Great Lakes Coastal Wetland Monitoring Program

Standard Operating Procedure

Fish Sampling and Laboratory Processing

Synopsis: A standardized method for collecting fish community data according to Great Lakes Coastal Wetland Monitoring Program protocols

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Contents:

1.0 PURPOSE

The purpose of this Standard Operating Procedure (SOP) is to provide a standardized method for sampling fish in Great Lakes coastal wetlands according to protocols developed by the Great Lakes Coastal Wetlands Consortium. The methods described in this SOP describe how to sample fish following Great Lakes Coastal Wetland Consortium protocols. Index of Biotic Integrity (IBI) scores can be derived from data obtained using these methods.

2.0 RESPONSIBILITIES

Scientists and field teams sampling wetlands as part of a monitoring program following Great Lakes Coastal Wetland Consortium protocols should ensure that all work performed satisfies the specific tasks and requirements outlined in this SOP and the project's quality assurance project plan (QAPP).

All field and laboratory personnel performing fish sampling or laboratory processing as part of a monitoring program following Great Lakes Coastal Wetland Consortium protocols should follow this SOP and the project QAPP.

3.0 FIELD EQUIPMENT

Fyke nets – a set of both large and small fyke nets is used to sample fish communities. Because three replicate nets are set in each vegetation zone, a minimum of three nets of each size is required. However, six or more nets of each size is recommended. Nets should be adequately marked with contact information and any additional notes required by state, provincial, or institutional authorities.

Fyke nets should conform to these specifications:
Large nets

Lead:

- -25' x 3' (± 1 ft x 3 inches)
- -3/16" mesh (exact match required)
- -weighted line on bottom
- -floats on top
- -loops on top and bottom of each end for poles or similar strategy

Trap:

- -4' x 3' frames (2 frames, size ± 6 inches x 3 inches, approximately 3' apart)
- -3/16" mesh (exact match required)
- -1st hoop approximately 3' from second box
- -hoops approximately 1.5' apart
- -hoops diameter 30" (± 3 inches)
- -5 hoops
- -funnels on 1st and 3rd hoops

-funnel hole inside diameter 6-1/2" (± 1 inch)
-wings 6' long, 3/16" mesh (exact match required on mesh size)

Small nets

Lead

-25' x 1.5' (± 1 ft x 3 inches)
-3/16" mesh (exact match required)
- weighted line on bottom
-floats on top
-loops on top and bottom of each end for poles (or similar strategy)

Trap:

- 3' x 18" (2 frames, size ± 4 inches x 2 inches, approximately 18" apart)
-3/16" mesh (exact match required)
-1st hoop approximately 18" from back box
-hoops approximately 12" apart
-hoop diameter 12" (± 3 inches)
-5 hoops - 2 funnels
-funnels on 1st and 3rd hoops
-funnel hole inside diameter 4" (± 1 inch)
-wings 6' long, 3/16" mesh (exact match required on mesh size)

Steel conduit, t-shape fence posts, or similar material for setting fyke nets – generally fyke nets require 5-7 poles per net for setup.

Post pounder, mini-sledge hammer, or mallet: used to pound fyke net support posts into the substrate.

Net repair kits - Crews should carry repair kits containing netting scraps, various sizes of cable ties, and thread-like fishing line that can be used to sew and repair holes in fyke nets.

Marker buoys or flags – red or orange marker buoys or flags should be attached to nets in locations where there may be boat traffic and when nets are mostly submerged (i.e., difficult to see).

Trays – small trays to hold small fish being counted and measured. Field crews may choose to use the same trays that are used for macroinvertebrate picking.

Pails or coolers – at least 3 pails or 1-2 large coolers for collecting fish as they are poured out of fyke nets. A pail with euthanasia mixture should be kept ready. This pail should be clearly marked and use for this material only. For most US crews, this material will be MS-222.

Small dip nets for scooping fish out of pails – at least 2 aquarium-style nets.

Fish measuring board – small (e.g., 20-cm) and/or large (e.g., 1-m) measuring boards may be used for measuring fish.

Meter sticks – at least 2 meter sticks for measuring fish.

Small rulers – an assortment of small metric rulers should be carried. Plastic or stainless steel rulers work well for measuring small fish.

