorphology, flow regimes, depths, substrate characteristics, and bank slope; Holtschlag and Koschik 2002) as baseline parameters for fish habitat restoration by assisting an ongoing EPA funded project to meet AOC delisting goals by developing a "blueprint" for fish habitat restoration in the HEC.
3. Use information gleaned from objectives 1 and 2 to develop ecological process models that couple physical and biological fish habitat parameters and to identify sites where productive fish habitat can be restored.
4. Based on results of objectives 1-3, select candidate sites for construction of fish habitat (spawning reefs and nursery areas) to expand, improve, and restore habitats that produce native fishes;
5. Use accepted scientific methods and adaptive management principles to monitor the suitability of restored and constructed fish habitats to native fish populations and adjust research and management objectives accordingly.

Investigators:
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2c. Nearshore Fish Community

E. Weimer

In 2007, Division of Wildlife personnel from the Sandusky office began a trawling survey in the western basin to assess the composition and abundance of the fish community in the nearshore habitats of Lake Erie. Twelve trawling sites that represent a gradient of geomorphologic and anthropogenic influences to nearshore Lake Erie were sampled (Figure 2c-1). Sites were selected using geomorphologic and shoreline protection variables from the Lake Erie GIS. In 2008, several additional sites in the Maumee Bay area were added to the nearshore bottom trawl survey in an attempt to incorporate habitat with aquatic vegetation. Unfortunately, the 2008 survey was cut short by damaged trawls after only 4 sites. The re-occurring issue of hung and torn trawls during this survey has forced us to evaluate a different survey gear.

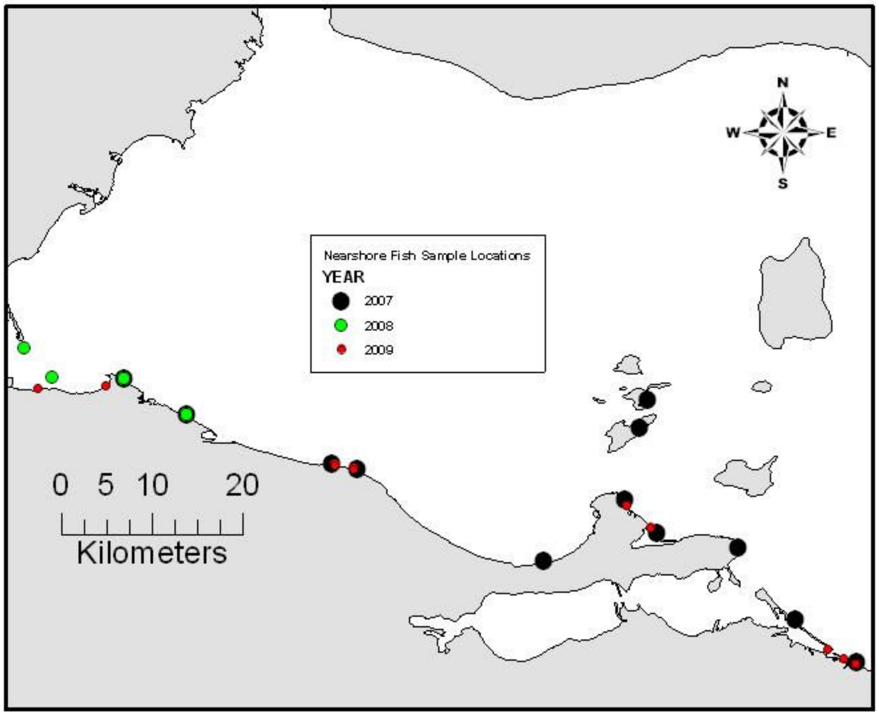


Figure 2c-1. Nearshore fish community assessment survey sites, 2007-2009. Fish were collected using bottom trawling in 2007 and 2008; fish were collected using daytime electrofishing in 2009.

In 2009, daytime electrofishing was used to sample nine sites in the nearshore along the Ohio mainland (Figure 2c-1). Island sites, as well as sites that required extensive travel from access points, were not surveyed in 2009; however, additional sites that were previously unreachable with trawling gear were added. Sampling took place on 8 August, 2 September, and 9 September. 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.

When compared to 2007, more individuals (289 vs. 1531) and more species (10 vs. 21) were collected during the 2009 electrofishing survey. This is due as much to the efficiency of the electrofishing gear in accessing shallower, more productive coastal habitat as it is due to the gear's ability to sample more effectively. For 2009 data, an Index of Biotic Integrity (IBI) was calculated for each site. We adopted a modified version of the Great Lakes littoral zone IBI developed by Minns et al. (1994), because it uses electrofishing data to index fish assemblages. It was modified by removing the biomass components of their IBI, as that is data we don't currently collect. Overall, the nearshore fish community in western Lake Erie had an IBI score of 61.9 ± 12, which qualitatively represents fairly good integrity. Examining IBI scores by site geomorphology, we find that fish communities within beach and bluff-bank shoreline habitats have lower scores than those in bedrock and wetland habitats (Figure 2c-2). However, bedrock and wetland shorelines were represented by only one site each in 2009, and additional sites in similar habitats will be added for 2010. IBI scores were significantly higher near unprotected shorelines than in protected ones (Figure 2), suggesting that human manipulation of shorelines (i.e., bank stabilization, construction of seawalls) have a direct impact on nearby fish communities.

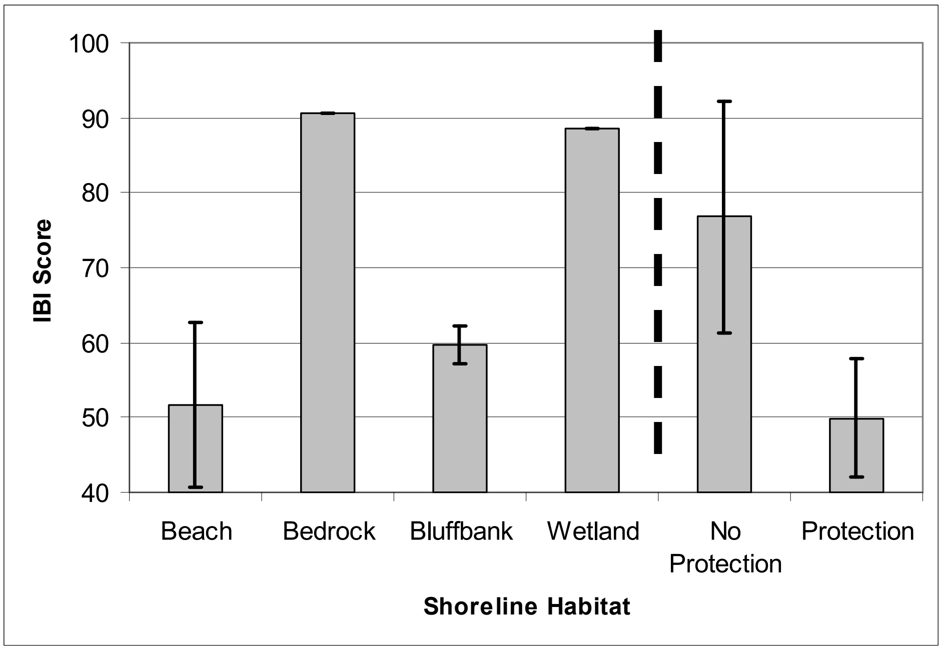


Figure 2c-2. Comparison of Index of Biotic Integrity (IBI) scores for nearshore fish communities in different shoreline habitats and levels of shoreline protection. Scale bars are 95%

References

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.

