

# Zebra mussel veliger density monitoring in Pelican Lake, Otter Tail County, MN, 2012-2016

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## Introduction

On September 29, 2009 zebra mussels (*Dreissena polymorpha*), were confirmed in Pelican Lake, Otter Tail County, by the Minnesota Department of Natural Resources. Zebra mussels are a non-native invasive species that first arrived to the Great Lakes region in 1988 via ballast water in trans-oceanic ships. Since 1988 Zebra mussels have spread throughout Minnesota and across much of the United States. Zebra mussels reproduce at alarming rates; an adult zebra mussel is able to produce up to a million eggs per year that soon develop into free floating veligers that are able to use byssal threads to attach themselves to any firm surface (USGS 2013).

In 2012-2016, the Pelican Group of Lakes Improvement District (PGOLID) monitored veliger densities throughout the summer on Pelican Lake in an attempt to calculate population dynamics and create a collection of data to be used for comparisons in future years of monitoring.

## Methods

Our methods follow Marsden 1992. In 2012-2014, Zebra mussel veligers were collected every two to three weeks between May and September in the same location the mussels were initially found in 2009 (Figure 1). The sample location provides an area for veligers to accumulate when a dominant west or Northwest wind is blowing. It also is an area where the Pelican River water funnels into the rest of the lake. In 2013 veligers were also collected monthly throughout the winter.

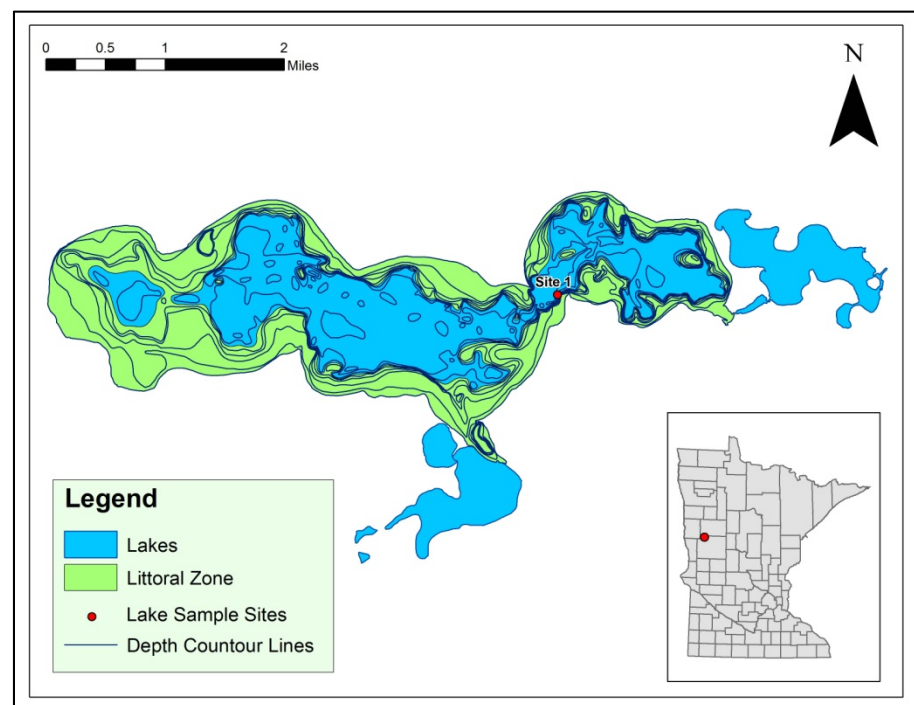


Figure 1. Location of first sighting of Zebra Mussels in 2009 and veliger sampling location on Pelican Lake, Otter Tail County, MN (-95.990847, 46.702906).

Sampling of veligers was done by conducting a 3 meter vertical tow using a 63 micron mesh net with a detachable cod end to collect the sample along with a rope used for retrieval. The sample was retrieved at

a rate of approximately 0.5m/second. The net was then thoroughly rinsed from the outside using gallon jugs of distilled water and a squirt bottle. The cod end of the net was then removed and the mesh screens were thoroughly rinsed to detach any organisms that might remain on the screen. The contents remaining in the cod end were poured into a wide mouth bottle and preserved with 80% ethanol (ethyl alcohol) for future analysis.

Zebra mussel veligers were identified using a magnification lens and dissecting microscope. The collected sample was filtered by pouring it into an 80 micron sieve and diluting the contents into a beaker with 100 ml of water. The concentrated solution was stirred and 1 ml was transferred into a Sedgewick Rafter counting slide using a pipette. Cross-polarized light filter was used to help identify the veligers which will glow under a dim microscope light. Ten - 1 ml subsamples from each sample date were counted. These 10 subsamples were averaged and counts per liter were calculated by taking the average number of veligers per mL, multiplying it by the processing sample volume (100mL) to get a count per tow, and dividing the count per tow by the tow volume (222 L).

