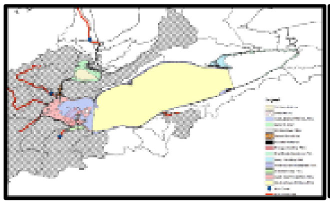
Report of the
Lake Erie Habitat Task Group
2019

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Charges to the Habitat Task Group 2018-2019

1. Systematically develop and maintain a list of functional habitats and impediments for species specified by the LEC Fish Community Objectives (FCO's) that can be used to identify and evaluate status of;
    a. Priority management areas that support LaMP, LEC Environmental Objectives (LEEO's and FCO's)
    b. Strategic research direction for the LEEO's
    c. Documentation of key habitat and research projects as related to priority management areas.

2. Assist member agencies with the use of technology (*i.e.*, side-scan, GIS, remote sensing, *etc*.) to facilitate better understanding of habitat in Lake Erie, particularly in the Huron-Erie corridor, the nearshore, and other critical areas.

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

Charge 1: List of functional habitats and impediments for species specified by the LEC Fish Community Goals and Objectives (FCO's)

Charge 1a: Priority Management Areas that support LaMP, LEC Environmental Objectives (LEEO's and FCO's)

S. Marklevitz, J. Tyson, and C. Harris

In 2016, the Council of Lake Committees (CLC) adopted draft Environmental Principles (*EPs*). The premise of the CLC-EPs is that "*sustainable fisheries can occur across the basin if functional habitats are protected or improved in each lake through a systematic, adaptive, cumulative, and collaborative approach that accommodates fishery value in decisions to act on manageable anthropogenic stresses."*

The emphasis of this approach is protecting, restoring or enhancing functionality to habitats that support fish production (e.g., spawning and nursery areas). The CLC prioritizes "protection" over "restoration" over "enhancement", (i.e. Protection > Restoration > Enhancement) and defines each as follows:

- ***Protection***: guarding against threats to habitats already in functional condition,
- ***Restoration***: addressing threats/stresses thereby improving functionality to an unimpaired condition,
- ***Enhancement***: addressing threats/stresses thereby improving functionality to a less impaired condition.

Whether protecting, restoring or enhancing a habitat, the focus is on addressing manageable (vs. unmanageable) sources of threats/stresses on habitat functionality. Habitat restoration or enhancement actions do not need to lead to restoring a habitat to "pristine" conditions but can simply improve conditions to benefit the production of desirable fish species.

The CLC-EPs approach also addresses uncertainty for prioritizing habitat actions (*i.e.* Protection, Restoration, Enhancement), as it is recognized that we lack complete knowledge of specific habitat requirements or impediments of species and/or stocks. Therefore, priorities must be determined based on best available information and expert judgment while using a precautionary and adaptive approach for prioritizing potential habitat actions and their expected outcomes.

The intention of the CLC-EPs is to aid in the *prioritization* of habitat actions that would promote sustainable fisheries in the Great Lakes Basin. Subsequently when applied at appropriate spatial scales with fisheries management priorities (from regulations, policies, and practices), the EPs should help identify "*priority areas"* where focus habitat actions could have the greatest benefits to Great Lakes fisheries.

Identification of *priority areas* will help communicate and align complex fisheries management priorities at various levels of governance with other Great Lakes governance groups, such as land-use, water quality, and wildlife management committees/commissions, agencies, or community groups. The alignment of priorities across governance groups could have synergistic benefits through the development of cross-disciplinary/agency partnerships, efficient use of resources (e.g., cross-agency programs, and/or what to do now versus later), and collaborative evaluations. Opportunities to align lake-specific priorities among various governance groups exist through binational initiatives, such as the Lake Erie Lake Partnership of the Great Lakes Water Quality Agreement and the new Great Lakes Regional Aquatic Habitat Connectivity Collaborative, and within and among various federal, provincial, and state government agencies in each Great Lake.

To address the CLC-EPs, the LEC and HTG have defined priority areas within the LEC jurisdiction from the Bluewater Bridge (St. Clair River) to Niagara Falls (Niagara River). To accomplish this the HTG is identifying potential "*habitat actions*" within "*functional habitats*" by life stage and stock of desired fish species. Through a systematic and adaptable application of the CLC-EPs and LEC fisheries management priorities to these habitat actions, functional habitats are evaluated to define priority areas where management actions could have significant effects of the production of desired fish species, referred to as Priority Management Areas (PMAs).

To begin we must clearly define the key terminology for the determination of PMAs.

Priority Management Area Exercise Terminology

Functional Habitat (FH): A dynamic system of hydraulically-connected areas that support requirements of desired fish species for sustained production. Considerations for identifying a FH include:

- ✓ Currently supports, or once supported, connected life stages of desired fish stocks and fisheries, as identified in the Fish community objectives (FCOs).
- ✓ Consists of, or once consisted of, features that vary naturally with inherent dynamic processes (erosion, deposition, water circulation, lake level fluctuations, etc.) to provide repeated habitats that could support eventual stock formation.
- ✓ Can be protected or improved in a manner that is expected to result in stable or increased production to a stock over an accepted time period (e.g., degradation has not completely eliminated all reasonable opportunities to increase production).
- ✓ Can be effectively defined and recognized spatially for application. Note: there can be overlap among functional habitats of different species or stocks, especially for migratory fishes.

Habitat Action (HA): An intentional action of protection, restoration, or enhancement as defined by the CLC-EPs on manageable threat/stress sources within a *FH*(s) for the purpose of promoting production of desired fish species. Production in this case is defined as abundance of the desired fish species and does not explicitly consider growth.

Priority Management Area (PMA): A specific location within the Lake Erie watershed where *HA(s)* are needed to improve *FH*(s). PMAs can have more than one *HA*, address more than one source of stress, or encompass more than one FH.

Methods:

PMAs are defined using a three-step approach to systematically derive priority management areas (Figure 1). In Step one, information on functional habitats by life stage and stock for all desired fish species was collected from technical experts around Lake Erie. Desirable fish species were defined by species listed in the Lake Erie Fish community goals and objectives (FCOs). Limiting habitat components were identified within each function habitat, their status (impeded or not), sources of impediments and proposed habitat actions with estimates time to implement, if applicable. This information was collected based on the best available information or expert judgment and this level of certainty also captured for each piece of information.

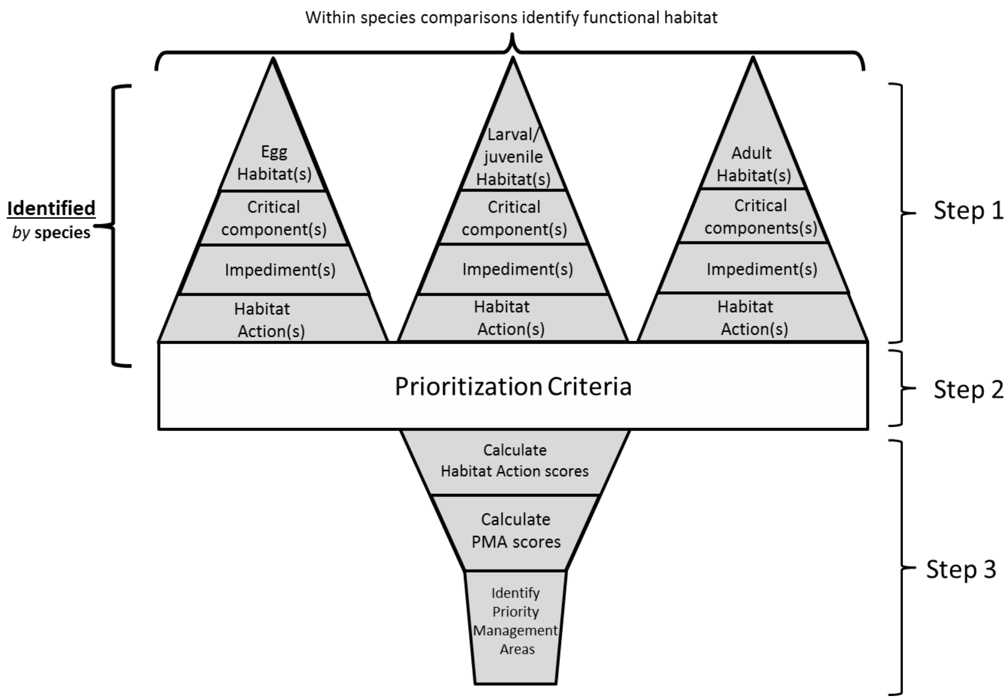

***Figure 1**: Schematic of the process for determining Priority Management Areas (PMAs)*

In Step 2, fisheries managers were surveyed to define broad management priorities for the management of individuals species, and broad spatial areas. This information was combined with the CLC-EPs to derive prioritization scoring (Table 1). Step 3 used a three-stage scoring process where first, individual scores for each proposed habitat action (HA) were calculated using the equation:

$$HA = Species \times Area \times \frac{Project\ type}{action\ certainty \times time\ to\ implement}$$

Where “species”, “area”, “project type”, “action certainty” and “time to implement” variables are defined in Table 1.