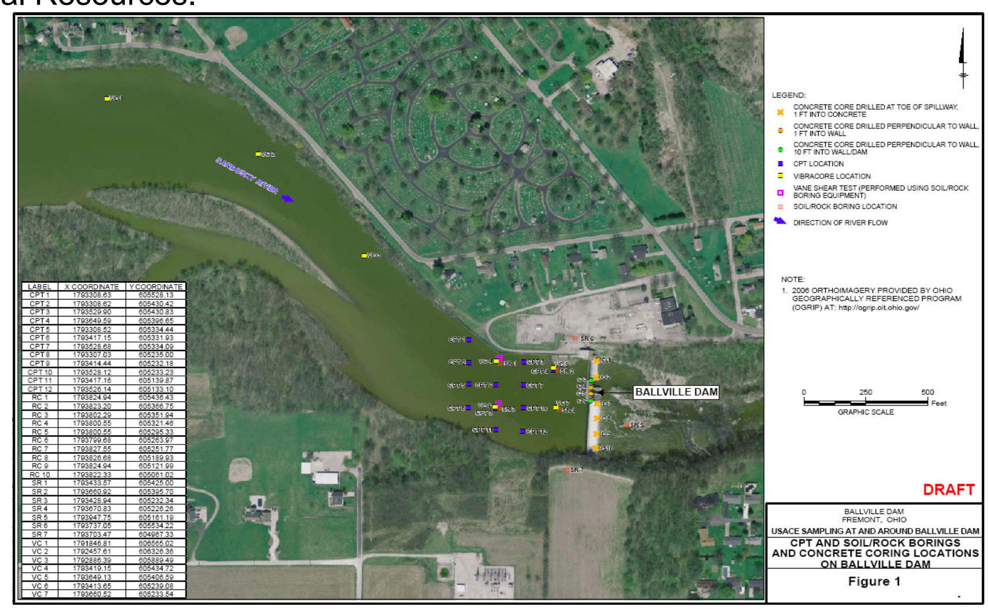
2d. Ballville Dam Removal Project

S. D. Mackey and E. Weimer

Geotechnical analysis and removal scenario modeling

The City of Fremont, Arcadis, and the USACE have worked cooperatively together to acquire additional data on the Ballville dam and reservoir. The USACE through the GLFER Program collected samples from 36 locations at the Ballville dam and reservoir for geotechnical analyses and assessment of the structural integrity of the dam (Figure 2d-1). Additional bathymetric data were acquired within the reservoir and detailed topographic information was collected within riparian areas adjacent to the reservoir and the river reach below the dam. Also structures (bridge abutments, levees, seawalls) were evaluated for potential risk of failure if a catastrophic dam failure were to occur.

Based on the data collected, Arcadis has developed several dam removal scenarios based on modeling results that assess erosion and potential downstream sedimentation impacts as a function of reservoir drawdown rates. A draft scope of work, schedule, and proposed budget for dam removal are currently under review by the City of Fremont. It is anticipated that the dam will be removed by December 2012 per agreement with the Ohio Department of Natural Resources.



LABEL	X COORDINATE	Y COORDINATE
CPT 1	1793308.63	605528.13
CPT 2	1793308.62	605430.42
CPT 3	1793529.90	605430.83
CPT 4	1793649.59	605396.65
CPT 5	1793308.52	605334.44
CPT 6	1793417.15	605331.93
CPT 7	1793528.68	605334.09
CPT 8	1793307.03	605235.00
CPT 9	1793414.44	605232.18
CPT 10	1793528.12	605233.23
CPT 11	1793417.16	605139.87
CPT 12	1793526.14	605133.10
RC 1	1793824.94	605436.43
RC 2	1793823.20	605366.75
RC 3	1793802.29	605351.94
RC 4	1793800.55	605321.46
RC 5	1793800.55	605295.33
RC 6	1793799.68	605263.97
RC 7	1793827.55	605251.77
RC 8	1793826.68	605189.93
RC 9	1793824.94	605121.99
RC 10	1793822.33	605061.02
SR 1	1793433.57	605425.00
SR 2	1793660.92	605395.70
SR 3	1793428.94	605232.34
SR 4	1793670.83	605226.26
SR 5	1793947.75	605161.19
SR 6	1793737.05	605534.22
SR 7	1793703.47	604967.33
VC 1	1791846.81	606565.02
VC 2	1792457.61	606326.36
VC 3	1792886.39	605889.49
VC 4	1793419.15	605434.72
VC 5	1793649.13	605406.59
VC 6	1793413.65	605239.08
VC 7	1793660.52	605233.54

Figure 2d-1. Map showing locations USACE soil borings, vibracores, and concrete borings acquired during summer and fall 2009 for geotechnical analyses at the Ballville Dam.

Fisheries surveys

In support of the Ballville Dam removal project undertaken by the City of Fremont, staff from the Ohio Division of Wildlife sampled the Sandusky River fish community weekly from March through June, and later in July, to assess habitat quality above and below the dam and to assess the potential changes to the migratory and residential fish communities following dam removal in 2012. The migratory fish community was surveyed using 5-minute electro-fishing runs at fixed locations above and below the dam (Figure 2d-2). Total length, sex, spawning stage, and catch were recorded for walleye and white bass, two key Lake Erie species that use the Sandusky River for spawning. This data will subsequently be used to develop a migratory run-strength index for both species in an effort to characterize the spawning run. Resident fish community sampling was done in conjunction with the Ohio Environmental Protection Agency (OEPA) annual sampling using their electrofishing methodology and sites (OEPA 1987; Figure 2d-2). Species collected were identified, enumerated, and mean weights (g) were recorded in order to calculate the IBI scores for each site.

