Massachusetts Congress of Lake and Pond Associations, Inc.
www.macolap.org
Summer 2008
Water Wisdom

Toxic Cyanobacterial Blooms

By Ken Wagner, , Ph.D., CLM, ENSR Corporation and Past President of the North American Lake Management Society (NALMS)

Toxin-producing cyanobacteria (commonly referred to as blue-green algae) are a critical and increasingly common issue for lake managers. Cyanotoxins can cause illness and death of humans and domestic and wild animals. Animals exposed to potent toxic cyanobacterial blooms can die within minutes following exposure. Children are at greater risk because of their small body size, and the way they play in the water (often ingesting water or playing with scums). Also, immuno-compromised individuals are at greater risk as well. While exposure from improperly treated drinking water represents some threat, it is recreational exposure that probably represents the greatest risk for most people in Massachusetts.

The environmental factors responsible for the formation of cyanobacterial blooms and toxicity are diverse, and bloom dynamics are complicated. Cyanobacterial blooms can be episodic or persist year-round, and often, but not always, occur in highly productive (eutrophic or hypereutrophic)


Blue-green surface scum
Photo by K. Frey

Continued on page 4

President's Message

Summer 2008

By Al Collings, MA COLAP President

Dear members and friends of MA COLAP, welcome to the MA COLAP Water Wisdom newsletter. As part of the reenergizing of MA COLAP, we are reinstituting this publication to provide lake and pond associations a source of information on issues of importance to all of you. Thanks to Frank Lyons for undertaking the coordinator's role to get this letter completed. We would appreciate your comments and suggestions.

Communication is our product. Managing communications for MA COLAP is a board of directors consisting of four officers and six at-large members. Each member association has one vote and is responsible for

Continued on page 6

Lake-Level Drawdown

as a Management Tool for Aquatic Plants

By Lee Lyman, Lycott Environmental Inc.

Aquatic biologists and limnologists have used lake-level drawdown or water-level manipulation for many years to aid in the management of aquatic plants in water bodies. Most of the literature published on this management technique indicates that many aquatic plants can be reduced by desiccation and/or freezing.

CONSIDERATIONS

1. An understanding of the hydrology budget for the water body.
2. The outlet structure needs to be evaluated.
3. It is important to know the bathymetry of the water body to determine the amount of sediment, or littoral zone that will be exposed during the drawdown.

Continued on page 2

Officers & Directors

List of Articles

Lake-Level Drawdown

Continued from page 1

4. Consideration of the adverse effect on private and public water supplies.
5. Clarification of ownership is necessary.
6. Proper management of the project. Weather conditions play an important role.
7. The potential lack a substantial gradient or drop in elevation between the outlet of the water body and an area downstream.
8. Proper evaluation of the Aquatic Plant Species and an understanding of which plants are not effectively managed with drawdown.

METHODOLOGY

With thirty years of experience, Lycott has developed specific methodology for the successful implementation of lake-level drawdown in most water bodies. It is recommended that the water level be drawn down during the middle of September, and no later than early October at a rate of approximately one-to-two inches per day. The lowered water level should be maintained during November and December until there is a prolonged period (5 - 7 days) of temperatures below 15° F, or the hydrology budget and weather conditions dictate refilling.

CONCERNS

Prior to instituting lake-level drawdown various items need to be considered.

1. Downstream impacts as a result of the water level manipulation.
2. Impact to bordering vegetated wetlands. Experience indicates that the plants in the wetlands are dormant during the fall and early winter and they are not adversely impacted.
3. Impact to fisheries. Many published articles indicate that there are no adverse impacts to most fisheries as a result of lake-level drawdown and they may even benefit from it.
4. Unsafe ice. However, access to the ice from the shoreline is not adversely impacted any more than it would be if the water body was not drawn down.

