WHITE LAKE Property Owners Association Environment Volunteers

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Special Report

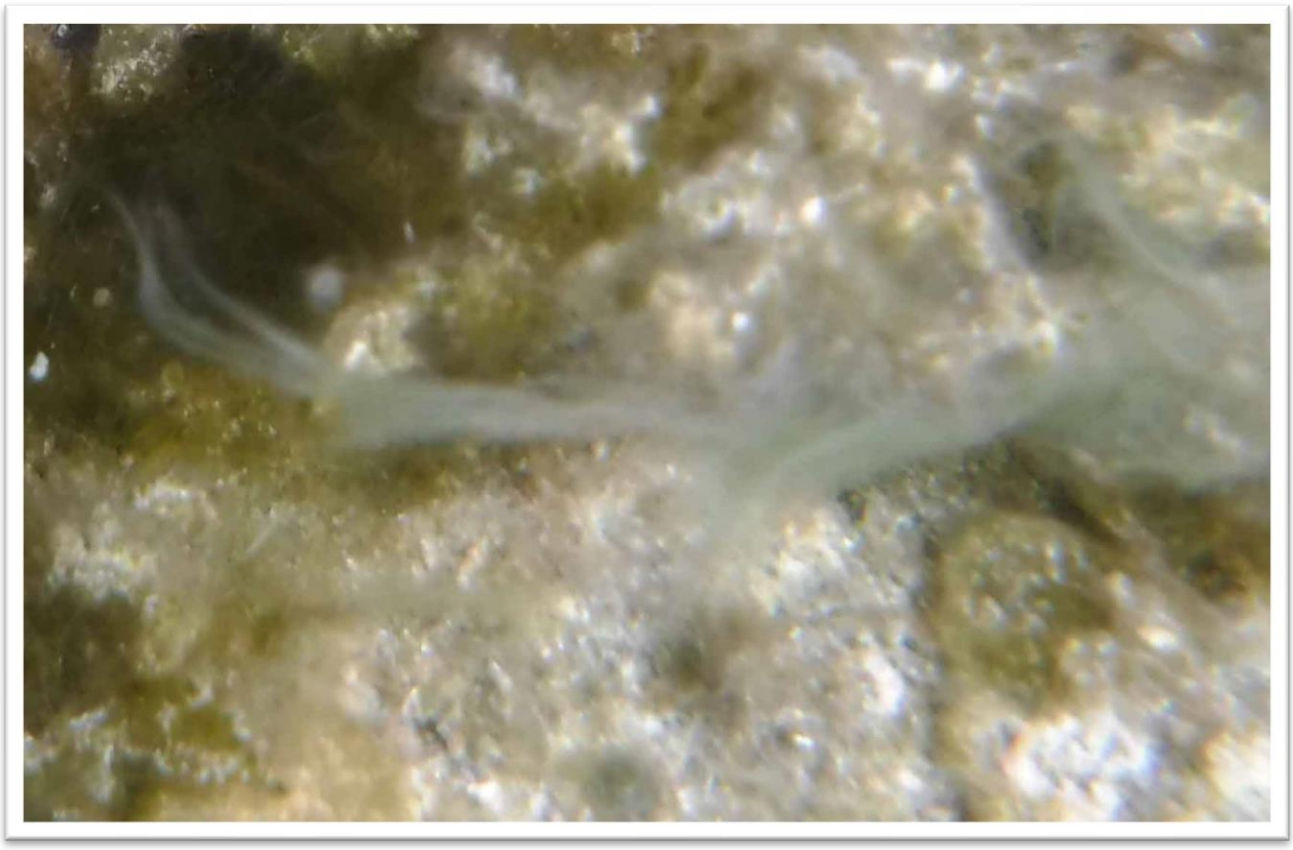
Propagation of Zebra Mussels in White Lake 2016 to 2021

Introduction

Anyone who maintains a floating dock and removes it in the fall, is intimately aware of the successful reproduction of zebra mussels in White Lake. Last summer, zebra mussels settled onto smooth flat surfaces like the underside of flotation pontoons. By late fall they appeared to be evenly spaced and of a similar size. These are the survivors of the 2021 zebra mussel breeding season. It is known that many zebra mussel shells approach adult length or at least achieve a third of their potential maximum length within the first year of growth.