Individual HA scores were then aggregated to form average scores for each life stage, stock, species within a functional habitat. Finally, average scores for each life stage, stock, species within a functional habitat were summed within functional habitats (FH) to form the PMA score using equation:

$$PMA\ score_{FH} = \sum (\overline{HA})_{area,\ species,\ stock,\ life\ stage}$$

PMA scores were grouped based on percental ranges into priority levels: very high (>90%), High (75-90%), Medium (50-75%), low (25%-50%) and no priority (<25%).

Table 1*: Priority Scores derived from fisheries managers survey and Council of Lake Committee Environmental principles used to calculate Habitat Action scores*

Species		**Area**		**Project type**		**Action Certainty**		**Time to implement**	
Walleye	*26*	West Basin	*19*	Protection	*3*	Very high (supported by quantitative data)	*1*	0-5yrs	*1*
Yellow Perch	*26*	Central Basin	*16*	Restoration	*2*	High (supported by qualitative data)	*2*	5-10yrs	*2*
Lake Trout	*10*	East Basin	*19*	Enhancement	*1*	Moderate (supported by anecdotic evidence)	*3*	10-15yrs	*3*
Whitefish	*5*	Detroit River	*12*			Low (professional opinion)	*4*	15-20yrs	*4*
Burbot	*1*	Niagara River	*8*					20yrs+	*5*
Lake Sturgeon	*10*	St.Clair River	*10*					unknown	*5*
Smallmouth Bass	*5*	Lake St.Clair	*16*						
Rainbow Trout	*5*								
Rainbow Smelt	*1*								
Lake Herring (Ciscos)	*1*								
Northern Pike	*1*								
Muskellunge	*5*								
Emerald shiner	*4*								
Gizzard Shad	*1*								
Other forage species	*1*								

Results and Discussion:

Technical experts around Lake Erie identified 116 functional habitats used by 139 distinct fish stocks of the 13 species identified in the FCOs (Appendix A). PMA scoring identified 12 functional habitats as very high priority (>90%), and 15 high priority PMAs (75-90%), illustrated in Figure *2*. Within the top 10 PMAs, the top ranked habitat actions range in scope from site specific actions (e.g. dam removal, fish passageways, shoreline softening/naturalization) to broad scale regional actions (e.g. watershed actions including nutrient and sedimentation reduction initiatives, conservation of local stocks) (Appendix B). The need to conduct more research, ranging from generic fish-habitat interactions to more specific question including forage abundance, resource competition, hypoxia, and specific habitat use, was also prevalent in the top 5 actions. It was interesting to note that the PMA scoring method was able to identify specific projects such as the Ballville Dam removal and more generic projects through work to maintain and project nursery and spawning habitat in the Maumee River which is supportive of the Maumee River Sturgeon Restoration initiative, both projects will be further discussed later in this report.

Through the PMA scoring, the HTG was successfully able to assign priority to Functional Habitats to define PMAs at different spatial scales through the systematic application of fishery value (LEC priority and CLC-EPs) on manageable stresses. This collaborative approach is adaptable as new information becomes available, manageable threats/stresses are addressed, or fishery values change. Furthermore, the systematic approach provides full traceability for factors driving prioritisation that can be used in the further refinement of landscape level actions for habitat protection, restoration and enhancement to influence strategic plans and initiatives by other governance groups around Lake Erie.

There are two important limitations of the current PMA scoring approach. First, is the susceptibility of the prioritization to the weighting of data provided for individual Functional Habitats. This has the potential to exclude Functional Habitats with limited information from being high ranking PMAs. The HTG continues to work to address this limitation through the integration of the PMA data into a geo-spatial framework. This will enable information from Functional Habitats to be extrapolated across similar habitats with less available information (see future direction # 4). The second limitation is that the PMA scoring process does not implicitly account for other management priorities includes agency specific priorities, multi-species management and leveraging of other initiatives. As designed, the PMAs and Habitat Action ranks is a tool to aid in the identification of key landscape level habitat protection, restoration and enhancement actions with the potential to increase production of desired fish species. When examined under the lenses of other management considerations, the PMA tool is intended to help in the refinement of priority management actions. PMAs and Habitat Action ranks thus do not represent a standalone lists of definitive rank priorities of the Habitat Task Group, Lake Erie Committee or individual agencies.

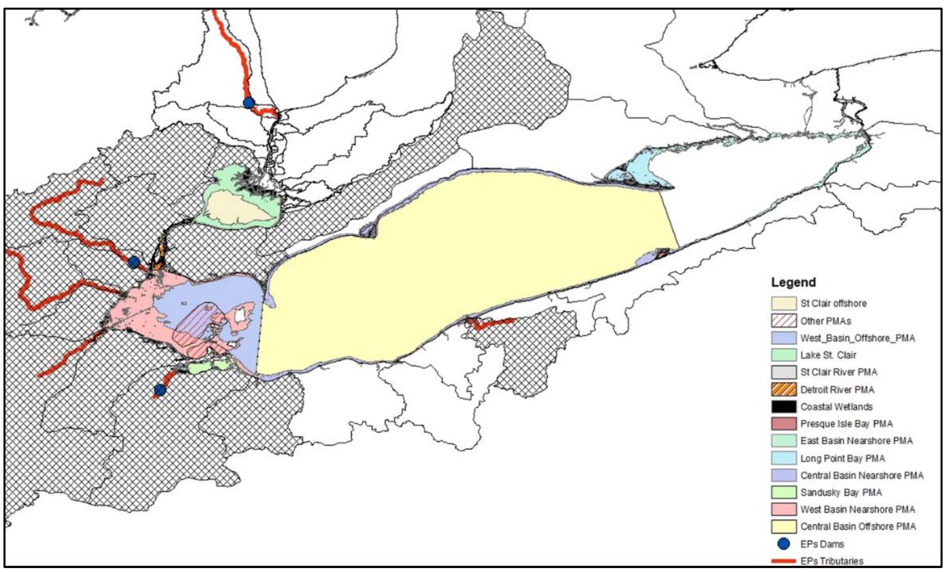

Figure 2: A map of specifically identified very high and high priority PMAs in the Lake Erie Basin based on the PMA scoring

Future direction:

1) The HTG will continue to update and populate information about Functional Habitats when new information becomes available.
2) The PMAs will start to guide fisheries value in strategic plans such as the lake wide action plan and is being used in the development of the 2019 Lake Erie-LAMP
3) The PMA dataset will be used to identify knowledge gaps and guide re-development of the strategic research direction for the LEEO's
4) The HTG and Great Lakes Aquatic Habitat Framework (GLAHF) will collaboratively explore ways to transition the PMA dataset into a geospatial framework. This will increase the power of the approach by minimizing effects the weighting of information in well studied Functional Habitats and improve the accessibility of the data for fisheries biologist, managers and other environmental organizations by enabling better data visualization.

