Rapid decline in Eurasian watermilfoil and planktonic algae in Les Cheneaux waters over a four-year period.

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Three lines of evidence suggest that characteristics of Les Cheneaux waters have changed during the past four years as reflected by a sharp decline in stemmed aquatic plants, especially Eurasian watermilfoil (EWM), and in free-floating algae (phytoplankton) densities. This is not to say that LCI water quality has declined. In fact, the recreational water quality of LCI waters is excellent. The shift in EWM and plankton densities appears real and with the decline of EWM as well as the plankton community long term shifts in the lower aquatic food web could occur. Changes in the lower food web can affect the invertebrates populations such as dragonflies, mayflies and damselflies which, in turn, can affect the fishery.

Eurasian watermilfoil density decreased by 80% from 2013 through 2016 as determined by quantified surveys conducted by Enviro-Science biologists and Mark Clymer (Fig. 1). The decline was statistically the same for EWM in the two most infested bays, Sheppard and Cedarville, for this period.

The drop in EWM density was also uniform for 10 of the 11 survey sites throughout LCI between 2013 and 2016 (Fig. 2). The anomaly was a middle entrance site where the EWM population was low for the entire period. A map showing Point Intercept sites and annual counts from 2013 through 2016 is provided in Appendix A. This map provides a visual feel for the downshift in EWM density.

Two other lines of evidence are the decrease in algae concentration and the simultaneous rise in Soluble Reactive Phosphorus (SRP), a primary algal nutrient during the 2013-2016 period (Fig. 3). As the planktonic algae community decreased, the SRP concentration increased throughout LCI waters. Each of the data points represent analysis of samples from 12 sites monitored 5 times per season, or a total of 60 data points used for each dot on the curves. With SRP being a primary planktonic algae nutrient, it follows that SRP concentrations would increase if the algal population had less demand for using it as a nutrient.

No reasons for the drop in EWM and planktonic algae during this period are obvious. In the case of EWM, it could be that inhibitory metabolite concentrations became elevated during the time of intense growth in Sheppard and Cedarville Bays in 2011 and 2012 and were reflected by decreased densities during the past four years. Similarly, natural EWM vectors such as virus, bacteria or fungi could have risen to levels which caused the crash. Included in those possible vectors are the native fungus that LCWC has been experimenting with and/or an increase in the native weevil population.

Reasons for the observed EWM crash do not translate as contributing to the algal decline. One explanation for the decline of algae could be the rapid 38 inch increase in Lake Huron level during the same period. Inflow of the nutrient-poor water from L Huron would decrease total nutrients available to both algae and EWM. The deeper water would also permit less light to reach the EWM early in the growing season. The answers are likely more complex than this and LCWC will be vigilant to learn more from our own studies as well as studies being conducted in our area by multiple universities.

A steep downward trend in Eurasian watermilfoil (EWM) density in Cedarville Bay (CB) and Sheppard Bay (SB) observed from 2013 through 2015 continued during the summer of 2016 (Fig. 1). EWM presence at eleven sites throughout the islands were monitored for EWM growth during 2013 and again in 2016. EWM density at ten of the eleven sites dropped precipitously during this four-year period (Fig.2.) One site, the Middle Entrance, had higher EWM density in 2016 but the density was so low in both instances that EWM values are considered of little importance relative to all other sites monitored.

