Better-Informed
Invasive and Native Macrophyte Management

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Using information from the past, present, and potential future to guide management decisions

Introduction

Many lake managers know all too well that the opinions of a lake community towards aquatic plants, invasive or not, tend to vary widely. While anglers may prefer dense beds of macrophytes in their lake to provide cover for the fish they target, these same dense growths can be a massive source of frustration to boaters. Many lake-users also loathe touching "seaweed" when swimming off their dock, and some may prefer to see no aquatic plants in their lake whatsoever. Lake managers of course know that in most, if not all cases, a lake owner's desire for a crystal-clear lake with zero algae, zero plants, and huge fish is usually not the most feasible goal, especially in eutrophic waterbodies like those present in parts of the northeast. If the nutrients are present, something or other will try to use them, and in the absence of vascular plants, algae and potentially cyanobacteria will usually become the dominant primary producers. What, then, should be done about large, legitimately problematic growths of invasive plants that impede the use of a lake and threaten native species (Figure 1)? The solution, of course, will be different for every lake, and lake managers pull from a wide range of management methods to handle different situations.

Figure 1. Dense beds of brittle naiad (Najas minor) *dominates shallow areas in a New York Lake.*

Many of the lake management programs in the northeast are beginning to strive to emphasize the importance of acting proactively in order to address growth of harmful algae blooms. While reactive management, such as the chemical treatment of a cyanobacteria bloom, is necessary at times, there have been efforts to encourage the development of long-term plans that work to identify the conditions that allow blooms to occur and to act prior to the start of a bloom. It stands that management of invasive aquatic macrophytes can be approached in a similar manner. The more information that is available about a lake's vegetation community and current management activities, the more well-informed a long-term management plan can be created. Relevant information includes not only current, modern-day conditions, but also historical data. Furthermore, a long-term management plan can help prepare for several years in the future by drawing from known conditions in the lake and surrounding area and by fostering an increased interest in the lake community.

Drawing from the past

I have received the comment from lake users before: "My family has been on this lake for 40+ years and we have never seen this plant in here before." This brings about several questions. Whether an invasive plant or a native one, was it introduced to the lake recently, or was/has it been present for some time and gone

unnoticed? If it was introduced, by what pathways might it have entered the lake? If the species is suspected to have been present for many years, when does it begin to occur in historical records? What conditions might now be present that allow the plant to grow to more noticeable densities?

Whether assessing the macrophyte community as a whole or combatting one or two invasive plants specifically, the assessment of historical data can provide a surprising amount of information and potentially shed light on some of these questions, as well as others.

Lakes that have many years of documented assessments performed by limnologists will strongly benefit here, especially regarding more recent history. In such instances, lake scientists may create a long-term database of measurements and observations collected each season. These can be used to explore trends in water quality, plant observations, weather conditions, and other parameters, providing a sense as to what baseline conditions may be and allowing managers to assess the effects of extreme events.

While intensive macrophyte surveys may not always be performed on an annual basis, compiling and comparing the results of each survey can allow managers to create the timeline of an invasion and apparent impacts on native plants or correlate changes in macrophyte density with weather, water quality measurements, or other factors. As an example, invasive macrophyte species such as curlyleaf pondweed (*Potamogeton crispus*), water chestnut (*Trapa natans*), or hydrilla (*Hydrilla verticillata*) largely reproduce from seeds or over-wintering vegetative structures (turions or tubers, Figure 2). Do the historical data suggest that the invasive is relatively new, and that the seedbank can be largely diminished after a few years of aggressive treatment? Or has the species existed in the lake for a decade or more and produced a large propagule-bank? The latter may call for a different long-term management plan than the former.

Even if formal assessments of a lake's plant community are not regularly conducted on a lake, historical information may still be obtainable, at times from surprising sources. Simple plant observation data, when compiled, can display interesting trends in a lake's

Figure 2. Invasive Hydrilla verticillata *tubers and turions collected as part of a management program in central New Jersey.*

macrophyte community. Observation records can be particularly useful in obtaining an estimation for when approximately an invasive species has entered the lake. The United States Geological Survey's Nonindigenous Aquatic Species (NAS) database maintains observational records of aquatic invasive plants, providing historical data for their invasion in the United States.

Another form of observational macrophyte data that is particularly useful for this is herbarium records. Herbaria are repositories of pressed plant specimens collected by botanists and often stored in controlled conditions by universities or other institutions, some of which can be as much as a century old. Scans and records of these specimens are often available online, including databases containing herbarium records from multiple institutions.

It should be noted that the availability of historical plant records will vary largely between waterbodies. Small private lake communities that have typically only stayed within one or two families or reservoirs that have only recently been impounded are less likely to have available data. Furthermore, historical data should be checked for identification accuracy as best as feasible. This is where herbarium records are helpful, in that the plant itself can be examined and the identification double-checked. Last, both the names of waterbodies and scientific names of macrophytes are subject to change over time or may be referred to under multiple different names, depending on the source.

Assessing and addressing the present

While historical information can tell a lake manager and the lake community a lot about what has grown in the lake in the past, many members of a lake community will likely be more interested in knowing what is growing in the lake right now and what needs to be done about it. In order to make well-informed management decisions, a survey of a lake's macrophytes should be conducted, especially if one has never been conducted in the past or has not been conducted in several years.

