Regional Examination of Harmful Algal Blooms

Summer 2011

REHAB Volunteer Newsletter 2

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A bloom that tests non-toxic one day can turn toxic the next day.

Update on CDC's Harmful Algae Bloom (HAB) Program

You are part of a cooperative agreement with the Centers for Disease Control and Prevention (CDC) looking at public health impacts due to toxic cyanobacteria. Washington is one of ten states participating in the pilot project entitled, "Harmful Algae Bloom-related Illness and Surveillance System (HABISS)." Our agreement with CDC includes the Regional Examination of Harmful Algae Blooms (REHAB) project, whose objectives include measuring toxicity levels in 30 lakes, determining how often they are toxic, and observing how long toxicity levels last. Partners include Washington State Departments of Health (DOH) and Ecology (Ecology); King, Pierce, and Snohomish counties; and Seattle University. At this point (June 2011), we are beginning the third year of monitoring 30 Puget Sound lowland lakes for toxic blooms. Data from the study entered into CDC's national database are used to track toxic events and human and animal illnesses associated with HABs.

The first and second years of the REHAB project have been remarkably successful in terms of lake sampling and toxicity testing. Over a period of five months, project lakes will be sampled biweekly by volunteers or county staff. King County Environmental Laboratory (KCEL) tests for microcystins (liver toxins), anatoxin-a (nerve toxin), saxitoxin (nerve toxin) and cylindrospermopsin (liver toxin). Results are available in a few days to a week after samples are collected. Based on toxicity levels, county staff will be able to make management decisions about each lake as the summer progresses. If concentrations are above guidance values, staff can post warning or caution signs to protect humans and animals from exposure to a toxic bloom. Phytoplankton are identified and counted as part of the project.

We have applied for funds for the fourth year, which will likely include sampling a reduced number of lakes (10 total). We hope that information from sampling will help determine why blooms become toxic and that this information will help lake managers prevent toxin production.

Waterborne Illness Reminder

The high number of illness reports from many lakes during the hot weather in 2009 resulted in DOH working to improve its investigation procedures and response coordination with local health agencies. DOH staff from Communicable Disease Epidemiology, the BEACH Program, Recreational Swimming Program and the Harmful Algae Bloom (HAB) Program developed a streamlined chart to coordinate responses in the event of future waterborne illnesses outbreaks. A videoconference workshop for state local health jurisdictions was held using the web - state and local agencies are now more prepared to assist citizens and cities who report illnesses during a short period of time.

- 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 a 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

Future File

Lake Wilderness, King County, courtesy of Barb Petit

The 2011 sampling season has begun for King, Pierce, and Snohomish Counties. Remember to keep an eye out for all blooms. Blooms that occur between scheduled sample dates are to be sampled, too! For 2011, bloom samples will be analyzed by Ecology. If you take a bloom sample, be sure to fill out a datasheet, and the bottom portion too, so we can track it. Also, be sure to write down your Secchi depth; if it touches the bottom, please note that on your datasheet. If you do not have access to a dock or a boat and are taking algae samples from a public beach location, you don't have to take a Secchi reading - just note you are sampling from the beach and use the Secchi for the particle reading.

Questions? Contact your volunteer coordinator: Beth Ledoux/Chris Knudson (King County), Lindsay Tuttle (Pierce County), or Marissa Burghdoff (Snohomish County).

Associated Legislation

Phosphorus Bill Passes

The 2011 legislature and Governor Gregoire passed a bill that bans the use of lawn fertilizer containing phosphorus from being sold in Washington State. This is a landmark in the fight against toxic algae since scientists have been able to link excess phosphorus to increased algae blooms. The goal of the bill is to keep phosphorus where it is needed - agriculture, flower beds and vegetable beds - and out of where it isn't needed - lawns and golf courses. The bill will go into effect in 2013 across the state and then we're one step closer to cleaner water!

A bloom may be found somewhere in western Washington nearly any month of the year and at water temperatures as low as 45-50 degrees Fahrenheit.