POTENTIAL NEGATIVE IMPACT

1. Loss of well water.
2. Loss of recreational activities. Fishing, water skiing, and boating may be hampered.
3. Aesthetic appearance. During drawdown, the shoreline is exposed and the appearance of the water body is aesthetically displeasing.
4. Effects on benthic organisms.
5. Doughnut Effect. Any aquatic plants growing below the ice level after the water body is lowered will not be affected.
6. Odors. The exposed sediments can, and usually do, give off faint odors of methane gas and hydrogen sulfide.
7. Disruption of moorings. After the outlet structure is closed and the ice pack expands and rises, it causes the movement of boulders, moorings and docks.
8. Floating islands. These can occur as the result of a successful drawdown and refilling program, which can dislodge stumps and areas

Continued on page 3

Lake-Level Drawdown

Continued from page 2

where lily pad rhizomes are prevalent.

BENEFICIAL EFFECTS

1. Many of the invasive aquatic plants in New England can be managed with lake-level drawdown.
2. When the water is removed from the water body, large concentrations of phosphorus and nutrients that would otherwise be available for additional plant growth the following year will be flushed out of the water body.
3. Due to the exposure to various weather conditions during the fall and early winter, the sediments will be scoured moving small soil particles, laden with nutrients, to deeper portions of the water body.
4. Solar flection takes place during drawdown. After several drawdowns have been undertaken, the organically rich sediment may be converted to a gravel-type sediment.
5. During the winter months the ice pack on the water body expands and cracks during freezing. This reduces the ability of the aquatic plants to become re-established the following spring.
6. While the water body is in a drawn down condition, the exposed sediments can be examined for springs, seeps and/or leachates.
7. Many residents look forward to the fall drawdown so that they can manually rake and clean up their shoreline. It also provides an opportunity to repair walls and/or other shoreline structures.
8. During the initial year of drawdown, when the water body is refilled organic sediments will not return to their original condition and the depth of the water over the sediments will be increased by several inches.
9. For aquatic plant species resistant to freezing, the key to effectively reducing/managing the invasive plant growth is allowing the exposed sediments to form a two-to-three inch frost layer and the water level should then be quickly refilled to prohibit the plants ability to become re-established the following year.

PERMITTING

Prior to instituting the management program it may be necessary to acquire a permit from local and state authorities. Since the permitting requirements vary from one state to another, it is prudent to contact the state environmental agency to determine if, and what permit(s) will need to be required.

***Please note**

This article has been condensed. Please contact Lycott Environmental, Inc. to obtain the complete article and additional valuable information: Ph: 508-765-0101, e-mail: lycottinc@aol.com, website: www.lycott.com.

A Pond Group Contributes

to the Success of Significant New Wastewater Treatment Technology

By Frank Lyons, HBPA President

The Hop Brook Protection Association (HBPA) has been dealing with eutrophication in 130 acres of ponds in the Hop Brook watershed for years. This problem was caused by excess phosphorous in the effluent from the Marlborough Easterly Waste Water Treatment Plant (MEWWTP).

The City of Marlborough was fighting a new operating permit for the MEWWTP that would reduce the phosphorous limits significantly. Back in 1993 the HBPA took an approach of trying to help Marlborough find an innovative cost effective solution for their problem.

For four years (1994-1998) we applied for and received a couple of Small Lakes and Ponds Grants (we matched the funds) and worked with Dr. Ron Lavigne, an Adjunct Professor in the Department of Plant and Soil Science at U Mass Amherst. We constructed an 80 ft. x 30 ft. greenhouse on the grounds of the MEWWTP and experimented with phragmites, reed canary grass and cat tails embedded in sand bed filters. After almost four years it did not look like this constructed wetlands process was going to provide a cost effective workable solution so we decided to look at other options.