Zebra mussels harvested from a floating pontoon, 2021

For successful reproduction, male and female zebra mussels must release sperm and eggs into the lake at the same time. This is called synchronicity, a process which depends on the release of a chemical signal between male and female mussels. Zebra musselss are but one of many species that release unfertilized eggs into the open water. Once secreted into the lake, fertilization must happen quickly. This is important to the mussel as any chance for fertilization decreases exponentially with increasing time and distance. The hormone seratonin is thought to act as the trigger. Every year millions of eggs will fail to be fertilized, however our floating docks show this strategy for reproduction works only too well for zebra mussels! The photo below captured what appears to be a spawning event between zebra mussels at Curley's Island.

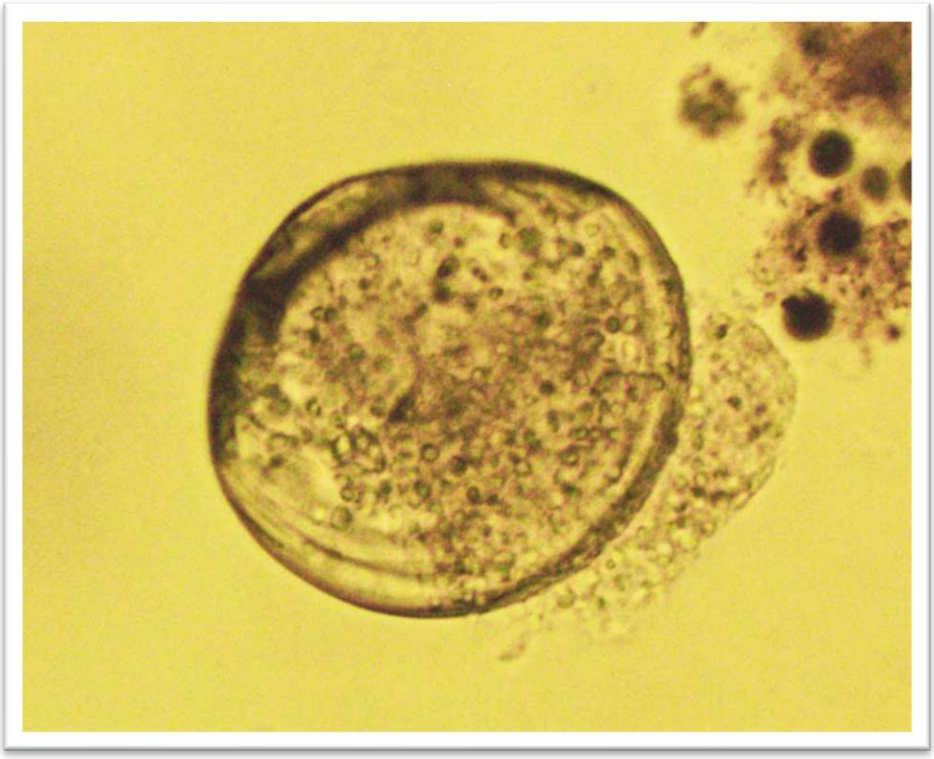


Spawning event at Curley's Island: 19 August, 2018

White Lake Zebra Mussel Veligers: 2021

In 2021 we followed the cycle of zebra mussel veligers in the open waters of White Lake. Veligers are microscopic free swimming larvae of zebra mussels. For a short period of time they form a significant part of the free swimming plankton community. As

planktonic veligers, their challenge is to not be eaten by predators such as fish nor be ingested by adult zebra mussels.



A veliger with the exposed vellum it uses for feeding and swimming

Sampling for Zebra Mussel Veligers

Every two weeks, water samples are taken at nine stations on White Lake as part of the Ministry of the Environment's Lake Partners Program (LPP). At these times, we also take a sample of the water column using a net for our own observations of planktonic life. The 80 micron mesh is the same size as used in the LPP water filters. The sample is taken by either a horizontal or vertical trawl and the length of the sweep is recorded. The filtered material is concentrated to 80 ml or less and allowed to settle for 30 minutes. Veligers are heavier than most other plankton and will settle out quickly. The sample is then examined under a microscope at 40x magnification and any veligers present are counted.