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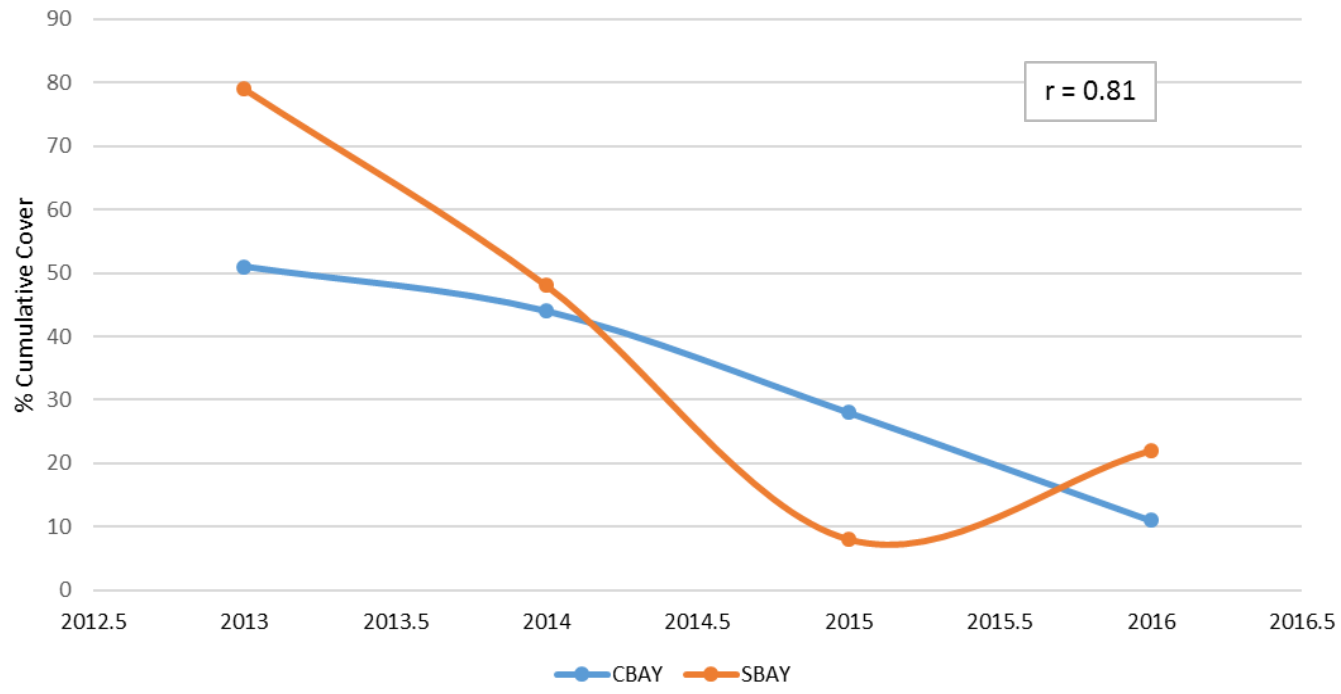
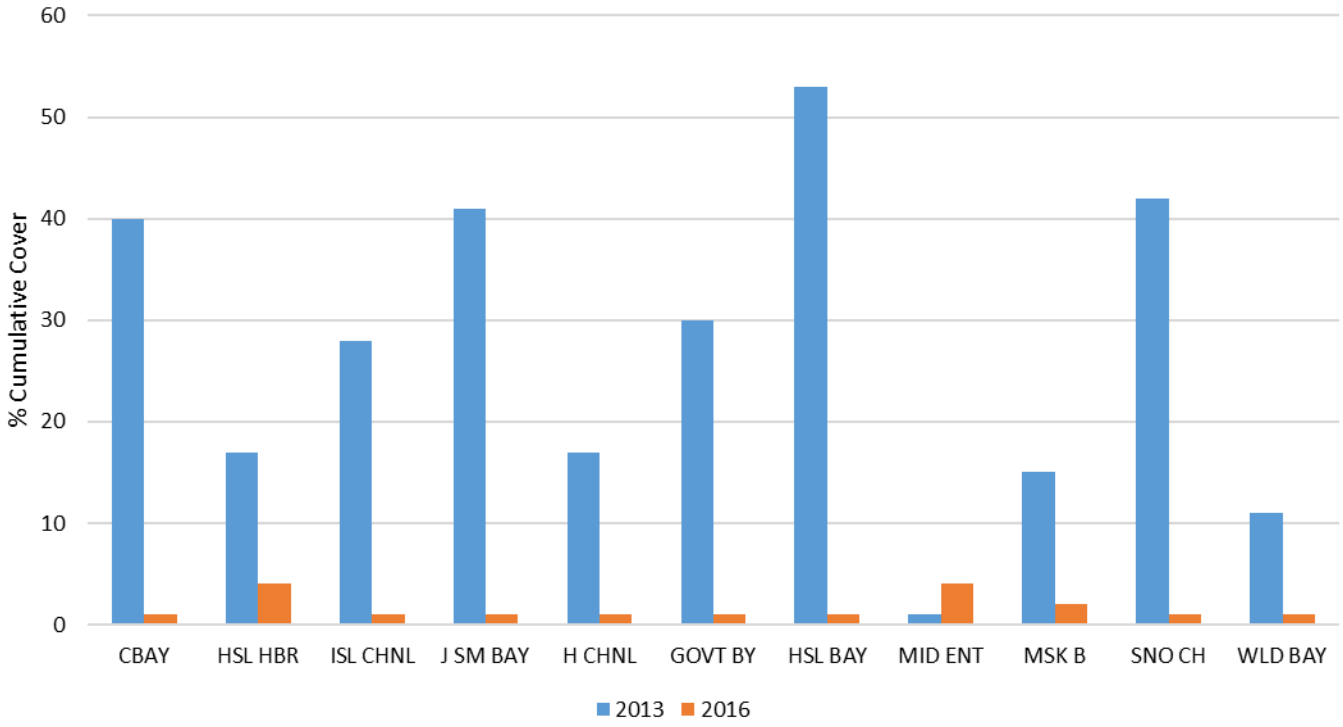
Fig. 1. EWM trends expressed as % cumulative cover for Cedarville and Sheppard Bays <ESI CBAY VS SBAY 4YR 031216 O5> data from ESI T 3.1 and T 3.4, 2016



