

North Lake

Dexter and Lyndon Townships, Washtenaw County
Michigan

Management Opinion

2008

Executive Summary:

- ~ Milfoil, curly leaf pondweed, weedy hybrid pondweed, and starry stonewort are expected to grow to nuisance levels in 2009 in different parts of the lake. Aggressive, but selective control is recommended all of these plants. The slow response of milfoil to treatment with 2,4-D suggests that care must be taken to insure the proper level of suppression is attained in 2009.
- ~ Some discrete control of near-shore, native plants may be required to improve swimming and boat access near some residences.
- ~ Starry stonewort may eliminate the need for herbicide use in some areas in the future, even though it had little impact on milfoil in 2008. The total area where algaecide applications will be necessary for the suppression of starry stonewort could be significant in 2009.
- ~ Conditions need to be monitored to evaluate the outcome of future treatment programs, increasing impact of starry stonewort, and the probably proliferation of harmful algae.
- ~ The lake must be monitored to detect the invasion of several submersed plant species that have recently been found in nearby lakes. These species include, cylindro (blue green algae), hydrilla, invasive pondweed, and red ludwigia.

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Purpose of Inquiry:

To evaluate status of the submersed flora of North Lake and update lake management plan.

Introduction:

North Lake is located in Dexter and Lyndon Townships, Washtenaw County, Michigan. The submersed vegetation community was briefly surveyed by Washtenaw County and Aquest Corporation personnel, several times during 2008 as part of an ongoing review of conditions that can be used to update the lake improvement and management plan. These data and observations are critical to provide direction for the implementation of lake management plans and as a means of assessing the efficacy of lake management programs.

Administrative and Management Authority:

North Lake is managed under the authority of the Washtenaw County Board of Public Works which has established a special assessment district to fund improvements to the lake.

Morphometric Data:

Lake Size:	246 acres
Maximum Depth	58 feet
Mean Depth	~ 10 feet
Nuisance Vegetation Management Area	~ 65 to 75 acres

note: These data were approximated from a Institute for Fisheries Research/MI DNR map which was downloaded from the MI DNR website. This are only approximations.

Management Objectives Overview:

Lakes are complex. Aquatic ecosystems are comprised of number of independent but related systems similar to systems found in people or any other organisms. When considering human health we may focus on cardiac health (circulatory system), bone strength (skeletal system), or nervous or motor disorders (nervous system) and the impact of diet, environment, and genetics on all of those systems. Similarly some of the lake systems that must be considered in a lake management plan include the open water (limnetic) and near shore or bottom associated (littoral and pelagial, respectively) systems. Usually, nuisance conditions develop more rapidly when ecosystem disturbance(s) reaches a level that internal mechanisms in a lake are altered to make it easier for opportunistic or nuisance species to become established and flourish. Ecosystem functions are compromised by a wide range of conditions which are referred to as natural and cultural (man-made) disturbances. Common sources of cultural disturbance include shoreline development, recreation, changes in water levels, sediment loading, and essential plant nutrient equilibria, the introduction of invasive species.

Some of the more common biological problems found in Michigan Lakes include poor water clarity, blue green algae blooms, excessive rooted and vascular plant growth, invasive macroalgae (plant-like algae) growth, nuisance mats of filamentous algae, declining fisheries, and nuisance fish and wildlife. It is good practice to identify the root cause of lake problems, in order to implement the best known remedies. However, causative agents can be difficult to identify and sometimes nearly impossible to correct. Consequently, lake management usually involves the implementation of strategies or technologies that help to mitigate against the impacts of pollution, invasive species introductions, and restore the stability and integrity of aquatic ecosystems.