The photo below shows part of the sample count from Three Mile Bay on June 13, 2021. The net sweep of 4 metres represents a volume of 12.5 litres in which 2,784 individuals were found. This result indicates that at least 223 veligers/litre were present at that location on that date.

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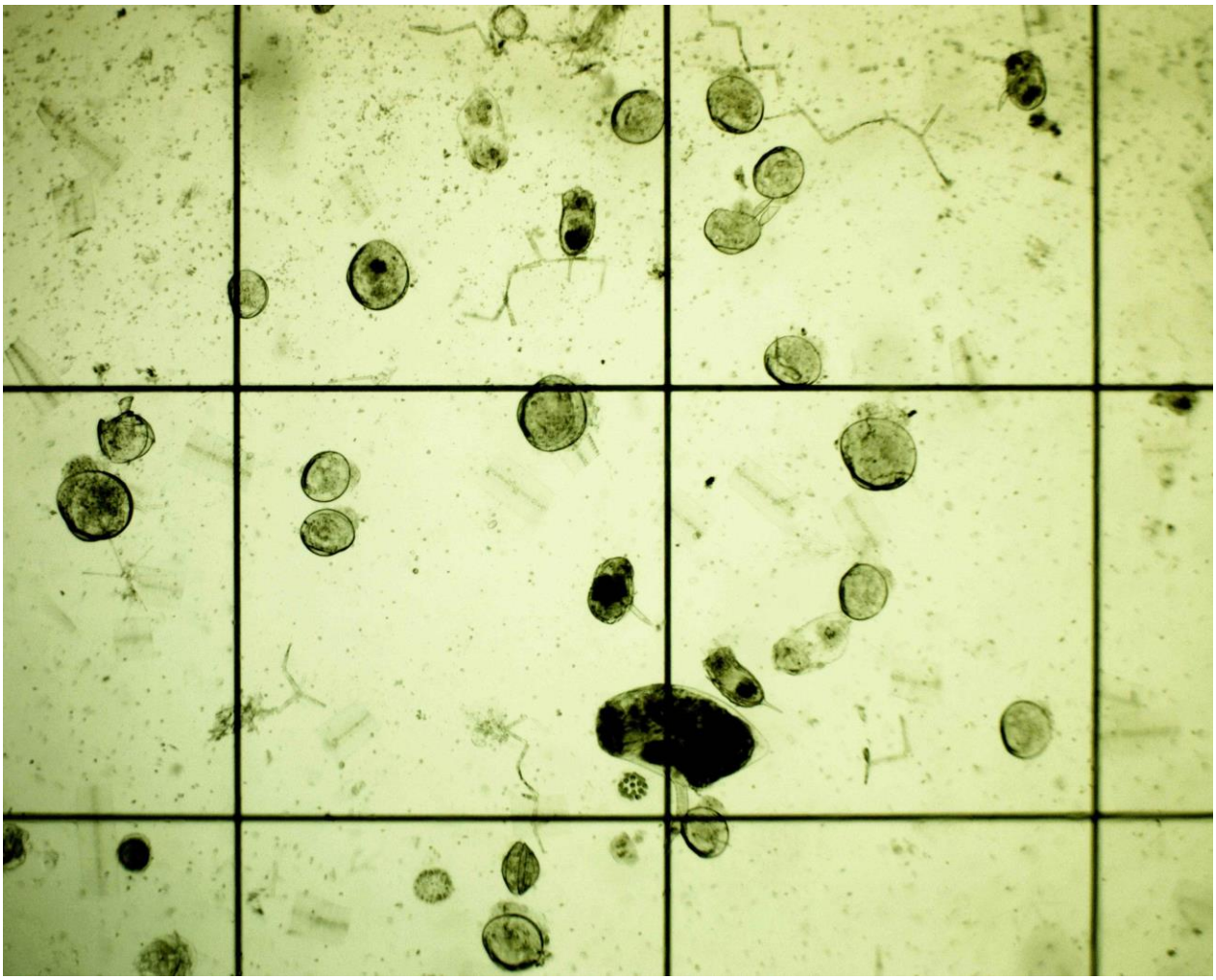
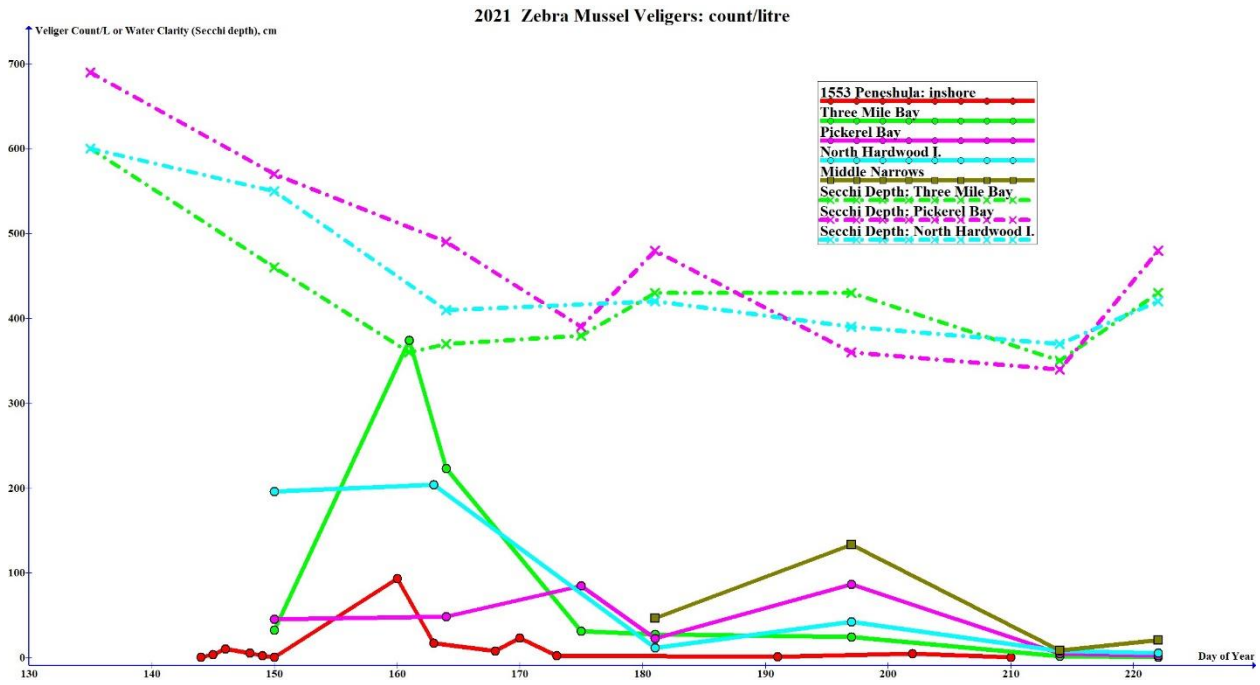