Ecology's Algal Identification and Toxicity Testing Program to Continue

Governor Gregoire recently signed a bill that removed the expiration date from the Freshwater Algae Control Program. Funding for this program was due to end next year, but this bill allows it to continue in perpetuity. The legislature also increased Ecology's responsibilities to include saltwater algae. Currently the program funds the algal identification and toxicity testing program and an annual small grants program to help state and local governments fund projects to manage toxic cyanobacteria (blue-green) blooms. In the future, Ecology will, in addition to continuing these two programs, "set aside" emergency funding in a contingency fund to help local governments deal with the monitoring and removal of accumulations of sea lettuce along Puget Sound. This emergency funding can also be tapped if non-native, invasive marine algae are discovered in local waters. Ecology expects that marine algae emergencies will only occur sporadically so that most of the program funding will continue to be directed towards toxic freshwater blooms.

Lake Ketchum, Snohomish County, courtesy of Gene Williams

Reduce nutrient loading of local ponds and lakes by using only the recommended amounts of fertilizers and pesticides on your yard.

Results from the Second Year

2010 was the second year of REHAB monitoring. One striking difference between 2009 and 2010 was the weather - 2009 was much sunnier and warmer than 2010. Since weather influences algae growth and the number of people who go swimming, the cooler 2010 season had many fewer human and animal illness reports.

Major findings during the first two-and-a-half years of the project include the first survey of cylindrospermopsin in Washington lakes, with confirmation of cylindrospermopsin in two Snohomish County lakes (Ketchum Lake - 2009 and Sunday Lake - 2010). Additional tests confirmed the presence of saxitoxin in two Washington lakes (Waughop Lake, Pierce County - 2009 and 2010 and Cassidy Lake, Snohomish County - 2009).

During routine REHAB monitoring, seven samples from four lakes produced microcystin levels above the recommended 6 ug/L guideline. Six lakes tested above the state guideline during bloom events, for a total of 25 REHAB samples being higher than the recommended 6 ug/L.

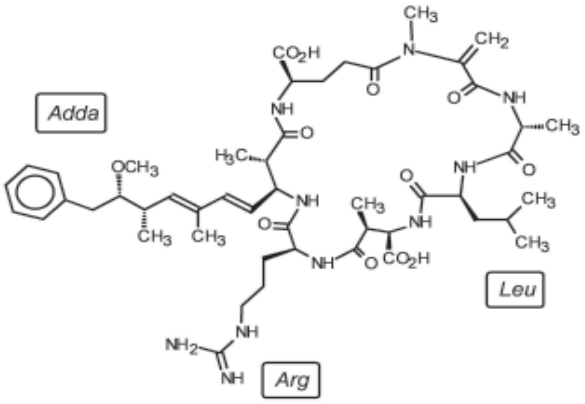
For anatoxin-a, no REHAB lakes produced levels higher than the state recommended guideline of 1 ug/L. However, some lakes did test positive for this toxin at low levels. During routine samples, five lakes had levels above the detection limit of 0.05 ug /L while two lakes tested above 0.05 ug/L during bloom scenarios.

It will be interesting to see what the weather will do in 2011. We are eager to see results from the third summer, the final year of sampling all 30 lakes. At this time we are planning for the possibility of sampling ten lakes total in the summer of 2012, depending on funding levels and on results from the first three years.

A Closer Look at Cyanotoxins

Cyanotoxins include a broad range of chemicals and mechanisms of toxicity. REHAB samples are tested for four of the cyanotoxins: microcystins, anatoxin-a, saxitoxins, and cylindrospermopsins.

Major classes for all of the cyanotoxins identified so far around the world include liver toxins (hepatotoxins - microcystins and nodularins); strong nerve toxins (neurotoxins - anatoxin-a, anatoxin-a (S), and saxitoxins); a toxin that inhibits protein synthesis (cylindrospermopsin); lipopolysaccharides, which can irritate any exposed tissues; and toxins that target the skin (aplysiatoxins and lyngbyatoxins).

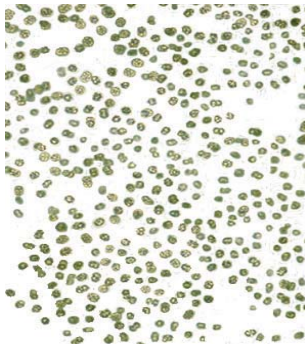


Microcystin-LR

Microcystins are the most commonly tested and detected cyanotoxins in Washington and have been found at concentrations from <1 to 18,700 µg/L (Spokane Lake). These liver toxins are of concern because they are widespread and have the potential to harm animals and humans. Microcystins damage liver tissues, and at high doses can cause liver failure and death. Microcystins are produced by species of *Microcystis*, *Planktothrix*, and *Anabaena*. In addition, microcystins are suspected tumor-promoters, and animal studies show they are capable of interfering with the development of the brains of mice. These toxins have been associated with higher rates of primary liver cancer in people drinking waters with high densities of cyanobacteria, particularly in China. Symptoms of liver toxin exposure may include pain, diarrhea, and vomiting in humans and death in animals.