When aquatic vegetation grows at nuisance levels, it is usually necessary to apply remedies to treat the symptoms of the problem rather than the source of the problem (see adjacent text box). Lake management plans are used to guide the decision making required to create a prescriptive course of action to remedy obvious problems or their symptoms and to recommend activities that will help to protect, preserve, or improve the resource. This must be done within the context of all available technology, current regulatory considerations, the sociological disposition of the shoreline community, and available financial resources. Fortunately, there are a variety of things that can be done to enhance and protect lakes. There are no simple cures for many lake problem but there are things that can be done year after year to improve conditions and remediate some of the consequences of ecosystem disturbance.

Disturbed lake ecosystems are typically characterized by low species diversity and habitat complexity. They are commonly described as not meeting the expectations of lake user groups from an aesthetic, utilitarian, or recreational perspective. For this reason, management plans must be multi-faceted and directed toward mitigating against disturbance while causing as little additional disturbance as possible. Compared to the wide variety methods, tools, and strategies used in terrestrial vegetation management practice and agriculture, there are relatively few aquatic plant management tools and strategies. There is no way to manipulate the aquatic environment to provide and sustain the wide range of conditions that are possible in terrestrial systems. Lakes that are geographically predisposed to a certain condition and must necessarily be managed within that context. It is not possible to sustain the conditions found in some relatively unproductive (clear, few weeds) upper great lakes regions lakes in most of the lakes in Michigan. Swimming pool conditions can be created but not sustained. Therefore, the North Lake Management plan is intended to foster the growth of plants that posses characteristics that are consistent with the expectations of lake users. This discourse forms the basis for the North Lake Improvement Plan.

Aquest Tip:

Aquatic Plant Myths and Misinformation

Rooted Plants and Phosphorus

Aquatic plants continue to be the source and subject of misunderstanding and misinformation. During the late 1960's, scientists identified phosphorus, a plant fertilizer and frequent pollutant, to be one of the principal reasons for declining water quality in lakes, reservoirs, rivers, and ponds. It was determined and has been confirmed repeatedly that phosphorus can stimulate suspended algae growth and lead to nuisance algae blooms which can make water resources look like "pea soup". Unfortunately, technical bulletins and scores of publications glibly state that phosphorus pollution can lead to nuisance plant growth too. Actually the converse can be true. The total area covered by nuisance plant growth is frequently limited by available light and the depth of the water resources. If phosphorus levels are not high enough to support nuisance suspended algae production, then the water will be clearer, there will be greater light penetration, and rooted aquatic plants can grow to greater depths. Rooted plants may become an even greater problem where they are already growing at nuisance levels. What about phosphorus and the potential to stimulate greater rooted plant growth? Rooted aquatic plants use their roots to extract phosphorus from the sediments. Most sediments contain more than enough phosphorus to support luxuriant aquatic plant growth. Other factors seem to be more important in limiting rooted plant growth, such as wind fetch and water flow, substrate type, nitrogen and light availability. The key here is that watershed management that focuses on phosphorus loading limits may help to reduce the intensity of algae blooms but may actually worsen rooted plant problems by improving the clarity of the water.

General Goals of the Lake Management Plan

1. Preserve or enhance ecosystem stability by protecting species and habitat diversity, This is accomplished with the application of targeted, selective management of nuisance opportunistic plant species such as watermilfoil, curly leaf pondweed, weedy hybrid pondweed and starry stonewort.
2. Monitor the resource to evaluate the effectiveness or outcome of any applied management efforts and to identify any species that might invade and proliferate and diminish biological and habitat diversity of the lake.
3. Enhance recreational options through the discrete and localized control of nuisance plants near critical use areas only. This will not include the maintenance of localized and specific problems that may exist in the water immediately adjacent to a very limited number of home sites. A balance shall be established between the maintenance of ecosystem stability and recreational use demands.

Aquest Tip:

Choosing the Right Tool

The growth of nuisance native species can be controlled by chemical, biological, or mechanical strategies. Once a lake has been invaded by an invasive aquatic plant or alga species, control efforts must be applied to that lake every year or the invasive species will return and over-take the lake again. It is absolutely critical that the proper strategy or range of management tools be applied to a given nuisance condition in a lake. Failure to apply the proper tool or to do nothing at all will result in further degradation of aquatic resources.