In the northeast, lakes that receive herbicidal treatments or other forms of macrophyte management usually receive some form of macrophyte survey. This may be as simple as conducting a visual survey from a boat or can involve a more intensive survey that explores the entirety of the littoral zone (Figure 3). While they are often more expensive and labor-intensive, a full-scale macrophyte survey performed by professional lake scientists will often provide the lake community with the most detailed information, including all plant species present, where in the lake each species is located, and the approximate densities at which they are growing, among other things. Madsen and Wersal (2017) detail several methodologies for aquatic macrophyte surveys; the method best used for a particular lake may depend on factors such as the size of the littoral zone, the species present, overall budget, and goals of the lake community. The professional lake scientist can recommend a plant survey methodology best suited for the lake community's needs.

In some lakes I work with in the northeast, macrophyte surveys are performed more than once over the course of the season. This regime can provide

Figure 3. Aquatic macrophytes sampled as part of a rake-toss survey in an Adirondack Park Lake.

lake managers with information pertaining to how the macrophyte community behaves over the course of a year and can be used to track the effectiveness of current management implementations. Often, surveys that occur more than once a year do not employ as rigorous a methodology as an intensive full lake macrophyte survey might but are focused on specific areas or concern or the detection of problematic species.

While a professional lake management service can't necessarily be at a single lake every single week, members of the lake community can be. In monitoring a lake's aquatic plants, the lake user community can often bring attention to concerns that may not be otherwise identified in as timely a manner. Observations from lake users can't fully replace a thorough survey conducted by professionals, but lake users can identify the beginnings of a problematic growth or the presence of a previously undetected invasive species, alerting managers to potential areas of concern. As the identification of aquatic plants can sometimes be difficult, lake users should collect samples and/or good photographs in order to confirm the species of the problematic plant with their lake manager.

Observations by lake users can be critical when it comes to invasives such as water chestnut, which can be easy controlled by hand-pulling if addressed early enough in the invasion. A lake management service can assist a lake community in developing a volunteer monitoring program for this purpose that involves the mapping of plants located and tracking the number of plants pulled each year.

As mentioned briefly already, reactive management – addressing the problem when it occurs – is certainly not always ideal when compared to a long-term plan, but nonetheless it is sometimes necessary. It is an unfortunate fact that, in most cases, once an invasive species is starting to cause problems to the average lake user, it is likely past the point of simple eradication, and focus must at this point instead be placed on limiting the spread of the species within the lake or on maintaining areas suitable for boating or swimming (Harvey and Mazzotti 2014). In many cases in the northeast, this typically involves the seasonal application of herbicides, although some lake communities may opt for mechanical harvesting (Figure 4), diver-assisted suction harvesting (DASH), the use of triploid grass carp (*Ctenopharyngodon idella*), or other proven methods. Each methodology has its strengths and weaknesses, and each lake may benefit most from a different management method. As a long-term macrophyte management plan is developed, the use of these and other methodologies can be more strategically conducted or changed if necessary.

Figure 4. Dense invasive water chestnut (Trapa natans) *plants are mechanically removed from a pond in the New York metropolitan area.*

Preparing for the future

While lake managers find themselves busy with the management of invasive and nuisance plant populations currently present in a lake, it pays to also be aware of potential new invaders and the pathways by which they may enter the waterbody. In many cases, the simplest and most cost-effective form of invasive species management is the prevention of these species entering the lake at all. Many programs, such as those used by the Adirondack Watershed Institute, check boats entering and leaving a lake to prevent movement of invasives between waterbodies (Kelting et al. 2021). Some private lake communities may take this a step further and only allow the launching of boats that are strictly used only in their respective lake, and only after a thorough cleaning protocol.

As invasive species may enter a lake through pathways other than boaters, a lake community may benefit from also learning about newer invasive species that may be occurring in their area. How are these species known to spread? Do the water quality, chemical, and physical aspects of the lake put it at greater risk for the establishment of species that do enter? Attention should be paid to other waterbodies in the lake's watershed, as plants from these locations may spread downstream to the lake in question. Keeping open lines of communication with neighboring lake communities can strongly assist with the tracking of new potential invasives.

Waterbodies downstream of the lake may also be considered, especially if they are known to harbor a new invasive species not yet present in the lake. Are boats often used in this downstream waterbody before entering the lake being managed? Is there the potential for waterfowl and other animals to spread the invasive species upstream? While some of these pathways are not easily prevented, identifying them may allow a lake community to prepare for a potential introduction.

As previously mentioned, lake users in the community can assist with the potential identification and potential removal of a new invasive. This requires, however, that the lake user community be interested and informed as to what species are presently in their lake and what invasives to look out for. Realistically, not everyone will inherently take interest in the macrophytes growing within their lake, but fostering an interest in the lake's macrophyte populations and other ecological aspects in the lake user community can lead to an overall better community stewardship of the lake. This can be accomplished through educational programs such as plant identification workshops or the encouragement of lake owners to submit observations of life found in their lake.

The wildlife identification smartphone app iNaturalist has seen some popularity among professional and novice ecologists alike and may provide functionality to lake managers looking to encourage interest in the lake community towards the macrophytes and other organisms living in their lake. Projects can be created via the app to log submissions of specific taxa or from a specified area, and community members and managers can assist each other in species identification. These projects can also be used by a professional lake manager to keep an eye on what species lake owners are seeing, allowing for further rapid identification of species of concern.

I've heard it said before around the lake management circle – a lake is not a swimming pool; it is more like a garden. A lake community that understands this may be better prepared to deal with a new invasive or nuisance densities of already established plants. While the "swimming pool" mentality may suggest that aquatic macrophytes should be completely eradicated from one's lake, the "garden" mentality may foster a management style that encourages the growth of a healthy, diverse population of macrophytes that serve ecological functions while not rendering the lake unusable to community members. By viewing a lake's macrophytes from an ecological perspective, lake communities may make better informed decisions in the management and curation of their "garden".

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