

**HLLT + HLA Water Quality Meeting Minutes**  
**Wednesday, February 26, 2020**  
**Windham Public Works Multi-Purpose Room**

- **Welcome and Introductions**
- **Motion made to approve 9/17/19 & 11/4/19 meeting minutes. Motion carried.**
- **Public Comment period opened and closed with no comments**
- **Karen Wilson from USM and Jeff Dennis from the Maine DEP** – Reviewed the discussion items of the December 2019 science roundtable
  - Karen gave an overview of the science background. Number of questions (nutrients, indirect food web, unique abilities of picocyanobacteria, or a combination of all) including the facts we know about the lake:
    - Secchi depth readings are similar throughout the lake.
    - Bloom appears to be Cyanobium, a single cell picocyanobacteria, dominated the cyanobacteria present. The analysis of the eDNA left the scientists fairly certain that toxicity is not an issue, although it was suggested it could be and will continue to monitor for toxins.
    - Jeff added the following thoughts and reviewed graphs:
    - In 2018 there was a 40kg phosphorus increase in phosphorus from July to August during a dry season
    - In 2019 the same pattern of bloom started but crashed sooner than in 2018. Total phosphorus in the lake was 20% higher than in 2018 and the maximum occurred in June from a late spring runoff causing an external loading of phosphorus.
    - The bloom crash doesn't line up with the phosphorus reduction.
    - Phosphorus concentration in Highland Lake is average for Maine Lakes.
    - Phosphorus doesn't seem to drive what is causing bloom.
    - The bloom on Highland Lake is unique in North America
  - Alewives graph
    - Highland Lake does not experience high alewife numbers when compared to other lakes in Maine.
    - Other lakes with alewife populations do not experience blooms such as this.
    - Definitely a change in water clarity secchi readings beginning in 2012, which coincides with large numbers of alewives entering the lake.
    - 2018 & 2019 experienced a bloom but the clarity (secchi readings) was not as diminished and it disappeared more rapidly than blooms from 2014 through 2017.
- **Hypothesis #1-- Food Chain disruption due to Alewife migration.**
  - Larval alewives are overgrazing on nanoplankton that, in turn, eat the cyanobium. With the cyanobium predators greatly diminished, they flourish very rapidly within the lake
    - Early June – The cyanobium population is controlled by mixotrophic and heterotrophic nanoplankton grazing (including flagellates and ciliates) on the cyanobium.

- Late June/July – Larval alewives graze on nanoplankton, releasing Cyanobium from grazing pressure.
  - Mid to late July – Cyanobium blooms
  - Mid to late July – YOY alewives grow consuming larger prey and relaxing nanoplankton from consumption. The new food source for the YOY alewives also prey upon the nanoplankton. Now the alewives are not only not eating the nanoplankton, but they are eating the other predators of the nanoplankton. These two steps significantly reduce the pressure on the nanoplankton, and their population explodes.
  - Late July to August (in 2018 & 2019) – the rejuvenated nanoplankton population grazes on Cyanobium and bloom crashes.
  - In previous years when the bloom reached maximum levels and lasted well into August, the lag for the recovery in nanoplankton appeared to take several weeks longer than in 2018 and 2019.
  - Reducing phosphorus is overall good for the lake to slow eutrophication but won't eliminate the bloom. It may reduce it, but not eliminate it.
- Pete Countway of Bigalow Labs said that Highland Lake has laid groundwork that is vitally important and now we can go back and test for specific DNA.
  - Question: Why this isn't happening in other lakes with alewives runs? It may be that the rapid introduction and short length of time since the introduction that the lake has not yet responded to the influx of alewives. As time goes by, there may be different ratios of nanoplankton populations in the lake that are impacted less than what we had when the first large influx of alewives entered the lake. This impact may have occurred in other lakes years ago, and they have since reached a steady state balance that Highland Lake is still working toward.
  - Stocking Question: Would fully-grown stocked brown trout eat the larval alewives and minimize the problem? No, these larval alewives are not a source of food to the larger predatory fish like bass and brown trout until they are larger. The experts don't think there is connection between the end of stocking brown trout and the bloom.

- **Hypothesis #2 – There is phosphorus recycling activity in the lake**

- This hypothesis is trying to explain where the Total Phosphorus jump in readings came from in July 2018. The same may have been happening in 2019 but the peak after the bloom appears obscured by TP that were already relatively high as a result of spring rains.
  - Strong northerly winds move the water in a conveyor belt movement with surface water flowing south into the south basin, and the deeper water flows back to the north basin to replace the surface water.
  - As this is happening, an opposite flow is set up in the metalimnium/hypolimnion in the north basin. These flows can move more phosphorus that is released from the iron in the anoxic sediment to other parts in the lake to be utilized by various phytoplankton and/or to settle out in different areas of the lake.
  - This pattern could result in the recycling of phosphorous even though the amount of aluminum would suggest otherwise.
  - This phosphorus would then be available to the cyanobium to exacerbate the blooms, **but not cause them.**

- More sediment sampling is necessary to see if the iron is recycling phosphorus annually and to more clearly identify the pattern of aluminum to iron ratios in various areas of the lake.
  - The lake morphology difference between the north and south basins might contribute to the recycling, if this hypothesis proves to be true.
  - What are the material changes that can be completed to reduce phosphorus?
  - Phosphorus from erosional sources are coming from everywhere in the watershed.
  - Phosphorus made available from the horse farm from previous manure pile and the paddock areas must be addressed in the Watershed Management Plan.
  
- **Testing Protocol:**
  - What should we do on the lake this summer to validate or invalidate these hypotheses?
    - **Hypothesis #1** – identify specific testing that will either prove or disprove this hypothesis. The HLA will need to balance what is possible to do with funding & available manpower. In a perfect world one would repeat everything that was done in 2019. In a realistic world there can be some pairing down some of the measurements in certain time periods or depths in 2020. If the HLA volunteers could do the sampling regime for secchi, temperature profiles, phosphorus profiles, that would free up Karen and her staff for other activities. Oversight from USM and DEP from proper sampling collection protocol will be required to assure valid data.
      - Pete and Karen are involved in Maine eDNA sampling program. Karen doesn't have money to get a second intern and has no time to manage collection of limnologic data with her team. The HLA will have to fund a second intern if it is determined that one is needed.
    - **Hypothesis #2**
      - Establish a sediment sampling protocol to identify if there are areas of the lake sediment that may be recycling phosphorus. A grid of sample locations and timing needs to be established. Keith Williams and Karen Wilson to follow up with Stephen Norton.
        - Samples are normally taken before anoxia happens, typically before mid-June.
  
- **Heather reviewed Watershed Management Plan and previous history.**
  - HLLT leadership is crucial to success of this plan
  - This is a marathon and not a sprint
  - Heather would like HLLT to adopt the watershed management plan
    - Spring application for 319 funds. Doesn't need to be officially adopted by HLLT but EPA/DEP has to approve it.
    - Nathan thinks each town should be adopting these plans through resolution. Barry wants to know estimated cost.
    - Water Quality testing funding should be assigned.
    - Heather would like to pull together DEP edits and have HLA + HLLT meeting
    - Adopt at next month's meeting.
      - Nathan thinks it should be a resolution and embed 'no funding commitment'.
      - Pull together 319 application and share with town councils for approval.
  
- **Meeting adjourned.** Doodle poll will be sent out to schedule next meeting.