1-m square quadrat – PVC quadrat for estimating plant coverage.

Rod (approx. 2-cm diameter x 1-2 m) – rod is pushed into the sediment to determine organic/soft sediment depth. Plastic or plastic-coated garden stakes work well.

Sediment coring device – 10-cm deep sediment cores will be collected if sediment %loss on ignition (%LOI) is being determined. This is an optional, though recommended, variable. Coring devices are available for purchase, though a simple coring device can be made by sharpening the end of a piece of plastic pipe. Core diameter does not matter since samples will be homogenized.

Trowel or spoon for mixing sediment – a garden trowel or spoon will be used to homogenize sediment if sediment samples are being collected for %LOI analysis.

Plastic bags for storing sediment – Zip top plastic bags should be used for storing sediment if samples are collected. Alternatively, plastic jars may be used.

Global Positioning System (GPS) – each field crew should carry at least one GPS. Recreational-quality GPS receivers are sufficient. Also carry spare batteries or its charger. Heavily-used GPS's, or those with weak batteries, may require a mid-day recharge. Adapters that connect to 12 v boat batteries are available and may be desired by crews.

Laser range finder – a laser range finder is useful for measuring the distance to shore to estimate site slope, and for estimating the size of large vegetation zones. Spare batteries should also be carried.

Binoculars – for navigation and for evaluating shoreline land use.

Equipment/supply checklist – an equipment checklist should be used before leaving on every field trip, and before leaving the boat launch.

Field data sheets – pre-printed waterproof data sheets for logging field data.

Fish identification books and other materials – multiple sources appropriate for the region being sampled should be carried to aid in fish identification.

Printed site map – pre-printed map and aerial photographs of the site, along with any maps needed for navigating to the boat launch and from the launch to the site. Printing on waterproof paper is recommended.

Field notebooks or spare waterproof paper – waterproof notebooks or spare waterproof paper should be carried by each field crew to note any information not included in field datasheets.

Clipboard with storage compartment – all field sheets should be stored in a closeable clipboard or similar device.

Digital camera – for photo documentation of each site and any anomalies encountered as well as for photographing large fish that will not be preserved in reference collections. Also carry spare batteries or its charger.

Specimen storage containers – for storing fish to identify in the laboratory and for reference specimens. Plastic bottles are recommended unless fish are to be frozen, in which case plastic bags can be used.

Euthanasia chemicals – for euthanizing specimens. For most US crews, MS -222 may be the only material allowed. A solution of 200 mg L^{-1} MS-222 will be mixed in the field when euthanasia is necessary. Clove oil also works for euthanasia. A concentration of 400-600 mg L^{-1} (10x anesthetic dose) may be used if approved by institutional and state/provincial authorities.

10% buffered formalin – for preserving voucher specimens and unidentifiable specimens.

Internal sample labels – pre-cut labels for identifying preserved fish

Cooler with ice – for short-term storage of euthanized fish before preservation in formalin.

Institutional approval – documentation of approval by applicable Institutional Animal Care and Use Committee (IACUC) or Canadian equivalent.

State/provincial permits – All required permits for sampling fish.

Written permission for site access – where applicable.

Personal equipment – field crews will need waders, appropriate outerwear, sunscreen, insect repellent, etc. for working in coastal wetlands. All crew members should have personal floatation devices.

Boat/motor/trailer with all required safety and maintenance supplies and equipment – many sites will require navigation by boat. Spare parts carried by crews should include spark plugs

and appropriate wrenches, a spare tire for the trailer, drain plug, fuel line, sheer pins (if used), and a spare propeller. Each crew should also have a first aid kit.

A copy of this SOP – SOP should be printed on waterproof paper.

4.0 INSTRUMENT CALIBRATIONS AND FIELD PREPARATIONS

See the water quality SOP for water quality instrument calibrations.

GPS units: GPS receivers should be tested prior to and after the field season by taking repeated readings at known localities visible on aerial photographs or USGS benchmark locations. Instructions for this are available on the CWMP website. During the field season, field crews should upload GPS readings regularly to their base GIS lab (in this case, the GIS laboratory at the Natural Resources Research Institute). A subset of GPS points uploaded will be displayed on an aerial photograph for crews to confirm upload success. All tests and results should be logged and the logs archived by field crews and with the QA managers.