D-shaped veligers in Three Mile Bay June 13, 2021 Day 164

Frequency of Occurrence of Zebra Mussel Veligers in White Lake: 2021

Results from the veliger survey are displayed in the following graph. Each colour refers to a specific sampling site. Solid coloured lines represent veliger counts at particular sampling stations. Veliger counts are expressed as veligers per litre. The red-dotted line represents an inshore location where depth was less than 2 metres. Secchi depths (water clarity) are represented by the broken coloured lines indicating a Secchi reading at that location on a particular day. Depths are given in centimetres. These Secchi depth readings are the same ones taken for the LPP program.



The above graph reveals a number of facts:

1. Shallow Secchi readings indicate the presence of more suspended material in the water column when compared to other days.

2. At each sampling site, there is a relationship between Secchi depth readings and veliger counts. As veligers increase in number, there is a corresponding decrease in Secchi depths for all sampling sites. Veligers contribute to decreasing Secchi values, but it is the abundant phytoplankton that veligers are feeding on that generates more shallow Secchi readings. As veligers decline in number, Secchi depths and hence water clarity increases.

3. Pickerel Bay (purple line) had a smoother trend with smaller peaks in veliger counts when compared to Three Mile Bay or the North Hardwood Island sites. The Pickerel Bay sampling site is more distant from zebra mussel spawning beds, so it has an averaging effect on the counts as veligers arrive from many different locations and at different times. The exact time of a spawning event occurring in other parts of the lake may not be indicated in these data.

4. Three Mile Bay, North Hardwood Island and the inshore site show major spikes in veliger counts, while Pickerel Bay shows a delayed rise and lower counts.

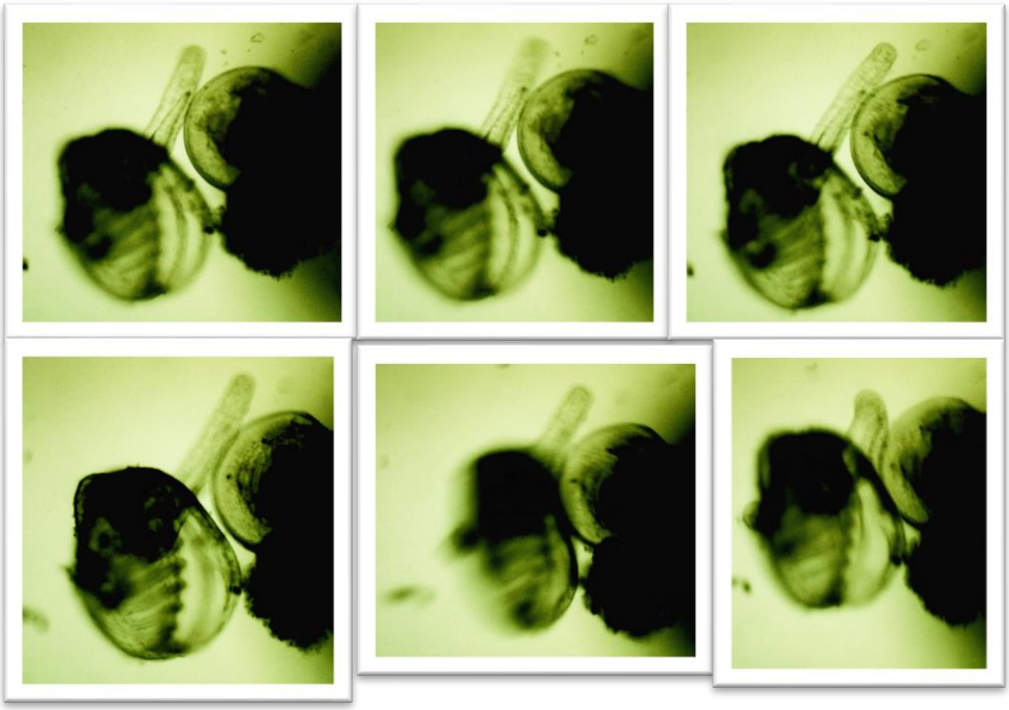
5. The single inshore site is in close proximity to weed beds and a rocky shoreline. These conditions allow for the sampling of a local spawning event which is less subject to influence from more remote locations.

6. The graph also shows that veligers are present thoughout the summer. There is no ‘safe’ period when water can be taken from the lake without the risk it being contaminated by veligers.

Veligers may well be the major cause for the spread of zebra mussels in Ontario lakes. A source for much of the contamination could be from transported bilge water in watercraft. A vessel moored for a few days could attract the settlement of pediveligers which are virtually invisible to the unaided eye. As the name implies, 'pediveliger' refers to the stage in a veliger's development when it has grown a 'foot' which can be used to move around on a solid surface. This is all the more reason for White Lake residents and guests to maintain a clean boat policy whenever watercraft are transported off the lake.