Aquatic herbicides algaecide can be applied to provide selective control of many, but not all nuisance plant and algae species in Michigan. Selective control is key for the improvement of plant community biodiversity and habitat complexity. Aquatic herbicides only provide relief or control of nuisance plant species for 6 weeks to 2 years, depending on the herbicide and the target species. The recent emergence of herbicide tolerant plant genotypes make it necessary to use different herbicides and combinations of herbicides to maintain the effectiveness of these management tools.

Mechanical harvesting is used to alleviate nuisance conditions but can create selective pressures that favor the growth and domination many of the most weedy and opportunistic plant species and depress the production of more desirable plants if it is improperly applied to a set of conditions. Like any management tool, harvesting can cause serious ecosystem damage if it is not used properly.

Currently, there are no independently proven biocontrol methods that can be used to protect or improve submersed aquatic plant community biodiversity. The milfoil weevil has not been proven to be an effective agent for attaining sustainable lake management goals by independent sources.

Fundamental Considerations of the Management Plan

North Lake is a 246 acre lake, located in Dexter and Lyndon Townships, Washtenaw County, Michigan. It is a kettle lake with a maximum depth of 58 ft. and a mean depth of 10 ft that is oriented in a west to east plane. There are no major inlets. The outlet is on the southwest side of the lake. Nearly all of the area in the lake that is less than 5' deep appears to be suitable for the support of luxuriant plant growth and much of the area that is from 5' to 10' also appears to be capable of supporting rooted plant growth. There is a MI DNR public launch site on the eastern shore.

The organic content and fertility of the sediments in North Lake appear to be variable and range from very low fertility in some areas to highly enriched organic substrates in others. Nearly the entire bottom of the lake appears to be capable of the support of vegetation except for some shallow or sandy wave swept areas that are scattered around the lake. Contrary to popular opinion, research clearly demonstrates that the highly organic or mucky areas of lakes are not particularly favorable for submersed rooted aquatic plant growth. These areas are commonly dominated by floating leaf or aerial leaf species such as water lilies and wetland plants. Only the most opportunistic rooted plant species seem to be able able to colonize these areas and many of these plants are considered to be weedy and undesirable. Plants that have no roots such as coontail, bladderwort, filamentous and charoid algae can sometimes grow to nuisance levels over muck sediments. The combination of opportunistic plant species and nuisance algae growth in areas dominated by organic sediments can cause these areas of lakes to be considered as unsightly or undesirable. Consequently, these areas may require more management effort and expense to be maintained as acceptable levels. North Lake contains several species that are capable of nuisance growth over all types of sediments, including muck sediments. The most important plants in this group are Eurasian or hybrid watermilfoil, curly leaf pondweed, and starry stonewort.

Cultural Use Considerations:

North Lake is classified as a "multi-use" or "multi-sports" lake. It is used for boating, power boating, skiing, swimming, fishing, wild life production, and lawn irrigation. Consequently, it is critical to manage the vegetation community to accommodate the requirements of a wide range of uses. Tall plants are needed to provide refuge and nursery for the fishery and create edge effect to improving fishing. Low growing plants should cover the bottom of the lake where boating and swimming occur.

Watershed Considerations:

Most of the North Lake shoreline has been developed for residential uses and most of the residences on North Lake appear to be "year round" or "four season" dwellings. The Detroit Board of Education Maintains a camp on the north shore and the shorelines in that area are still in a natural state. Wetlands and wetland vegetation are located found in shallow areas around the southern and western shorelines of the lake. The North Lake watershed is characterized by mixed uses which includes agriculture, forested areas, some residential, and the afore mentioned wetland complexes. Waterside landscapes should be managed to minimize disturbance of the lake ecosystem.

Biological Survey Overview:

Milfoil: The exotic plant species, watermilfoil has been recognized as a problem in North Lake for at least 20 years. Studies, recently completed by University of Michigan - Flint and Aquest Corp. researchers have demonstrated that the exotic Eurasian watermilfoil and native northern watermilfoil have crossed and have produced a variety of hybrid genotypes. The milfoil hybrids possess varying degrees of characteristics inherited from the parental genotypes. There are also several Eurasian watermilfoil genotypes in Michigan lakes. The different milfoil genotypes appear to exhibit varying degrees of tolerance to common control strategies. The dominant milfoil genotype in North Lake is not known but it does appear that it could be one of the hybrid genotypes. It is impossible to make a definitive determination without genetic analysis. According to reports, milfoil was a significant nuisance in more areas of the lake in 2008 than what was observed in 2007. Starry stonewort is a superior competitor to milfoil, but did not seem to impede the spread or production of milfoil in 2008.

Curly Leaf Pondweed: Curly leaf pondweed is another exotic invasive plant species, like milfoil. It is widespread and creates significant problems in many Michigan lakes prior to the Fourth of July holiday. It has all the same abilities to diminish plant community biodiversity and destabilize ecosystems as does milfoil. It is, however, among the easiest plants to suppress being sensitive to a broad range of aquatic herbicides. It should be easy to manage this plant in North Lake if it becomes a problem.

Starry Stonewort: Dr. Doug Pullman, Aquest Corporation was the first to identify starry stonewort in a Michigan inland lake in the early spring of 2006. Since that time it has been found in numerous lakes from Ludington to lakes throughout SE Michigan. This plant is actually an alga species that strongly resembles native Michigan charoid species. It appears that starry stonewort is more aggressive than any other plant currently found in Michigan lakes. Starry stonewort is a charoid species that is nearly impossible to distinguish from other native or endemic Michigan chara species during normal vegetation surveys. Endemic chara rarely grows taller than 6" but starry stonewort has been observed to grow 7' tall. Starry stonewort can crowd out even the most aggressive and opportunistic species such as milfoil and curly leaf pondweed. Once introduced into a lake, it can seriously diminish plant community biodiversity. It has also been found to blanket fish spawning areas and for this reason (and others) is currently believed to be a significant threat to the fisheries of inland Michigan Lakes. Fortunately, it is fairly easy and relatively inexpensive to control.

It was identified in North Lake in 2008. It was observed growing at nuisance levels, combined with the native alga, chara, in the north end of the lake near some of the inhabited shorelines. The area was treated with algaecides and the outcome of treatment was considered to be effective. The hot 2008 summer months appeared to suppress the growth and spread of starry stonewort in many Michigan lakes and this seemed to occur in North Lake. Starry stonewort appears to prefer colder water and did not recover significantly from the hot summer months until late October. A large patch of starry stonewort was found in the east end of the lake in October, but the overall impact of starry stonewort on the North Lake submersed flora was less than expected in 2008. It will certainly become a nuisance in 2009.

Pondweeds: Native broadleaf pondweed species have also been recognized to be problematic by some North Lake residents. Nuisance plant growth of this type is generally subjected to discrete, contact herbicide, controls that are restricted to those areas where the pondweeds directly interfere with swimming and boat dock access. In contrast to the management of milfoil and other opportunistic species, mechanical harvesting can be used for native pondweed control without creating worse problems. It is important to remember that starry stonewort is likely to crowd out most native plant species, including the pondweeds. Any problems that may have occurred as a result of pondweed production is likely to diminish in the coming years as starry stonewort spreads and dominates North Lake.

Unfortunately, a emerging broad leaf pondweed genotype was observed in North Lake in 2008. This plant is nearly as aggressive and invasive as milfoil and is referred to as weedy hybrid pondweed. It is easier to manage than most pondweeds; however, it is currently protected by MI DEQ policy. The spread and functional characteristics of this plant must be monitored to create a case for management if an expanded control area is necessary to protect plant biodiversity and recreation.

Management Program Guidelines and Specifications:

The North Lake higher plant community is threatened. Milfoil and starry stonewort are present in North lake and will have a profound impact on lake ecology, recreation, and lake management and improvement budgets. Weedy hybrid pondweed is also present and it could also create an unstable situation. Ecosystem stability will be compromised by the uncontrolled spread of these species; however, some recreational values may be temporarily enhanced by the spread of starry stonewort. Starry stonewort has been observed to make areas of some lakes more accessible to boating. On the other hand, the fishery may decline as a result of the spread and proliferation of starry stonewort. Current MI DEQ policies prohibit the effective management of starry stonewort for the protection of fisheries. The fishery will decline as a result of excessive plant cover. Plant community monitoring is strongly indicated for 2009.

According to reports, the milfoil in North Lake is unusually tolerant of the aquatic herbicides that have been and that will continue to be used to suppress its production. The herbicide 2,4-D has been used in the lake since the early 1990's and it should be expected that more herbicide tolerant populations would emerge and come to dominate the flora. The milfoil population that was treated in the 2008 herbicide application showed strong indications of a low dose response. Much of the treated milfoil did not drop from the water column until the first week in July and much did not decline until after the Fourth of July Holiday. This was fully 2 weeks later than would normally be expected. The slow decline of the milfoil was very characteristic of a low dose response to 2,4-D. Herbicide tolerant milfoil populations in other lakes in Michigan demonstrated a similar and equally slow response. Fortunately, conditions in 2008 appeared to favor season-long suppression of milfoil, even after an obvious low-dose response. North Lake and others with similar milfoil populations remained free of the plant for the remainder of the growing season. The tolerance factors appear to be more strategic than systemic. In other words, tolerance seems to be mediated by a synergy between the milfoil population and the muco-organo-complex and associated microflora that coat the outside of an aquatic plant. The degree of tolerance is governed by the state of that particular dynamic microbial community at the time of the herbicide application. In contrast, systemic tolerance appears to be related to internal, or physiological mechanisms in the plant itself, that render it more tolerant to a particular herbicide. In North Lake, strategic tolerance appears to be dependent on the environment or biofilms that cover a plant and appears to protect the plant from not just 2,4-D, but most aquatic herbicides. For 2 of the last three years, Michigan lakes that contained strategically tolerant milfoil populations have produced poor or less than expected outcomes from herbicide applications. Slow die back, rapid weed recovery, and mats of sickened vegetation that have not fully dropped from the water column and that have suppressed the growth of desirable plants are all characteristics that were observed in these lakes. Recreation conditions have been improved, but have not been improved to the level that had been achieved previously - before the strategically tolerant milfoil populations had emerged. The first herbicide tolerant populations were observed years ago and operational testing has revealed that strategically tolerant milfoil is slow to decline in lakes unless special steps are taken to insure that the expected results or outcomes are achieved. Ideally, the milfoil should drop completely from the water column in 2 weeks or less and milfoil should not return to highly conspicuous levels before Labor Day. Combinations of algaecides and herbicides can be applied to strategically herbicide tolerant milfoil populations to enhance the activity of the control agents and hasten the response of the treated plants. These combinations of herbicides and algaecides are strongly recommended for use in North Lake in 2009 to increase the likelihood of acceptable outcome.

The recommended lake improvement program is intended to preserve key ecosystem functions that are necessary to support positive ecosystem attributes. Native, invasive plant controls may be needed in the short term, but should still be strictly limited to only those areas where it is absolutely necessary. Milfoil, curly leaf pondweed and starry stonewort all need to be aggressively managed as soon as possible. Starry stonewort management strategies are still in development; however, action needs to be taken to protect the lake and fishery

Management Recommendations

Management Objectives:

The introduction and evolution of invasive plant and animal species in Michigan's inland lakes coupled with the emergence in increasingly disturbance tolerant "native" or hybrid genotypes represents a significant threat to the stability and integrity of inland lake ecosystems. Consequently, the principal management objective of the North Lake vegetation management plan should be to suppress the production of invasive submersed plant species to the greatest degree possible.

The management of Eurasian watermilfoil and curly leaf pondweed can be accomplished by the application species selective aquatic herbicides, and create little further disturbance of the ecosystem. An algaecide known as Cutrine Ultra has been found to be an effective tool to mitigate against the protective functions provided the microflora in strategically tolerant milfoil populations. This must be used with 2,4-D applications in 2009 to lessen the chances of failure.

Although the management of native plant species (broad leaf pondweeds and thin leaf pondweeds) is not a primary objective of the lake management plan some of these plant species were observed to grow at a nuisance level in North Lake. It is anticipated that a discrete shoreline submersed vegetation management program will be necessary in some areas to alleviate nuisance conditions.

Chara production was very evident in North Lake in 2008 and should be encouraged and supported to cover as much of the bottom of lake as possible. However, the management of starry stonewort will be required to protect chara populations and other species. Best management practices have not yet been determined for starry stonewort. Some trial and error management strategy development will be required to effectively manage starry stonewort in North Lake. The management plan for starry stonewort must be created within the context of proximity to other plants which are known to be a part of the submersed flora of North Lake.

Water lily and spatterdock are common in North Lake. They do not appear to constitute a significant nuisance accept in most of the lake at this time. The MI DEQ will not permit the use of herbicides in some of the areas where the water lilies may be considered to be a significant nuisance. Mechanical harvesting is not regulated by the MI DEQ and can be used to clear lanes through the water lilies in some parts of the lake.

Action Plan:

The application of contact herbicides and algaecides is recommended for the control of nuisance plant growth in North Lake in 2009 because they are able to provide reasonably selective control of nuisance species. Unlike other lake vegetation management strategies, herbicides and algaecides can be used to target nuisance plants and protect desirable species. Unfortunately, the Michigan DEQ places restrictions on the use of aquatic herbicides and in turn have created a barrier to the use and implementation of strategies that would have the greatest benefit for North Lake. These restrictions will limit the the total area where controls can be implemented.

A combination of 2,4-D and Cutrine Ultra should be applied to milfoil populations in the deep water and contact herbicide/algaecides should be applied to nearshore nuisance plant populations as soon as the plant growth and water temperature permit the application of these agents. Starry stonewort should also be treated at the same time. An initial herbicide/algaecide application, made in the early summer, should provide acceptable control of nuisance species through the Fourth of July Holiday or beyond. A midsummer contact herbicide application may be required to manage nuisance native pondweed production milfoil and starry stonewort. One or possibly two algaecide applications may be necessary for the control of nuisance algae and starry stonewort. Lake resident participation in this part of the management program is essential.

Further Reading

Aquest Corporation strives to create concise reports that are not bloated with “filler”. Consequently, we have developed a number of narratives that help to understand some of the concepts and ideas used to develop the lake management plan. These are provided as “Aquest Tips” and are offered to assist the reader if they wish to gain a deeper understanding of the fundamentals of the management plan.. Some are included in the report and identified in text boxes. Others are attached to the management plan update for those who wish to read and consider their content.

Aquest TIP:

Blue Green Algae Part 1:

Why All the Concern?

Blue green algae blooms are becoming increasingly common in Michigan. Blooms can appear as though green latex paint has been spilled on the water, or resemble an oil slick in enclosed bays or along leeward shores. Blue green algae blooms are usually temporal events and may disappear as rapidly as they appear. Blue green algae blooms are becoming more common for a variety of reasons; however, the spread and impact of the zebra mussels has been closely associated with blooms of blue green algae according to MSU researchers.