Charge 1b: Strategic research direction for the LEEO's

S.Marklevitz, and C.Harris

In 2017, the LEC linked the HTG strategic research direction for the LEEOs to the development of PMAs. As outlined in the previous section of this report, in 2019 the HTG completed the first iteration of the PMA exercise. Over the next year the HTG will use the PMA dataset to identify and prioritize knowledge gaps to develop a list of strategic research questions.

Charge 1c: Documentation of key habitat and research projects as related to priority management areas.

- Reef Restoration and Maturation in the St. Clair-Detroit River System

E.Roseman, R.DeBruyne, and, J.Fischer

Restoration of fish spawning substrates in the St. Clair-Detroit River System (SCDRS) reached a milestone in 2018 with the construction of the Fort Wayne Reef, near Fort Wayne, MI in the Detroit River (Figure 3; Figure 4). The Detroit River and St. Clair River are both identified as a place-specific functional habitat with high Priority Management Area rankings (Appendix A). The four-acre reef is the seventh constructed in the SCDRS and the last of four reef complexes constructed in the Detroit River (Figure 1) to increase availability of lithophilic fish spawning habitat and address the "loss of fish and wildlife habitat" Beneficial Use Impairment listed for the Detroit River Area of Concern. Long-term monitoring of fish egg deposition and larval drift over the reef and throughout the SCDRS will continue and will be used to evaluate the effectiveness of the project at providing fish spawning habitat.

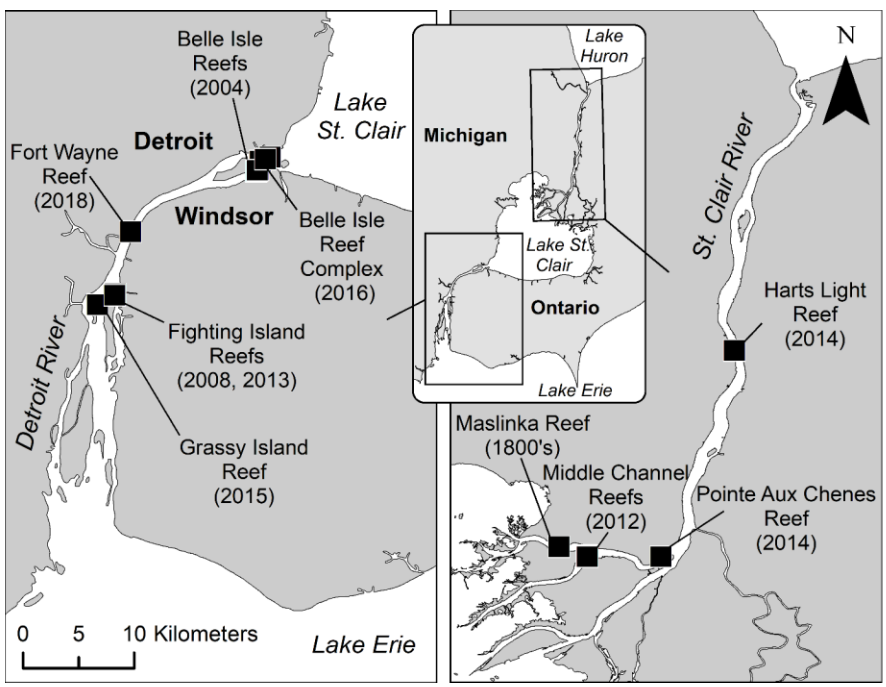

Figure 3: *Map of the St. Clair-Detroit River System with locations and construction years of fish spawning reef remediation projects. Multiple years of physical habitat (e.g., sediment composition) monitoring beginning within a year of reef construction occurred at the Harts Light, Pointe Aux Chenes, Middle Channel, and Grassy Island Reefs.*

In addition to evaluating the biological response to reef restoration projects, scientists at the U.S. Geological Survey (USGS) Great Lakes Science Center and Michigan Department of Natural Resources (MDNR) have been evaluating the physical maturation of reefs constructed in the SCDRS since 2014. Documentation of sand accumulation over the channel spanning Middle Channel Reefs in 2013 lead to improvements in reef design, including

Figure 4: *Construction of the Fort Wayne Reef in the Detroit River. Photo credit: University of Michigan Water Center.*

construction of long, narrow reefs oriented parallel with river flow and inclusion of geomorphic criteria (e.g., location of sediment sources and sediment deposition potential). To evaluate the effectiveness of the revised reef restoration process, we quantified physical maturation of constructed reefs using annual side-scan and down-looking sonar surveys conducted by the MDNR beginning in 2014 and underwater video surveys conducted by the USGS beginning in 2015. Reef areas and hardness were measured from sonar surveys and underwater video was used to quantify surficial sediment composition. Area and hardness of reefs developed using geomorphological criteria decreased with time, but at rates slower than what was observed at the Middle Channel Reefs. Sediment composition of the reefs remained similar through 2017 and prevalence of reef rock was high, except at Harts Light Reef, where dreissenid mussel shells composed 32% of the surficial substrate by age three (Figure 5). However, accumulation of fine sediments was documented at all reefs in 2018. Despite using geomorphic criteria to identify areas most suitable for reef construction, reef sediment composition has changed, and future reef restoration projects could benefit by incorporating methods for maintenance, in addition to using geomorphic criteria, to identify restoration sites.

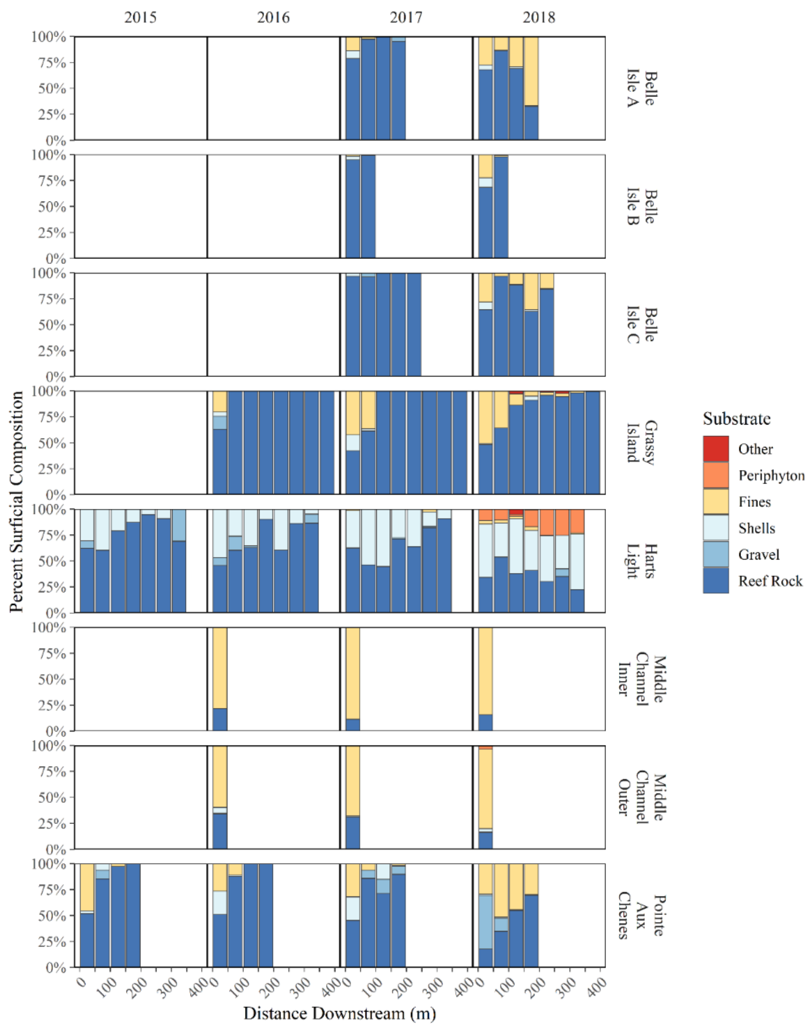

Figure 5: *Mean surficial sediment composition within fish spawning reefs constructed in the St. Clair-Detroit River System by year and distance downriver from the upstream end of a reef. In 2018, fine substrates (sand and silt) were documented at most reefs and tended to be most prominent near the head of the reefs, although large patches of fine sediments were also documented at the downstream portions of the Belle Isle Reefs A and C.*

