



Protocols for Sampling Aquatic Macrophytes in Freshwater Wetlands

Adapted from methods developed by the
New Hampshire Department of Environmental Services



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**Bureau Water Quality
Division of Environmental Assessment
Biomonitoring Program**

**Standard Operating Procedures
Protocols for Sampling Aquatic Macrophytes in Freshwater Wetlands**

*Adapted from Methods Developed by the
New Hampshire Department of Environmental Services¹*

- 1. Applicability.** This standard operating procedure (SOP) applies to sampling and surveys of aquatic macrophyte communities from inundated freshwater wetland habitats, including marshes, pools and other depressional wetlands, lacustrine and riverine fringe wetlands, low-gradient river and stream reaches, lakes and ponds. It describes methods for sampling and enumerating abundance of aquatic plant species using a standard rake sweep, and conducting visual plant surveys within a 5-meter radius plot.
- 2. Purpose.** The purpose of this SOP is to provide standardized methods for sampling and surveying aquatic macrophytes to characterize plant community structure in Maine wetlands.
- 3. Definitions.**
 - A. Macrophytes - Aquatic plants growing in or near the water. Macrophytes may be emergent, submergent or floating.
 - B. Emergent species/form - Rooted plants with significant portions extending above the water surface. Examples include Arrowhead (*Sagittaria spp.*), Pickerelweed (*Pontederia cordata*), cattail (*Typha spp.*), purple loosestrife (*Lythrum salicaria*), bulrushes (*Schoenoplectus spp.*), spikerushes (*Eleocharis spp.*), sedges (*Carex spp.*).
 - C. Submergent species/form- Plants that grow primarily under the water surface. Upper leaves may float near the surface and flowers may extend above the surface, although they are mostly rooted to the bottom (although the inflorescence may be above water). Examples include bladderworts (*Utricularia spp.*), waterweeds (*Elodea spp.*) and milfoils (*Myriophyllum spp.*).

¹ NHDES, 2017. Aquatic Macrophyte Sampling Protocol for Wetland Assessment. Watershed Management Bureau. New Hampshire Department of Environmental Services. Concord, NH.



- D. Floating-leaved species/form: Plants that are rooted to the bottom but typically have floating leaves. Examples include water lilies (*Nuphar*, *Nymphaea*), and water shield (*Brasenia schreberi*).
- E. Floating species: Plants that float freely on the surface and are not rooted to the bottom; primarily species in the *Lemnaceae*, (duckweed family), which includes *Lemna*, *Wolffia*, and *Spirodela*.

4. Responsibilities.

- A. The section leader of the Maine DEP Biomonitoring Program in the Division of Environmental Assessment (DEA) has the following responsibilities:
 - (1) Assist in procurement of programmatic funds.
 - (2) Provide technical support related to biological assessment.
 - (3) Participate as a member of a field team as time allows.
- B. The Wetlands Subsection Leader has the following responsibilities:
 - (1) Write proposals and manage grant funds.
 - (2) Manage contracts for seasonal staff.
 - (3) Purchase and maintain supplies and equipment.
 - (4) Update wetland SOPs.
 - (5) Coordinate with other DEP programs and partners during selection of wetland sampling locations and scheduling of field teams.
 - (6) Train and oversee wetland monitoring field teams.
 - (7) Supervise seasonal wetland program staff.
 - (8) Participate as a member of a field team.

5. Guidelines and Procedures.

- A. Sampling Period
 - (1) Sampling and surveys of aquatic macrophyte communities are conducted during the period from June through September. Scientific justification for departing from the normal sampling period must be provided, and interpretation of results must include professional judgement to ensure that seasonal differences are considered.
 - (2) This period was selected to coincide with the portion of the growing season when aquatic macrophyte taxa have developed sufficiently to be identified. For some species, identification to species level is difficult early in the growing season since distinguishing features such as flowers and fruits may not be present. Later in the season, some species may have begun to senesce.



B. Supplies (see supply list, Appendix 1)

C. Selecting Macrophyte Sampling Locations

- (1) Sample and/or survey aquatic macrophytes within the following preferred habitats if present at the site:
 - (a) Areas having emergent, submergent and/or floating-leaved plants and water depth of 1 meter or less. Areas selected should be representative of the overall habitat at the site.
 - (b) Sampling locations may include similar areas within or adjacent to other habitat types, for example pockets of emergent, floating-leaved or submerged vegetation occurring within a scrub-shrub wetland.
- (2) Locations selected for all replicate samples collected at a site should be as similar to each other as possible with regard to water depth (1 meter or less), vegetative community structure and substrate type.
- (3) If aquatic macroinvertebrates are collected on the same date, macrophyte and macroinvertebrate sampling should be performed in close proximity to each other for each of the 3 locations.