Fyke nets: Before and after deployment, all nets should be inspected for holes. Small holes can be repaired using repair kits that should be carried by each crew. Large holes, or more substantial damage, may require the assistance of a net-making company.

5.0 SUPPORT FACILITIES

Support facilities for fish sampling crews are relatively light and include a microscopy laboratory with nearby vent hoods for handling preservative. The laboratory should be equipped with dissecting microscopes that magnify to at least 50x, and appropriate guides for Great Lakes fish (e.g., Bailey *et al.* 2004, Hubbs *et al.* 2004, Corkum 2010).

6.0 BRIEF METHOD SUMMARY

Crews should sample fish from up to three plant zones in each wetland during June through early September, with sampling dates targeting the appropriate phenology for the latitude. Sampling can begin earlier in the season in the most southerly portions of the Great Lakes. Preliminary identification of plant zones can be made from recent aerial photographs of each site (see zone definitions below), with confirmation or re-adjustment made on-site by field crew leaders based on the vegetation actually present at the time of sampling. Fish are sampled using fyke nets set for one net-night (12-24 hours). Fish should be identified to species in the field, if possible, and released alive. Specimens that cannot be readily identified in the field will be taken back to the laboratory for identification. IBI scores can be calculated from the species- level data. Sampling methodology is based on Uzarski et al. (2005) and Cooper et al. (2007).

It is very important that all fields on the field data sheets are completed appropriately. Blank fields cannot be properly interpreted. If data cannot be collected, this should be noted with the

appropriate explanation. Crews should also be aware that there is a large difference between a zero and "no data". For example, a net full of holes will have no fish, but should not be recorded as a zero because it could not have caught fish; a true "zero catch" only occurs when the net could have retained fish but did not. It is especially problematic when no distinction is made between true zeros and no data for water quality parameters because of a problem or just because someone forgot to take the reading.

7.0 SAMPLING PROCEDURES

Sampling dates: Sampling can begin in mid-June in the most southerly regions of the Great Lakes and continue into early September, moving north with the phenology of wetland plant community development.

Crews: In most cases, fish will be sampled during the same sampling trips as macroinvertebrates to maximize efficiency and reduce travel expenses. Therefore, this SOP is redundant with portions of the macroinvertebrate SOP, especially regarding plant zones and net placement. Note that there will be some sites or plant zones within a site that cannot be sampled for fish because of insufficient depth or vegetation density, but that will be sampleable for macroinvertebrates and water quality, as well as the other data categories.

7.1 Sampling Locations

Site selection: Wetlands should be selected *a priori* using the probabilistic site selection methodology outlined by the Great Lakes Coastal Wetland Consortium and the project QAPP.

Launch location: Before leaving the boat launch, create a waypoint and record its number and lat/long for easy return to the launch and to help future crews locate it quickly. Also, go over the pre-launch checklist (back side of site field sheet) to verify that everything is ready for launch.

Site verification: When crews arrive at a site they should quickly determine whether or not the site is sampleable for fish based on the following criteria: safe access for the crew, there is an open connection to the lake or connecting channel, the site still exists as a wetland and has not been destroyed by human disturbance (sites should still be sampled in this case if it is a benchmark site); there is sampleable vegetation at depths between 20 cm and 1 m. If any of these conditions do not exist, then the wetland may not be sampleable for fish. The condition for rejection must be completely explained at the bottom of the site field sheet and documented with photographs. Care should be taken when rejecting due to water depth or vegetation density to ensure that there truly are no areas that can be sampled. Even if a site cannot be sampled for fish, if the site is accessible, the first page of the site field sheet should be completed by the crew.

Site description: Upon arrival at the site, while other personnel are collecting water quality samples, one person should complete the front side of the field form. This describes the site, its surroundings, how it is influenced by the lake, and what human disturbances are potentially affecting the wetland. Site ID comes from the site map and aerial photo provided by the GIS coordination lab. This is VERY important to keep field forms associated with the proper sites and MUST appear on every page of the field sheets. Please also add crew names and identify the crew chief so everyone knows whom to ask if questions arise about a site.