- ## Biological and Habitat Assessment of the Lower Rouge River, Michigan

E. Roseman, J. Fischer, R. DeBruyne, and S. Jackson

The Rouge River flows into the Detroit River is a Great Lakes Area of Concern with a listed Beneficial Use Impairment related to loss of fish and wildlife habitat. The anticipated removal of concrete channelization within the Lower River will help restore soft shoreline and vegetated shallows and nearshore spawning habitat including fringe and coastal wetlands in the Detroit River. The Detroit River has been identified as place-specific function habitat that is a is a high ranked PMA (Appendix B). A key component of evaluating the success of habitat remediation projects is determining pre-remediation conditions, both biotic and abiotic, to establish a baseline and compare with post-project conditions. A biological and habitat assessments of the river, which focused on an approximately 7 kilometer stretch that included the proposed section of concrete channel to be removed, was conducted to determine pre-restoration conditions. Surveys documented the presence and quality of physical habitat, presence of herpetofauna, and quantified macroinvertebrate and fish assemblages at 12 sites (three upstream of the concrete channels, six within the concrete channel, three downstream of the concrete channel). Macroinvertebrate assemblages were dominated by chironomids and oligochaetes for both June and September. Electrofishing catch-per-unit-effort was driven by emerald shiner catches in June and emerald shiner and gizzard shad catches in September. Northern Map Turtles were the most common herpetofauna observed throughout the lower Rouge River. No submergent macrophytes were found and riparian vegetation was sparse in the concrete channel section. No sites scored above ‘good’ for overall qualitative habitat assessments and all concrete channel sites were ranked as ‘marginal’ or ‘poor’ habitat. Results from this assessment can be used to compare with post-remediation projects in the lower Rouge River.

- ## Clinton River Mouth Ecosystem Restoration Project, Michigan

C. Harris

Prior to the 1960s the confluence of the Clinton River with Lake St. Clair was a small river delta with Great Lakes coastal wetlands. Beginning in 1964, dredge material was placed in the confluence area, developing a confined disposal facility (CDF) that reached capacity in 1977. Part of the CDF revetment included armoring the shoreline with large rip-rap and ultimately eliminating much of the Great Lakes coastal wetlands. In more recent years, the invasive phragmites became well established, creating a monotypic stand and eliminated much of the native vegetation across much of the outer point of the CDF. The site was identified as a priority for the Clinton River Area of Concern and a restoration project began in 2015 through collaboration with US Army Corps of Engineers (USACE), Environmental Protection Agency, Michigan Departments of Natural Resources and Environmental Quality. This project is being completed in the nearshore Lake St. Clair at the confluence of the Clinton River, which have been identified as respectively as very high and med PMAs (Appendix A).

The project objectives are to soften the shoreline around the CDF, restore coastal wetland and eliminate invasive species in on the CDF. To accomplish these objectives, the USACE designed a shallow sloped shoreline off the southern shoreline of the CDF that would allow emergent vegetation and submerged aquatic vegetation to fluctuate with the changing water levels in the Great Lakes (Figure 6). Dredge material was used to create the slope to avoid uncapping the CDF. To protect the newly sloped shoreline, tree clusters were anchored in offshore to break up wave energy and provide an additional habitat component. The tree clusters protect 6,000 linear feet of shoreline and 14 acres of aquatic shoreline. In addition, 4 acres of upland habitat was cleared of invasive species and structured into wet mesic savanna.

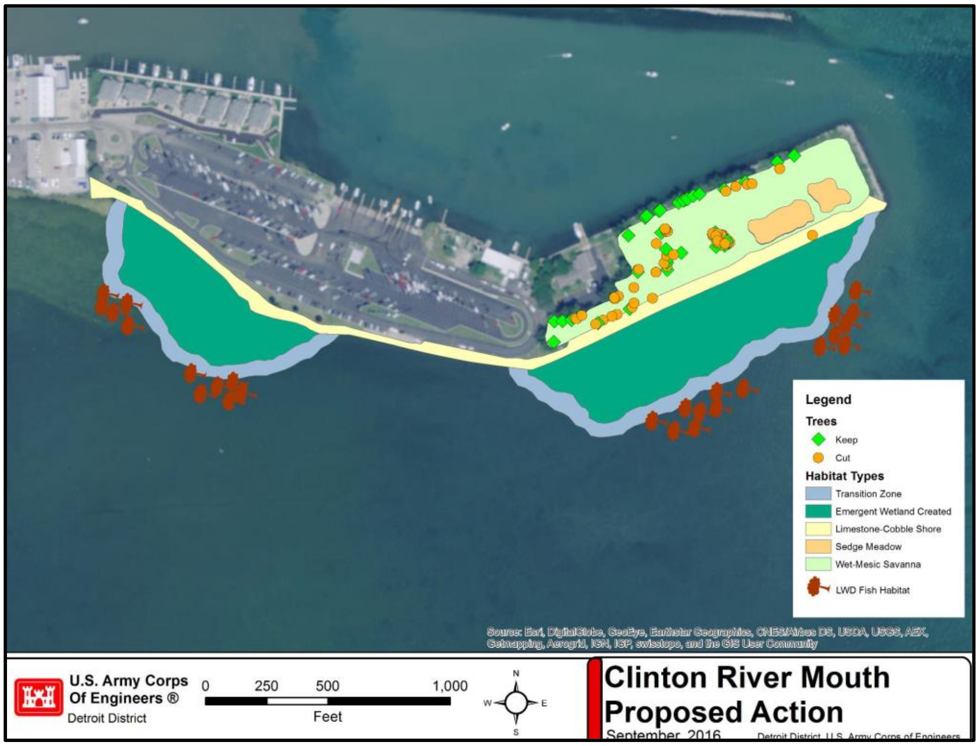

Figure 6: *Conceptual drawing of the Clinton River mouth habitat restoration project, located at the confluence of the Clinton River and Lake St. Clair.*

- ## Henry Ford Estate Dam fish passage to the Rouge River, Michigan

C.Harris and J. Braunscheidel

The Henry Ford Estate Dam is the first dam on the Rouge River, located 8 miles upstream of its confluence with the Detroit River and blocks all fish migration to upstream habitats. Providing fish passage beyond the dam was identified as a priority delisting target for the fish and wildlife habitat and population beneficial use impairment within the Rouge River Area of Concern. The Detroit River which includes its tributaries such as the Rouge River has been identified as place-specific function habitat that is a high ranked PMA (Appendix A). The Henry Ford Estate Dam is identified as a National Historic Landmark presenting an additional challenge for restoring appropriate fish passage. A collaborative effort led by the Alliance of Rouge Communities with support from federal, state, and local entities developed and are executing a plan to restore fish passage around the dam.

To restore fish passage upstream of the dam and maintain the integrity of the National Historic Landmark, an 850 linear feet by-pass channel around the dam was designed and implemented (Figure 7). Natural channel design was used for the by-pass channel that would create riffle/pool sequences allowing a wide variety of fish species to pass under many flow conditions. The by-pass will hydrologically reconnect 50 miles of the mainstem Rouge River and 108 miles of its tributaries to the Detroit River. In addition to the reconnection, bank stabilization and erosion control efforts will be employed to ensure the sustainability of the project. The designs were completed in 2017 and creation of the by-pass began in 2018; it is expected to be completed in 2019.

Figure 7: *Ford Dam Fishway under construction in November of 2018 with Ford Estate and Dam in the background*.