Anabaena

Aphanizomenon



Microcystis

Toxicity is hard to predict, in part, because a single species of algae can have toxic and non-toxic strains.

A Phytoplankton Story - It's a Small World *by Maribeth Gibbons*

It's a small world, but such a busy little world.

These are my thoughts as I peer intently through my microscope at a water sample contained within the counting chamber below. I am a limnologist, a freshwater ecologist, specializing in the identification of freshwater phytoplankton and zooplankton, microscopic plants and animals that live in lakes. Today, I'll be examining water samples collected by volunteer monitors from a variety of lakes in western Washington, specifically identifying and quantifying the phytoplankton or algae.

Phytoplankton are microscopic aquatic plants suspended in freshwaters. Like their land-based cousins, they synthesize organic carbon (food) from carbon dioxide and inorganic matter (nutrients) using sunlight as an energy source through photosynthesis. Phytoplankton form the basic foundation of food production in a water-body, the base in the aquatic food web ultimately culminating in higher order populations of fish and other aquatic vertebrates. Because of their pivotal position within the lake ecosystem, characterizing algal assemblages provides a valuable tool not only for assessing changes in important lake conditions (attributes) but also for inferring probable causes of impaired environmental conditions. Tiny but mighty, they are an awesome part of aquatic life, which is why I enjoy studying them.

So, while many algae are beneficial cogs in a lake ecosystem, some types don't play "nice" with the rest of the aquatic organisms, including us humans. For example, certain phytoplankton, such as some types of **cyanobacteria** or blue-green bacteria (historically called blue-green algae), can cause nuisance "blooms" creating visual, taste, and/or odor problems. Of more critical concern are several cyanobacterial forms that can also produce dissolved substances (i.e., cyanotoxins) hazardous to human and animal health. Such production can result in a condition referred to as harmful algal blooms (HABs). Some common genera of cyanobacteria capable of producing toxic strains are *Anabaena*, *Aphanizomenon* and *Microcystis*, collectively referred to as "Annie, Fannie, and Mike." Under the microscope, members of this algal triad appear quite colorful and beautiful in their colonial structure, making it hard to believe they could be so deadly to animals and us (although not all strains of AFM are toxic). While I carefully note occurrence of all algal types in each microscopic sample, it is these potential toxin-producing cyanobacteria that really grab my attention.

Microscopic examination provides the types and quantity of algae in a lake (measured as algal cell numbers and cell volumes) and is one of the main methods used to monitor cyanobacteria levels in lakes. Very simply, a measured volume of a lake water sample is placed in a special covered counting chamber and algal cells are identified and counted using a compound microscope under high magnification. Although the counting cell I use only holds a milliliter of water, it can be the site of quite a tangle of algal forms. In fact, when cyanobacterial lake blooms are really bad, I often see millions of algal cells/ml in such a subsample, which can make sorting through and counting the various species quite taxing. It's important to note that the presence of any of the potentially toxic cyanobacterial genera in a lake sample doesn't necessarily mean they are toxic. While microscopic evaluation lets us know if these bad guys are present, it does not measure actual algal toxicity levels, which are detected using additional analytical laboratory tests or more limited field screening tests. Together microscopic identification and toxicity testing techniques allow us to identify and quantify a potential health threat caused by HABs in lakes.

A small world indeed!

Volunteer News

A big thanks to all new and veteran REHAB volunteers. Teamwork makes this project possible!

King County

Fifteen volunteers monitored ten lakes for the King County REHAB program. This year we added new volunteers Sarah Fisher on Beaver Lake and Matt McCain on Cottage Lake. Barb and Ray Petit (Lake Wilderness), Glenn Ross (Lake Sawyer), and Jessica Williams (Echo Lake) also participate in the King County Lake Stewardship Program, which monitors nutrients biweekly during the summer (May to October). As always, our volunteers watched over lakes and helped sample over weekends and during bloom events. All volunteers have been vigilant throughout the year watching for scums on their lake. The volunteers took 99% of the samples on the 10 King County lakes from May to October 2010. This project would not be a success without them!

