Synopsis for: " Phosphorus and phytoplankton dynamics in the Les Cheneaux Islands during a rapid rise in Lake Huron water level" 180416

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The LCWC studies nutrients in the water, primarily phosphorus, and the density of free-floating algae, phytoplankton, to get an idea of what the season's weed growth might be like. More nutrients means more weed growth. Less nutrients translates to less weed growth. The phytoplankton are also monitored because they also reflect the nutrients available that might trigger dense algae blooms in the water, turning it to pea soup as has long been a problem in Lake Erie. Rooted aquatic weeds like Eurasian watermilfoil get most of their nutrients from the bottom sediments and algae get their nutrient directly from the water.

Fortunately, with exception of the aggressive Eurasian watermilfoil growth in 2012, we have never experienced extreme algae or weed growth . That is one reason we need to remain vigilant in tracking these nutrients.

So what happens when we get a rapid rise in lake level as we have witnessed since January of 2013, the record low point for Lake Huron water level? From 2013 to the end of 2015 we experienced a 37 inch rise in lake levels. An unprecedented lake rise for a two year period.

Our channels are dredged to seven ft and high traffic bays such as Cedarville and Sheppard have mostly the same depth. To experience another three feet of water means that the nutrients in those channels and bays have essentially be diluted by about 30%. What effect does that amount of dilution have on the weed growth, phytoplankton growth and availability of nutrients? That is what this paper addresses.

Please refer to the full text to view Figures.

Fig. 1. Shows chlorophyll-a declining from 2013 to 2014.

This is explained by:

1. Chlorophyll-a is extracted from the phytoplankton and therefore is an indication of phytoplankton density during this 4 yr period.

    a. Why the increase in chl-a from 2012 to 2013?

        1) Year 2013 saw a 12-14 inch rise in lake level. Therefore, why do we see the phytoplankton increasing if, as conjectured above, the nutrients would be diluted by the lake level increase?

        In addition to lake level increase, there was also a significant die off of Eurasian watermilfoil in both Cedarville and Sheppard Bays. The degraded plants would provide excess nutrients for phytoplankton and one could, therefore, expect an overall rise in the chl-a levels the following season, as is the case in Fig. 1.

    b. By 2014 it is suggested that the excess nutrients for phytoplankton growth had largely been metabolized in 2013 and with a continued rise is lake level the available nutrients were diluted and therefore the algal population was lower than observed in 2013.

c. Lower chl-a levels recorded in 2015 follow the same pattern for reasons stated for 2014.

Fig. 2. Here we get a look at nutrient availability vs algae populations for this period.

a. The form of phosphorus that is most readily utilized by algae is Soluble Reactive Phosphorus, or SRP.

b. As before, the algae (or phytoplankton) density is reflected by the chlorophyll-a (chl-a) and is measured in the laboratory.

c. Recall from Fig. 1 that Chl-a decreased in concentration from 2013 through 2015. Those values are shown in this figure as well. We also see the nutrient of concern, SRP rises through the same three season period.

1) If algae densities were dropping it would follow that the SRP would not be as much in demand and would be expected to rise, which is the case.

2) The SRP rise is exceptional in that it would be expected to decrease due to dilution from increased lake level, yet the curve continues to rise making the effect of lower SRP demand by algae even more pronounced.

Fig.3. This figure shows that the relationships posed above are internally consistent.

a. Again, the Chl-a decreases from 2013 to 2014.

b. Another form of phosphorus is now included: Total Phosporus (TP). For purposes of this discussion we will deal with two forms of phosphorus: Soluble Reactive Phosphorus (SRP) which is the form most easily metabolized by phytoplankton (algae) and Particulate Phosphorus (PP), a form that requires either chemical or microbial conversion to a usable form and which is most commonly the energy form plants rooted in the sediment. TP is the sum of PP + SRP.

c. Of significance here is that the SRP curve is lower than the TP curve. This indicates that all values are consistent. It should also be noted that each of these data points is taken from seasonal means for 12 different LCI sites and represents 60 independent measurements, lending increased reliability of the data.

Fig. 4. This series of graphs shows how SRP and Chl-a relationship for individual sampling stations through LCI during the three year period.

a. The point here is to look at the overall position of the SRP curve vs the Chl-a curve.

b. When algae have a constant demand for SRP as their nutrient source the curves will be very close together. As the demand by algae decreases, the SRP curve will appear higher than the Chl-a curve, indicating less demand.

c. This relationship is indeed seen during 2014 and 2015.

1) The SRP curve is consistently above the Chl-a curve for 2014 and the distance between the two curves is even greater in 2015.

2) Therefore, all data shown from Fig. 1 through Fig. 4. are consistent and support the concept that, for whatever reason, the density of algal populations in LCI declined from 2013-2015.

Temperature did not appear to be a factor in algae population decline. The temperature decreased in 2014 but increased to 2012 levels in 2015.

One explanation for the decline in algae density throughout LCI is that their nutrient base had been diluted as a result of the 37” rise in lake level during a two year period.

As of this writing it is not known if the observed shifts in phytoplankton density and phosphorus concentration were in response to an abrupt water level increase, the rapid demise of Eurasian watermilfoil, a combination of the two, or if a review of LCI water chemistry archives will exhibit a similar pattern.

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