- ## Celeron and Stony Islands Habitat Restoration, Michigan

C. Harris and J. Braunscheidel

As reported in the Lake Erie Habitat Task Group 2018 Annual Report, habitat work continued around Stony and Celeron Islands (Figure *8*), located in the lower Detroit River. The habitat restoration efforts were initiated to address the beneficial use impairments of fish and wildlife habitat loss for the Detroit River Area of Concern. These actions will restore soft shoreline, vegetated shallows and nearshore spawning habitat including fringe and coastal wetlands in the Detroit River. Detroit River has been identified as place-specific function habitat that is a high ranked PMA (Appendix A).

Figure 8*: Image of the habitat restoration off the south shores of Stony Island (left) and Celeron Island (right) in lower Detroit River.*

Restoration efforts around Stony Island were completed in spring 2018 that have re-established spawning and nursery habitat along with revitalizing coastal wetlands around the island. In addition to protecting 600 linear feet of the island and 50 acres of backwater habitat, 92 habitat structures for aquatic species (fish, mudpuppies, and turtles) were installed and vegetation management (including invasive species control) occurred over 10 acres. Post construction monitoring began in 2018 and will continue in 2019.

Restoration efforts around Celeron Island began once the Stony Island restoration was completed in spring 2018. Restoration efforts off the southern end of Celeron Island were completed, including: 35 habitat structures installed, creation of rock shoals to protect the island and habitat structures, along with depth contouring in the protected area between the island and rock shoals. Restoration effort off the northeast portions of the island will begin in 2019, followed up by post construction monitoring in 2020. In total the restoration around Celeron Island will protect 3,000 linear feet of shoreline along with 67 acres of backwater habitat and restore/create 2,800 linear feet of shoal and 6 acres of nesting barrier beach.

- ## Removal of the Ballville Dam on the Sandusky River, Ohio

E. Weimer

The Ballville Dam was built on the Sandusky River between 1911 and 1913 near river kilometer 29 and approximately 2.5 kilometers upstream of the City of Fremont, Ohio. The removal of the Ballville Dam was identified as a habitat action within the Sandausky River, a very-high ranked PMA (Appendix B). The dam, at 128 meters long and 10 meters high, was originally constructed to produce hydroelectric power, but insufficient seasonal flows led to its sale to Fremont in 1959 to provide a water supply to the city. The last major renovation to the dam was in 1969.

The Ballville Dam is a barrier to migratory fish and other aquatic organisms on one of Ohio's largest tributaries to Lake Erie. It is believed that the Sandusky River walleye spawning population's production is limited to only eight hectares of spawning habitat due to the presence of the Ballville Dam. An additional 35 kilometers of riverine habitat exists between Ballville Dam and the next dam upstream in the City of Tiffin, including approximately 122 hectares of additional spawning habitat. The presence of the dam also has impacted the downstream movement of coarse-grained substrates to the existing spawning habitat downstream of the dam. A portion of this existing spawning habitat has become gravel-starved, further limiting available spawning habitat for migratory Lake Erie fish species like walleye and white bass. Sandusky River walleye spawning populations are regionally and internationally significant and supply catchable fish as far east as New York.

Additionally, by the mid-2000's, the impounded area upstream of the dam no longer met Ohio designations for Aquatic Life Uses and impacted in-stream (reservoir) and downstream habitat quality. These impacts extend to many river resident species as well, including the Greater Redhorse and Three-horned Wartyback (Ohio Threatened Species), River Redhorse and Deertoe (Ohio Species of Concern), and an array of non-listed aquatic and riparian species.

In the 1980's, concerns regarding the condition of the Ballville Dam began to be raised, and in 2007 the Ohio Department of Natural Resources issued a Notice of Violation related to dam condition and public safety. The following year the Ohio Environmental Protection Agency filed a Findings and Orders Notice related to the operation of a Public Water System; specifically, elevated nitrate levels exceeding drinking water limits. As a result of these notices, the City of Fremont undertook construct of a new upground reservoir for the city's water supply (completed in 2013) and signed an agreement with the ODNR to remove the Ballville Dam.

The option to remove the Ballville Dam was selected for several reasons. First, removal was significantly less costly than repairing the dam; estimates placed repairs between $9 and $11 million, plus the continued liability and maintenance associated with dam ownership. Removal estimates were $7 million (final costs were less than that), with the added benefit of several revenue streams available to offset City costs of removal. Second, several ecological benefits existed for removing the dam, including 1) increase connectivity between upstream and downstream habitats, 2) restore coarse-grained sediment supply to downstream reaches, 3) restore riverine conditions and Aquatic Life Uses to approximately 2 miles of the Sandusky River, and 4) restore instream, fringe, and forested wetlands.

Demolition of the dam occurred in two phases (Figure 9): Phase 1 began on September 13, 2017, by removing a 6.1-meter-wide and 3.0-meter-tall section of the dam resulting in a "notch" in the south spillway. The notch strategy was intended to diminish the initial delivery of sediment to downstream reaches by limiting the initial depth of channel incision. This strategy also constrained storm-driven export, because the impoundment would maintain backwater conditions during higher flows. The dimensions of the notch were only large enough to convey approximately 57 cubic meters/second. The notch also drew down the pool level enough for seeding to occur on approximately 20 of the 47 acres that were dewatered to limit erosion and mobilization of fine-grained sediment. Phase 2, the final removal of the Ballville Dam, began in July of 2018, and was completed approximately a month later. Post-removal activities are planned for the upcoming years. This includes extensive planting of the dewatered impoundment with the objectives of 1) limiting the export of sediment, 2) accelerating the recovery of instream, fringe, and forested floodplain wetlands, and 3) preventing the establishment of exotic invasive species. Fish community assessments are planned to evaluate the removal's impact on local and migratory fish. A detailed habitat assessment of the newly available stretch of the Sandusky River will be conducted starting in 2019, with the intent of developing Habitat Suitability Indices for walleye and other species of fish to aid in future recovery and restoration activities. Acoustic telemetry will be used to evaluate the movement of walleye and other species into the newly available portion of the river. Monitoring is designed to capture conditions as the sediment deposits degrade and redistribute over time and document fish community response to barrier removal, information that will be used to inform future dam removals and their ecological impacts. The post-removal activities will be working towards addressing the 4th and 5th ranked actions within the Sandusky River PMA.

Figure 9: *Ballville Dam before, during and after removal*

- ## Maumee River Sturgeon Restoration, Ohio

J. Chiotti, and J. Boase

Lake sturgeon (*Acipenser fulvescens*) recruitment in the Lake Erie basin is currently supported by two connecting channels, the St. Clair – Detroit River System and Niagara River. Historically, there were 16 other spawning populations in Lake Erie with an estimated adult population ranging between 300 thousand to 1.1 million (Haxton et al. 2014). In an effort to delist this endangered species in the State of Ohio and throughout the Lake Erie basin, efforts are underway to rehabilitate lake sturgeon populations in suitable river systems. The Maumee River, located in western Lake Erie, historically supported large runs of lake sturgeon, but currently, sturgeon are considered functionally extirpated from the system. A habitat suitability model for spawning adult and age-0 lake sturgeon indicates sufficient habitat is present in the Maumee River (Collier et al. 2018). Therefore, the river is a strong candidate for a lake sturgeon reintroduction. As a result, a lake sturgeon restoration plan has been drafted for the system and approved by the Ohio Department of Natural Resources and Great Lakes Fishery Commission Lake Erie Committee. This year marks the first of a twenty-year program to restore lake sturgeon in the Maumee River.

In the spring of 2018, gametes were collected from 9 female and 37 male lake sturgeon in the upper St. Clair River. Sturgeon were reared at the Genoa NFH and a streamside rearing facility operated by the Toledo Zoo. Survival, movement, and imprinting will be evaluated between the two stocking strategies. As a result of the collections, 2,949 young of year (174 mm TL) lake sturgeon were released into the Maumee River, following the guidelines of the Maumee River Lake Sturgeon Restoration Plan.

The Maumee River rearing facility is the only one operating on Lake Erie and the fall stocking event was the first in the Lake Erie basin. The Maumee River Lake Sturgeon Restoration Program is a partnership between the Ohio Department of Natural Resources-Division of Wildlife, Ontario Ministry of Natural Resources and Forestry, Michigan Department of Natural Resources, Purdy Fisheries Ltd., Toledo Zoo & Aquarium, The University of Toledo, University of Windsor, U.S. Fish and Wildlife Service, and U.S. Geological Survey. The restoration program supports efforts that will address the all the top 5 actions of the 1st ranked Priority Management Area (Appendix D)

Haxton, T., G. Whelan, R. Bruch. 2014. Historical biomass and sustainable harvest of Great Lakes lake sturgeon (*Acipenser fulvescens* Rafinesque, 1817). J. Appl. Ichthyol. 30:1371-1378.

Collier, J.J. Creating a Spatially-Explicit Habitat Suitability Index Model for Lake Sturgeon (*Acipenser fulvescens*) in the Maumee River, Ohio. 2018. University of Toledo, PhD Dissertation.

- ## Remediating the effects of the Dunnville Dam on the Grand River, Ontario

T. MacDougall

A lowhead dam on the Grand River, in the town of Dunnville, Ontario serves as a barrier to upstream movement of most fish species, including a recognized Lake Erie stock of Walleye. The Grand River has been identified as place-specific functional habitat that is a medium PMA (Appendix A). Efforts to provide access to migratory fish via a Denil fish passage have proven ineffective. In addition to fish passage problems, a suite of ecological issues has been identified as attributable to the presence of the dam which is situated within the historic estuary of the river, in particular, a recently developed water management plan for the watershed (GRWMP, 2014) specifically notes the negative effects of the impoundment on water quality both within the river and Lake Erie nearshore. Action toward rehabilitation has been hindered by the inability to predict outcomes of various actions such as dam removal. Beginning in 2014, a series of workshops were convened to develop concise objectives and rehabilitation alternatives in a systematic way using a Structed Decision Making (SDM) approach. In 2018, a document was produced that incorporated 10+ years of research and data into “Performance Measures” (PMs) that will be used to rank alternative habitat rehabilitation actions. A technical review of the PM document was completed in December 2018 and a final ranking of alternatives and recommended management actions will be produced in spring 2019. An advantage to this approach is that the path to decisions and recommendations is transparent and, in many ways quantifiable. Modification of the dam structure, in some way, is a likely recommended outcome of this exercise. Development of the PM document has resulted in a variety of tools (high resolution surface and bathymetric DEM, water level modelling approach, predictions of wetland movement) which will be useful when remediation actions begin (Figure 10).

Figure 10: *Area of exposed shoreline following removal of the main channel weir at average lake level; estimated using SGR DEM (OMNRF 2016), and physical and HEC-RAS model outputs (Annable and Plumb, 2009)*

- ## Niagara River Habitat Restoration Projects, New York

T. DePriest, and J. Robinson

The Niagara River has been identified as place-specific functional habitat that is a medium PMA (Appendix A). The following are summaries of some of the habitat restoration efforts underway in New York State

Spicer Creek Coastal Wetland Restoration (in design): 15 acres of GL coastal wetland will be restored at Spicer Creek Wildlife Management Area through techniques to reduce anthropogenically derived wave energy forces reaching the nearshore area along 2,000 m of the Niagara River. Once established the emergent and submerged plant community will benefit spawning and early life stages of Muskellunge and forage species. This project is funded through US EPA/GLRI for delisting of Niagara Area of Concern and is expected to be constructed later this year.

Beaver Island Living Shoreline (in construction): 800 linear feet of degraded Niagara River shoreline in Beaver Island State Park is being restored by Buffalo Niagara Riverkeeper using living shoreline techniques of grading, native vegetation planting, and wave attenuation structures. The project extends into the nearshore area and will provide vegetated shallow water habitat that will benefit spawning and early life stages of Muskellunge, and forage species, and provide nursery habitat for early life stages of yellow perch and small mouth bass. This project is funded by NY Power Authority through the Habitat Enhancement and Restoration Fund.

Adaptive Management of Motor Island Shoreline Restoration (completed): 500 linear feet of shoreline was restored in 2011 through removal of bulkhead and other infrastructure from shoreline of Motor Island. The original project involved construction of off-shore rock berms to intercept wave energy and ice floes from reaching nearshore area. Due to increased water levels in recent years, the berm crest elevations were raised 1.5 feet to offer better protection of near shore area to promote aquatic and wetland vegetation establishment. Once established, the restored shoreline and nearshore habitat will benefit spawning and early life stages of Muskellunge and forage species as well as nursery habitat for Yellow Perch and Smallmouth Bass. This project was completed by NY Power Authority as required by 2007 Niagara Power Project re-licensing agreement with NYS DEC and FERC.

Figure 11 *Section Motor Island Shoreline*

East River Marsh Coastal Wetland Restoration (in construction): Seven acres of GL coastal wetland are in the process of restoration along 1,500 feet of Niagara River Shoreline that have been severely degraded by excessive recreational boating activity. Techniques include construction of large off-shore rock berms and anchoring of large wood structures in shallow water to reduce wave energy and intrusion of recreational boats. Once established, the restored coastal wetland habitat will benefit spawning and early life stages of Muskellunge and forage species as well as nursery habitat for Yellow Perch and Smallmouth Bass. This project is funded through US EPA/GLRI for delisting of Niagara Area of Concern provided to NYS Office of Parks Recreation and Historic Preservation and is expected to be completed early 2019.

Figure 12 *Construction of Rock Berms at E. River Marsh*

Unity Island Coastal Wetland and Aquatic Connectivity Restoration (near completion): 10 acres of aquatic and hemi-marsh wetland habitat have been restored and hydrologically re-connected to the Niagara River at Unity Island by the US Army Corps of Engineers. The project involved the beneficial re-use of 65,000 cubic yards of clean dredge sediment from the Buffalo River, diverting the spoil from the open lake disposal area in Lake Erie. Prior to the restoration, the site was isolated from the Niagara River by a large rock berm as part of a former confined dredge disposal facility, which was breeched with a 50-meter gap as part of the project. The project will be completed later in late 2019 once the final phase of plant installation is complete. This project is funded by NY Power Authority through the Habitat Enhancement and Restoration Fund.

Figure 13 *Conceptual plan for Unity Island project*

Charge 2. Assist Member Agencies with Technology Use

Members of the HTG are involved in a variety of projects, often using specialized equipment and techniques to identify, survey, and modify aquatic habitat in Lake Erie and its surrounding watersheds. The HTG is always interested in assisting agencies and researchers with the selection, use, and analysis of data collected with these technologies in a standardized fashion. In 2018, there was no additional work toward this charge to report beyond what has been report in previous HTG reports.

Charge 3: Support other task groups by compiling metrics of habitat

Habitat influences the distribution of fish species. Evaluating how fish relate to habitat can play an important role in assessing and modeling key fish species in Lake Erie, particularly Walleye and Yellow Perch. The HTG has been tasked with assisting other task groups in understanding the role of habitat in assessing these key species where appropriate. In 2018, there was no additional work toward this charge to report beyond what has been report in previous HTG reports.

Protocol for Use of Habitat Task Group Data and Reports

- The 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.

- All data provided from the PMA exercise is reported with the caveat that it is a working dataset based on the best available information. The intention, as designed, is for the HTG to continuously refine the data as new information becomes available and prioritizations are subject to change. Use of the PMA information should be done with this understanding and consultation with HTG co-chairs to ensure proper interpretation of the most recent dataset is highly advised.

- 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.

Acknowledgements

The HTG would like to acknowledge and thank the many contributors to the work presented in this report. As this report is mostly an overview of projects underway in the Lake Erie basin, it is impossible to identify every project and every individual involved. If you are involved in a habitat-related project in the Lake Erie basin and would like your work to be represented in the project table, please contact a member of the Habitat Task Group.

Appendix A: *Priority Management Areas scores for the 116 identified functional habitats in Lake Erie.*

Funtional Habitat			PMA scoring			Species (n = distict stocks)													
Region	Habitat type	Place	PMA Score	Percentile (within funtional habitat group)	Priority	Burbot	Emerald shiner	Gizzard shad	Lake Sturgeon	Lake Trout	Muskellunge	Northern Pike	Rainbow Smelt	Rainbow Trout	Smallmouth Bass	Walleye	Whitefish	Yellow Perch	Total
St.Clair River			147	33%	LOW	1	2	1	2		1	2	2	1	4	1	1	3	21
	Rivers/ tributaries		147	65%	MED	1	2	1	2		1	2	2	1	4	1	1	3	21
		Belle River, MI	26	57%	MED			1						1	2			1	5
		Black River, MI	57	76%	HIGH			1						1	2	1		1	6
		Constructed reefs	0	0%					1										1
		generic- St.Clair River	59	77%	HIGH	1	2	1	2		1	2	2	1	2	1	1	3	19
		Mill Creek, MI	4	33%	LOW													1	1
		Natural reefs (under bluewater bridge)	0	0%					1									1	2
Lake St.Clair			483	50%	MED		2	1	2		3	2		1	3	2		2	18
	Coastal wetlands		167	73%	MED				1		2	1			1			2	7
		generic	57	74%	MED						1	1			1			1	4
		St.Clair River delta	111	94%	VERY HIGH				1		2	1						2	6
	Nearshore		111	50%	MED		2	1	2		3	2			2	1		2	15
		Anchor Bay	5	36%	LOW										1				1
		generic- <10m	105	91%	VERY HIGH		2	1	2		3	2			2	1		2	15
	Open water- benthic		54	12%					2						1	1		1	5
		generic	54	71%	MED				2						1	1		1	5
	Open water- pelagic		11	0%							2					1		1	4
		generic	11	46%	LOW						2					1		1	4
	Openwater – reef/shoal		58	15%														1	1
		generic	58	77%	HIGH													1	1
	Rivers/ tributaries		82	35%	LOW			1			1	1		1	1	2		1	8
		Clinton River, MI	37	63%	MED			1						1	1	2			5
		generic	22	54%	MED						1	1						1	3
		Sydenham River, ON	12	47%	LOW											1			1
		Thames River, ON	13	50%	MED			1			1					1			3
Detroit River			82	17%			1	1	2		1	1	1	1	1	2	2	1	14
	Rivers/ tributaries		82	31%	LOW		1	1	2		1	1	1	1	1	2	2	1	14
		Constructed reefs	3	30%	LOW				1										1
		generic- Detroit River	76	82%	HIGH		1	1	2		1	1	1	1	1	2	2	1	14
		Natural spawning reefs	3	30%	LOW				1										1
West Basin			1863	100%	VERY HIGH		1	1	5	1	5	6	1	1	3	17	3	1	45
	Coastal wetlands		97	42%	LOW						1	1						1	3
		Port Clinton to Catawba Island, OH	8	42%	LOW						1								1
		Catawba Island to East harbour, OH	2	27%	LOW							1							1
		generic	87	86%	HIGH						1	1						1	3
		Middle Harbour, OH	0	18%								1							1
	Nearshore		324	92%	VERY HIGH		1	1	5	1	2	3	1		1	2	3	1	21
		Breast Bay	0	0%			1												1
		generic- <10m	134	97%	VERY HIGH		1	1	5	1	1	1	1		1		3	1	16
		Maumee Bay, OH	22	55%	MED		1	1								1			3
		Pelee Island	0	17%			1												1
		Point Pelee, ON	0	17%			1												1
		Port Clinton to Marblehead and Islands, OH	68	79%	HIGH						1				1				2
		Sandusky Bay, OH	99	89%	HIGH		1	1			1	2				1	1	1	8
	Open water- benthic		78	23%					5	1								1	7
		generic	78	84%	HIGH				5	1								1	7
	Open water- pelagic		215	81%	HIGH		1			1	1	1		1		17	3	1	26
		Detroit River Plume	42	64%	MED											2	3	1	6
		generic	104	90%	VERY HIGH		1			1	1	1		1		17	3	1	26
		Huron River Plume	5	34%	LOW											1		1	2
		Lake Huron	0	0%												1			1
		Maumee River plume	28	60%	MED											1		1	2
		River Rasin Plume	5	34%	LOW											1		1	2
		Sandusky River plume	32	62%	MED											1	1	1	3
	Openwater – reef/shoal		439	96%	VERY HIGH										1	2	1	1	5
		generic	56	73%	MED													1	1
		Ohio Reef complexes	186	97%	VERY HIGH										1	1	1	1	4
		Ontario Reef complexes	197	98%	VERY HIGH										1	1	1	1	4
	Rivers/ tributaries		710	100%	VERY HIGH			1	3		1	1		1	3	4		1	15
		generic	48	69%	MED										1			1	2
		Huron River, MI	106	92%	VERY HIGH			1	1					1	1	1		1	6
		Maumee River, OH	229	100%	VERY HIGH			1	1		1	1				1		1	6
		Plum Creek, MI	1	23%				1											1
		River Raisin, MI	123	96%	VERY HIGH			1	1						1	1		1	5
		Sandusky River, OH	202	99%	VERY HIGH			1								1		1	3

Funtional Habitat			PMA scoring			Species (n = distict stocks)													
Region	Habitat type	Place	PMA Score	Percentile (within funtional habitat group)	Priority	Burbot	Emerald shiner	Gizzard shad	Lake Sturgeon	Lake Trout	Muskellunge	Northern Pike	Rainbow Smelt	Rainbow Trout	Smallmouth Bass	Walleye	Whitefish	Yellow Perch	Total
Central Basin			1033	83%	HIGH	2	1	2		2	5	5	2	7	4	15	5	3	53
	Coastal wetlands		115	54%	MED						2	3			1			3	9
		generic	70	80%	HIGH						1	1						3	5
		Presque Isle Bay	0	16%								1							1
		Rondeau Bay, ON	46	67%	MED						1	1			1			1	4
	Nearshore		200	77%	HIGH	2	1	2		2	2		2		3		4	3	21
		Cleveland (<10m)	10	43%	LOW										1				1
		Fairport to Conneaut, OH (< 10m)	12	48%	LOW										1		1		2
		generic- <10m	108	93%	VERY HIGH	1	1	1		1	1		2				4	3	14
		Lorain area (<10m)	10	43%	LOW										1				1
		Pennsylvania Ridge	0	0%		1													1
		Point Pelee, ON	1	23%									1						1
		Presque Isle Bay	60	78%	HIGH	1		1		1	1				2		1	1	8
	Open water- benthic		89	38%	LOW	2				1			2					3	8
		generic	89	87%	HIGH	2				1			2					3	8
	Open water- pelagic		158	69%	MED		1			1	1		2	7		15	4	3	34
		Central Basin River Plumes	25	57%	MED													3	3
		generic	111	95%	VERY HIGH		1			1	1		2	7		15	4	3	34
		Port Alma Reef, ON	6	37%	LOW											1			1
		Sandusky River plume	16	52%	MED											1			1
	Openwater – reef/shoal		222	85%	HIGH											3	2	3	8
		generic	80	16%													1	3	4
		Ohio Central Basin Reef complexes	95	88%	HIGH											1		3	4
		Ohio Reef complexes	2	25%	LOW												1		1
		Ontario Reef complexes	2	25%	LOW												1		1
		Pennsylvania Shoals	0	0%												1			1
		Port Alma Reef, ON	42	65%	MED											1			1
		Port Burwell, ON	2	30%	LOW												1		1
	Rivers/ tributaries		248	88%	HIGH			1			1	2	1	3	1	5		3	17
		Ashtabula River, OH	1	20%				1											1
		Big Creek, ON	0	0%												1			1
		Big Otter Creek, ON	0	0%												1			1
		Black River, OH	1	20%				1											1
		Conneaut Creek, OH	1	24%				1						1					2
		Cuyahoga River, OH	47	68%	MED			1				1				1			3
		Elk Creek, PA	9	43%	LOW										1				1
		generic	74	81%	HIGH							1		1	1			3	6
		Grand River, OH	99	90%	HIGH			1			1					1		1	4
		Kettle Creek, ON	1	19%										1		1			2
		Pennsylvania creeks	0	0%				1											1
		Raccoon Creek, PA	2	29%	LOW								1						1
		Walnut Creek, PA	12	0%											1				1

