

EMERGENT VEGETATION SURVEY PROTOCOL

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Division of Fish and Wildlife
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Monitoring Strategy for Aquatic Vegetation

The following protocol is currently being used by the IDNR Division of Fish and Wildlife to provide a quantitative sampling mechanism for emergent aquatic plant surveying and allow for historic comparison within select areas and at a lake-wide scale. Pearson (2004) provides additional details regarding the protocol and an example of its use to quantify the occurrence and distribution of emergent aquatic plants in northern Indiana lakes. Aquatic vegetation is monitored in an assortment of lakes and reservoirs across the state as part of a variety of projects. The following procedure is applicable for State-sponsored surveys, integrated fisheries management, pre-treatment and post-treatment herbicide application, and possibly for volunteer monitoring. For the purpose of this protocol aquatic emergent vegetation includes floating-leaved plants (water lilies), as well as true emergent species (cattails, pickerelweed). Species that are considered submerged but have floating leaves (floating-leaf pondweed) should not be included in this survey.

Equipment and Software

Equipment needed to complete a survey includes;

- Boat
- Handheld GPS
- Range Finder
- Datasheet
- Compass

Software needed to complete the data analysis and mapping includes;

- Microsoft Excel
- ESRI ArcGIS (or similar mapping software)

Sampling

For state-sponsored projects sampling is typically conducted during the growing season between July 15 and August 31. Begin the sampling effort by recording general waterbody information on the datasheet (Appendix A). All data fields on the datasheet are explained in detail in Appendix B. The sampling operation is composed of multiple steps;

- 1.) Navigate to the nearest bed of emergent vegetation. Surveying should occur in a counter-clockwise direction around the lake. Maneuver the boat so it is positioned along the edge of the bed on the lakeward side.
- 2.) If the bed is larger than 625 sq. ft., record the GPS coordinates and record an “S” in the “S/E/C” column of the datasheet for starting point. If the bed is smaller than 625 sq. ft. continue to step 8.
- 3.) Using a rangefinder, determine the distance from the boat to the landward edge of the bed. If the rangefinder cannot detect the vegetation, use the rangefinder to determine the distance to shore. If the bed does not extend to shore, the width of the bed can then be determined by subtracting the distance to shore by the estimated distance between the landward edge of the bed and shore. Be sure to measure this along a transect that runs perpendicular to shore. Record this distance under the “Width” column of the datasheet.
- 4.) Determine the heading of the transect using a compass. Record the bearing in degrees on the datasheet in the ‘Bearing’ column.
- 5.) Indicate what species are present along this transect. For the species noted on the lakeward edge of the bed and immediately adjacent to the boat, record ‘1’ under the corresponding species column on

the datasheet. For species not located adjacent to the boat but within the emergent bed along the transect, record a ‘9’ under the appropriate species column on the datasheet.

- 6.) Continue to navigate along the lakeward edge of the emergent bed. Record points where the bed changes shape, where bed width drastically increases or decreases, or where species composition changes. Each point should include listing the width, bearing, and species encountered as described in step 2. Once you have reached the end of a bed, record an “E” for end point on the datasheet.
- 7.) For offshore emergent beds greater than 625 sq. ft, record GPS coordinates for points around the entire bed, using ‘S’ and ‘E’ for starting and end points. Similar to methods above, use ‘1’ for the dominant species in the bed and ‘9’ for other occurring species. Bed width and bearing do not need to be recorded.
- 8.) If an emergent vegetation bed is less than 625 sq. ft., record the GPS coordinates and denote “c” for clump on the data sheet. Indicate the dominant species of that clump with a ‘1’ under the appropriate species column. Record a ‘9’ for any other species in the clump if necessary. Bed width and bearing do not need to be recorded.
- 9.) When field identification of a plant is uncertain, or a species is suspected not to be in the state herbarium at Purdue University North Central or another official location, representative specimens of each species should be collected and submitted as voucher specimens as necessary. For those species for which the genus and/or species are unknown, a species code should be assigned. Record the voucher number (“V1”, “V2”, etc) and corresponding species code in the “Comments” section on the datasheet. Complete instructions on assigning species codes for unknown species and collecting voucher specimens is outlined in the next section.