D. Recording Site Characterization, Habitat and Land Use Data

- (1) Complete all applicable sections in the header of the of Maine DEP Biological Monitoring Program Wetland Aquatic Vegetation Sampling Form (Sampling Form, see Appendix 2), including Station ID, Date, Crew, Town, and Waterbody Name.
- (2) Identify whether the water level is considered high, medium, or low and circle the appropriate category on the Sampling Form. Water level should be estimated relative to any water marks on rocks, trees, exposed roots, flooded shrubs, etc. and not relative to any seasonal changes. Low water is considered low regardless of whether in June or August.
- (3) Take one to several representative digital photos of the site to be monitored. Record the photo numbers on the Sampling Form.
- (4) Unless previously recorded during macroinvertebrate sampling, record GPS waypoint name and accuracy for the sampling site (not for each macrophyte sampling location). Follow manufacturer's directions in manual for GPS unit used.
- (5) If not previously completed for another type of sampling (i.e. macroinvertebrates and/or algae), complete the Biological Monitoring Wetland Human Disturbance Assessment form (refer to *Protocols for Completing the Biological Monitoring Wetland Human Disturbance Assessment*, DEPLW-1259).

E. Recording Physical/Chemical Measurements in the Field (Refer to *Protocols for Using Dissolved Oxygen and Specific Conductance/pH Meters in Rivers, Streams, and Freshwater Wetlands* (Connors 2019).

- (1) If physical/chemical water quality measurements are taken (temperature, dissolved oxygen, pH, specific conductance) and have not previously been recorded on another



type of sampling form (i.e. for macroinvertebrate sampling), record the measurements in the appropriate space on the Wetland Aquatic Vegetation Sampling Form.

F. Manage all data collected in accordance with the *Protocols for Managing Biomonitoring Data*, DEPLW-1202A-2014.

G. Rake Sampling Procedures

- (1) Sample macrophytes at 3 locations per site. Select macrophyte rake sampling locations using criteria described in Section C above.
- (2) Use the shrub rake to sweep just above the bottom substrate for a one-meter sweep using a continuous motion and lift the shrub rake and any collected vegetation out of the water.
- (3) For each sampling location, record the water depth, substrate type, estimated percent open water and any related observations if appropriate.
- (4) Review the plants retrieved. If no plants were collected by the shrub rake, indicate as such in the appropriate notes section on page 2 of the Sampling Form. It may be helpful to spread plants out on a white plastic bag to group by species and photograph the material retrieved by the single sweep of the shrub rake. If photographs are taken, add a label/sign in the photograph for later reference to associate it with a site and location (e.g. station number / date / Rep 3 retrieved).
- (5) Identify the species of the plants collected with the shrub rake and record each species on the Sampling Form.
- (6) If the genus is known, but species is unknown, add to the genus a number and short description of identifying characteristics (e.g., *Potamogeton* 1 – fine subm. lvs).
- (7) If neither genus nor species name is known, create a descriptive pseudonym reflecting growth habit, microhabitat, or some distinctive morphological feature (e.g., Emergent 1, narrow-lvd, red base).
- (8) Check for any invasive species as well as any rare, threatened or endangered species. Collect a voucher specimen of any potential invasives for confirmation and notify the Maine DEP Invasive Species Program. Consult with the Maine Natural Areas Program in the Department of Agriculture, Conservation and Forestry for information on documenting and collecting rare plants.
- (9) Estimate and record the relative abundance of each species in the “Ab” column under the appropriate replicate number for “retrieved” samples on the Sampling Form (for example, Retrieved - Rep 1) using the following categories (note abbreviation codes in bold):

Dominant > 60% **Common 21-60%** **Sparse 2-20%** **Present < 2%**

Relative abundance estimates are based on the relative quantity of material retrieved on the shrub rake. For example, 100 Lemna minor plants would be assigned a smaller relative abundance category than 2 Nuphar plants and leaves.



- (10) Record the observed growth form for each species in the “Form” column under the appropriate replicate number for “retrieved” samples using the following categories (note abbreviation codes in bold):

F-Free-floating **Floating Leaved** **Submergent** **Emergent.**

- (11) Check for animals collected with the rake’s retrieved material such as freshwater sponges, crustaceans, snails, small fish or other vertebrates. Record any organisms collected in the notes section of the Sampling Form and release them.
- (12) Place any unidentified plants in a plastic zip-lock or Whirl-Pak bag (with water if appropriate), labeled in permanent marker with the wetland station number, date and corresponding pseudonym indicated on the Sampling Form.
- (13) It may be helpful to photograph individual unknown plants and/or groups of plants remaining at the site to document growth habit and features which may deteriorate with sample age (e.g. flower shape and color). If photos are taken of plant taxa, record photo numbers in the space provided on the Sampling Form.
- (14) If the plant identification and abundance estimation process cannot be completed in the field due to weather conditions, time constraints, etc., the retrieved plant material can be placed in opaque plastic bags and transported to the lab or office for processing within 1-2 days. Plant material should be kept in a cooler with ice or refrigerated.

H. Visual Survey Procedures

- (1) Conduct macrophyte visual surveys at 3 locations per site, in the same vicinity and habitat type as macrophyte rake sampling and macroinvertebrate sampling, if performed. Avoid areas that have previously been disturbed by sampling. Select sites for visual surveys based on criteria described in Section C above.
- (2) Record all observed plant taxa within an estimated 5-meter radius plot in the appropriate space on the Sampling Form. Include all plants growing or rooted at or below the normal high water line or bank-full line, even if the substrate is exposed due to low water levels. During high water conditions where water levels may extend beyond normal boundaries, plots may include all inundated areas that meet other site selection criteria.
- (3) Proceed as described in G (6) – (14) above.

