Water Quality Monitoring of Province Lake in 2011

Presented to the Province Lake Association (PLA) Annual Meeting on July 21, 2012

2011 was the 21st consecutive year of water quality monitoring conducted at Province Lake. We sampled four times last season. The test results for 2011 on water samples collected by Steve & Mary Craig, John Wilkinson, Montana Arsonault, Amy Sargent, and Norm Dudziak were reviewed by the New Hampshire Department of Environmental Services (NHDES). State reports for a number of years are available by clicking this web site.

Many of the terms in this report include hyperlinks to interesting related web sites. By clicking on most of the underlined terms, you can access additional information. If the same word is hyperlinked more than once, the different occurrences lead to different web sites.

As occurs every 2 years, for those lakes with at least 10 consecutive years of data, the State conducted a statistical regression analysis to determine objectively if water quality has changed over time. This is a major payoff for having had a continuous and consistent sampling program. Unfortunately, due to state budget cuts, we did not receive an individual detailed lake report as we have in past years, but were lumped into a "White Mountain [WM] Region Regional Report", which includes those 12 lakes (out of 127; 19 with data) that have data for at least 10 consecutive years. I have used our October 2011 data report plus the Regional Report in preparation of this summary, so some of the data I have used is not posted online as it had been in the past.

The overall summary is that transparency has degraded, but no other statistically analyzed parameters have changed significantly since 1991. Also, we have had September cyanobacteria blooms 2 years in a row. The NHDES report on the quality of water in the lake for 2011 indicates the following:

1. The average amount of **algae** in the lake was slightly more than the low level of the previous year, as indicated by the chlorophyll-aconcentrations. The 2011 mean concentration is approximately equal to the average of the previous 6 years (2005-2010) and less than each of the 5 years before that (2000-2004), so the slight short-

term increase is of no concern. We have never returned to the high levels observed during the weed removal activities of 1996 and 1997, and their lingering effects in 1998. The State's statistical analysis shows that the amount of algae has **not significantly changed** over all the years since monitoring began in 1991. Our amount of algae is only about 80% of the amount that New Hampshire lakes have, on average. This low level is good because dying algae forms the brown floating bottom masses that come to your shore when the wind blows hard in July and August. The algae masses settle loosely on the bottom when the lake is still and cloud the water when wind or boat wakes stir things up.

2. Water **transparency** (a measure of how deep you can see into the water) was an average of 2.0 meters (6.7 feet). This was our least average transparency on record, comparable only to1998 and 2000, which were the only years that had a maximum transparency less than that of 2011 (2.35 m or 7.7 ft). However, I am happy to say that the first reading of 2012 was 3.15 m or 10.3 ft, one of our best readings ever. For the first time, the State's statistical analysis shows that the transparency has **degraded** since monitoring began in 1991. Of the 12 analyzed lakes in the WM Region, 42% had degraded transparencies, so we are not alone. The trend is not dramatic, but it is disturbing, there being no obvious cause. As always, Province Lake's transparency was less than the statewide median of 3.2 meters (10.5 feet), but is not unreasonable considering that we have a shallow lake, so sediments are easily stirred up. The shallowness means that it is important to educate lake users on the importance of operating jet skis and boats at slow speeds in shallow areas to minimize disturbance to sediments and vegetation. Churning up the bottom sediments releases phosphorus, which promotes algae growth, increases turbidity (scattering of light by suspended particles), and decreases clarity. The deepest part of the lake is only 16 to 17 feet deep, as shown on the bathymetric chart.

3. **Phosphorus** is a nutrient required for plant and algae growth and is typically the nutrient whose availability most limits plant and algae growth in NH lakes. The average phosphorus levels in the upper water layer in 2011 were slightly less than in the previous year (2010), while still being a bit more than the 6 years prior to that (2004-2009). At this time, the varying phosphorus levels appear to be simply a matter of natural variation, and not a cause for concern. As is typical for Province Lake, this level is slightly higher than in 50% of the lakes in NH (the median). The State's statistical analysis shows that the phosphorus concentration has **not significantly changed** since monitoring began in 1991.

In the lower water layer, the phosphorus levels were slightly more than in the previous 7 years (2004-2010), equaling 2002, while still being slightly less than 2001. Our lower level phosphorus was above the NH median, but approximately equal to

the median for lakes in NH that are similar to Province Lake. This is a good thing. Again, powered watercraft disturbance of bottom sediments is probably an important source of phosphorus for our lake. Too much phosphorus may increase the growth of plants and algae in the lake.

The phosphorus concentration at the Rt. 153 Inlet continues to be elevated, with its 2011 level a bit higher than in the previous 3 years. The phosphorus concentration at the Island Inlet on Bonnyman Road was lower than the prior 2 years. This supports my suspicion that culvert, bank, and road construction activity surrounding the Island Inlet sampling site in 2009 and 2010 was the main reason for the increase in those years and that the phosphorus has finally settled. Phosphorus clings to sediments, so soil erosion and sediment disturbance from road construction can increase phosphorus concentrations. Both inlet locations have a history of elevated and fluctuating total phosphorus concentration.