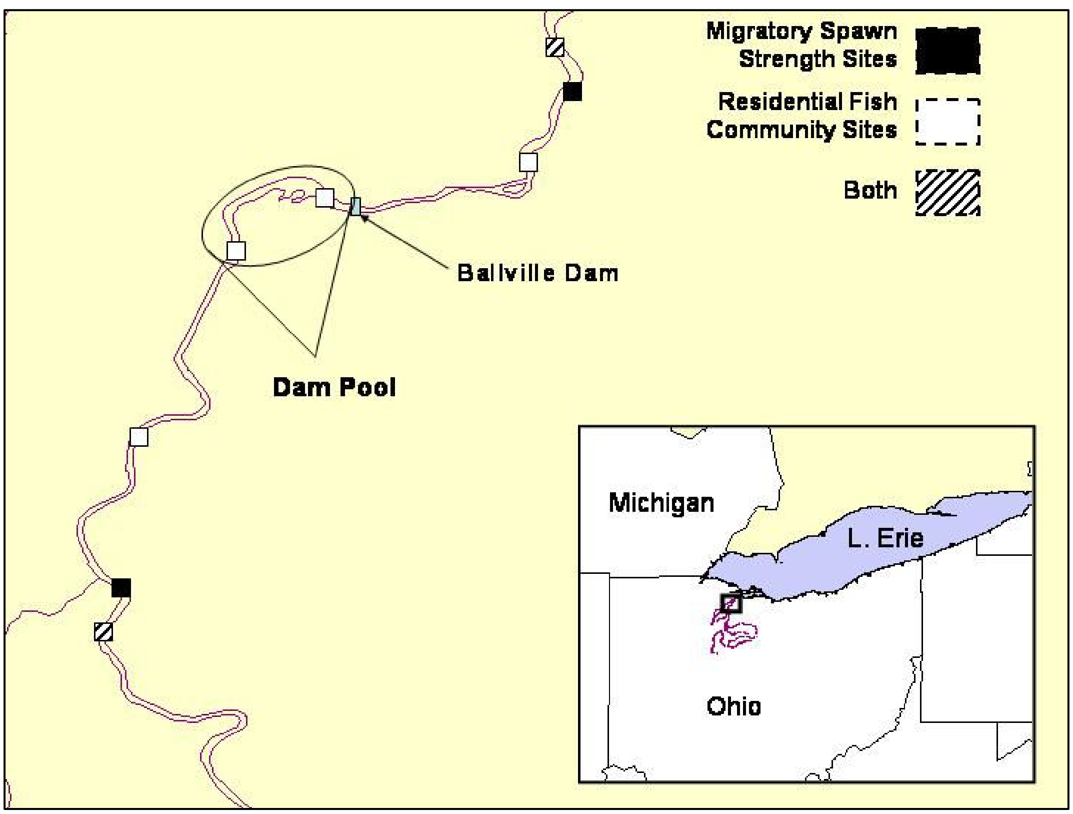


Figure 2 d-2. Migratory and residential fish community sampling locations on the Sandusky River, Ohio.

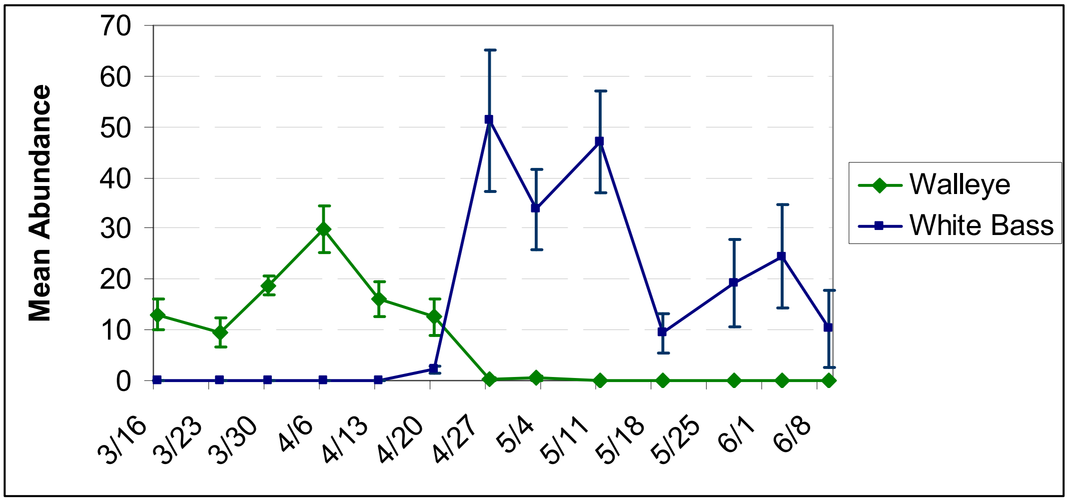


Figure 2d-3. Mean weekly catch-per-transect of walleye and white bass from the Sandusky River, downstream of the Ballville Dan, 16 March-9 June 2009.

The migratory fish survey revealed that neither species was present upstream of the Ballville Dam, indicating no remnant population remains. Downstream, walleye catch-per-transect peaked at 30 walleye on April 6th (Figure 2d-3), while white bass peaked at 50 fish on April 28th. The results for the first year of sampling (2009) in the resident fish community survey revealed the sites located in the dam pool area (Figure 2d-2) had much lower IBI scores than the other sites that were sampled. Additional analysis of migratory and residential fish community data and pre-removal sampling will continue in 2010.

2010 and Beyond

Through the State of Ohio, funding proposals were submitted to the USFWS Restoration Act, NOAA's Habitat Restoration Initiative, and U.S. EPA's Great Lakes Restoration Initiative to assist with the removal of the Ballville Dam. The Ohio Division of Wildlife and the Ohio State Aquatic Ecology Laboratory are prepared to assist with habitat characterization and fish monitoring efforts before, during, and subsequent to removal of the Ballville dam in 2014.

References

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2e. Central Basin Hypoxia and Yellow Perch

AM. Gorman and C. Knight

Historically, lake stratification leads to hypoxic and even anoxic conditions on the lake bottom 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). Therefore, fish are distributed differently every year and may concentrate at the lateral or vertical edges of the hypoxic zone (Edwards et al. 2005).

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 is suitable and that there is an equal chance of occurrence of yellow perch at each site. It is possible that these hypoxic zones may be intolerable and uninhabitable for yellow perch.

The objectives of this project are to examine:
1). The potential annual and seasonal changes in the hypoxic zone
2). How the bottom trawl sampling design and analysis of historic datasets could be affected based on changes in hypoxic conditions

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.