EWM TREND IN CBAY AND SBAY FROM 2013 THROUGH 2016 EXPRESSED AS PERCENT CUMULATIVE COVER FROM POINT-INTERCEPT ANALYSIS
ESI CBAY VS SBAY 4YR 031216

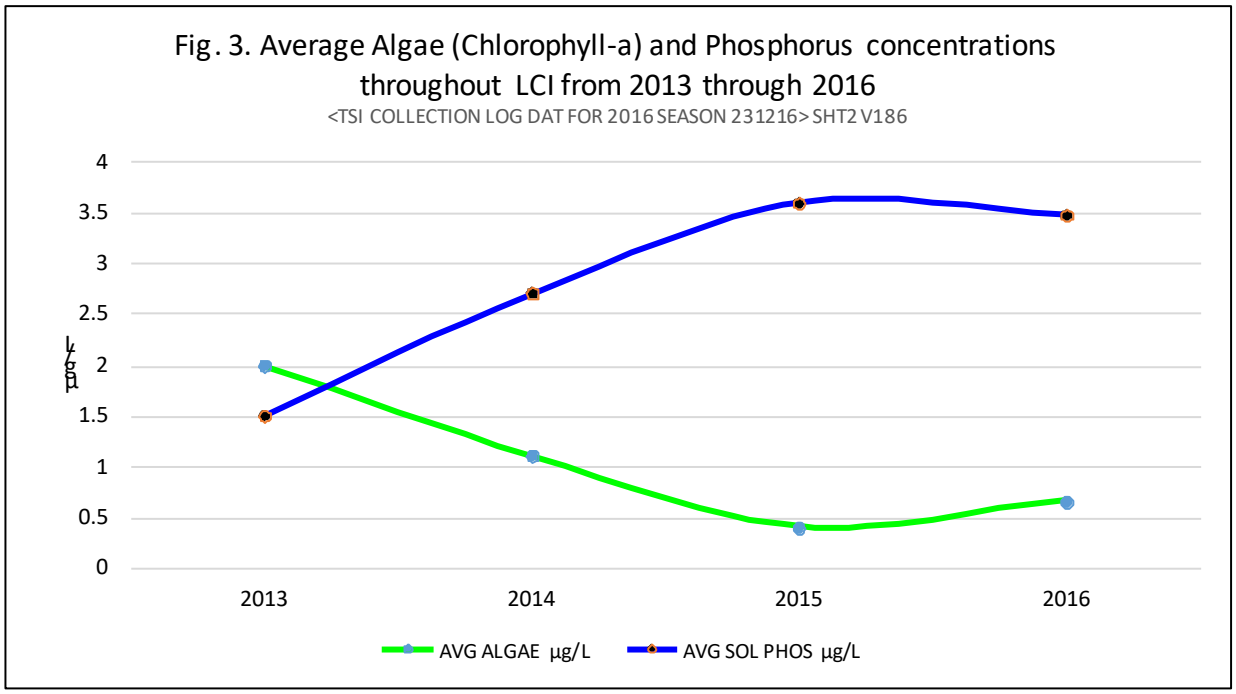
LEGEND
-Number of annual observations from 2013 - 2016 for CBay were n=146,146,113 and 146, respectively.
For SBay annual observations were n=147,147,120 and 143, respectively.
Correlation coefficient for the two data sets is: 0.81
-Data source: Table 3.1 for CBay, T 3.4 for SBay