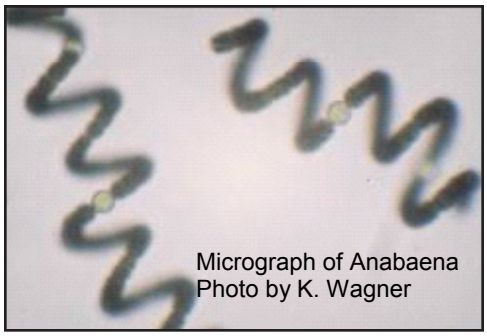
We had heard there was a group working from the MIT Fusion Lab on a process called high gradient magnetic separation (shortened to the CoMag™ process) which showed some promise in achieving low phosphorous levels in sewage treatment. We contacted Dr. Joseph Minervini, a Sudbury resident at the time, who was working at the MIT Fusion Lab, to see if there was a way we could work together

Continued on page 5

Toxic Cyanobacterial Blooms

Continued from page 1

waters. The eutrophication (overfertilization) of surface waters has lead to the increasing frequency, duration and magnitude of toxic cyanobacterial blooms. Toxic blooms are difficult to treat safely due to the risk of liberating the toxins into the water. Massachusetts DEP has a policy requiring an algal analysis and restricting treatment for larger lakes with blue-green bloom problems, as liberation of toxins from cells in dense blooms could actually increase the threat of toxicity, at least temporarily.



Micrograph of Anabaena
Photo by K. Wagner

Which cyanobacteria produce toxins and what types of toxins are produced? Approximately 50 species of cyanobacteria have been shown to produce toxins that are harmful to vertebrates. Common bloom-forming species include members of the genera Microcystis, Anabaena, Planktothrix (formerly Oscillatoria), Cylindrospermopsis, Aphanizomenon, Plectonema (formerly Lyngbya) and Nodularia. All cyanobacterial toxins can affect humans, although the risk of actual effects varies. Cyanotoxins fall broadly into three groups: neurotoxins, hepatotoxins and dermatoxins. Neurotoxins primarily cause neurological symptoms, including paralysis and respiratory failure. Hepatotoxins include microcystin (80 + variants), the most common algal toxin, and act primarily on the liver and kidneys. The most common dermatoxin is lyngbyatoxin, which causes skin irritation, rashes and gastrointestinal upset. Some data also suggest that some toxins can be carcinogenic (causing cancer) and teratogenic (causing birth defects), but this has not been confirmed. Although each of the toxins acts somewhat uniquely, initial, low-level exposure may include skin irritation and gastrointestinal upset, regardless of the specific toxin involved.

Particular problems arise from these cyanobacteria in drinking water supplies. Microcystins and cylindrospermopsin are highly heat stable (boiling will not destroy them), and they are not easily removed by conventional drinking water treatment methods such as sand filtration, if they are free (dissolved) in the water. Of these cyanotoxins, microcystin, cylindrospermopsin, and anatoxin-a are on the US EPA Contaminant Candidate List and are currently being evaluated for risk in treated drinking water. Canada and several other countries have already established drinking water guidelines for microcystin-LR.

History and threats posed by Cyanotoxins Toxic cyanobacterial blooms are not a new phenomenon. They have been documented for over two thousand years dating back to ancient Rome. Initial increases in cyanobacterial bloo ms in North America coincided with European colonization of the continent, resulting in continued growth and development of population centers and substantial land use changes in watersheds and associated increases in nutrient export over the last 200-300 years. More recently, it appears that milder winter temperatures, reduced ice cover, and warmer summers are increasing the occurrence of blooms across the United States and Canada. Additionally, resting stages (akinetes) produced by some toxin-producing cyanobacteria can remain viable for hundreds of years in the sediments, remaining as a 'seed bank' to initiate cyanobacterial blooms.