Taxonomy, Species Codes, and Voucher Specimens

Plants should be identified to the species level, or lowest taxonomic level possible, using the following taxonomic keys or similar references: Fassett (1957), Voss (1972, 1985), and Gleason and Cronquist (1991). A list of the emergent aquatic species typically found in Indiana is included in Appendix C. Species codes not available in Appendix C are determined by using the first three letters of the genus name followed by the first three letters of the species name. Note: For those genera that represent nearly indistinguishable species, it is sufficient to simply identify plants to the genus level. Examples of these taxa are listed in Appendix C by the genus name followed by “sp.”.

If the genus of a plant is known and species unknown, make up a new code with the first three letters of the genus name followed by “001” for the first unknown species in the genus. Any subsequent and different unknown species in the same genus should be labeled “002” and so on (for example, “NYM001” for *Nymphaea* sp.). If the genus is unknown, make a unique code (e.g., “UNKN01”, “UNKN02”, etc.) for each unknown taxon. Upon positive identification, uncertain and unknown species codes will be confirmed or replaced with new codes.

Collect voucher specimens for each individual taxon whose identity is in doubt for follow-up verification by external taxonomists, or if a taxon is suspected not to be in the state herbarium at Purdue University-North Central or another official location. Vouchers should include multiple specimens (3 to 5) of the plant, including all available morphological characteristics (leaves, flowers, fruit, roots, tubers, etc.). Specimens should be sealed in an individual ziplock bag and immediately placed on ice in a cooler with a label placed inside the bag that lists the following information: waterbody name, county, date, name of collector, voucher number (eg. V1, V2, and so on) and taxonomic name, if known. Two or more voucher specimens for each unknown taxon should be collected from different points within the lake, if possible. Voucher specimens are directed to the attention of Dr. Robin Scribailo at Purdue University-North Central or other official state herbarium.

Threatened, Endangered, or Suspected New Invasive Species.

Threatened or endangered species (T&E) or suspected new exotic species should be vouchered, recorded on the datasheet, and described on the Indiana Special Plant Survey Form (Appendix A). Records on T&E species should be sent to the IDNR Division of Nature Preserves. **Suspected new exotic species must be reported immediately to the Aquatic Invasive Species Coordinator, IDNR Division of Fish & Wildlife. Using a GPS unit, record the location of the collected species and the approximate extent of the species' distribution.**

Data & Equipment Management

All datasheets are identified with the sampling organization's name and waterbody name. Copies of all data sheets must be available upon request of the LARE program office **within two weeks of completing the survey**. All originals are retained by the sampling organization. In addition to original datasheets, electronic copies of the data in Excel as well ArcGIS may also be required.

To avoid the spread of Aquatic Invasive Species (AIS), survey crews should insure that all traces of aquatic vegetation are removed from boats, motors, and sampling gear before surveying other waterbodies. Even if an exotic species such as Eurasian watermilfoil is known to occur in two bodies of water, care should still be taken not to transfer plant fragments between these waterbodies since herbicide resistant genotypes may be spread to lakes where they did not previously occur. For waterbodies where other aquatic invasive species (e.g., zebra mussels) are known to occur, specific steps should be taken to eliminate the hazard prior to going to another body of water. For zebra mussels, this includes one of the following measures: drying equipment for five days, pressure washing with 104°F water, or chemical disinfection. A list of zebra mussel positive waterbodies can be found at www.invasivespecies.in.gov. For additional information on reducing the spread of AIS contact the DNR AIS Coordinator.

Data Analysis

ArcGIS or similar software should be used to map each bed on the most current aerial imagery available. This same software can be used to calculate the overall coverage of emergent vegetation at the lake as well as the individual acreage of each bed (Appendix D). The editing tool COGO in ArcGIS utilizes the compass bearings and is recommended to help more accurately map the bed. As long as the data is collected in sequence around the lake, bed size can also be calculated manually if desired (Pearson 2004).

In addition to generating maps showing the location, shape, and size of each bed, various summary statistics can be calculated to describe the lake as well as individual bed characteristics. A few of these statistics are listed below, with additional information on summary statistics and analytical procedures available in Pearson (2004).

Species richness: A count of *all* plant species observed during the survey.

Native species richness: A count of *native* plant species observed during the survey.

Maximum number of species per point: The highest number of species observed at any point.

Mean number of species: The average number of all species observed per bed or lake. This is calculated as the number of all species observed at each point summed for all points and divided by the total number of points (i.e., $((\sum s_{i,j})/N)$, where s is the total number of species at each point, summed from points numbered i to j , and N is the total number of points surveyed).

Frequency of occurrence: This parameter measures the proportion of points where each species is present and is calculated as $(s/N)*100$, where s is the number of points where the species is present and N is the total number of points surveyed.

Bed-length : Shoreline-length ratio: This parameter measures the ratio of total emergent bed length to lake shoreline length. This is calculated as $(B/S)*100$, where B is the total length of the lakeward side of all emergent beds and S is the total length of the shoreline excluding channels.

References Cited

Fassett, N.C. 1957. A Manual of Aquatic Plants. University of Wisconsin Press, Madison, Wisconsin.

Gleason, H.A., and A. Cronquist. 1991. Manual of Vascular Plants of Northeastern United States and Canada. Hafner Press, New York.

Pearson, J. 2004. Guidelines for sampling floating-leaf emergent plants in Indiana lakes. Indiana Department of Natural Resources, Division of Fish and Wildlife, Indianapolis, Indiana. 17pp.

Voss, E.G. 1972. Michigan Flora Part I: Gymnosperms and Monocots. Cranbrook Institute of Science, Bloomfield Hills, Michigan.

Voss, E.G. 1985. Michigan Flora Part II: Dicots. Cranbrook Institute of Science, Bloomfield Hills, Michigan.

APPENDIX A

Emergent Aquatic Vegetation Survey Datasheet

Page _____ of _____

Quad Code: _____

Indiana Special Plant Survey Form

Element Name: _____

Surveyor (s): _____ Date: _____ Time: ____ to _____

Contact information (telephone or email): _____

Location: ____ ¼ ____ ¼ ____ ¼ ____ Sec. ____ T ____ R ____ Quad name: _____

Repeat visit: Yes No Repeat visit needed: Yes No When: _____

EO boundaries mapped: Yes No County: _____

Area name (if applicable): _____

Biology

<u>Phenology</u>	<u>Approx # Indiv</u>	<u>Population Area</u>	<u>Age Class</u>
__In leaf	__ 1-10	__ 1 yd ²	__ % Seedlings
__In bud	__ 11-50	__ 1-5 yd ²	__ % Immature
__In flower	__ 51-100	__ 5-10 yd ²	__ % 1 st year
__In fruit	__ 101-1000	__ 10-100 yd ²	__ % Mature
__Seed Dispersing	__ 1001-10,000	__ 100 yd ² -2 ac	__ % Senescent
__Dormant	__ 10,001+	__ 2 ac +	

Comments on above: _____

Compared to your last visit to this site: Approx # Indiv Population Area Age Class

 __more __more __same
 __same __same __diff
 __less __less

Reproduction Is reproduction occurring?__ Type: __sexual, __asexual, __both

Show exact location and boundaries of taxon on map. (attach)

Population Distribution solitary, clumps or dense groups, small patches or cushions
 small colonies or large carpets, large, almost pure population stands.

Vigor: 1) very feeble, 2) feeble, 3) normal, 4) exceptionally vigorous

Evidence of symbiotic or parasitic relationships: _____

Habitat

<u>Aspect</u>	<u>Slope</u>	<u>Light</u>	<u>Topographic Position</u>	<u>Moisture</u>
<input type="checkbox"/> N	<input type="checkbox"/> Flat	<input type="checkbox"/> Open	<input type="checkbox"/> Crest	<input type="checkbox"/> Inundated (Hydric)
<input type="checkbox"/> E	<input type="checkbox"/> 0-10'	<input type="checkbox"/> Filtered	<input type="checkbox"/> Upper slope	<input type="checkbox"/> Saturated (Wet-mesic)
<input type="checkbox"/> S	<input type="checkbox"/> 10-35'	<input type="checkbox"/> Shade	<input type="checkbox"/> Mid-Slope	<input type="checkbox"/> Moist (Mesic)
<input type="checkbox"/> W	<input type="checkbox"/> 35' +		<input type="checkbox"/> Lower slope	<input type="checkbox"/> Dry (Xeric)
	<input type="checkbox"/> Vertical		<input type="checkbox"/> Bottom	

Elevation: _____ ft to _____ ft. Surface Relief: ____/:____ ∪:____ ∩:____ —:____ ~~

Substrate/Soils: _____

Associated Natural Community/Plant Community: _____

List other members of this genus co-occurring at this site:

Characteristic associated species:

Estimated size of potential Habitat: (as in population area) Boundaries mapped: yes no

Ownership info: (if known) _____

NOTE: Collect specimen if a healthy, viable population exists. Collection # _____

APPENDIX B

Explanations of Fields on the Emergent Aquatic Vegetation Survey Datasheet

SITE INFORMATION

Waterbody name:	Common name of the waterbody. Name should be consistent with the name found on the USGS Topographic Map (e.g. Lake Lemon, not Lemon Lake). If not identified by USGS, list all commonly used local names for the waterbody (e.g., Little Maxinkuckee, Lost Lake and Hawk's Lake).
County(s):	Name of the county(s) where sampling was conducted. When the waterbody section traverses more than one county, list the primary county (county with the greatest acreage of water) first.
Surveying Organization:	Name of agency, corporation, group, individual, etc. that is collecting the data.
Crew leader:	The full name to identify the individual responsible for certifying that the samples and the data on the data sheets were collected in compliance with current protocol and are, to the best of their knowledge, complete and free of errors. This identifying field is an important chain-of-custody procedure.
Recorder:	Name to uniquely identify the individual recording the data on the data sheets.
Contact Information:	Means of reaching the surveyor (telephone or email address).
Date:	The month (MM), day (DD), and year (YYYY) on which a site was sampled. Zeros (0) must be written in so that the date has eight digits (MMDDYYYY).
Weather:	Record weather conditions that exist at the time of sampling.
Comments:	A field for recording any additional observations. Voucher codes, with their corresponding species codes, should be recorded here.
Site:	Record the number of the point.
S/E/C:	Record whether the sample point is the starting point "S", ending point "E", or Clump "C".
Latitude:	The latitude coordinate for the point recorded in decimal degrees (e.g., 40.12345). NAD 83 is the preferred datum and all of Indiana is located in zone 16.
Longitude:	The longitude coordinate for the point recorded in decimal degrees (e.g., 85.12345). NAD 83 is the preferred datum and all of Indiana is located in zone 16.
Width:	The measured width (in feet) from the lakeward edge of the bed to the landward edge of the bed or shoreline along a perpendicular transect at the sampling point.

Bearing: The compass bearing (in degrees 0-360) from the lakeward edge of the bed to the shoreline along a perpendicular transect at the sampling point.

Species code: Record encountered species along a perpendicular transect at each sampling point. For each point “1” indicates species located next to the boat (within a 10 foot square) on the lakeward edge of the bed and “9” indicates any other species located in the bed within 10 feet of the transect. For the purpose of this protocol aquatic emergent vegetation includes floating-leaved plants (water lilies), as well as true emergent species (cattails, pickerelweed). Species that are considered submerged but have floating leaves (floating-leaf pondweed) should not be included in this survey.

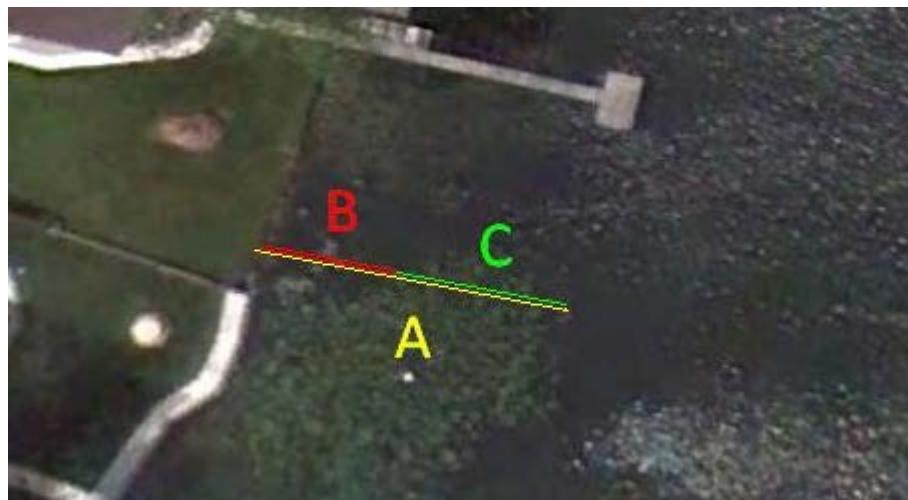
Notes: Note any unusual situations or observations

Other plant species observed at lake:

Additional species observed in the lake while traveling between sampling points are listed at the bottom of the datasheet, using species codes.

BED WIDTH EXAMPLE

The picture below provides an example for how to calculate the bed width when the bed does not extend to shore. A represents the distance from the boat to shore measured using a rangefinder, while B represents the estimated distance from the landward side of the bed to shore. The calculation for determining bed width is $C = A - B$.



APPENDIX C

Aquatic Vegetation Species Codes

Species Code	Scientific Name	Common Name	Vegetation Type
ALISMA	<i>Alisma sp.</i>	a water plantain species	E
BARSCH	<i>Brasenia schreberi</i>	watershield	F
CAREX	<i>Carex sp.</i>	a sedge species	E
CEPOCC	<i>Cephalanthus occidentalis</i>	buttonbush	E
DECVER	<i>Decodon verticillatus</i>	swamp loosestrife	E
ELEOCH	<i>Eleocharis sp.</i>	a spike rush species	E
EQUFLU	<i>Equisetum fluviatile</i>	water horsetail or pipes	E
JUNEFF	<i>Juncus effusus</i>	common rush	E
JUNCUS	<i>Juncus sp.</i>	a rush species	E
JUSAME	<i>Justicia americana</i>	American water willow	E
LYTSAL	LYTHRUM SALICARIA	PURPLE LOOSESTRIFE	E
NELLUT	<i>Nelumbo lutea</i>	American lotus	F
NUPADV	<i>Nuphar advena</i>	spatterdock	F
NUPVAR	<i>Nuphar variegata</i>	yellow water lily or bullhead lily	F
NYMODT	<i>Nymphaea oderata s. tuberosa</i>	white water lily or fragrant water lily	F
PELVIR	<i>Peltandra virginica</i>	arrow arum	E
PHAARU	PHALARIS ARUNDINACEA	REED CANARYGRASS	E
PHRAUS	PHRAGMITES AUSTRALIS	COMMON REED	E
POLYGO	<i>Persicaria amphibia</i>	water smartweed or water knotweed	E
PONCOR	<i>Pontederia cordata</i>	pickerelweed	E
SAGITT	<i>Sagittaria sp.</i>	arrowhead	E
SCIACU	<i>Schoenoplectus acutus</i>	hard-stemmed bulrush	E
SCIRPU	<i>Schoenoplectus sp.</i>	a bulrush species	E
SCIVAL	<i>Schoenoplectus tabernaemontani</i>	soft-stemmed bulrush or great bulrush	E
TYPANG	TYPHA ANGUSTIFOLIA	NARROW-LEAVED CATTAIL	E
TYPLAT	<i>Typha latifolia</i>	broad-leaved cattail	E

TYPLAT	<i>Typha x Glauca</i>	hybrid cattail	E
UNKN01		unknown specimen no. 1	
UNKN02		unknown specimen no. 2	

Note: The scientific and common names of invasive species are shown in ALL CAPITAL LETTERS.

Key to Vegetation Types: F = floating-leaved, rooted vegetation, E = non-floating emergent vegetation

Appendix D

Example of mapped emergent beds and associated square footage of each bed at Round Lake, Indiana.