- *Shoreline structure:* estimate the types of shoreline as percents for the site. Should sum to 100%.
- *Nearshore landcover:* estimate landcover that can be seen from your location in the wetland as a percent. Should sum to 100% (note that there is a spot for % that is not visable).
- *Photos:* take photos that illustrate the site and disturbances to it. Pictures of the shoreline can be particularly informative. Record digital photo numbers.
- *Braiding index:* For riverine systems, please select the appropriate braiding index from the list. Choose only one. NOTE: for riverine wetlands, also sketch a cross-section of the wetland and river channel.
- *Hydrologic connection:* choose the description that best fits the wetland. Choose only one.
- *Water level:* select as many from the list as necessary to describe what is influencing the water level of the wetland on the day(s) that you are sampling.
- *Habitat structure:* select all habitats present in the wetland and then choose the most appropriate vegetation zone structure.
- *Disturbances:* circle all disturbances occurring within the site or within 250 m of its boundaries (use binoculars as necessary). Provide additional descriptions as requested on the field form. This information is very useful in interpreting invertebrate IBI scores; please fill it out carefully.
- On the back of the sheet, note *weather conditions* in the appropriate box. Update this as necessary throughout the sampling event.

Zones: Fish sampling is stratified by plant zone. Three replicate fyke nets should be set in up to three monodominant vegetation zones that are of appropriate depth and meet the size requirements (see below). Crews should sample up to three zones meeting the criteria below that are the most dominant in the wetland. *Vegetation zones* are patches of vegetation in which a particular plant type or growth form dominates the plant community based on visual coverage estimates. Coverage of the dominant emergent or floating-leaved form must be 75% or greater to qualify as a monodominant zone. For example, a zone would be considered a *Typha* zone if the emergent+floating leaved vegetation was dominated (>75%) by *Typha* spp., even if submersed plants were found throughout the *Typha* spp. stand. However, if a zone contains a mix of different emergent species/growth forms or a mix of emergent and floating leaved species/growth forms, it should be avoided unless there are no other zones to sample; then it can be sampled as a Mixed Emergent zone. For example, if a stand contains both *Nymphaea* spp. (water lily) and *Schoenoplectus* spp. (bulrush) and neither of these plant types dominates (i.e., neither is >75% of the total emergent+floating leaved community), then the

zone should be avoided, unless it is being sampled as a Mixed Emergent zone. Similarly, if a zone contains a mix of *Schoenoplectus* spp. and *Peltandra virginica* and neither plant type dominates the emergent+floating leaved community, then the area should be avoided, unless it is being sampled as a Mixed Emergent zone. A Mixed Emergent zone can be sampled if it represents a significant and conspicuous habitat type within the wetland and there are not three other monodominant zones to sample. For SAV zones, there must be very little emergent (< 5 stems per m^2) or floating leaved vegetation (< 1 stem per m^2) mixed into the SAV for the zone to qualify as an SAV zone. Note that other species or growth forms will likely occur sporadically within a given vegetation zone; however, the dominant plant type will be conspicuous if it exceeds 75% coverage. Also note that zones are not necessarily a monodominant stand of just one species (e.g., *Typha latifolia*), but instead may be a morphotype (see the list of zones below).

Crews should draw on aerial photos of the site to indicate the location and size of vegetation zones, and to indicate fyke net locations. A laser range finder should be used to determine the approximate size of the zone. At least one measurement should be made along the long axis of the zone and at least one distance should be measured along the short axis of each zone. The location of these measurements should be indicated with lines drawn on the aerial photo along with the distances.