Fig 2. EWM PRESENCE AT 11 LCI SITES REPORTED AS % CUMULATIVE COVER BASED ON AVAS ANALYSIS FOR 2013 VS 2016 <ESI CBAY VS SBAY SHT 2 AC50>



Comparison of EWM at 11 different LCI sites as reflected by AVAS analysis exhibits a pattern similar to PI analysis. Sheppard Bay not included in this figure because there were no 2103 data.

Observations:
--- the phenomenon of significant EWM decrease from 2013 through 2016 was common throughout LCI.
--- temp was an unlikely factor due to annual temps in Gov't Bay, Mid Ent and Wld Bay are appreciably lower than in the more shallow areas examined.



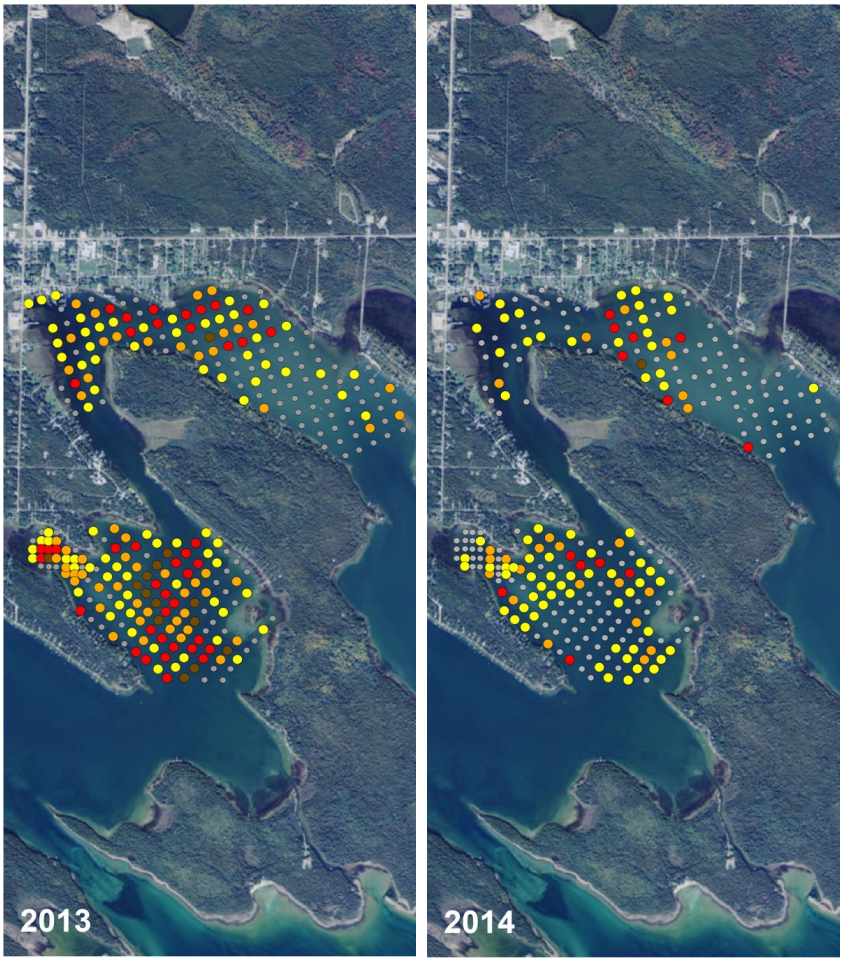
In a manner similar to the quantified decrease in macrophyte densities throughout LCI, a similar and significant decrease in phytoplankton was also quantified during the same period (Fig. 3). During the period of plankton decrease the soluble reactive phosphorus, or SRP,(the form readily metabolized by plankton) was observed to increase. This pattern is believable in that less demand from phytoplankton would be reflected in a rise in SRP concentration. Indeed, the slight plankton increase between 2015 and 2016 is accompanied by a perceptible decrease in SRP.