4. We have never sampled Province Lake for **nitrogen** as part of the monitoring program. However, a 1987 DES Lake Assessment Program survey determined that plant and algae growth in Province Lake is actually limited by the amount of nitrogen, rather than by phosphorus. Therefore, it is important to be sure nitrogen-containing fertilizers are not used near the shoreline, or streams or ditches feeding the lake, and to be sure septic systems are operating properly.

5. Province Lake experienced its first reported and confirmed bloom of **cyanobacteria** (also known as blue-green algae) in September 2010, when it had an official DES Lake Warning issued from 9/03/2010 to 9/15/2010. That sample was screened for toxins on 12/30/2010 and yielded 0 parts per billion (ppb) of toxin. When the bloom is in progress, there is no way for us to know if it is toxic or not, so we need to act as if it is toxic.

Last year, I discovered an apparent cyanobacteria bloom on Friday morning, 9/23/2011. I took photos and contacted the Cyanobacteria Hotline that day, but no one from DES visited. A later email from Sonya Carlson at DES said:
"Thank you for the links to the pictures of the bloom on Province Lake. While it is not definitive, that does appear to be a bloom similar to the bloom on Province Lake in 2010. ...
"The bloom conditions reported at Province Lake this year did not occur until well after the swim season was finished. Our swimming beach inspection program runs from Memorial Day through Labor Day. Although some people do swim year round, the bulk of vacationers are done swimming by Labor Day. Lake visits and inspections outside of the swim season are more difficult to accommodate since our staff is greatly reduced after Labor Day."

The message here is clear. While Province Lake is more prone to cyanobacteria blooms in September, DES is constrained from doing much about it then. Therefore, it is important to know what a bloom looks like and to act accordingly. If we suspect

we have a bloom, we'll try to make a posting to Facebook and/or the PLA web site. Having had September blooms 2 years in a row means we are susceptible to having them in future years, especially in late summer.
[Indeed, cyanobacteria blooms were seen, photographed, and sampled by lake residents, and confirmed by NHDES analysis in September 2012. The PLA sent emails to all members about this situation, and the content of those emails was subsequently posted to Facebook. The blooms were localized and dispersed quickly from any one location, so NHDES decided that a Lake Warning was not warranted in this case.]

As a reminder: If present in large amounts, cyanobacteria can be toxic to animals and humans. Large concentrations would be caused by a bloom, which would be seen as the formation of a green, blue, or pink surface scum in a section of the lake. Bear in mind that this is different from the tan or yellowish foam seen sometimes after strong winds. It will likely look different than what you have seen before September 2010. While recreational exposure to cyanobacteria toxins is a major concern of NHDES, **there have been no documented cases of cyanotoxin-related illnesses in New Hampshire**.

If you think you are seeing a bloom, stay out of the water and especially, keep your children and pets out of the water. Call the**NHDES Cyanobacteria Hotline at (603) 419-9229** to describe what you see. If suspicious, during "swim season" NHDES will sample and analyze the suspected bloom, then post a Lake Warning if there is any danger. They will monitor the situation and remove the postings when all is clear. The best ways to avoid having cyanobacteria blooms are by eliminating fertilizer use on lawns, keeping the lake shore natural,protecting against shoreline erosion, and properly maintaining septic systems.

6. A **pH** between 6.5 to 7.0 is ideal for fish. Ours in 2011 was an average of 6.7, just about perfect. The state average is 6.6. The pH at the Rt. 153 inlet was 6.0, equal to its long-term average. Since it drains a large wetland, it has a high concentration of tannic, humic, andfulvic acids, which give it the color of tea and reduce its pH. No problem is indicated.

7. The **dissolved oxygen** concentration measured in 2011 showed a high degree of saturation at all depths sampled in the deep part of the lake. A high oxygen level is a sign of the lake's overall good health. I encourage powered watercraft to operate far from the shore to mix the deep waters and boost the oxygen concentration, while minimizing their operation in the shallows.

8. Based on some elevated measurements made in 2010, ***E. coli*** **bacteria** sample testing was done on the campground brook in 2011. On 6/16/2011, the sample

location just before the brook flows into the lake had 360 counts per 100 milliliters (cts/100mL), below the state standard, but upstream at the culvert where Remick Road crosses the brook, the result was 1,060 cts/100mL, which exceeds the State standard of 406 cts/100mL for recreational surface waters. On 7/8/2011, those respective locations had 86 and "less than 10" cts/100mL. At a third location 200 feet upstream of the road, 10 cts/100mL was measured. This likely means that the source of the high readings is wildlife, not the campground. Since the brook has minimal outflow, it is likely that any *E. coli* counts here will have minimal effect on the lake water quality, however, these results do lead me to recommend caution about entering the brook's waters.