White Lake Pediveligers- Veligers with feet

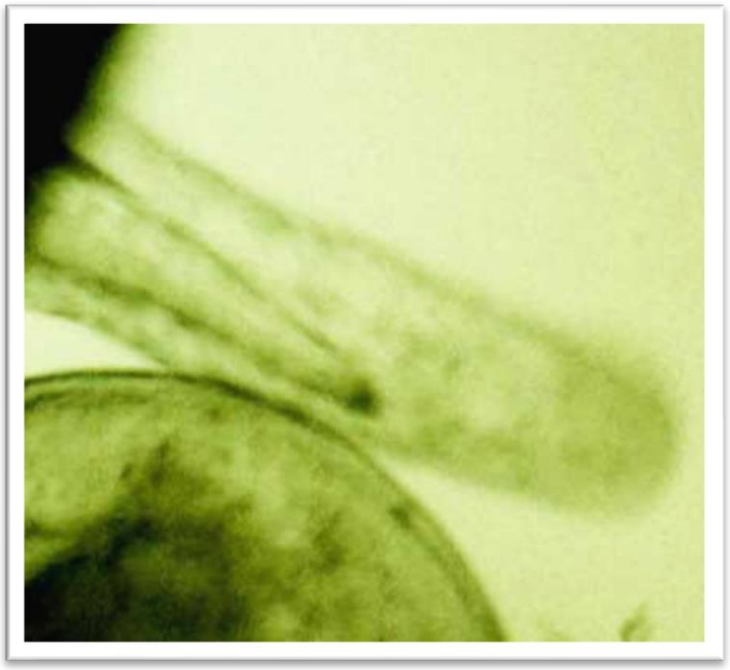
Veligers that survive through the plankton stage face another life challenge. As they grow beyond 0.15 mm in length, they also grow a foot for a future life as adults attached to hard surfaces. But first they must find a secure footing. Foot development continues regardless of whether a suitable hard surface is available. Pediveligers will not survive if they settle into the soft oxygen poor sediment of White Lake. Video images below capture a pediveliger foot in motion.



Pediveliger with extended foot: Three Mile Bay, July 3rd 2021; magnification: 100x.

Pediveligers and juveniles can relocate after they have settled. They will seek out shaded and less exposed surfaces. They also move towards each other to form clusters. Both juveniles and adults retain the ability to crawl with their foot.

Pediveligers secure themselves by a mucuous thread that is moulded and extruded by a groove in the base of the foot (see the photo below). These 'byssal threads' are laid down daily and their number will depend on the degree of environmental stress experienced by the zebra mussel.