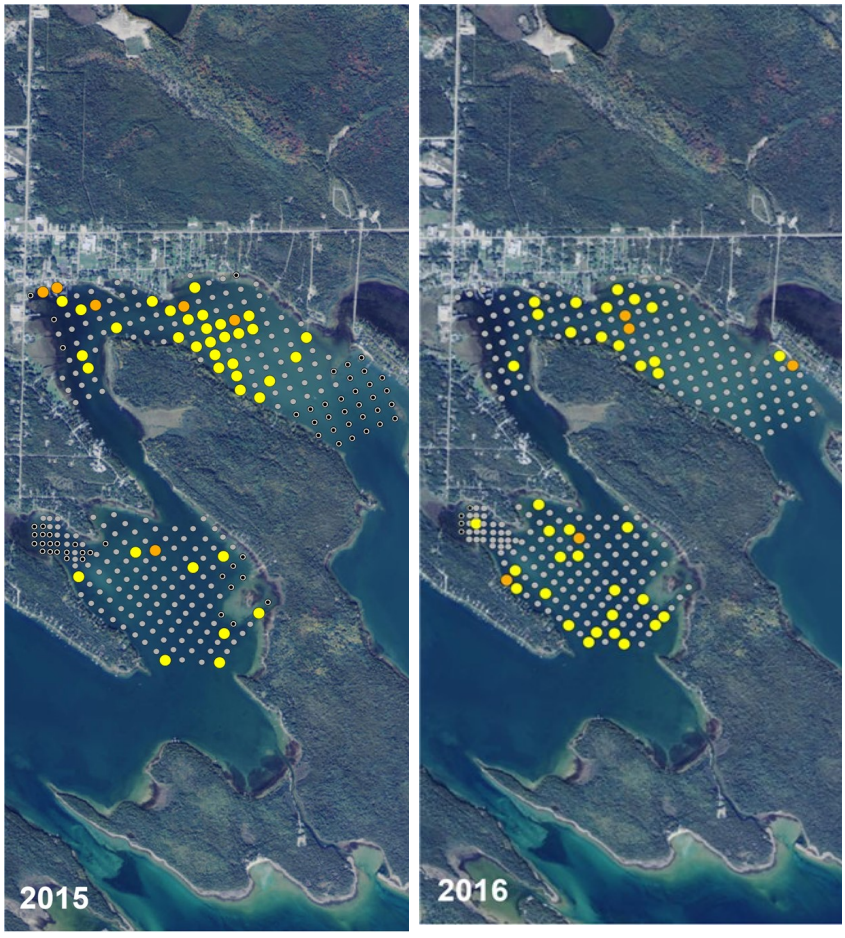
DISCUSSION: Reasons for the steady decline of EWM from 2013 through 2016 are unknown. Possible contributors could include:

- Natural chemical inhibitor to EWM growth produced by the plants themselves during times of intense growth in Cedarville and Sheppard Bays. The residual self-induced inhibitors could affect EWM population density for multiple years. This argument does not hold for areas where EWM growth was less dense than in these two bays.
- Build-up of natural EWM pathogens that could include: Fungi, Bacteria, Virus, Algae and Periphyton. These vectors could easily spread throughout the islands to influence the drop at ten different locations observed between 2013 and 2016 (Fig. 3).

Rapid rise in lake level: 38” from 2012 through 2016, thereby diluting nutrients in the water column and limiting light penetration relative to the pre-2012 lake level.

APPENDIX A





Point Intercept Map of Cedarville and Sheppard Bays from 2013 through 2016.

- Observations were made during August of each year.
- Cedarville Bay EWM annual counts were:
- 2013: 72 with PI value of 52
- 2014: 37 with PI value of 45
- 2015: 33 with PI value of 27
- 2016: 18 with PI value of 12
- Sheppard Bay EWM annual counts were:
- 2013: 111 with PI value of 78
- 2014: 70 with PI value of 48
- 2015: 9 with PI value of 8
- 2016: 22 with PI value of 22

Correlation coefficient comparing data sets from the two bays is 0.81