Plectonema mat
Photo by K. Wagner

Cyanobacterial blooms occur in all freshwater systems, from man-made dugouts and natural ponds to rivers, lakes, and reservoirs. Though they tend to occur at the height of summer and early fall, some can persist well into late fall or winter. Also, some cyanobacteria cause blooms under ice which can be extremely toxic and may persist through spring ice-out. Most bloom-forming cyanobacteria (Microcystis, Anabaena and Aphanizomenon) accumulate in characteristic scums that initially look like blue-green paint or slicks on the water surface, and later develop into bubbly masses that can get quite thick, and their color can range from yellows and browns to bright blue. Wind often concentrates these scums near boat docks or shores. Not all toxin-producing cyanobacteria form scums. Cylindrospermopsis does not concentrate at the surface, remaining more evenly distributed in the subsurface waters. Some species of Planktothrix concentrate at depths where light intensities are much reduced. As in under-

Continued on page 5

A Pond Group Contributes

Continued from page 3

to determine feasibility and cost effectiveness of the CoMag™ process.

We discussed with Marlborough the possibility of running a pilot project of the CoMag™ process on the grounds of the plant and they agreed to let us do so. We then raised $20K, with a significant contribution from the Sudbury Foundation, to fund the pilot project.

Once the funding was in place we talked with the group from the MIT Fusion Lab and, in the fall of 1997, they brought a tractor trailer full of equipment (Fig 1) to run their process to the MEWWTP. To make a long story short, the pilot project ran for 6 months and was a great success. They achieved phosphorous levels as low as .01mg/l and had been able to determine that levels of 0.1 mg/l could be achieved at half the capital cost of standard technologies.

In the interim a corporation was formed to further develop and market the technology. Micromag Corp ultimately evolved into Cambridge Water Technology.

Unfortunately Marlborough did not take advantage of the results of the pilot project and chose to continue to fight the permit in the legal and political arenas. However the Town of Concord was paying close attention to the results.

Concord ran a much larger and longer pilot project. They processed up to 140,000 gallons per day and ran for more than a year. Being pleased with the results, they signed a contract with Cambridge Water Technology to upgrade their plant which empties into the Concord River. The upgraded plant became operational on December 1, 2007.

There is a lot of additional interest in this new technology. Maynard, Billerica and Charlton have been following the progress in Concord and are seriously interested in using the same technology to upgrade their plants. There is an ongoing year long evaluation in Spokane, WA to treat their effluent to a .01 mg/l phosphorous level and there is also a lot of interest in China.

The future for the CoMag™ process looks promising and the Hop Brook Protection Association is proud of its role in helping the technology be evaluated.

For more information on the company and the process you can visit their web site www.cambridgewatertech.com.

Toxic Cyanobacterial Blooms

Continued from page 4

ice blooms, these blooms at depth can contain very high concentrations of microcystin.

Exposure routes to cyanobacterial toxins include ineffectively treated drinking water and casual recreational water contact from swimming, fishing, and water skiing. Recreational exposure includes skin contact, ingestion or inhalation. As mentioned above, children are at greater risk, as are family pets (e.g., dogs) which may receive high doses of toxins when wading or swimming in bloom-infested water. Exposure also occurs via popular food supplements containing Aphanizomenon flos-aquae and Spirulina, although not all strains of potentially toxic species will produce toxins, greatly complicating assessment of risk.

Most US states and Canadian provinces have documented toxic cyanobacterial blooms. Toxic cyanobacteria alerts are now routinely issued in many states that have monitoring programs. Unfortunately, there is no standard program or approach for monitoring toxic cyanobacterial blooms, and most go undocumented. The Massachusetts DEP program for assessing blooms in response to treatments requested in response to blooms is a step in the right direction, but can be a burden and does not cover all situations. We need to gather data for a few years to assess how to best assess this threat!

Issues and Concerns Relating to Cyanotoxins

1. North American countries have no federal recreational polices or practices regarding toxic blooms.
2. Prevention, monitoring and control must be coordinated at the local, state, provincial, and national levels. Protection and mitigation efforts are poorly supported in most cases.
3. Adequate monitoring programs do not exist in most systems, and there is little infrastructure in place to notify populations at risk from developing or fully developed cyanobacterial blooms.