Pierce County

The 2010 REHAB sampling season in Pierce County was a success, with 8 primary volunteers and 11 secondary volunteers participating. We appreciate all the volunteers that stuck with the program and have completed their second sampling season. A special thank you goes to Don Russell who again went above and beyond by sampling two lakes and helping out with a third. We are looking forward to working with returning and new volunteers for the 2011 season.

Snohomish County

The dedication of volunteers once again allowed 2010 to be an extremely successful year for the REHAB project in Snohomish County. Nearly all of our volunteers returned in 2010 as well as new recruits Kelly and Wesley Frazier (Sunday Lake). In total, 15 volunteers helped to collect samples or take additional environmental data at the ten Snohomish County lakes. Collectively, volunteers were able to sample on 94% of the sample dates and took 73 sets of toxic algae samples! In 2010, Chris Sandys, Brad Paulson, and Jim Ballew also began taking biweekly dissolved oxygen and temperature profiles of their lakes (Lakes Ketchum, Cassidy and Loma) to help better understand why toxic blooms might be occurring. Since we highlighted our monitoring veterans last year, we would like to say a big thanks to our newer volunteers, including the Collins family (Missy, Jack, and Erick McRae) and Beth Allen (Lake Stevens), Tina Brysz (Lost Lake), and Jim Collins (Sunday Lake).

Maintain a buffer of natural vegetation around ponds and lakes to filter incoming water.

Related Cyanobacteria Projects

There are a few studies that are going on in the Puget Sound region that are not part of REHAB – we thought you might be interested in the following projects:

- We are looking at *Microcystis* communities in Waughop, Steilacoom, Cassidy, Ketchum, Cottage, and Wilderness lakes to see if they are genetically identical. Also, we are looking at changes in microcystin genetics over the bloom season.
- Ecology is investigating whether microcystins accumulate in fish muscle tissue during blooms. Some of you have collected fish for the study. There are still some questions about chemical analyses that need to be answered before we can say whether active microcystins are present and/or are at levels high enough to be of concern to human health. Stay tuned - the project is ongoing.
- This year, DOH will develop outreach materials for veterinarians statewide on toxic cyanobacteria. You can help by telling your neighbors about the harmful effects of algal toxins on pets.
- This summer, King County will study the effectiveness of floating barriers to keep cyanotoxins and blooms away from swimming areas. If the results are successful, this approach may provide a practical way to manage beaches in lakes that are having difficulty managing algal blooms.

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Featured REHAB Lake: Waughop Lake, Pierce County

Waughop Lake is located within Lakewood, Washington's Fort Steilacoom Park. The lake has a surface area of approximately 33 acres and a mean depth of seven (7) feet. There are no natural surface inflow or outflow channels. However, stormwater from an adjacent college campus provides some inflow to the lake. There is no residential development along the shoreline, although there is a paved trail around the lake providing numerous points of access to the water.

Waughop Lake has been monitored for a number of years by the Tacoma-Pierce County Health Department for cyanobacteria blooms through the CDC REHAB Project. For both the 2009 and 2010 sampling seasons, Waughop Lake had the most persistent toxic blooms and the highest microcystin concentrations of all the thirty lakes being monitored. Luckily, no human illness or animal illness or death has been reported to date.

The lake has had an ongoing problem with toxic cyanobacteria since February 2009, and a warning advisory remains in effect. In June 2010, the Health Department also issued an advisory recommending against eating fish from Waughop Lake. The advisory was issued based upon a number of factors, including the ongoing bloom in the lake and Ecology's study that detected microcystins in the tissue of brown bullhead and largemouth bass collected from the lake.

Concern that park goers might not see advisory signs has spurred discussion with the Lakewood Parks Department to find better ways to get information out to the public. Signs located at entrances to the park and flyers available at the dog park area are some possible ways to make the information more accessible.

Will Waughop Lake lead the way again in 2011? Stayed tuned to find out…

Waughop Lake, courtesy of Don Russell