Blue green algae really a form of bacteria known as the cyanobacteria. They are becoming an important issue for lake managers, riparian property owners and lake users because studies have revealed that substances made and released into the water by some of these nuisance algae (cyanobacteria) can be toxic or carcinogenic. They are known to have negative impacts on aquatic ecosystems can potentially poison and sicken pets, livestock, and wildlife. Blue green algae and can have both direct and indirect negative impacts on fisheries. Persons can be exposed to the phytotoxins by ingestion or dermal absorption (through the skin). They can also be exposed to toxins by inhalation of aerosols created by overhead irrigation, strong winds, and boating activity. Studies are in progress to determine how serious the potential risks are to lake users and those exposed to blue green algae tainted water by other means.

An invasive, exotic blue green alga has recently been found in Michigan. *Cylindro* is also capable of producing phytotoxins and has been implicated in some public health incidents in Florida. Work groups in Indiana and Wisconsin have not reported similar incidents in their respective states. Unfortunately *cylindro* blooms are not obvious and the water must be sampled and analyzed to detect their presence.

It is estimated that approximately one half of obvious blue green algae blooms contain phytotoxins. Water resource managers and users are urged to not panic, but remain pre-cautious. Until studies are completed, it is recommended that persons not swim in waters where blue green algae blooms are conspicuously present. Specifically persons should avoid contact with water where blooms appear as though green latex paint has been spilled on the water, or where the water in enclosed bays appears to be covered by an “oil slick”. Pets should be prevented from drinking from tainted water. Because the blue green algae toxins can enter the human body through the lungs as aerosols it is suggested that water where there are obvious blue green algae blooms not be used for irrigation of areas where persons may be exposed to the irrigation water. Blue green algae blooms are usually temporal events and may disappear as rapidly as they appear, so it is important to closely monitor lakes that contain occasional or persistent blue green algae blooms.

Fortunately, blue green algae can be easily controlled by a variety of methods. There is increasing evidence that the blue green algae can be targeted specifically with certain algaecides. These strategies could help lake managers to selectively manage and improve suspended algae communities. The MI DEQ does not permit these treatments, so lake users are advised to use caution when entering blue green tainted water.

Aquest TIP:

Blue Green Algae Part 2:

Why Do Blue Greens Become a Problem:

Blue Green Algae are probably not very good competitors with other, more desirable forms of algae. They typically bloom and become a nuisance when resources are limiting or when biotic conditions reach certain extremes. Some of the reasons that blue green algae can bloom and become noxious are listed below:

1. TP and TN

The total phosphorus (TP) concentration in a water resource is usually positively correlated with the production of suspended algae (but not rooted plants, i.e. seaweed). Very small amounts of phosphorus may result in large algae blooms. If the ratio of total nitrogen (TN) to total phosphorus is low (<20), suspended algae production may become nitrogen limited and noxious blue green algae may dominate a system because they are able to "fix" their own nitrogen from atmospheric sources. Other common and desirable algae are not able to do this.

2. Free Carbon Dioxide

All plants, including algae, use carbon dioxide in photosynthesis. Alkalinity, pH, temperature, and the availability of free carbon dioxide are all closely related and inter-regulated in what can be referred to as a lake water buffering system. Concentrations of these key water constituents will shift to keep pH relatively constant. Carbon dioxide is not very soluble (think about the bubbles of carbon dioxide that escape soda pop). The availability of this essential substance can be in short supply in lake water. Many blue green algae contain gas "bubble" that allow them to float upward in the water column toward the water surface where they can access carbon dioxide from the atmosphere. Consequently, blue green algae that can float have a competitive advantage in lakes where carbon dioxide is in low supply in the water. This is also why blooms form near the surface of the water.