I. Decontaminating Sampling Gear

- (1) The DEP DEA uses standardized methods for cleaning and disinfecting all sampling equipment to prevent the spread of invasive species and disease pathogens which threaten amphibians and other wildlife in Maine. These methods are described in *Protocols for Decontaminating Biomonitoring Sampling Equipment*, DEPLW0919A-2014.



6. References

Connors, B., 2019. *Protocols for Decontaminating Biomonitoring Sampling Equipment*. Maine Department of Environmental Protection, Augusta, ME. DEPLW0919A-2014.

Connors, B., 2019. *Protocols for Managing Biomonitoring Data*. Maine Department of Environmental Protection, Portland, ME. DEPLW-1202A-2014.

Connors, B. and J. L. DiFranco, 2019. *Protocols for Completing the Biological Monitoring Wetland Human Disturbance Assessment*. Maine Department of Environmental Protection, Portland, ME. DEP-LW1259.

Connors, B., 2019. *Protocols for Using Dissolved Oxygen and Specific Conductance/pH Meters in Rivers, Streams, and Freshwater Wetlands*. Maine Department of Environmental Protection, Portland, ME. DEPLW0636A-2014.

NHDES, 2017. Aquatic Macrophyte Sampling Protocol for Wetland Assessment. Watershed Management Bureau. New Hampshire Department of Environmental Services. Concord, NH.



Appendix 1: Aquatic Macrophyte Sampling Equipment List

Equipment

- Canoe (with paddles and PFDs) or waders to access sampling locations
- GPS unit to record site location
- Shrub rake with 48" metal handle and 8- inch wide head (at least 11-times wide).
- Clip board and pencils
- Extra blank Rite in the Rain paper for plant labels
- Cooler with ice
- A supply of 13 gallon white opaque plastic trash bags
- A supply of 1-2 gallon self-closing plastic bags (e.g., Ziploc)
- A supply of Whirl-Pak bags
- Wetland Aquatic Vegetation Sampling Forms on Rite in the Rain paper
- Map/imagery of lake/ pond/ wetland (with bathymetry or depth information where available)
- Waterproof camera
- Meter stick or weighted measuring tape
- Polarized sunglasses
- Permanent marker (to label plastic bags)
- List of Rare/Threatened/Endangered species in freshwater aquatic environments (and ID info)
- ID information for invasive plant species (Maine Field Guide to Invasive Aquatic Plants)
- Mylar "bag" (to hold plastic bags and "shade" plants)
- Anchor for canoe (optional)

Lab equipment

- Large white shallow pan or dishpan
- Plant press with blotters and newsprint
- Wax paper (for pressing of thin or fine-leaved aquatic plants).

To keep collected plants cooler on sunny days, make a Mylar emergency blanket into a bag (fold in half and tape the sides and bottom with packing tape). Keep plastic bags of collected specimens in Mylar bag until they can be put in a cooler and taken back to lab for ID/pressing/ processing.



Appendix 2: Maine DEP Biological Monitoring Program Wetland Aquatic Vegetation Sampling Form

Revised 5/13/2019

Station ID:	Date:	Crew:
Town:	Waterbody name:	
Water level: high / med / low	GPS waypoint: _____ Accuracy: _____ m Site photo numbers:	
	Temp: _____ °C D.O. _____ mg/l % D.O. Sat: _____ pH _____ SPC _____ uS/cm	
	D.O. Meter # _____ pH/SPC meter # _____	

Species Name or Pseudonym	Observed - Rep 1		Observed - Rep 2		Observed - Rep 3		Retrieved - Rep 1		Retrieved - Rep 2		Retrieved - Rep 3		Plant Taxa Photo Numbers:
	Depth: (cm)		Depth: (cm)		Depth: (cm)		Depth: (cm)		Depth: (cm)		Depth: (cm)		
	substrate:		substrate:		substrate:		substrate:		substrate:		substrate:		
	% open water:		% open water:		% open water:		% open water:		% open water:		% open water:		
	Form	Ab	Form	Ab	Form	Ab	Form	Ab	Form	Ab	Form	Ab	



Species Name or Pseudonym	Observed - Rep 1		Observed - Rep 2		Observed - Rep 3		Retrieved - Rep 1		Retrieved - Rep 2		Retrieved - Rep 3		Photo numbers:
	Depth: (cm)		Depth: (cm)		Depth: (cm)		Depth: (cm)		Depth: (cm)		Depth: (cm)		
	substrate:		substrate:		substrate:		substrate:		substrate:		substrate:		
	% open water:		% open water:		% open water:		% open water:		% open water:		% open water:		
	Form	Ab	Form	Ab	Form	Ab	Form	Ab	Form	Ab	Form	Ab	

Notes:

General:
Observed Rep 1:
Observed Rep 2:
Observed Rep 3:
Retrieved Rep 1:
Retrieved Rep 2:
Retrieved Rep 3: