The Roles of Aquatic Vegetation and Aquatic Vegetation Survey Methods

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OVERVIEW OF AQUATIC VEGETATION AND THE ROLE FOR LAKE HEALTH

The overall health of any lake is strongly connected to the type and density of aquatic vegetation present in the lake. Aquatic plants (macrophytes) are an essential component in the littoral zones of most lakes in that they serve as habitat and food for macroinvertebrates, contribute oxygen to the surrounding waters through photosynthesis, stabilize bottom sediments (if in the rooted growth form), and contribute to the cycling of nutrients. In addition, decaying aquatic plants contribute organic matter to lake sediments which further supports healthy growth of successive aquatic plant communities that are necessary for a balanced aquatic ecosystem. An overabundance of aquatic vegetation may cause organic matter to accumulate on the lake bottom faster than it can break down.

Aquatic plants generally consist of rooted submersed, free-floating submersed, floating-leaved, and emergent growth forms. The emergent growth form (i.e. cattails) is critical for the diversity of insects onshore and for the health of nearby wetlands. Submersed aquatic plants can be rooted in the lake sediment (i.e. pondweeds), or free-floating in the water column (i.e. coontail). Nonetheless, there is evidence that the diversity of submersed aquatic macrophytes can greatly influence the diversity of macroinvertebrates associated with aquatic plants of different structural morphologies (Parsons and Matthews, 1995). Therefore, it is possible that declines in the biodiversity and abundance of submersed aquatic plant species and associated macroinvertebrates, could negatively impact the fisheries of inland lakes. Alternatively, the overabundance of aquatic vegetation can compromise recreational activities, aesthetics, and property values. Similarly, an overabundance of exotic aquatic plant species can also negatively impact native aquatic plant communities and create an unbalanced aquatic ecosystem.

Native aquatic plants are indigenous to a particular lake and each species has a unique function to perform within that lake. Native aquatic plants assume many different forms from tall growing plants that grow high into water columns to low-growing plants that stay close to the lake bottom. Native aquatic vegetation can grow out of control like exotic plants can, but they do not tend to form dense canopies. Examples of native aquatic plant species include Elodea, White-stem Pondweed, Southern Naiad, and White Waterlilies, among many others.

Exotic aquatic plants (macrophytes) are not native to a particular site, but are introduced by some biotic (living) or abiotic (non-living) vector. Such vectors include the transfer of aquatic plant seeds and fragments by boats and trailers (especially if the lake has public access sites), waterfowl, or by wind dispersal. In addition, exotic species may be introduced into aquatic systems through the release of aquarium or water garden plants into a water body. An aquatic exotic species may have profound impacts on the aquatic ecosystem. Examples of exotic aquatic plant species include Eurasian Watermilfoil, Curly-leaf Pondweed, Starry Stonewort, Purple Loosestrife, and Phragmites to name a few.

AQUATIC VEGETATION SAMPLING METHODS

There are three aquatic vegetation survey methods commonly used to survey aquatic vegetation communities in inland lakes. These methods are useful tools for determining the total cover of both native and invasive aquatic plant species and assist lake managers with treatment protocols and lake communities with monitoring changes in aquatic plant distribution with time.

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THE AQUATIC VEGETATION ASSESSMENT SITE (AVAS) SURVEY METHOD:

The Aquatic Vegetation Assessment Site (AVAS) Survey method was developed by the Michigan Department of Environmental Quality (MDEQ) to assess the presence and percent cumulative cover of submersed, floating-leaved, and emergent aquatic vegetation within and around the littoral zones of Michigan lakes. With this survey method, the littoral zone areas of the lakes are divided into lakeshore sections approximately 100 - 300 feet in length. Each AVAS segment is sampled using visual observation, dependent on water clarity, and weighted rake tows to verify species identification. The species of aquatic macrophytes present and density of each macrophyte are recorded onto an MDEQ AVAS data sheet. Each separate plant species found in each AVAS segment is recorded along with an estimate of each plant density. Each macrophyte species corresponds to an assigned number designated by the MDEQ. The MDEQ has designated density codes for the aquatic vegetation surveys, where a = found (occupying < 2% of the surface area of the lake), b = sparse (occupying 2-20% of the surface area of the lake), c = common, (occupying 21-60% of the surface area of the lake), and d = dense (occupying > 60% of the surface area of the lake). In addition to the particular species observed (via assigned numbers), density information above is used to estimate the percent cumulative coverage of each species within the AVAS site. If shallow areas are present in the open waters of the lakes, then individual AVAS segments are usually sampled at those locations to assess the macrophyte communities in offshore locations. This is particularly important since exotics often expand in shallow island areas located offshore in many lakes.

The MDEQ AVAS survey of a lake will result in a table showing the relative abundance of each aquatic plant species found and a resultant calculation showing the frequency of each plant, and cumulative cover. A map showing the locations of each species is also provided and is used to generate the tabular data.

THE GPS POINT-INTERCEPT GRID SURVEY METHOD

While the MDEQ AVAS protocol considers sampling vegetation using visual observations in areas around the littoral zone, the Point-Intercept Grid Survey method is meant to assess vegetation throughout the entire surface area of a lake (Madsen et al. 1994; 1996). This method involves conducting measurements at Global Positioning Systems (GPS)-defined locations that have been pre-selected on the computer to avoid sampling bias. Furthermore, the GPS points are equally spaced on a map. The points should be placed together as closely and feasibly as possible to obtain adequate information of the aquatic vegetation communities throughout the entire lake. At each GPS grid point location, two rake tosses are conducted and the aquatic vegetation species and abundance are recorded. In between the GPS points, any additional species and their relative abundance may also recorded using visual techniques. This is especially important to add to the GPS Point-Intercept survey method, since Eurasian Watermilfoil and other invasive aquatic plants may be present between GPS points but not necessarily at the pre-selected GPS points. Once the aquatic vegetation communities throughout the lake have been recorded using the GPS points, the data can be placed into a Geographic Information System (GIS) software package to create maps showing the distribution of a particular species. The GPS Point-Intercept method is particularly useful for monitoring aquatic vegetation communities through time and for identification of nuisance species that could potentially spread to other previously uninhabited areas of the lake. A large number of grid points (Figure 1) is recommended for a water body to dramatically increase the sample size necessary to reduce variability among lake sampling sites and to yield an accurate estimate of cover by invasive aquatic plants.

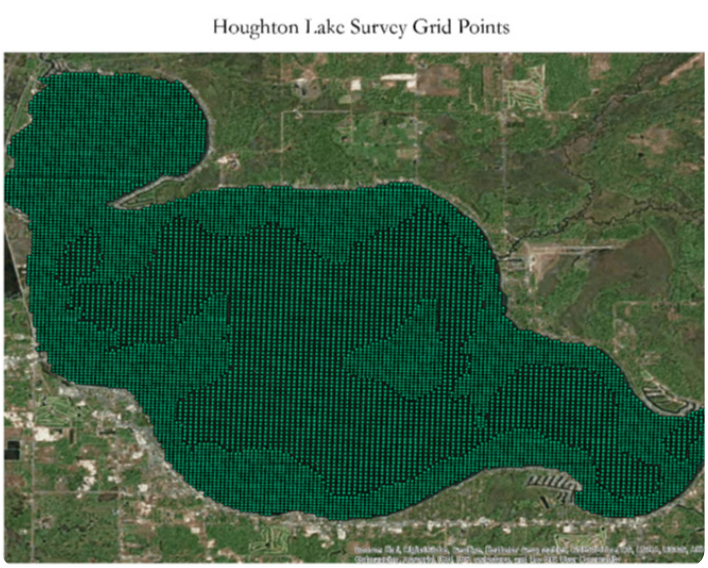

Figure 1.
Aquatic vegetation sampling point locations in Houghton Lake (June 22-July 1, 2016). Note: The closely-spaced points represent shallow areas and the more distant-spaced points represent the deep water sampling locations.

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THE GPS BENTHIC SCANNING METHOD:

While the MDEQ AVAS protocol considers sampling aquatic vegetation using visual observations in areas around the littoral zone, the GPS Benthic Scanning Survey method is meant to assess aquatic plant biovolume throughout the entire surface area of a lake. This method involves conducting a scan of the entire bottom of a particular lake. Once the aquatic vegetation communities throughout the lake have been recorded using the GPS Lowrance® HDS 8 or 9 unit, the data can be uploaded into a Geographic Information System (GIS) software package (BioBase®) to create maps showing the aquatic vegetation biovolume and bottom hardness and depth contours. The GPS Benthic Scanning method is particularly useful for monitoring aquatic vegetation communities through time and for determining the possible impacts of various aquatic vegetation treatment methods on overall aquatic plant biovolume. The benthic scan will result in a whole-lake aquatic vegetation biovolume map (Figure 2).

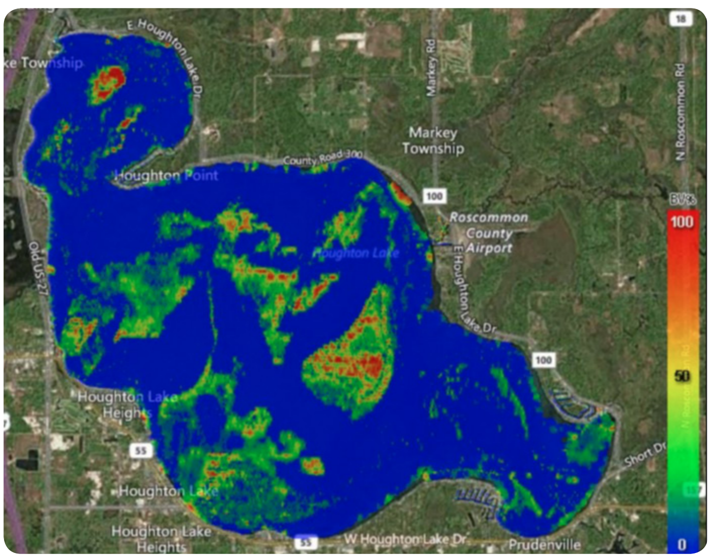

Figure 2.
Aquatic vegetation biovolume scan map of Houghton Lake (June-July, 2016). Note: The blue color represents areas that are not covered with aquatic vegetation. The green color represents low-growing aquatic vegetation and the red colors represent high-growing aquatic vegetation. This scan does not differentiate between invasive and native aquatic vegetation biovolume which is why the GPS-point intercept survey is also executed in concert with the whole-lake scan.

CONCLUDING REMARKS:

Many large lakes may require a combination of the aforementioned aquatic vegetation survey methods. All of the methods are useful for determining the scope of invasive aquatic vegetation but each has additional attributes that allow for more precise determination of aquatic plant locations and cover. All of the survey methods may be used as tools for evaluating the baseline and post-treatment conditions of aquatic vegetation communities prior to and after improvement methods have been executed. The GPS Point-Intercept surveys can be easily conducted along with the benthic scans and this allows for precise determination of the size and shape of individual weed beds.

Literature Cited:

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