3. Biotic Factors

Zebra mussels and zooplankton (microscopic, free-floating, animals) are filter feeding organisms that strain algae and other substances out of the lake water for food. They already know about the blue green algae and find them unpalatable. Studies have shown that filter feeding organisms often reject blue green algae and feed selectively on the good algae. Over time, and given enough filter feeding organisms, a lake will experience a net loss in "good" algae and a gain in "bad" blue green algae as the "good" algae are consumed and the "bad" algae are rejected and "spit" back into the water. This is one of the most disturbing factors association with the invasion and proliferation of the zebra mussel. Lakes that are full of zebra mussel may not support the production of "good" algae and experience a partial collapse of the system of "good" algae that are necessary to support the fishery.

Aquest Tip:

Rationale for Managing Aquatic Vegetation

Lake leaders and managers cringe when they hear someone say that “the lake has never been this bad before”. Often the comment is made without accurate recollection of recent lake conditions; however, there is truth in the statement when lakes are considered within the context of the past several decades. When aquatic vegetation cover and biomass become sufficiently high to disrupt the natural balance of a lake and interfere with recreation people begin to seek solutions to the problems. Aquatic weeds are usually referred to as being a nuisance or invasive. The list of nuisance and invasive plants has grown much longer in the past three decades as weedy species have invaded North America from other continents and other species have become more problematic as they respond to human activity and the introduction of foreign species. Excessive aquatic plant growth interferes with nearly all forms of recreation and causes many biological problems. For example, dense plant growth at the water surface impedes exchange of gases between the air and water, thereby contributing to nighttime dissolved oxygen depletion and large daily pH fluctuations. Dense invasive species growth can cause the desirable plants to decline and can destroy the quality of spawning habitats. Production of desirable sport fish (e.g., largemouth bass) is maximized at intermediate levels of plant cover and biomass. Boaters and swimmer are usually satisfied with the conditions that support a good fishery. It is fortunate that there a number of things that can be done to improve or renovate aquatic plant communities to enhance recreation, improve fishery habitats, and make lakes more resilient to the invasion of new or emerging weeds.

The list of invasive plant species that create problems in Michigan lakes is expanding rapidly. Invasive species are often exotic, which are plants that do not naturally occur in the same geographical area but invade lakes after being introduced from other parts of the world. Invasive plants do not necessarily have to be exotic. Native species or hybrids can emerge as invasive plant genotypes that dominate parts of a lake in response to the selective pressures placed on aquatic vegetation communities as a result of human activity and invasion of other invasive species. Exotic and invasive plant genotypes typically form dense mono-specific (single species) plant beds that result in a loss of plant community diversity, habitat complexity, ecosystem stability, and resilience. Lake quality is seriously degraded unless interventions are applied and the offensive plant species are suppressed. It is not possible to reduce the total amount of aquatic plant biomass that is produced in a lake. And, it may not even be desirable to do that. Generally the problem is not really too much plant growth, but too much of the wrong kind of plant growth.

At moderate density levels, aquatic plants provide important benefits to the lake, including sediment stabilization, invertebrate habitat and cover for small fish. Thus, management of problem aquatic plant growth should be carried in such a way as to preserve desirable aquatic vegetation or preferred plant species. Most preferred species are characteristic of stable, undisturbed ecosystems and are not usually considered to be a nuisance. Effective aquatic plant management can preserve beneficial aquatic vegetation in a number of ways. Selective techniques control problem species with minimal effect on desirable ones. Desirable vegetation can also be preserved by limiting the application of control techniques to areas where they are needed. In general, areas in every lake should be set aside to support different types of plants. For example some of these areas may support plants that may interfere with boating, but create good “edge effect” for anglers. There are lower growing plant species that should be maintained in areas of the lake where boating is really important. Because invasive species fail to recognize the boundaries of the lake management plan proper vegetation management is a “whole lake proposition”. It is certain that a lakes in Michigan will never have “been so bad” unless responsible lake communities take action to mitigate against the consequences of ecosystem disturbance and target invasive species for suppressive management activity.