Continued on page 7

CONTRIBUTIONS TO OUR NEWSLETTER AND WEBSITE ARE WELCOME

If you or your association have any material that you feel would be of interest or value to others, then please send it to our Newsletter Editor, Frank Lyons at franktlyons@verizon.net.

Please be advised: There is no guarantee of publication; all submissions are subject to editing for content and or length. Do not send valuable, one of a kind, original, sentimental or legally important photos, slides, or documents by mail as there can be no guarantee of their safe return.

President's Message

Continued from page 1

electing the officers and at-large Board members. Each association is also responsible for sending and receiving communications about lake and pond issues. We are only as good as this communication effort. We encourage you to share with us your lake and pond problems and solutions including your involvement with your boards of health, conservation commissions and other local government bodies.

Senator Brewer

I mentioned at the January workshop our desire to support additional chapters of MA COLAP in the eastern, northeastern and Cape Cod areas of the state as well as revive the Central MA COLAP chapter. The model for a successful chapter continues to be LAPA West in western Mass. Local chapters can create a local forum for exchanging ideas to solve lake and pond management issues. To do this we need volunteers. Contact any member of the board of directors or me if you are interested in a chapter in your area.

Please feel free to contact me with any comments or questions.

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Webster Lake Presentation

SPECIAL MEMBERSHIP MEETING REPORT

Our 21st Annual Winter Workshop held at Assumption College on January 26th was attended by nearly one hundred people. From State Senator Stephen Brewer's greetings to the excellent Webster Lake keynote presentation and a great variety of workshop sessions, everyone left the day with new and renewed insights to lake and pond management. We conducted a brief special meeting and made two modifications to our by-laws. The first was to allow for the MA COLAP annual meeting to be scheduled at a different time during the year, most likely to coincide with the annual January workshop. The second change allows chapters of MA COLAP to collect chapter dues separately and eliminate the complexity of MA COLAP billing, collecting and then reimbursing the chapters for their portion of the collected amounts. Speaking of dues, in August of this year we will be sending a notice of MA COLAP dues for the fiscal year beginning October 1, 2008 and ending September 30, 2009. At the special meeting, we voted $40.00 for lake and pond associations and $20.00 for individual dues. While we have a reasonable treasury balance, we are undertaking this and hopefully a semi-annual newsletter and we are upgrading our MA COLAP web site to better serve you. It takes money to provide these services and we thank you for your anticipated response to the dues request.


Participants listen

Quagga Alert: Mussels On The Loose!

By Mark Briggs, Lake Singletary

No doubt many of you have heard or read about the impact that zebra mussels have had in the Great Lakes. Well get ready. Its close cousin, the quagga mussel, is even more threatening and pernicious. Zebra mussels (Dressnia polymorpha) were first discovered in Lake St. Clair in the mid-80's. Quagga mussels (Dressnia rostiformis bugensis) were first observed at Port Colborne, Ontario on Lake Erie in September 1989. Both are thought to be introduced via the bilges of transatlantic shipping originating from the Caspian Sea. By 1991, Quaggas had spread to the Mohawk and Hudson Rivers. Look out Massachusetts! Lake Champlain already has zebra mussels. Zebras have invaded mainly the Great Lakes and the Mississippi; Quaggas however have turned up in Nevada, Arizona and California in significant numbers. So

Continued on page 7

Mussels On The Loose!

Continued from page 6

much so that a number of lakes have been closed to outside boats. Existing, docked or moored and rental boats only!

These mussels are fairly distinguishable by their coloration and size. Zebras have darker, more distinctive stripes and range from brown to green, while Quaggas are lighter in color from tan to white. Zebras are pointed in shape and can be stood on their hinge and Quaggas are flatter and more fan shaped. Zebras grow to about ½" and are dormant in winter while Quaggas grow up to 1" and feed (filter) year round. And though perch have developed an appetite for them, as walleye have for Zebras, the fact that Quaggas are active year-round make them even more of a threat. They can withstand much greater variations in water temperature and are therefore more likely to be absorbed in the food chain. When placed in competition Quaggas however can displace Zebras at a ratio of 14:1, even colonizing over zebra beds. One Quagga mussel can produce a million larvae or veligers a year and are diaecious i.e male and female at the same time. Though mortality rate is about 99%, Quaggas can also thrive in deeper waters, up to 350' vs. 50' for Zebras.

