Regional Examination of Harmful Algal Blooms

Summer 2010 REHAB Volunteer Newsletter 1

In This Issue:

Laboratory tests are the only way to tell if a cyanobacterial bloom is producing toxins.

CDC, Your County, Cyanotoxins, and You

Last summer, a team of scientists and volunteers began an ambitious and timely study. Washington State Department of Health (DOH), in partnership with Snohomish, King, and Pierce Counties, Washington State Department of Ecology (Ecology), and Seattle University are investigating toxicity of algae blooms in western Washington lakes. The Centers for Disease Control and Prevention (CDC) funded a 5-year cooperative agreement with DOH to determine public health impacts of cyanotoxins. Data from the study will be entered into CDC's Harmful Algae Bloom-related Illness and Surveillance System (HABISS).

Cyanotoxins include a number of different kinds of poisons produced by cyanobacteria. Some are nerve toxins, some are liver toxins, and some cause skin rashes. Cyanobacteria used to be called blue-green algae. Although cyanobacteria have been around for at least 3.5 billion years, the study of impacts in our state lakes due to cyanotoxins has only recently begun.

The HABISS team developed the Regional Examination of Harmful Algal Blooms (REHAB) project, which includes routine monitoring of lowland Puget Sound lakes. This study is funded by a grant from the CDC, and funding has been secured for a second year of study (2010). We applied for funds for the third year and will hear later this summer if we were successful. The team selected ten lakes from each of the three counties for sampling, based on the type of cyanobacteria present in the lake, whether it has had previous toxic blooms, and if it has public access.

Goals of the project are to measure toxicity levels in 30 lakes, determine how often they are toxic, and observe how long toxicity levels last. Washington State Recreational Guidance Values are used to evaluate toxicity and are set at levels that protect children and adults from long-term exposures to cyanobacterial toxins. Another objective is to track animal and human reports of illness associated with exposure to toxic blooms. Additionally, project partners are hoping that data collected through the study will help unlock clues as to why cyanobacteria produce toxins and identify if there is a way to prevent toxin production.

Over a period of five months in 2009, project lakes were sampled biweekly by volunteers or county staff. Samples were sent to the King County Environmental Laboratory (KCEL) which tested for microcystins (liver toxins) and anatoxin-a (a nerve toxin). KCEL also tested some lakes for the cyanotoxins saxitoxins (nerve toxins) and cylindrospermopsin (a liver toxin). The consulting firm WATER Environmental Services, Inc., identified and counted phytoplankton samples for the project.

2010 sampling began in June. Results of the toxin analyses are usually available within a week after collecting the sample. Knowing whether toxicity values are above DOH guidance levels allows county staff to make management decisions, such as whether to post warning signs or to close a lake if there are reports of human or animal illnesses.

Sampling bottles.
Courtesy of Rob Banes

Future File

With the 2010 sampling season well underway, equipment has been checked and distributed to all volunteers who will be taking samples. The schedule includes 10 routine sampling dates between June and October, with the inclusion of bloom samples as they happen. Changes for 2010 include regularly testing for saxitoxin and cylindrospermopsin. We are looking forward to another successful year of monitoring our lakes. Thank you to all the volunteers! Don't forget to keep an eye out for blooms and contact the volunteer coordinator for each county with any questions.

Human Health and Animal Illnesses

Washington has become a national leader in recognizing cyanobacteria and their toxins as a serious environmental and public health problem.

The primary goal of CDC's HABISS project is to find out about human and animal illnesses following exposure to toxic blooms. In our state, the primary routes of exposure to cyanotoxins are through swimming, water skiing, and other recreational activities. Very few lakes are used as a drinking water source in our state. Eating fish is another possible exposure route to humans. Ecology and DOH are looking into the possible bioaccumulation of cyanotoxins in fish. So far, the HABISS project has identified many historical situations where animals became sick or died and a few instances where people became ill after swimming.

If you, your child, or your pet feels sick or experiences flu-like symptoms after swimming in a lake, please contact your local health jurisdiction or DOH at 1-877-485-7316 (toll free).

If you observe a bloom on your lake and think it should be tested for toxicity, contact your local health jurisdiction or Ecology at 1-425-649-7288.

For more information on toxic blooms and toxicity symptoms, go to:
http://www.doh.wa.gov/ehp/algae/default.htm or
http://www.ecy.wa.gov/programs/wq/plants/algae/index.html

Cottage Lake, King County.
Courtesy of Beth Cullen.

Cyanobacteria Facts

They were formerly known as "blue-green algae."

They are photosynthetic organisms.

They have lipid soluble chlorophylls and carotenoids.

Phycocyanin, a water soluble pigment, gives them their unique colors.

Since they are nitrogen fixers and some have gas vacuoles, they have a competitive advantage over true algae.

They come in many forms: single cell, filamentous, colonial.

They are Earth's oldest photosynthetic organisms.