Vegetation zones include (see abbreviations on field data sheet):

- *Typha* (cattail)
- *Lily* (water lilies, combined)
- *Schoenoplectus* (bulrush; if there appear to be stem density differences in thick zones, use the distinctions below)
    - Inner *Schoenoplectus:* relatively-dense inner zones along the shoreline that are protected from wave action by outer zones of vegetation.
    - Outer *Schoenoplectus:* sparse outer zones where stem densities are lower than in inner zones due to wave action.
- *Peltandra-Sagittaria-Pontederia* (arrow-arum-arrowhead-pickerel weed)
- *Sparganium* (bur-reed)
- Wet Meadow (mixed vegetation, typically *Juncus* and *Eleocharis;* if water ≥20 cm)
- *Phragmites*
- Mixed Emergent
- Submersed aquatic vegetation (SAV)
- Wild rice (Zizania)
- Floating bog mat
- Open water (appropriate only for benchmark sites when a wetland has been degraded to the point that vegetation can no longer persist or if an area is being sampled to provide pre-restoration information)
- Potentially other types if encountered (please contact Valerie Brady or Matt Cooper before creating another zone; the number of zone types needs to be limited).

Zone selection and size: Using a recent aerial photograph of the site, field crews should preliminarily identify vegetation zones. Upon arrival at the site, the crew leader should determine what vegetation zones can actually be sampled based on what is present in nearly monodominant stands (SAV and Mixed Emergent zones are an exception) with appropriate water depth of 20 cm to 1 m. This information should be sketched onto the aerial photo, showing how things have changed since the photograph was taken.

Minimum zone size is approximately 400 m^2 so that nets can be separated by at least 20 m. However, in cases where multiple disjointed smaller patches of the same vegetation type exist within a wetland, these smaller patches can each be sampled (1-2 nets each) as long as the combined area exceeds approximately 400 m^2 and no patch is smaller than approximately 100m^2. This strategy will most often be used in riverine wetlands where habitats are heterogeneous and plant patches tend to be small.

Depths: The depth range for fish sampling is 20-100 cm.

Fyke net placement: Three replicate fyke nets are set in each inundated plant zone to provide a measure of variance associated with sampling. Within each plant zone, each of the three replicate nets should be located at least 20 m from any other net to prevent the nets from interfering with one another. Spacing from one net to the next (i.e., between net 1 & 2 or 2 & 3) should not exceed 250 m in cases where the nets are set in the same patch. Note that macroinvertebrate sampling locations are associated with and adjacent to fyke net locations. Water quality is also sampled in each plant zone.

Select the three fyke net locations to represent, to the degree possible, the variability in the plant zone. In large plant zones, the three sampling points should correspond with different shoreline features if they occur and if this can be done under the spacing constraints mentioned above. For example, in a large fringing wetland where the outer *Schoenoplectus* zone extends along the shoreline lakeward of a cottage, a forested area, and a wet meadow, sampling locations will be chosen to correspond with these different features. However, in many cases, a given vegetation zone will not cover enough area to be associated with different shoreline features, in which case sample locations should be chosen to represent, to the degree possible, the variability of the zone itself. GPS waypoints should be created for each fyke net location.

7.2 Sample and Data Collection

Avoiding contamination of water quality samples: Since macroinvertebrates, fish, and water quality will all be sampled in each vegetation zone in very close proximity, field personnel should be very careful not to interfere with one another or compromise the other samples. Every attempt should be made to collect water quality data and water samples first at each location before any movement is made around the point or zone. When traveling to the site by boat, water quality data and water samples should be collected from the boat before anyone

enters the water. After water quality sampling, macroinvertebrate sampling and fish net deployment can commence.

Setting fyke nets: Fish communities are passively sampled by deploying fyke nets overnight at three locations each in up to three monodominant vegetation zones containing water of appropriate depth (20-100 cm). Shallower or deeper water cannot be effectively fished with fyke nets of the dimensions listed in section 3.0. Thus, in complex wetlands, 9 nets will be set.

The small nets should be set in water approximately 20-50 cm deep; larger nets are set in water depths of 50 – 100 cm. The depth of water in each plant zone will dictate net size used since the main difference between large and small nets is height. The critical determinants are that the funnels are underwater and the opening frame is not overtopped.

In dense vegetation or for small vegetation patches, nets should be placed perpendicular to the vegetation zone of interest with leads extending from the center of the mouth of the net into the vegetation. Therefore, fishes in the plant zone are the most likely to be caught. Wings should be set at 45° angles to the lead and connected to the outer opening on each side of the net. If the patch is small, the wings should be set to block fish from outside the target zone from getting into the net. In large plant zones, or less dense zones, nets should be set in the middle of the zone with the lead pointing toward shore. Nets should be set so that the top of the cod end is far enough above the water surface to prevent turtles and other air breathing vertebrates from drowning. Nets should be set for one night (at least 12 hrs) and then checked. Record water depth at first frame (opening of net) where lead meets frame.

