Citizen Science – Boat Wake/Water Quality Study

By: Steve Wingate and Abigail Adams

Supposition: Cyanobacteria blooms and other water quality issues have been increasing in Lake Winnipesaukee waters as well as other NH Lakes. Cyanobacteria is concerning as it is known that some species are toxic if ingested, and this bacteria seems to be connected to serious health affects in humans, pets, and wildlife. Cyanobacteria blooms appear to be associated with increasing levels phosphorus and other fertilizing compounds in lake water. Two potential sources of these contaminants could be shoreline erosion and bottom disturbance where phosphorus is stored on soil particles and organic debris, also in dead and decaying algae, and or in bottom sediments.

Lake Winnipesaukee and many other lakes have dams originally used to store water for industrial waterpower. Today these dams may generate electricity but are primarily managed to enhance recreational boating, docking, and shoreline activities where water depths are shallow. Dam owners and or management agencies have not studied the environmental effects of dam management policies.

Ever increasing boat size and traffic, plus artificially maintained, high-water levels may be encouraging shoreline erosion and bottom disturbance. These conditions are likely compounded by a new trend in recreational boating called "wake boating, wake surfing or wake boarding." These activities involve a special boat with water tanks that can be flooded to make the boat ride lower in the water. When driven at moderate speeds, such boats displace large volumes of water, creating an exceptionally large wake for surfing or "wake boarding."

Today's average boat wake is considerably larger and releases considerably more energy than natural waves created by even the strongest of winds. The effects of these artificial waves are most noticeable in bays, harbors, and channels, which comprise the majority of shoreline waters in Winnipesaukee. The effects on the shoreline of waves generated by boats in general are compounded by the large, high-energy waves created by the wake boats.

Proposal: During the boating recreation season:

Measure water turbidity and phosphorus levels, and

Make observations of boating activity during periods of low and high boating use.

Methods:

- Volunteers will collect samples and make boating observations during the time when boating activity is anticipated to be low and also when it is high.
- Sampling periods would be seasonal, weekly, and daily. Seasonal dates would be:

Late spring when boating is underway but expected to be light, June 22 thru 27.

Fourth of July week, June 29 – July 5.

Mid-summer, Aug 3 – 8.

Labor Day week, Aug 31 – Sept 6 when boating activity will be higher. Likely variables here are lower water levels and higher temperatures.

Mid-September 14 – 19 when boating activity is likely to be very light.

Other variables will be the highest water levels and the coolest water temperatures.

Samples and observations will be taken one weekday, Tuesday thru Thursday and one weekend day, Saturday or Sunday. Volunteers will select which weekday and weekend day to sample based on weather forecast in anticipation of weather most conducive to boating activity and the least occurrence of potential variables such as rainfall or high winds.

Sampling times on days selected will be at 8am when boating activity is light and 2 pm when it

is likely to be heavy.
Samples and observation will be taken from the same location each period at the prescribed time. Volunteers will collect a turbidity and phosphorus sample from a depth of 0.5 M. This will be off a dock or pier at least 10' from shore where the water depth is at least 4' but not more the 6'. To minimize the possible effects of the dock structure, the sample will be taken at least 8 feet away from the dock and 0.5 M below the surface. (To facilitate this sampling, 10-foot PVC poles will be constructed with a right angle at one and a 3' leg. This will enable volunteers to insert a sample bottle in a tight fitting cup on the leg and dip the sample bottle in up to a 0.5 m mark). The turbidity samples will be recorded that day and analyzed with a meter. Turbidity meter and training to be provided by Bob Craycraft. The phosphorus sample will be sent to the UNH Lab for analysis. Phosphorous sample bottles will be labeled "Boat wake study" with location date and volunteer name.

After taking samples, volunteers will make observations.

- An observation line will be established, and same line and criteria used for each observation period. The line will start at the sampling point and go to an identified location on the opposite shore. (it is assumed that the sample location is in a harbor or channel, pond, or small lake.)
- The volunteer will count all boats that cross the sample line during a 5-minute (??) period and in addition, note the number of boats that are conducting "wake generating recreation i.e., "wake boating".

Other information recorded will be:

- Water temperature at 0.5 M,
- The nature of any floating debris (leaves, pine needles, grass clippings, aquatic vegetation – pipe wort – looks like a grass clod, floating algae, or blooms – algae scum).
- Observations should also include weather conditions and current lake level as measured at the outlet damn, available at, https://www4.des.state.nh.us/rti_data/WEIN3_TABLE.HTML
- Volunteers will be provided with data sheets which will include fill in lines for all information collected, check boxes for weather and surface observations and instructions where needed.

Expectations: (Disclaimer) This study likely does not have enough sampling periods to provide statistically significant observations, however, any observed trends could be used as justification for further, more intense sampling.
Increased boating activity results in increased wave action and wave energy striking the shoreline and disturbing the bottom. Those increasing events will result in higher measured turbidity and phosphorous in solution. Increased wake boat activities will further raise measured turbidity and phosphorous in solution.
There may also be a relationship associated with seasonal changes in water depth and or water temperatures. These variables could also have a canceling effect. The results could also show trends but provide information and experience that could lead to a better method of studying the issues.
Notes: This proposal is influenced by the authors, perceived availability to do sampling (time). This prejudice shows in the need to adjust sampling days relative to weather predictions, which could be opportunity for bias. If qualified and trained volunteers with more available time could be organized, there would be the opportunity to do a more scientifically and statistically valid

study.
Other possible issues worthy of study and suggestion could be the location and method of collecting turbidity and phosphorus samples and the method and period of assessing the degree of boat traffic. If the volunteer time were available, better information could be achieved from more frequent, periodic counts during the day (hourly?) and a longer counting period at sample time. This would be particularly true for assessing wake boating activity. The author has observed one to several families wake boating from a few passes to continuously for half a day. While a periodic count could vary significantly through the day, the result in measured water quality would probably show a constantly raising trend during the day.