Elements of Ecology's Freshwater Algae Control Program

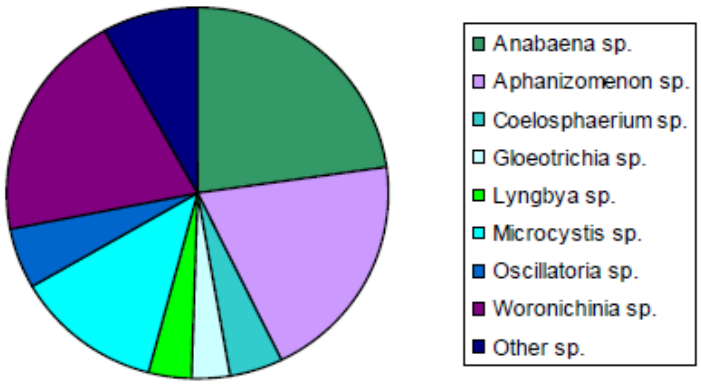
In another effort to track toxic blooms in Washington lakes, Ecology began a Freshwater Algae Control Program in 2006. Program funding comes from vessel registration fees (RCW 88.02.045). One dollar of each vessel registration fee is deposited into the Freshwater Aquatic Algae Control Account. This generates approximately $250,000 per biennium for the Freshwater Algae Control Program. The legislature appropriates these funds to Ecology to manage the program.

Ecology typically offers approximately $150,000 annually to state and local governments in the form of grants for freshwater algae projects. Ecology awarded funding to local governments experiencing problems with toxic algae for nine grant projects during 2008 and 2009. Appropriation problems prevented Ecology from distributing funds in 2010. Ecology's laboratory budget is about $50,000 per year for algal identification and toxicity testing. Remaining funds pay for staff time for algae program grant administration, technical assistance, reporting, and data entry.

Elements of Ecology's program include:

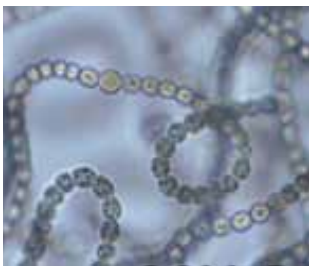
- A grants program that funds freshwater algae projects with priority going to projects dealing with harmful algae blooms (HABs).
- Toxicity testing of cyanobacterial blooms for two common algal toxins - microcystins and anatoxin-a.
- Identification of bloom-forming algae in Washington's lakes, ponds, and rivers.
- A searchable online database for the public to view algal identification and toxicity test results.
- A freshwater algae electronic mailing list.
- Partnership with DOH for health-related questions about algal toxicity, development of recreational guidelines for toxic algae blooms, and development of warning signs and educational materials.
- Ecology and DOH websites with information about freshwater algae, management methods, and human and pet health risks from toxic cyanobacterial blooms.

Toxic Algae Species
Washington State Lakes
2008



What Happens at the Lab?

Microcystis, Aphanizomenon

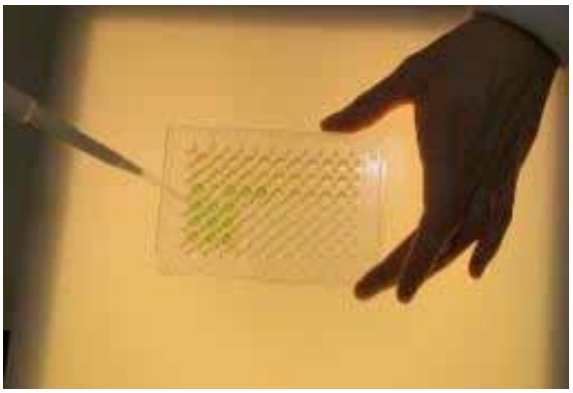


Anabaena
Photo courtesy of Robin Matthews.

Gloeotrichia echinulata
Photo courtesy of Robin Matthews.

Oscillatoria
Photo courtesy of Robin Matthews.

Aphanizomenon
Photo courtesy of Robin Matthews.



Once REHAB samples arrive at the laboratory, they are logged in by the sample receiving department. Each sample has its own unique sample number that is entered into the Laboratory Information Management (LIMs) database. Laboratory scientists are notified that samples have arrived and sample preparation begins as soon as possible, often within minutes of arrival. Samples for microcystin, cylindrospermopsin, and saxitoxin are placed in a -20 º C freezer and frozen overnight to break open the algae cells. In a similar process, samples for anatoxin analysis are chilled and placed in glacial acetic acid overnight. The next day, frozen samples are thawed and "sonicated" – high frequency vibration is used to further break open the cells and free up toxin for analysis. Anatoxin samples then go through several solvent extraction steps, are concentrated and extracted to detect very low concentrations of the toxin.

Analysis for most of the toxins – microcystin, cylindrospermopsin, and saxitoxin – is performed using a method called enzyme-linked immunosorbent assay or ELISA. ELISA assays are a technique for determining the presence or amount of a toxin in a water using an enzyme that bonds to an antibody and causes a color change which is read by a spectrophotometer. Anatoxin-a concentrations are determined by a more traditional analytical chemistry method called high performance liquid chromatography or HPLC. Quality control (QC) samples (blanks, spikes, etc.) are included with each run of lake samples to ensure data quality.