Checking nets: Upon return to the nets, crews should first quickly look the net over to confirm that it appears to have remained upright, reasonably intact, and in the same condition as when the crew left. Record water depth in same location as initially measured when net was set. As the net is being pulled, any holes or other damage that might have affected net fishing integrity should be noted on field sheets. If the nets collapsed or had significant holes, crews must evaluate whether or not the zone was effectively “fished” (see *re-sampling* below).

Crews should also be on the lookout for air-breathing vertebrates that have been trapped. These should be either released as quickly as possible, or placed into a cooler or tub to revive, if necessary, before release.

Re-sampling: Fish sampling is considered successful only if at least 2 of the 3 nets in each zone are determined to have “fished” for the night. This means that the nets remained upright without large holes or were otherwise compromised. If 2 of the 3 nets in a plant zone are determined by the field crew leader not to have representatively sampled the plant zone, that zone’s nets should be re-set for a second night. The senior field crew leader and/or the team’s PI should be consulted on this decision. If the fishing integrity of nets is not maintained for at least 2 of the 3 nets for a second night, the team’s PI must be consulted about whether to reset nets or move to the next site. In addition, if less than 10 fish are collected in total from all 3 nets within a plant zone, the nets should be re-set for an additional night.

Fish processing: Fish should be identified to species, counted, measured, and released alive. A minimum of 25 individuals per species and age category (2 categories: young-of-year [YOY] vs. older [i.e., not YOY]) will be measured to the nearest mm (total length [TL]). Fish smaller than 20 mm TL will not be counted or identified because fish this small are not accurately sampled by nets of our mesh size. When individuals are counted, separate tallies should be made for YOY vs. older individuals of each species. Any fish with external deformities (see list on field sheet) should be noted and photographed, if possible. All fish handling should follow university/governing agency wildlife use and care guidelines, and approved project-specific plans should be in place at each institution before sampling begins. Appropriate state and provincial permits should also be obtained before sampling begins.

Fish identification: All crews should have photo keys of Great Lakes fish species, including their key taxonomic characteristics. Such keys have been developed by Uzarski *et al.* (for GLCWC) and Brady *et al.* (for GLEI). If a fish cannot be identified in the field, representative specimens or high-quality digital photographs should be returned to the laboratory for identification, with assistance from experts when necessary.

Euthanasia and preservation: Specimens being retained for a reference collection, ID confirmation in the laboratory (depending on fish size and state, provincial, and federal regulations), or those that have been severely injured during sampling should be humanely euthanized by over-anesthetization, typically with MS-222 mixed in the field to a concentration of 200 mg L^{-1}. Clove oil (400-600 mg L^{-1}) may also be used for fish euthanasia if approved by institutional and governmental agencies. Crews should use the methods approved by their university's IACUC committee or other governing body. The MS-222 (or clove oil) solution should be prepared in a 5 gallon pail, or other suitable, well-labeled container. The container size should be large enough to easily contain the entire fish. After euthanasia, fish should be preserved in 10% buffered formalin in a plastic, water-tight bottle of appropriate size with internal and external water- and preservative-proof labels (site ID, zone, fyke net number, unknown fish ID number, regional team code, and field crew leader name). Whenever unidentified fish specimens are kept, a note should be made on the field data sheets.

After use, the MS-222 solution (or clove oil) should be flushed down the drain to a sanitary sewer with excess water. If in a remote location where a sewer may not be readily available, further dilute the solution with water and dump wastes on land in a location away from water. To dispose of euthanized fish (not preserved in ethanol or formalin), carcasses should be placed in two sealed plastic bags, frozen, and placed in a dumpster on the day of trash pick-up for disposal in a licensed landfill. Note that regulations or policies regarding MS-222 or disposal of fish carcasses may vary by state/province, or institution.