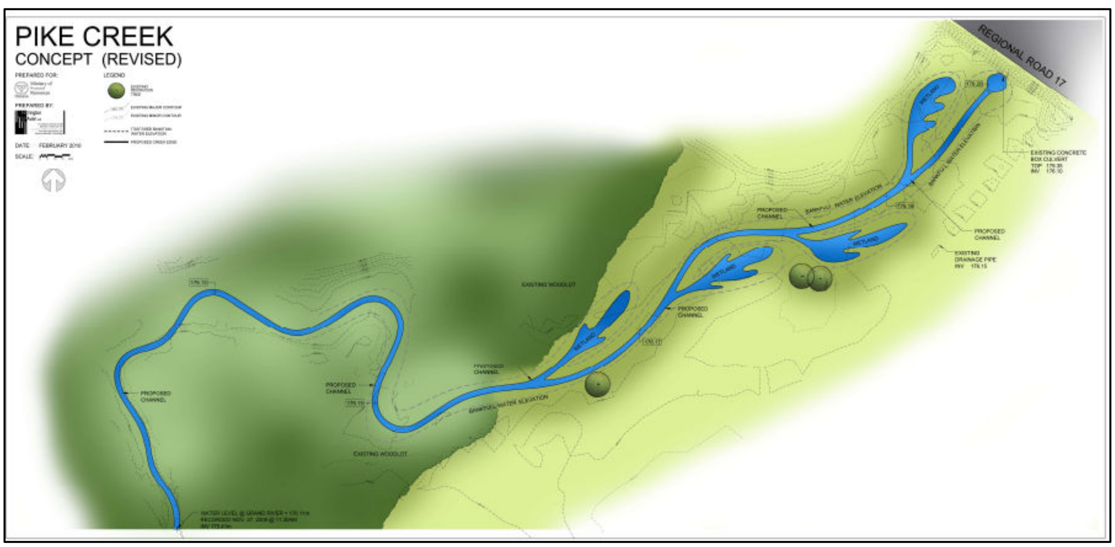
2f. Grand River (ON) Habitat Rehabilitation

T. MacDougall

Ongoing 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 2009, efforts focused on two target areas associated with habitat fragmentation, impoundments, migratory fish and ecosystem connectivity.

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.



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. 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 (resulting changes to channel morphology, changed flood risk, sediment transport) will be used to help make decisions regarding next steps.

Partners: OMNR, B. Annable/ University of Waterloo, GRCA, MOE, DFO, EC, SGR working group

2g. Other Notable Habitat Projects in Brief:

- *The Chautauqua Creek fish passage project*. This habitat rehabilitation involves altering two dams (notching and rocky ramp by-pass) in order to facilitate fish passage. It is scheduled to be completed during the summer/ fall of 2010 and will be beneficial to a variety of fish species (NYSDEC, USACE / GLFER). It is *funded through the GLFER program.*

- *Assessment of the Wetlands and Embayment at Long Point.* This two year assessment of multiple trophic levels and associated habitat measures focused on ecological associations with proximity to urban settlement and with connectivity (or lack of) with Lake Erie proper (OMNR, LPWA, BSC, COA)

- *Preliminary Restoration Plan for East Branch of Conneaut Creek Impoundments.* This is the initial phase of an investigations into feasibility, costs, and benefits associated with fish passage at a pair of dams near Albion PA on East Branch of Conneaut Ck. Results of this initial study will determine future direction of this project (PAFBC, USACE, Albion Sportsmans Club)

- *Rondeau Bay Ecosystem Rehabilitation.* Control of nutrient inputs to Rondeau Bay and establishment of wetland complexes to increase water retention on the landscape.(OMNR, OMAFRA, MOE, EC, DU, LRVCA, Friends of Rondeau,, Stewardship Kent, NAWMP, LTVCA, WHCanada)

Section 3. Lake Erie GIS Status

E. Rutherford

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's Department of Natural Resources (MDNR) and Department of Environmental Quality (MDEQ) that extended through September 2009 and March 2010, respectively. For MDNR, the work involved acquiring and mapping data on habitat and habitat suitability of non-game species within Michigan's waters of the Great Lakes. For MDEQ, the project developed a decision support project to aid in visualizing the impacts of lakebed alteration on fish habitat in Michigan waters of the Great Lakes. We are actively seeking funding for long-term management of the Great Lakes GIS project that will support data updates, education, and Internet distribution.

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 being conducted as part of HTG charge number three (lake trout spawning habitat identification). 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. Efforts are underway to incorporate the Lake Erie Limnological Synthesis database into the LEGIS. 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.

Information about LEGIS, and the overall Great Lakes GIS initiative, can be found at: http://www.glfc.org/glgis/GLGIS_User_Guide.htm

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

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

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). A project overview, background rationale and methodology for the HTG component of this initiative are detailed in the 2008 annual report of the HTG (http://glfc.org/lakecom/lec/HTG.htm).

Briefly, the project uses a multi-tiered approach that includes: 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.

Previous work has included the creation of a GIS model to initially identify potential sites based on the most current data sources, primarily the LEGIS database (2005-2006). Sidescan sonar and underwater video were then used to validate the results of the GIS model and examine potential spawning areas in greater detail (2006). In 2007, using a modified GIS model, a series of eastern basin, north shore shoals were targeted for Sidescan sonar mapping. Additionally, reconnaissance surveys were conducted at Brocton Shoal in New York waters, a historically recognized lake trout spawning site. In 2008, poor weather conditions compromised much of the planned fieldwork. Sidescan sonar surveys were limited to some infilling of data along the north shore shoals including a first look at Tecumseh reef. Surveys using RoxAnn seabed classification system were conducted along the north shore, including several areas that overlapped previously surveyed with sidescan sonar. Even though 2008 was a limited year for field surveys, considerable progress was made in 2008 on the development of a habitat classification system with the acknowledgement that it is the *integration* of substrate type with physical structure that provides the most useful assessment of fish habitat potential. Working from interpretations of the mosaicked sidescan sonar data, eleven substrate feature classes and nine structure classes were defined and applied to preliminary habitat maps. For details of the classes and examples of substrate and structure integration, see HTG annual report 2009 (http://glfc.org/lakecom/lec/HTG.htm)

In 2009, considerable progress was made on a number of fronts including sidescan sonar and RoxAnn surveys of the Pennsylvania, Clear Creek, and Long Point Ridge Complexes, as well as expanded sidescan coverage at previously surveyed Hoover Point, Tecumseh Reef and, significantly, the historic lake trout spawning area at Brocton Shoal. Assessment tools were expanded through the development of a classification scheme to guide and catalogue the subjective interpretation of underwater video. Joshua Morse, an undergraduate student from Oberlin College (OH) analyzed 160 independent video segments during a one-month Winter Term Project in January 2010.

To date, 128 km^2 of lakebed has been surveyed with Sidescan Sonar as well as 121 km^2 using RoxAnn classification. Areas of overlap will be analysed in order to clarify and enhance the interpretations of areas covered by one technology alone.

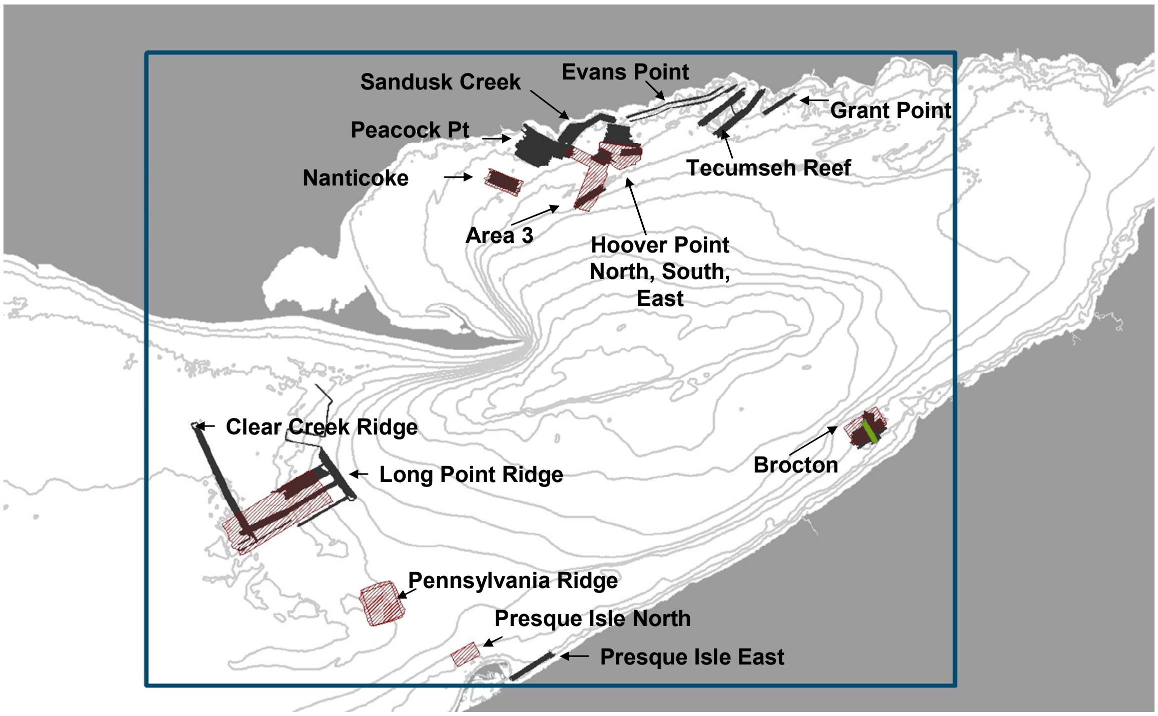


Figure 3-1. Areas of the east and east-central basin of Lake Erie surveyed with Sidescan and RoxAnn technologies between 2006 and 2009. Solid areas represent coverage by Sidescan sonar; Red, hatched areas represent coverage by RoxAnn.

Summary of Key Points 2009

North Shore Shoals

Based on Sidescan sonar information, multiple sites of suitable substrate exist within the Nanticoke Shoal, Peacock Point, Hoover Point South, and Tecumseh Reef portions of Ontario's eastern basin nearshore. At the end of 2008, the most promising north shore area was Nanticoke Shoal which, in addition to having areas of higher quality substrate, is situated in close proximity to deeper-water areas that may serve as lake trout nursery habitat. However, an examination of the eastern portion of Hoover Point in 2009 revealed areas of cobble, cobble/scarp, and fractured blocky bedrock covering a larger area than observed at Nanticoke Shoal. The complete area was not surveyed in 2009 and indications were that additional habitat existed to the south. Further examination of this area in 2010 with underwater video and Sidescan would be informative.

Historic Spawning site at Brocton Shoal as a reference site

Brocton Shoal in New York was initially surveyed by Thomas Edsall in 1987 as part of a study of historical nearshore lake trout spawning reefs in the Great

Lakes (Edsall et al. 1992). His results found that the best substrate for lake trout spawning and fry production were cobble ridges on sand that occupied about 38 ha on the south and west edges of the central reef crest. During our initial sidescan sonar work in 2007, this same area was re-surveyed and even though suitable lake trout spawning habitat was found to be present, the areal extent was surprisingly limited. A more comprehensive survey was conducted in 2009 south (inshore) and to the west of the earlier surveys, and the sidescan sonar data showed much more extensive spawning habitat compared to the area surveyed by Edsall (1992) and also initially in this study (Figures 3-2 and 3-3). Based on these new data, additional high resolution sidescan sonar data were collected over the area of best potential habitat. Despite the abundance of suitable habitat in this area (based on acoustic data), the clean rock piles observed by Edsall in underwater videos collected in 1987 were no longer evident. Recent underwater video data collected in 2007 and 2009 revealed rock piles extensively covered by *Dreissenids*, *Cladophora, with interstitial spaces filled with pseudofeces and silt (see video interpretation below)*. Numerous round gobies were also observed. In the Spring of 2010, additional underwater video data will be collected and SCUBA divers will further assess changes to habitat condition and compare what is present today with information and data collected by Edsall in 1987.

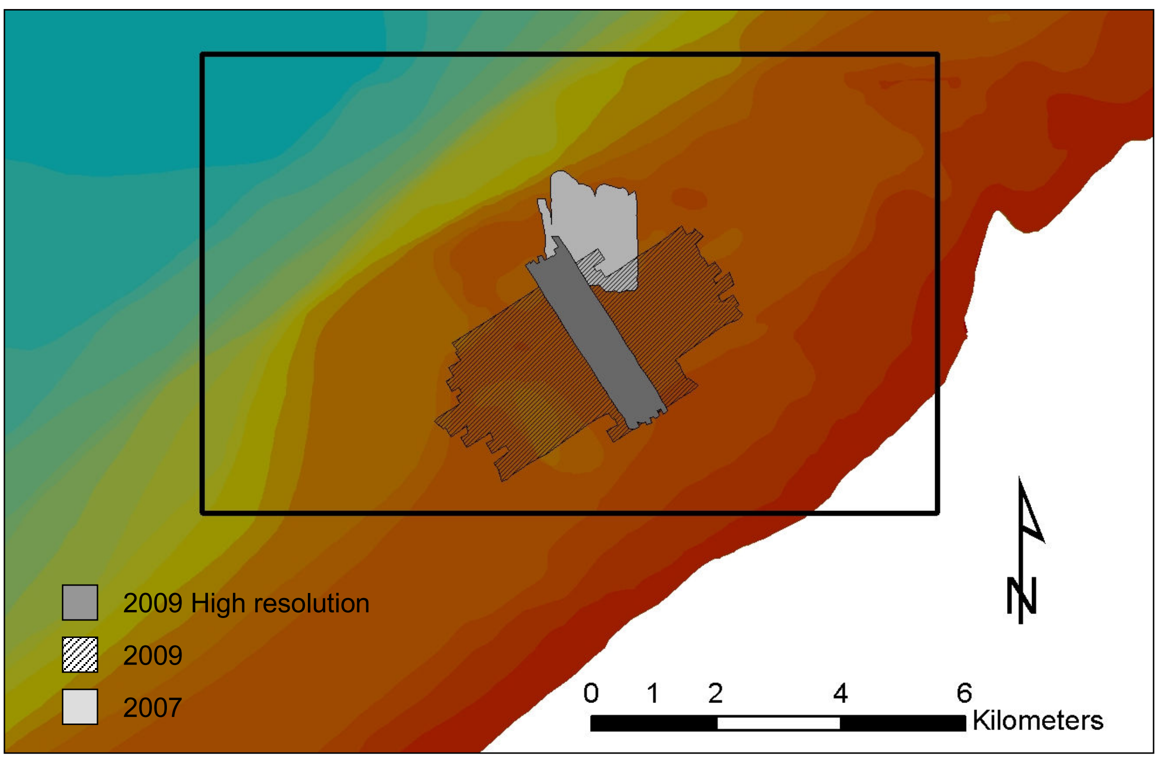


FIGURE 3-2. Bathymetric Map of Brocton Shoal, NY showing areas esonified by sidescan sonar in 2007 and 2009.

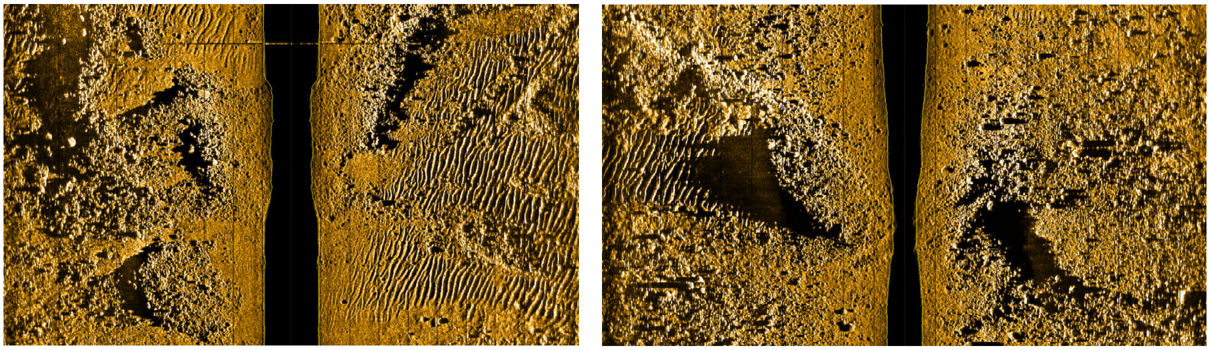


FIGURE 3-3. Sidescan sonar images from Brocton Shoal, NY in 2009 showing linear rock ridges and piles that may be suitable for lake trout spawning.

Long Point, Clear Creek, and Pennsylvania Ridge Complex

The Long Point, Clear Creek, and Pennsylvania Ridge Complex was chosen as a target based on: 1) its proximity to potential deep water nursery habitat, 2) speculation about underlying bedrock and glacial deposits, 3) increased potential for coarse-grained materials based on its high energy environment (currents and storm events) and 4) areas with suitably steep (>5%) slopes and bathymetric heterogeneity analogous to the Brocton Shoal reference site. Considerable effort was expended in this area in 2009 using both RoxAnn and Sidescan techniques. Both the RoxAnn and sidescan sonar surveys and associated ground truth data show that both the Clear Creek and Long Point Ridges are primarily comprised of highly mobile sand and fine gravel substrates. No suitable lake trout spawning habitat were observed in these surveys. The absence of *Dreissenids* on the coarser-grained gravel deposits suggest that these deposits are highly mobile and are indicative of high energy environments. Additional sidescan data along the eastern flank of the Long Point ridge area did reveal areas of exposed bedding (potential bedrock and cohesive clay deposits) and future surveys and ground truthing may yet reveal areas suitable as potential lake trout spawning habitat. Coarse grained material observed on the sidescan sonar data at the southern end of the Clear Creek Ridge did not have characteristics suitable for lake trout spawning.

New, Alternate Reference Site at Presque Isle, PA

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 the annual collections of spawn ready lake trout (pers. comm. Jim Grazio, PADEP). While this area was relatively shallow (5-10m) and did not have the cobble substrates or steeper slopes previously targeted, extensive areas of highly fractured bedrock, and associated rock debris could theoretically be used by lake trout as spawning 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. north shore Tecumseh

Reef). Further investigation of this area with underwater video is planned for 2010.

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 lithophyllic 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 lithophyllic 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 3-4).

Figure 3-4. Images of Brocton Shoal pre-dressenid invasion (left; 1987, Edsal) and post dressenid invastion (right; 2009 current study).

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. To date, there has been no evidence to indicate that these areas are being used by lake trout for spawning. For details see the LEC, CWTG report 2009 (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 and 2009 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 will continue through 2011.

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.

Potential Future Direction

- Identify areas desirable to lake trout during spawning time by establishing a systematic fall lake trout sampling program.
- Acquire sidescan sonar data and high resolution bathymetric data of areas identified from the fall lake trout sampling program to assess spawning habitat potential and utilization by lake trout.
- Acquire high resolution bathymetric data over sites already identified as potential spawning habitat areas and integrate with existing sidescan sonar and RoxAnnTM datasets.
- Establish an on-site video monitoring program to assess spawning habitat utilization by lake trout (or other species of interest).

Investigators

H. Biberhofer (EC), A. Gorman (ODNR), P. Kocovsky (USGS), S.D. Mackey (Habitat Solutions), T. MacDougall (OMNR), and J. Markham (NYSDEC)

Acknowledgements

Joshua Morse, Oberlin College (OH) for work on video classification and interpretation.

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Great Lakes Fish and Wildlife Restoration Act Grant # 30181-8-G021

Section 5. Identify metrics related to walleye habitat

AM. Gorman, E. Rutherford, Y. Zhao, S. Pandit and T. MacDougall

The HTG was charged with assisting the Walleye Task Group (WTG) with identifying metrics relating 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 and management unit (MU), thereby providing the LEC with an alternate way to allocate fishery quota for walleye. Presently, quotas are allocated proportionally based on surface area of waters less than 13 m deep by jurisdiction and MU (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 feels that HTG may be able to further improve estimates of preferred habitat through an expanded definition of habitat based recent literature, geospatial analyses and historic datasets.

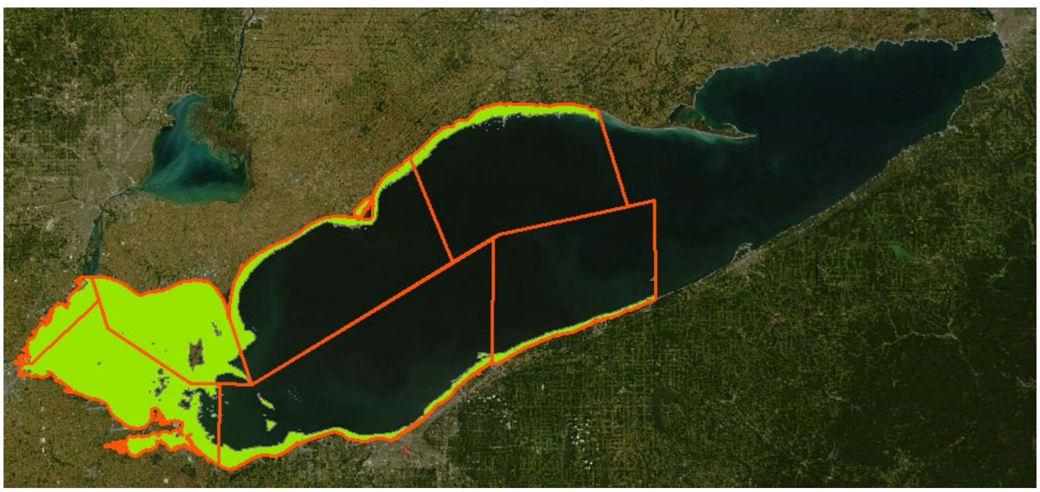

Figure 5-1. This map represents the present quota sharing allocation, which is proportionally based on surface area of waters less than 13 m deep (area in green) by jurisdiction and MU for Ohio, Ontario and Michigan (outlined in orange).

A sub-group consisting of HTG and WTG members was established to define a set of metrics and to use them to create estimates of preferred adult walleye habitat. Through several meetings and discussions, a series of habitat variables were chosen that were not only deemed appropriate for walleye but also for which datasets currently exist and provide lakewide coverage. We have decided to use a set of approaches and datasets for modeling walleye habitat suitability. First, we describe a logistic regression approach by Dr. Shubha Pandit, a post-doctoral researcher at the University of Windsor along with Yingming Zhao (OMNR) and Jan Ciborowski (University of Windsor). Pandit et al. uses logistic regression to determine the relationship between a variety of abiotic conditions and the probability of occurrence of walleye. Based on the literature (Christie and Regier 1988, Lester et al. 2004), parameters of importance, such as temperature, dissolved oxygen and light attenuation (Secchi depth) have been included in the model along with depth at which the fish were collected ('geardepth'). The presence or absence of walleye was designated based on results from the Ontario Ministry of Natural Resources (OMNR) Partnership index gillnet program (August-November, 1989-2008). The data on abiotic conditions were collected concurrent with fishing activities.

In fitting the relationship between the probabilities of walleye presence (p) and a set of explanatory variables, the following empirical model was used:

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

Where: β is the intercept constant; α is the coefficient parameter; and X indicates the environmental variables.

Pandit et al. used four environmental variables (dissolved oxygen, Secchi depth, water temperature and gear-depth) as explanatory variables to fit species presence/absence observations using a stepwise logistic regression procedure (Figure 5-2). Temperature and dissolved oxygen are values collected from the depth at which the gill net is fished. This is important because the fish are likely to distribute differently (vertically and laterally) in the Central Basin during months of stratification and hypoxia.

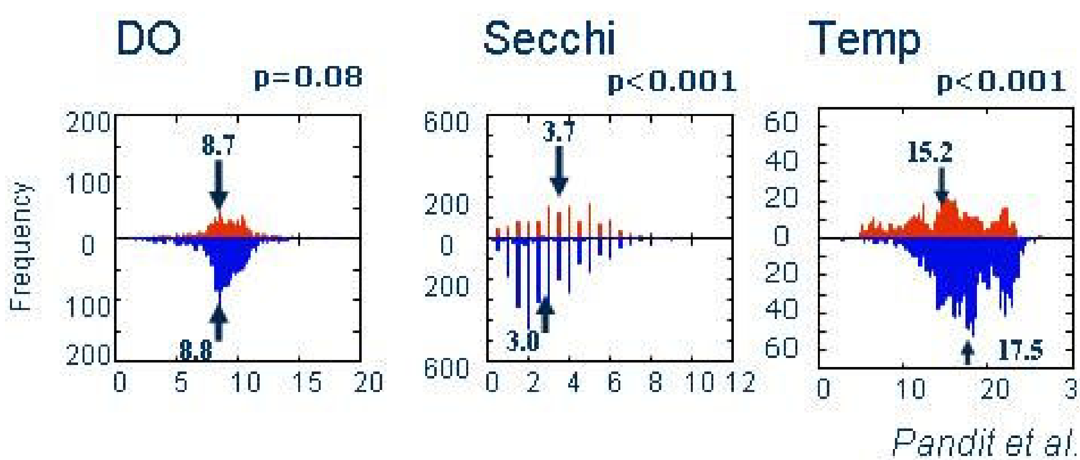

Figure 5-2. The frequency of OMNR gill nets (1990-2008) with walleye absent (red) and present (blue) with respect to dissolved oxygen, secchi and temperature at the net depth.

Once the logistic regression is fully developed the next step is to generate as series of habitat suitability maps. We will obtain all available datasets for Secchi depth, temperature and dissolved oxygen and interpolate across these point samples to create a continuous, rasterized coverage for the entire lake (~ 50 m cell resolution). The environmental variables that are retained in the generalized linear model will be used to create GIS maps predicting the suitable walleye habitat, with each pixel in the suitability map yielding the probability that a species will be present in that location (with probabilities ranging from 0 to 1).

Because habitat conditions vary dynamically across space and time, it is desirable to have depth-specific estimates of light, temperature and dissolved oxygen on a daily time step to generate the habitat suitability maps. Preliminary results from Dr. Pandit's work demonstrate different results for the amount of weighted suitable habitat if surface temperature is used compared to bottom temperature. For this reason, we plan to use output from a 3-D hydrodynamics model from NOAA GLERL that predicts oxygen, temperature and light across vertical and horizontal gradients through time. Additionally, we will examine the effects of extreme variance in temperature, stratification (i.e. larger hypoxic zone), and precipitation (i.e. light conditions) on the amount of suitable habitat by jurisdiction.

An alternative approach is to relate walleye relative abundance to habitat conditions using CPUE as the dependent variable in a generalized linear model (GLM). While we are aware this could substantially increase the complexity and difficulty of the exercise, it would allow us to incorporate population density, which may affect the distribution of fish. Furthermore, walleye tend to migrate farther with size and age, so we will also examine the role of gender and age structure on the linear model. Although the presence of preferred forage may dictate localized movements of walleye, we are uncertain that this is occurring at broader scales (by basin or Management Unit). We also intend to include forage density into the GLM to determine if there are instances (i.e. high walleye densities) when the distribution or CPUE of walleye may be primarily driven by the abundance of forage species.