### 2012 Results

On the days spent in the field, PGOLID measured surface water temperatures that ranged from 14.9 to 25.6 degrees Celsius over the 5 month study (Table 1, Figure 2). On July 9, 2012, PGOLID collected veliger densities that reached a high of 53.83 veligers per liter. On the same sample date the water was 25.6 degrees Celsius, the highest recorded temperature in the 10 sample dates. Throughout the summer, Zebra mussel veligers were sampled between rates of 0.23 and 53.83 veligers per liter (Table 1, Figure 2).

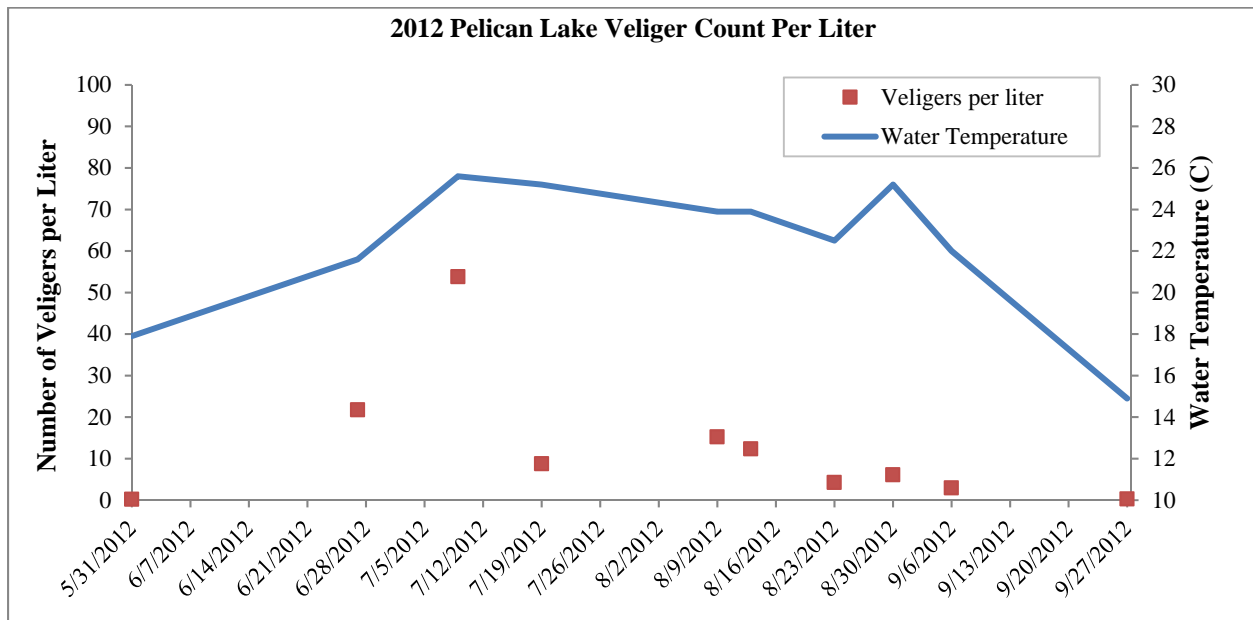


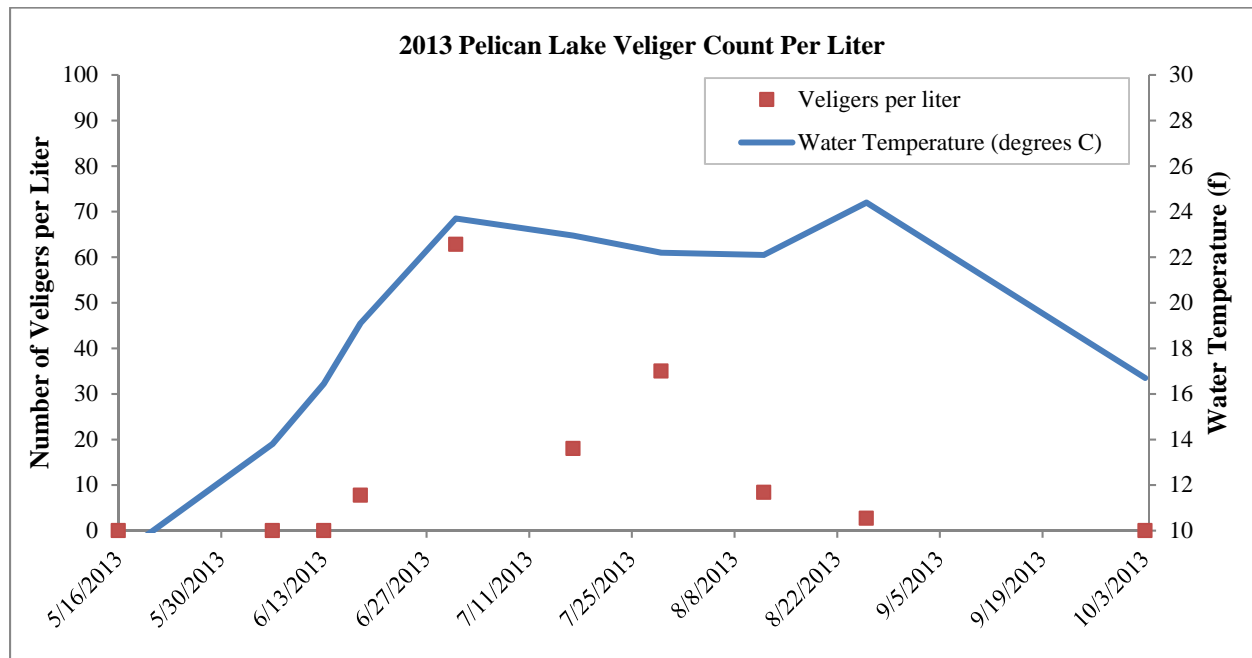
Figure 2. Zebra mussel veliger densities in Pelican Lake, 2012.