Funtional Habitat			PMA scoring			Species (n = distict stocks)													
Region	Habitat type	Place	PMA Score	Percentile (within funtional habitat group)	Priority	Burbot	Emerald shiner	Gizzard shad	Lake Sturgeon	Lake Trout	Muskellunge	Northern Pike	Rainbow Smelt	Rainbow Trout	Smallmouth Bass	Walleye	Whitefish	Yellow Perch	**Total**
East Basin			529	67%	MED	2	1	1	2	5	3	3	1	8	6	26	5	1	64
	Coastal wetlands		104	46%	LOW						1	1			1			1	4
		generic	28	58%	MED													1	1
		Long point Bay, ON	76	83%	HIGH										1			1	2
		Long point Bay, ON (inner bay)	48	70%	MED						1	1							2
	Nearshore		144	62%	MED	2	1	1	1	1	2	1	1		5	1	5	1	22
		Bar Point	0	0%			1												1
		Buffalo Harbour, NY	54	72%	MED			1	1		1				1				4
		Dunkirk Harbor	7	41%	LOW		1								1		1		3
		Eagle Bay, NY	0	0%				1											1
		generic- <10m	77	83%	HIGH	1	1	1	1	1			1		3	1	5	1	16
		Long point Bay, ON (inner bay)	6	37%	LOW	1	1	1				1	1				1		6
		Long point Bay, ON (outter bay)	0	0%		1					1								2
		Van Buren Bay, NY	0	0%			1	1											2
	Open water- benthic		40	4%		2				4			1					1	8
		generic	40	63%	MED	2				4			1					1	8
	Open water- pelagic		52	8%			1	1		5	3		1	8	1	26	5	1	52
		Cattaraugus Creek, NY - Plume	6	39%	LOW											1			1
		generic	42	66%	MED		1	1		5	3		1	8	1	26	5	1	52
		Grand River, ON - Plume	4	32%	LOW											1	1		2
	Openwater – reef/shoal		129	58%	MED					3						7	1	1	12
		Bournes Beach, NY	0	0%												1			1
		Brocton Shoal, NY	6	37%	LOW					2						1	1		4
		Evans Bar, NY	0	0%												1			1
		generic	57	75%	MED					1						1		1	3
		Lackawanna Shore, NY	12	50%	LOW											1			1
		Port Burwell, ON	2	28%	LOW												1		1
		Shorehaven Shoal, NY	0	0%												1			1
		Tecumseh Reef, ON	24	56%	MED					1									1
		Van Buren Bay, NY	28	59%	MED											1		1	2
	Rivers/ tributaries		60	19%		1		1	1			1	1	3	1	3	1	1	14
		Cattaraugus Creek, NY	10	45%	LOW									2		1			3
		Chautauqua Creek, NY	1	22%										2					2
		generic	16	51%	MED	1									1	1		1	4
		Grand River, ON	30	61%	MED			1	1			1	1	1		1	1	1	8
		New York creeks	0	0%				1											1
		Pennsylvania creeks	0	0%				1											1
Niagara River			79	0%			2		1		1	1	1		1	1		1	9
	Rivers/ tributaries		79	27%	LOW		2		1		1	1	1		1	1		1	9
		Fort Erie, NY (proximity)	7	40%	LOW											1			1
		generic - Niagara River	53	70%	MED		2		1		1	1	1		1			1	8
		Strawberry/ Beaver Islands, NY	20	53%	MED						1								1
Lakewide Total						**5**	**8**	**4**	**7**	**5**	**15**	**17**	**5**	**8**	**21**	**29**	**5**	**10**	**139**

Appendix B: *Top 5 ranked habitat actions within the top 10 Priority Management Areas in Lake Erie*

Priority Management Area (PMA)			Funtional habitat			Top 5 rank habitat actions within each PMA (* indicates tied rankings)				
Rank	**Score**	**Priority**	**Region**	**Type**	**Place**	**1st**	**2nd**	**3rd**	**4th**	**5th**
1	229	VERY HIGH	West Basin	Rivers/ tributaries	Maumee River, OH	Maintain nursery habitat.	Improve watershed management	Protect spawning areas from Ewing to Missionary Islands	Research - resource competition	Research -generic
2	202	VERY HIGH	West Basin	Rivers/ tributaries	Sandusky River, OH	Ballville Dam removal	Improve watershed management	Research - resource competition	Research -generic	Promote SAV growth through nature-based shorelines and
3	197	VERY HIGH	West Basin	Openwater – reef/shoal	Ontario Reef complexes	Nutrient reduction programs to limit P and HAB freq and intensity	Reduce watershed tiling and channelization, more wetlands, more buffer strips	Research - resource competition	Maintain various areas to limit extent of catastrophic storms	Research -generic
4	186	VERY HIGH	West Basin	Openwater – reef/shoal	Ohio Reef complexes	Nutrient reduction programs to limit P and HAB freq and intensity	Reduce watershed tiling and channelization, more wetlands, more buffer strips	Research - resource competition	Maintain various areas to limit extent of catastrophic storms	Research -generic
5	134	VERY HIGH	West Basin	Nearshore	generic- <10m	Nutrient reduction programs to limit P and HAB freq and intensity	Reduce watershed tiling and channelization; more wetlands; more buffer strips	Research -generic	Restore watershed wetlands	Design and install functional fish passage to coastal wetlands
6	123	VERY HIGH	West Basin	Rivers/ tributaries	River Raisin, MI	*Improve in-stream habitat** *Remove dam/barrier**		Research -generic	*Conserve local stocks** *Reconnect floodplain and backwater oxbows**	
7	111	VERY HIGH	Central Basin	Open water-pelagic	generic	Nutrient reduction programs to limit P and HAB freq and intensity	Research - resource competition	Research -generic	Improve watershed management	Research - abundance of forage species
8	111	VERY HIGH	Lake St.Clair	Coastal wetlands	St.Clair River delta	Restore and reconnect historic coastal wetland locations	Promote SAV growth through nature-based shorelines and structures (restoration)	*Research - current and zooplankton patterns** *Restore degraded natural shorelines through removal of Phrag stands**		Maintain shoreline/shallow water SAV (protection)
9	108	VERY HIGH	Central Basin	Nearshore	generic- <10m	Nutrient reduction programs to limit P and HAB freq and intensity	Research -generic	Reduce watershed tiling and channelization; more wetlands;	Promote SAV growth through nature-based shorelines and	Add substrate/structure
10	106	VERY HIGH	West Basin	Rivers/ tributaries	Huron River, MI	*Flat Rock Dam removal** *Improve in-stream habitat**		Research -generic	*Conserve local stocks ** *Reconnect floodplain and backwater oxbows**	

Disclaimer: This table is an overview summary of the output from the PMA exercise by the HTG and is an initial step to guide the development and prioritization of habitat actions to improve the productivity of desired fish species in Lake Erie. These actions have been identified using the best available information including peer-review literature, technical reports and technical experts opinions. The prioritizations presented are the product of the PMA scoring formula and highly influenced by the amount of content provided for a functional habitat. It is important to note that some identified actions may have limited benefits for a single species while other actions benefit multiple species. The PMA scoring process does not implicitly account for other management priorities includes agency specific priorities, multi-species management and leveraging other initiatives. This table is presented only to demonstrate functionality of prioritisation process and does not equate to LEC priority after consideration of the other management priorities.