Once data are generated by the instruments, they are transferred into an EXCEL spreadsheet, reviewed by a second analyst and saved to the LIMs database. The laboratory project manager then pulls the final data from the database, formats it into a report and emails the data to the customer, including state and local agencies, lake managers, and you.

Factors Associated With Blooms

Environmental
- Light, temperature, pH
- Percent oxygen saturation
- Nutrient availability and depletion

Physical
- Wind patterns
- Lake mixing
- Currents

Other
- Age of cells

REHAB Summary Data June 2009 - May 2010	
Routine Samples	
300	Routine samples taken
120	Samples with measurable toxins (21 lakes)
116	Samples produced microcystins
29	Samples in 8 lakes produced microcystin levels above state guidelines (6 ug/L)
11	Samples produced saxitoxins (10 from Waughop, 1 from Cassidy)
5	Produced anatoxin-a
1	Produced cylindrospermopsin
Supplemental Bloom Samples	
18	Bloom samples taken from 13 lakes
8	Samples in 5 lakes produced microcystin levels above state guidelines (6 ug/L)
10	Samples produced microcystin levels below state guidelines
0	Produced anatoxin-a
2	Produced saxitoxin
Highest Numbers	
4600 ug/L	Microcystin - Lake Cassidy
0.06 ug/L	Anatoxin-a - Clear Lake
193 ug/L	Saxitoxin - Waughop Lake
0.12 ug/L	Cylindrospermopsin - Lake Ketchum

Volunteer News

A hearty thank-you to all our stellar volunteers – without you this project wouldn't be possible!

King County

Fifteen volunteers monitored ten lakes for the King County REHAB program. Barb and Ray Petit, Glenn Ross, Jessica Williams, and Larry Miller also participate in the King County Lake Stewardship Program, which monitors nutrients biweekly during the summer (May to October). Volunteers were key in watching for blooms and taking samples when necessary outside of the routine sample season. Ed Grubbs on Cottage Lake and Larry Miller on Beaver Lake retired after 2009. They did incredible work with the Lake Stewardship Program for over ten years. Three new volunteers will continue sampling these lakes. We appreciate your great sampling efforts!

Pierce County

This year, 21 volunteers attended training to participate in the REHAB program for the Tacoma-Pierce County Health Department. We have new and returning volunteers for this project. A special thank you to Ron and Sandy Seibert, Sarah and Darice Gamache, Judy Miller, Tammy Taylor, Tom Blakney, and Dick Hurych for participating two years in a row and an extra special thank you to Don Russell for taking on two lakes again this year! For all the first time volunteers, we are thrilled to have you help make this year's sampling a success!

Snohomish County

Twelve volunteers worked to monitor six lakes in Snohomish County for the 2009 sampling season of the REHAB program. They did an amazing job sampling 98% of the sample dates and collecting 74 sets of toxic algae samples. Seven participants were new to volunteer monitoring and signed on specifically to help with the REHAB program. Herb Hainey, Nancy Dean, and Julie Callebert were already involved in the Snohomish County Lake Management Program. In addition to their biweekly water quality monitoring, they took on additional algae sampling for the REHAB program. They also took biweekly dissolved oxygen and temperature profiles of their lakes. Their additional monitoring efforts will help us better interpret algae sampling results. Thank you to all Snohomish County volunteers!

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Results from the First Year

2009 marked the first year of monitoring under the REHAB program. The data have been entered into databases and the results are interesting! While each county has its unique results, combined information from the three counties tells an exciting story.

It is important to remember it is hard to draw any conclusions based on one year of environmental data. Toxicity levels and algal communities found in a lake during one summer may not be the same during the next two years of sampling. Nonetheless, REHAB uncovered some interesting things during 2009 that you, the volunteers, helped us find through your work.

REHAB 2009 Summary

Microcystin was the only toxin to exceed state recommended recreational guidelines in REHAB lakes during 2009. While the program detected all four toxins, the majority (90%) of those detected were microcystins. Almost half (40%) of the routine samples produced detectable levels of toxicity. Although the program detected anatoxin-a in three lakes, none of the samples produced levels greater than 1 ug/L, the recreational guideline for Washington. Both saxitoxin and cylindrospermopsin were discovered in some REHAB lakes.

Pierce County lakes accounted for half of the samples that produced detectable levels of toxins in the region, and the majority (72%) were above state recreational guidelines for microcystins. Only one of ten lakes in Pierce County did not report any toxins - American Lake. Two bloom samples from Waughop Lake had high saxitoxin concentrations in addition to high microcystin levels. Waughop Lake accounted for over 25% percent of the samples in the REHAB program that were above state recreational guidelines.

Seven Snohomish County lakes tested positive for toxins. Only two posted levels above state recreational guidelines for microcystins. However, Snohomish County posted the three highest microcystin levels detected in the entire REHAB program, all from Lake Cassidy. Lake Ketchum was the only REHAB lake with detected concentrations of cylindrospermopsin.

King County lakes did not have the same toxicity issues found in Pierce and Snohomish lakes. Three King County lakes had microcystin levels above recreational guidelines, while the program observed some measurable level of toxicity in seven of the ten monitored lakes. The program did not detect saxitoxin or cylindrospermopsin in any King County REHAB lakes.