Reminders of Bigger Environmental Issues for Province Lake and Its Environs

Loons and Lead

A study published in 2009 [1] addressed the ingestion of lead objects by loons. Most birds swallow small stones to help them digest food. Many fishing sinkers fall into the size range that loons prefer. Being fish-eaters, loons have a lower stomach pH than waterfowl that eat vegetation, such as geese and most ducks. The lower pH more effectively dissolves the lead, which then kills the bird. Poisoning from ingestion of lead objects is the #1 cause of loon deaths in fresh water. Therefore, most lead fishing sinkers have been outlawed so, **if you still own any lead fishing gear, please stop using it immediately.** [See the 2008 report for more details.]

Earthworms

We have all learned that worms are our garden friends and make great fish bait. Until recent years, very few people realized thatearthworms are not native to post-glacial New England. In northern areas, like around Province Lake, you will notice that our woods have a thick layer of leaf litter and the soil is not mixed. This is because we don't have earthworms here. Our small native animalsdepend on the thick litter for shelter and native plants, such as lady slippers, need layered, unmixed soil. Without the litter and stable soil, they will eventually die out.
My point is that if you bring up or buy earthworms to use as bait, you absolutely should not release them on the ground. Either use them up, give them to someone else who can use them, or dump them in the lake, as far from shore as you can. Any soil you had the worms in can contain eggs or other life stages, so should not be dumped on the ground either. If you don't want to dump it offshore, you can put it in your freezer for more then a week to kill eggs or other life stages. Prevention is easy and is the only option. Once earthworms are established, there is nothing that can be done. The local ecology will slowly but surely be permanently damaged. If you already have worms living in your garden, don't spend a lot of time worrying about it. They may have been there for many years. There is nothing you can do about it except to be careful not to help them spread further. Since few people in the general public have heard of this so far, I am counting on you to spread the word to

your friends. If you are giving someone your worms, that is the perfect time to tell them.

Asian Longhorned Beetle

The Asian Longhorned Beetle is a tree-killing insect 0.75 - 1.25 inches long, with long antennae and a black body covered with white spots. It is an invasive beetle that was first detected in New England in August 2008 in Worcester, Massachusetts. As of July 2012, the Worcester quarantine area was 100 square miles. It was also discovered across the street from the Arnold Arboretum in Boston, but early detection and swift action has apparently completed eliminated that population. The Asian Longhorned Beetle affects you in two ways:

1. Please always use local firewood, to keep from spreading this beetle and other wood pests (such as Emerald Ash Borer) around. There are large fines for knowingly removing wood from the Worcester quarantine area. It is illegal to move firewood across most state lines in the Northeast now, and Province Lake is perched on a state line. Maine banned bringing firewood from other states into Maine, unless it is kiln-dried. New Hampshire has done likewise. This means you cannot legally take firewood across the lake from New Hampshire to Maine, or vice versa, so be careful not to get into trouble.

2. Watch for the beetle (July - October, most active in August), and more importantly, for signs of it.

- 3/8 to 1/2 inch diameter round exit holes, which may ooze sap
- Sawdust in tree crotches
- Tree leaves with only the midribs eaten out
- Trees dying from the top down (since the beetles and their larvae start eating at the top)
- Firewood with 3/8 to 1/2 inch diameter round tunnels through it, eaten out by the larvae

What To Do

-- If you suspect you have found evidence of the beetle, call **866-702-9938** from anywhere in the northeast US to report your possible discovery. Your call will be relayed to the appropriate agency, based on the area code you call from.
-- NOTE that all Asian Longhorned Beetle infestations in the US so far have first been discovered by individuals with no professional training. If you think you may have found something, don't be shy. Tell the professionals and let them check it out. This beetle can appear anywhere infested wood may have been moved to, which makes areas in and around campgrounds especially vulnerable.
-- You can learn much more at the following web sites:

- http://www.massnrc.org/pests/alb/
- http://www.uvm.edu/albeetle/

- http://www.dontmovefirewood.org/
- USDA ALB video

Other Web Site Listings

Last year's summary report will be posted LATER.
Prior year summary reports will be posted LATER.
The mercury in fish report from 2009 will be posted LATER.
Aquatic weed reports will be posted LATER.
I have created a Facebook page called "Province Lake, New Hampshire & Maine", which is not part of the PLA, but where people interested in the lake can share photos and information. As of September 2012, it has 50 members. It has been used in 2012 to provide pictures of localized cyanobacteria blooms and education about their dangers.

THANK YOU NOTE: I want to thank Steve Craig for taking the lead on the sampling activity since 2004. Each year the State report grades each sampling program and each year Province Lake receives Excellent ratings for sample collection and submittal. Thank you to Steve, and others who have helped out from time to time! We can always use more volunteers to help Steve with sampling, deliveries, or both, so please contact Steve or me, or any member of the PLA board if you are interested in helping out. You may also use the general PLA e-mail address, info@ProvinceLake.org.

Respectfully submitted,
Norm Dudziak, P.E., I.M.

FOOTNOTES:
1. Pokras, Mark; Kneeland, Michelle; Ludi, Anna; Golden, Ethan; Major, Andrew; Miconi, Rose; and Poppenga, Robert H. "Lead Objects Ingested by Common Loons in New England." Northeastern Naturalist 16(2):177-182, Humboldt Field Research Institute, Steuben, Maine, June 30, 2009.