Zebra mussel foot and groove

The First Year Cohort of Zebra Mussels in White Lake: 2021

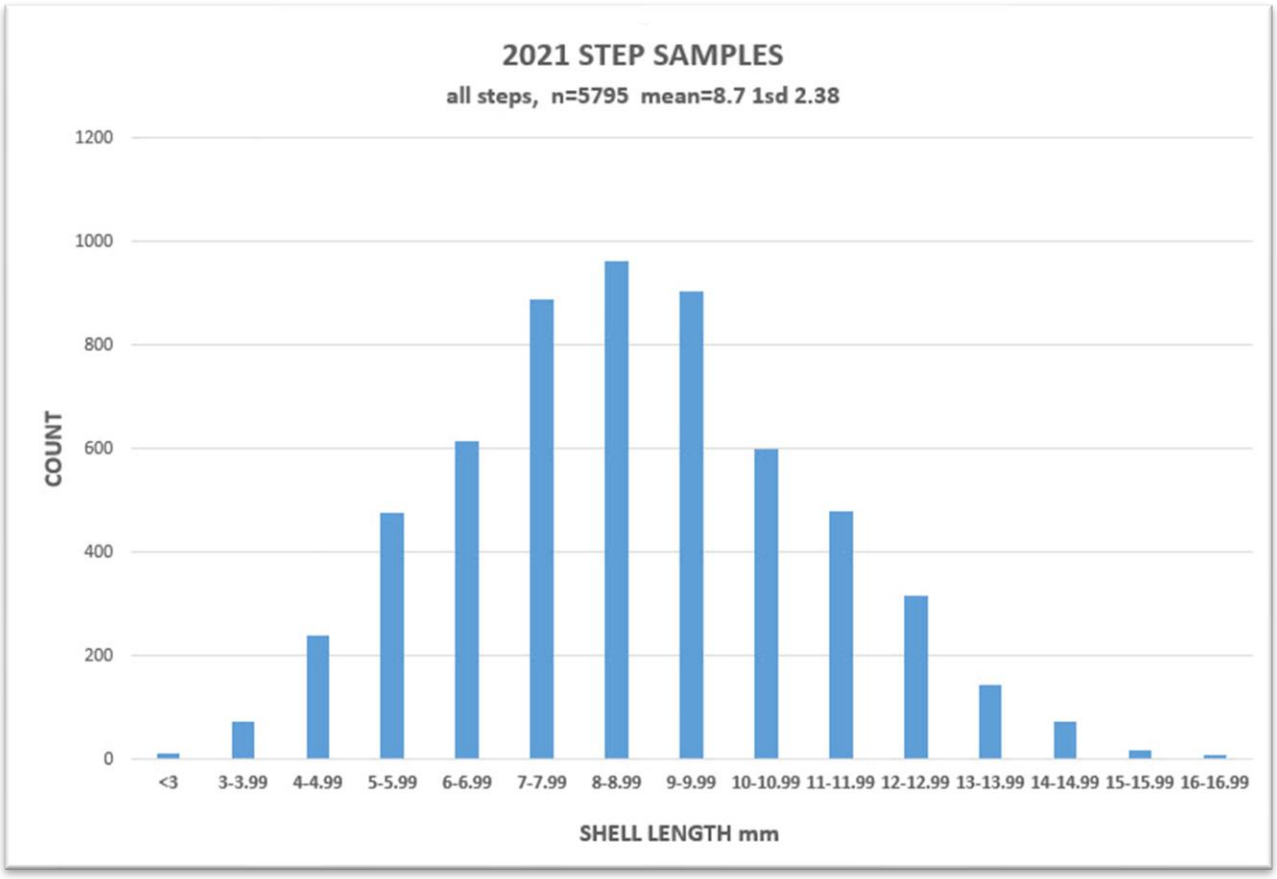
To gain an idea of survivorship for the 2021 cohort, we used an aluminum boarding ladder suspended off a floating wharf located 30 feet from the shore. Each of the five steps had a plywood strip attached to it's underside. Steps were separated at one foot intervals. The upper step was emmersed 4" below the surface. Steps were left undisturbed from May 17 until October 11, 2021, a period of 145 days. Harvesting involved the complete removal of zebra mussels from both sides of ~~an exposed~~ a plywood strip secured to the undersides of the steps. The photo below illustrates the underside of a step before harvesting.

Underside of third step: October 11, 2021

Size measurements were made with a digital micrometer unless individuals were less than 4 mm.
Measured lengths were plotted as a frequency distribution which we have done in previous years starting in 2016. (See previous White Lake Water Quality Reports)

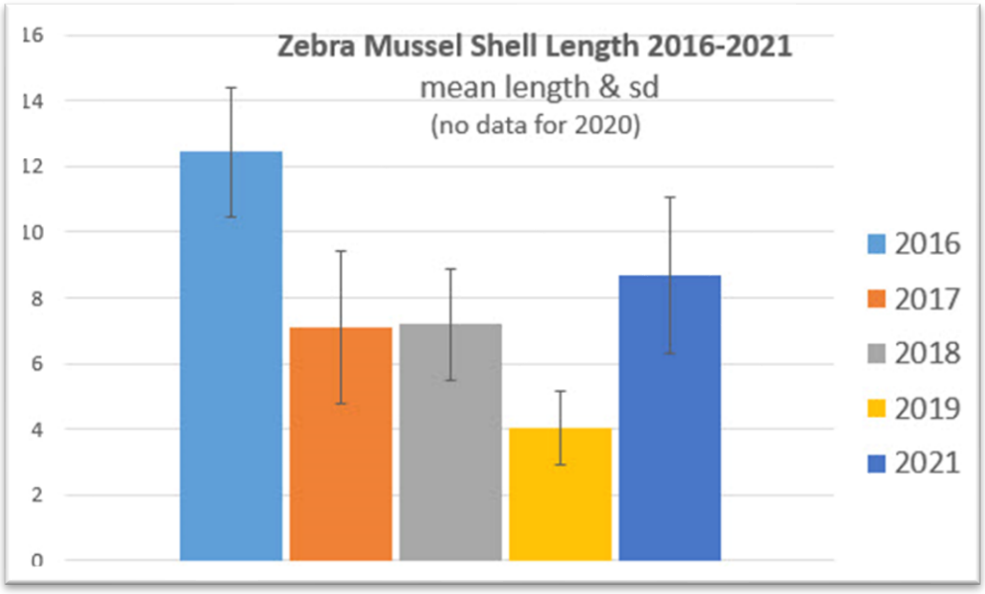
Distribution of Shell Size for the First Year Cohort of 2021