Looming on the horizon is yet another mussel, Dreissenia rostiformis grimmi, also from the Dneiper River drainage, which indicates a greater tolerance to salinity! So with the invasion of other species like Eurasian ruffe, the round gobi, snakeheads, hydrilla, Eurasian milfoil, fanwort and purple loosestrife, etc. etc. we may yet have another nuisance added to the list, one that can focus in on brackish and coastal areas.

Though there are differences in the studies from the Ukraine and Lake Erie and Lake Ontario (where they have really now taken hold), one thing is certain. They have a tremendous ability to adapt to more differing environments.

In short, all boaters must be ever vigilant particularly if boats, kayaks and canoes frequent infested waters. These mussels and their veligers can live up to a week on land without water. If you suspect or see anything that resembles them, please contact the Department of Fish and Wildlife in your area as soon as possible.

Toxic Cyanobacterial Blooms

Continued from page 5

4. The ecological and economic impacts of toxic cyanobacterial blooms can be very high.
5. The human health impacts of toxic cyanobacterial blooms can be profound and long term.
6. The public remains mostly ignorant of potential exposure routes to toxins present in cyanobacterial blooms. Children and immuno-compromised individuals are at greatest risk.
7. Almost all laboratory exposure data are based on mice and rats, with limited replication of complete studies, and few other appropriate mammalian models.
8. New toxins are being discovered, while known toxins still need to be fully characterized.

NALMS Positions on Cyanotoxins

1. NALMS supports the development of national limits on the primary toxins in drinking and recreational waters (microcystins, anatoxin-a, cylindrospermopsin).
2. NALMS supports international, national, provincial and state efforts to monitor, control and mitigate freshwater cyanobacterial blooms.
3. NALMS supports more research towards understanding the factors that control blooms and quantifying the effects of cyanotoxins on humans.
4. NALMS encourages and supports local efforts to protect lakes, and thereby limit cyanobacterial blooms. This includes public education, monitoring and mitigation programs.

What can you do?

1. Don't be scared, but be aware; cyanoblooms dense enough to represent a toxicity threat will usually make the water very unappealing for contact recreation, and it is not safe to swim in water of low clarity anyway.
2. Let your Association or neighbors know about this threat, but avoid scare tactics – very, very few people have died from exposure, but it is possible.
3. Become a volunteer monitor. Monitoring programs provide valuable data on water clarity and possible bloom conditions, and are beginning to include toxin assessment.
4. Be an advocate for proper funding for state programs to assess and manage lakes. The MA DCR is actively assessing blooms and possible toxicity, mainly in state controlled lakes, but with adequate resources this department would very much like to expand its efforts.
5. Properly fund assessment firms and algicide applicators to do the algal assessment work necessary to properly characterize threats from algal blooms.
6. Check out the Blue-Green Pages on the NALMS website at www.NALMS.org; there is a lot of useful information there!

*This article was based on the NALMS Toxic Cyanobloom Position

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Our Mission

MA COLAP is a non-profit organization dedicated to preserving the aesthetic, recreational, and commercial value of our water bodies through maintenance and improvement of water quality, watershed ecology, boating safety, agricultural soil practices, shoreline woodland management and residential building standards.

SPECIAL ANNOUNCEMENTS

SAVE THESE DATES! WRITE THEM DOWN! DON'T MISS OUT !!!

LAPA-West

would like to announce their

10th Annual Lakes & Ponds Symposium

Saturday, September 13, 2008
at Lee Middle & High School
Lee, MA

You won't want to miss it!

Full details, including directions, will follow in a separate mailing and will be posted on the website at www.lapa-west.org/events.html

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