For large specimens (>20 cm TL), or where collection of fish specimens is not allowed, fully-documented digital photographs will be collected instead of specimens. When digital images are used, the species name (if known), site ID, plant zone, net number, date, number of

specimens in the net, regional team code, and crew leader's name will be included in the image. Additional photographs of key features should be taken to aid identification of unknown specimens. Crews may find it advantageous to collect and archive a photograph of each different species encountered at a site.

7.3 Fish Reference Set

Laboratories should maintain a reference set of appropriately-preserved specimens if allowed by state, provincial, or federal regulations. Many regional laboratories already have reference collections of preserved specimens which can be used. However, if species are encountered that are not part of the lab's collection, a voucher specimen should be collected and preserved, if allowed. For larger fish, high quality photographs may serve as "vouchers", providing they are appropriately cataloged.

7.4 Additional Supplementary Data

Additional data to be collected at each replicate net include: latitude/longitude, vegetation percent coverage by growth form, plant zone size, organic sediment depth, mineral substrate texture, distance to depth zero (i.e., "shore"), and supplementary water quality data (if this hasn't already been done by the macroinvertebrate crew; see the water quality SOP for details).

Sampling point locations: All sampling point locations should be recorded and stored using a handheld GPS receiver. In case of GPS equipment failure, the crew should seek to borrow a GPS from another crew to finish the site, if possible, and should seek a replacement GPS unit. In the event that this is not possible, crews should endeavor to very accurately mark each fyke net location on their field map. Macroinvertebrate sampling points may be close enough that separate GPS waypoints are not needed for nets; coordination with the macroinvertebrate crew is recommended.

Distance to depth 0: This is a distance-to-shore measurement to help determine bathymetric slope. Standing at the point at which depth has been recorded for the net, use a laser range finder to estimate the distance to depth 0, where the edge of the water is at the present time. Usually a member of the field crew will need to stand at the water's edge so that the range finder has something to detect.

Vegetation quadrats: A 1-m quadrat is used to determine vegetation percent coverage at fyke net locations. The quadrat is placed at the mid-point of the net lead on the right-hand side when looking away from the net box. A ribbon or similar way of marking the midpoint of each lead is recommended. Make sure to randomly toss the quadrat in an area that has vegetation representative of the zone and that has not been trampled while setting the fyke net or dip net sweeping. Before estimating percent composition, use your hands to move emergent vegetation in and out of the quadrat, as needed, so that the quadrat only contains stems from within the 1 sq m area and not vegetation bent in from the outside.

Vegetation percent composition: Percent composition by growth form and cover type should be estimated visually within the quadrat at both the water surface and sediment surface directly under the quadrat separately. Growth forms and cover types to be estimated at the water surface are emergent, submergent vegetation floating at the surface, floating- leaved vegetation, filamentous algae and open water. At the sediment surface growth forms and cover types to be estimated are standing emergent stems (living or dead), submergent vegetation, coarse detritus, filamentous algae and bare sediment. If species (or genera) within each growth form category are known, they should be noted on the field data sheet. This is especially important for Mixed Emergent zones and extra effort should be made to identify as many genera/species as possible in these mixed zones. Although vegetation overlaps, the percentages should sum to 100%.

Zone/patch size: Crews should estimate the size of zones or the vegetation patches that comprise zones and note these on the fish data sheet. Range finders may be used to assist with this estimation. At least one measurement should be made along the long axis of the zone and at least one distance should be measured along the short axis of each zone. The location of these measurements should be indicated with lines drawn on the aerial photo along with the distances.

Organic substrate depth: Depth of organic substrate should be determined by pushing a 2-cm diameter rod into the substrate until mineral substrates are reached. Placing the finger at this point of the substrate/water interface allows the rod to be withdrawn and the depth measured with a meter stick. Note that this is not refusal depth; we are after the depth of organic matter.

Mineral substrate texture: The dominant and subdominant mineral substrate type should be recorded. Mineral substrate texture is determined by feel using the categories and guidelines on the field data forms. This should be done at each net location.