There are several datasets that we intend to use to model walleye habitat suitability. ODNR will provide a fall gillnet survey (September-November) that spans the Ohio waters of Lake Erie from 1990-2009. An additional dataset of walleye CPUE in gillnets from 1990-1992 can be used to assess monthly movements of walleye from May to November. These datasets include abiotic information, which can be used to create the raster maps for secchi depth, dissolved oxygen, and temperature. It is our intent to further validate the resulting probability model with harvest information provided by the WTG and an extensive tagging dataset provided by MDNRE, both georeferenced within the LEGIS. These will help us determine if there are areas where walleye may be overrepresented by the model.

We hope to develop 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 what abiotic changes may result in extreme changes in walleye distribution.

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Section 6. Strategic Research Direction for the Environmental Objectives

S. Mackey, AM. Gorman, and T. MacDougall

This charge, new to the HTG in 2007 involves the development of strategic research direction that is in accordance with the Lake Erie Environmental Objectives (Environmental Objectives Sub-Committee 2005). The Environmental Objectives (EO’s) outline issues and the conditions required to attain environmental conditions addressed in the Fish Community Goals and Objectives (FCGOs, Ryan et al. 2003). The primary concerns of the FCGOs are: minimizing contaminant loading, maintaining adequate dissolved oxygen levels, and restoring water clarity and coverage of submerged aquatic vegetation. In addition to the FCGOs, the EOs address the importance of improving fish access to habitat, assessing water levels and climate change and the habitat impacts of invasive species, as well as restoring coastal and shoreline processes, hydrologic function of rivers, and fish habitat, if possible.

Direction on this charge involved an exploration general research needs around three broad topics:

1) The impact of climate variability on fish habitat and fish populations, and

2). Human activity in the coastal margin and its impact on nearshore fish dynamics, including habitat, connectivity, how fish relate to their environments across a range of spatial and temporal scales.

3) Potential unforeseen impacts of existing and new aquatic invasive species that have become established in the Lake Erie basin. These organisms may directly affect fish spawning and nursery habitats, impact water quality and water clarity, and cause direct or indirect impacts to fish health. Moreover, these organisms may further change food-web dynamics that have already been impacted by *dreissenids*, round gobies, and filamentous algae (*cladophora*).

First, there are several major efforts to evaluate the potential impacts of climate variability on the Great Lakes (including Lake Erie) along with scenario development and a discussion of potential adaptive management strategies. Currently NOAA, U.S. EPA, Environment Canada, the IJC, and the Nature Conservancy have robust programs that are developing adaptive management strategies for the Great Lakes. Individual States, Provinces, and several academic institutions are also focusing on climate change impacts and adaptation strategies in the basin.

Unfortunately, many of these programs are proceeding without any guidance or information from the GLFC or Lake Committees, and most are unaware of (or have ignored) the current FCGOs and EOs. Even though FCGOs and EOs are posted on the GLFC website, few researchers in the Lake Erie Basin know of their existence or access them for guidance during their research. The HTG believes that a concerted effort needs to be made to make researchers, agencies, academic institutions, and NGO's aware of the FCGOs and EOs so that they can be incorporated into research and planning objectives of these institutions and ongoing programs. Copies of the FCGOs and EOs need to be distributed to key institutions and agencies working on Lake Erie environmental issues, and linkages need to be encouraged between these institutions, agencies, and the Lake Erie Committee.

Second, the Habitat Task Group will initiate and develop a "white paper" focused on potential impacts (or benefits) of climate change and climate variability. The white paper will consider how potential climate change impacts may affect future Lake Erie management strategies and how those changes might impact the fishery and fish habitat. This white paper would identify many of the main issues related to potential climate change impacts and identify both short and long-term issues for fishery resource management agencies to consider as part of their future research and monitoring efforts. The white paper will build on climate change scenarios and approaches/analyses already developed by other programs to develop possible adaptation strategies in response to climate change impacts.

Third, the interests of the GLFC, fishery resource management agencies, and the Habitat Task Group must be represented and incorporated into the ongoing efforts of other agencies. Recent discussions have led us to the conclusion that any strategic direction developed needs to address fish habitat in a much more specific way than the general statements of objectives as laid out in the EO document. The difficulty is to identify specific actions that can be taken to address the broader-scale issues and objectives identified in the EO document. Moreover, whatever actions are taken should address more than just the EOs, but the issues and problems of other task groups as well. Habitat is applicable to other task group charges, and it would useful to identify where strategic actions could be taken (or research initiated) that addresses multiple charges from different task groups. The Lake Trout Habitat charge and the more recent "Walleye Habitat charge" are good examples of how the needs of two different task groups can be addressed strategically by a single combined research and data collection effort. The HTG will work with the other Lake Erie task groups to identify additional problems/opportunities that could be addressed strategically by a combined effort between task groups.

References

Environmental Objectives Sub-Committee. 2005. Report of the Environmental Objectives Sub-Committee of the Lake Erie Committee, Great Lakes Fishery Commission, July 2005. Presented to the Standing Technical Committee, Lake Erie Committee of the Great Lakes Fishery Commission. Ann Arbor, Michigan, USA. Available at www.glfc.org.

Ryan, P.A., R. Knight, R. MacGregor, G. Towns, R. Hoopes, and W. Culligan. 2003. Fish-Community Goals and Objectives for Lake Erie. Great Lakes Fishery Commission Special Publication 03-02. Available at www.glfc.org.

Section 7. National Fish Habitat Initiative Update

P. Kocovsky

In June 2008, Representatives of several state, federal (U.S. and Canada), and tribal management agencies met in Detroit, Michigan for a strategic planning session to establish the Great Lakes Basin Fish Habitat Partnership under the U.S. National Fish Habitat Initiative. Primary products of the 2-day session were a strategic vision and a set of goals and objectives, both for the short term (1-5 years) and longer terms (up to 25 years), for fish habitat protection and restoration throughout the great lakes basin (The Great Lakes Basin Fish Habitat

Partnership Interim Steering Committee 2009). Establishment of these goals and objectives resulted in the Great Lakes Basin Fish Habitat Partnership being integrated into the NFHI. Inclusion of the Great Lakes Basin Fish Habitat Partnership in the NFHI increases opportunities for funding to support habitat protection and enhancement throughout the great lakes basin.

The Great Lakes Basin Fish Habitat Partnership Interim Steering Committee. 2009. Proceedings of the Great Lakes Basin Fish Habitat Partnership Strategic Planning Meeting. June 16-18, 2009
Detroit, MI 60pp.
http://www.fws.gov/midwest/GLBFHP/Documents/ProceedingsGLFHPMeetingDetroitJune2009.pdf

Web link to Great Lakes Basin Fish Habitat Partnership:
http://www.fws.gov/midwest/GLBFHP/

Section 8. 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 9. Acknowledgements

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