The 2021 frequency graph (below) shows a normal distribution for shell length with a mean value of 8.7 ± 2.38 mm (1 standard deviation). The overall range in size (2.4mm to 16.9 mm) suggest veliger settlements occured continually throughout the summer. This is in agreement with our veliger count survey. Production diminished significantly for sizes under 4 mm by the fall. It is likely difficult to separate individual spawning events in a headwater lake where veligers are retained and can accumulate in the water column during their free swimming stage and are not flushed downstream.



Changes in Recruitment of Zebra Mussels from 2016 to 2021

The figure below illustrates changes in the recruitmant (survival) of first year zebra mussels over the previous 6 years. These data suggest that recruitment is cyclical in



number and size, and reflects the mass die-off of the initial colonizing population. The reported age range of zebra mussels is thought to be about 3 to 5 years. The fourth year (2019) had the lowest harvested count and smallest mean size (4mm). Although we lack data for 2020, the 2021 data indicates zebra mussel recruitment is returning to values similar to those in 2016. We can speculate that this trend will continue in 2022.

A Comparison of zebra mussel populations from 2016 to 2021

	2016	2017	2018	2019	2021
Start Day	July 4	June 12	June 7	June 8	May 14
Retrieval Day	October 15	October 16	October 11	October 17	October 11
Days Immersed	103	126	126	131	145
Harvested Count	1680	5788	9026	3255	5794
Mean Shell Length, mm	12.4 ± 2.0	7.1 ± 2.3	7.2 ± 1.7	4.0 ± 1.1	8.7 ± 2.4
Size Range, mm	6-17	1.1 – 14.59	2.83 - 13.21	1.41 – 8.94	2.4 – 16.86
Wet Weight, g	422	341	161.4	48.5	727
Shell Weight, g	135	86.8	47.7	10.7	253.3

No data available for 2020

The above table shows that differences in shell weight to living wet weight ranged from 22% to 31% during the survey years. The 2019 data with the smallest mean value had the

smallest difference in weight (22%). The 2016 and 2021 data show a higher and similar weight range (35% and 31%).

The 2019 data had the second longest immersion period yet shell length achieved at best only 67% of shell lengths from previous years. The small mean size in 2019 suggests a late season start for zebra mussel settlement.

Estimation of Growth Rate of Zebra Mussels: 2016-2021

The following table is somewhat speculative in nature and is based on observations cited in this report. The analysis assumes a constant zebra mussel growth rate, and is based on the maximum length achieved for the maximum days available for growth.

This table suggests the bulk of zebra mussels (~70 %) establish themselves within a 24 to 44 day period. The timing of settlement for the bulk of zebra mussels seems to be shifting to later dates. There is the possibility this reflects a trend to periods of longer maturation and reproduction. Perhaps this trend is facilitated by a warming climate

approximations	2016	2017	2018	2019	2021
shell growth per day	0.165	0.115	0.104	0.068	0.116
days to mean length	75 days	61 days	74 days	58 days	75 days
day of mean length	day 214	day 228	day 210	day 232	day 209
date of mean length	Aug 2nd	Aug 16	July 29	Aug 20	July 28th
day range using 1 SD*	202-226	207-247	199-232	215-248	229-273
date range using 1 SD*	July21-Aug14	July26-Sept4	July18-Aug20	Aug3-Sept5	Aug17-Sept30

*Standard Deviation

Growth rate (mm/day) = maximum shell length/number of days of immersion
Number of days to reach mean length = mean length/growth rate
Number of days for SD interval = standard deviation values/growth rate
Date estimates = retrieval date – days of growth

March 1, 2022