Sediment samples: Collection of sediment for %loss-on-ignition (%LOI) analysis is optional but highly recommended. A 10-cm deep sediment core should be collected using a piston corer or similar coring device. Core diameter does not matter since samples will be homogenized for %LOI. Sediment samples should be associated with each net location. All samples from a given vegetation zone should be homogenized in a pail or tub (this can be done in the lab if desired). Approximately 100 ml (e.g., one trowel full) should be placed in a sealed container. Samples may be stored in sealed plastic bags or plastic jars and fully labeled. Samples should be stored on ice and then frozen.

Supplementary water quality data should be collected from each vegetation zone at the beginning of each sampling session. See the water quality SOP for detailed instructions.

Pictures: Crews should take digital images of each vegetation zone. Any anomalies encountered or unique anthropogenic impacts should also be photo documented. Digital images should be uploaded to a computer as soon as possible. Photo file names should include, at a minimum, the site ID, date, and vegetation zone. For photos of anomalies or disturbances, a word of description should be included in the file name. Photos should be organized in

directories labeled with site ID and sampling date.

8.0 SAMPLE HANDLING AND CUSTODY

Fish specimens should remain in the custody of field crews for the duration of each field trip. At the laboratory, unidentified fish specimens should be entered into the laboratory log-in sheet, along with the date received and any notes about sample condition, and the information transferred to the sample processing inventory sheet. Specimens may be transferred to 70% ethanol after 2-7 days in 10% buffered formalin. Preserved fish or their photographs (i.e., reference collections) should be stored for up to 5 years after collection in case there are further questions about proper identification.

9.0 EQUIPMENT TESTING, INSPECTION, and MAINTENANCE

Fyke nets will be examined for holes and defects before and after each net set. Crews should carry net repair kits with them and should repair nets in the field whenever possible. Major repairs may require the assistance of a net-making company. Boat repairs are also often necessary. Most towns around the Great Lakes have boat repair shops, which can be used by field crews as necessary. However, crews should carry spare parts such as those listed in the equipment list.

All units that store files electronically should be backed up nightly to a laptop. This includes water quality meters, GPS units, cameras, and any other such equipment. This will help protect against massive data loss should equipment malfunction or be damaged or lost.

To prevent the spread of invasive species, including disease, boats and trailers will be drained and inspected upon haul-out while still at the boat launch. All field gear, boats, and trailers will be drained, power-washed or disinfected, and thoroughly dried before moving between sections of the Great Lakes (e.g., eastern vs. western Lake Erie, northern vs. southern Lake Michigan, etc.), and before moving between the lakes. No water will be transferred from one section of a Great Lake to another section or to an inland lake or water body.

GPS receivers will be tested prior to and after the field season by taking repeated readings at known localities, i.e., benchmarks. All tests and results will be logged and the logs kept with the appropriate GPS units.

10.0 RECORD KEEPING/DATA ENTRY

Each field crew should carry with them maps and aerial photos of the sites to be visited, maps showing locations of the nearest boat launches, field data sheets for each scheduled site as well as spare datasheets, and a field notebook to document any additional information not contained on the field data sheet. Each field data sheet should be initialed by the crew chief once a site is completed, and page 2 of the site-level sheet requires the field crew chief's signature. Sample locations should be noted on the site map in the event that the GPS receiver

is not functional. Additional notes on anomalies or anthropogenic disturbances can also be made on the site map.

Documentation in the laboratory should include sample log-in where unidentifiable specimens as well as voucher specimens to be added to reference collections will be logged. All field data sheets as well as laboratory documentation are considered project records and should be archived for long term storage. A supervising individual should initial each record prior to entering data into the data management system (DMS).

All records should be entered into the DMS as soon as possible. Data collected in the field should be entered into the DMS as soon as possible after returning from each field trip. Fish identifications made in the laboratory should be noted on both the field data sheets as well as on the laboratory sheet and then entered into the DMS. All data should be verified by a second person after it is entered into the DMS. Field notes explaining anomalies, disturbances, etc. should also be entered into the DMS as soon as possible. All hard copy records (field data sheets, field notebooks, site maps with hand-written notes, laboratory notebooks, etc.) should be compiled and stored in a secure location at each laboratory.

11.0 REFERENCES

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12.0 FORMS

12.1 Field data sheet for fish and macroinvertebrates (attached)

12.2 Field supplies/equipment checklist for fish and macroinvertebrate crews (attached)