**Table 1. Zebra mussel veliger densities and corresponding water temperatures, 2012.**

Sample Date	Veligers per liter	Water Temp (C)
5/31/2012	0.23	17.9
6/27/2012	21.76	21.6
7/9/2012	53.83	25.6
7/19/2012	8.78	25.2
8/9/2012	15.27	23.9
8/13/2012	12.39	23.9
8/23/2012	4.28	22.5
8/30/2012	6.13	25.2
9/6/2012	2.97	22
9/27/2012	0.32	14.9

### 2013 Results

In 2013, Zebra mussel veliger samples were collected through the ice monthly from January to April to see if any veligers were present. The results showed no veligers present in these samples. The ice came off the lake on May 13, 2013. After ice off, samples were collected every 2-3 weeks to see when veligers began to be present and then to track their densities along with the water temperature. Veligers were first recorded on June 18, 2013 when the water temperature was 19.1 C (66 F). Like 2012, the highest veliger densities occurred on July 1 (Figure 3, Table 2). Veliger densities dropped on the 7/17/2013 sample date, but the area received 1.28 inches of rain in the three days prior to the sample and those days were below average air temperature. Overall, veliger densities ranged from 2.7 - 62.8 veligers per liter in 2013 (Table 2).



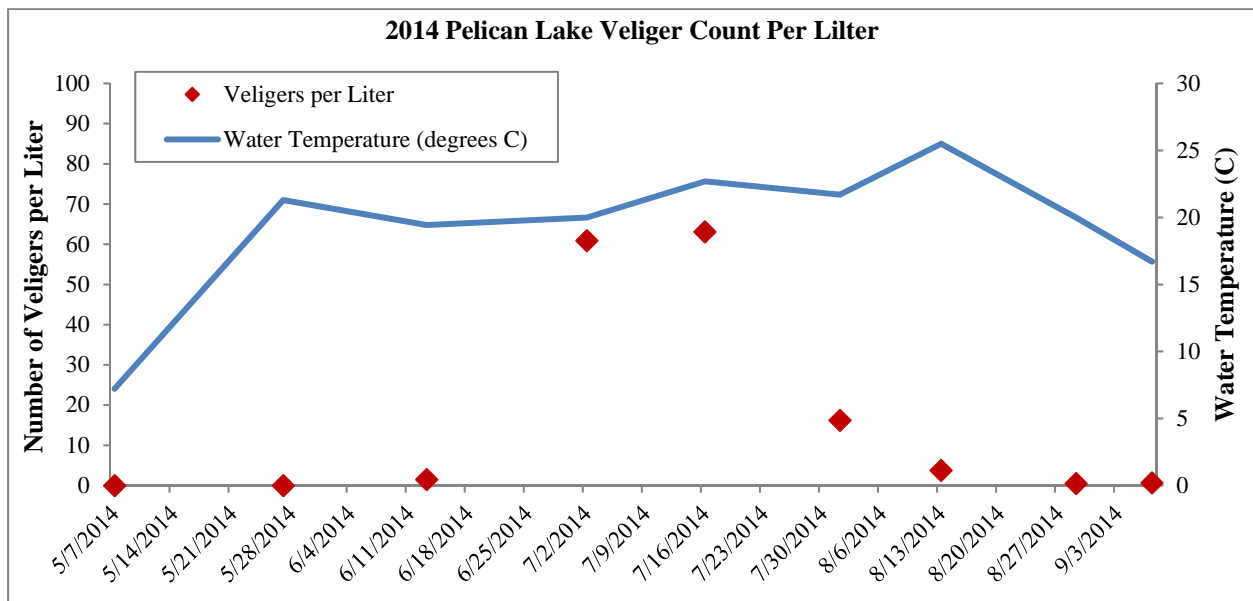
**Figure 3. Zebra mussel veliger densities in the ice-off period of 2013.**

**Table 2. Zebra mussel veliger densities and corresponding water temperatures, 2013.**

Sample Date	Veligers per liter	Water Temp (C)
1/16/2013	0	3
2/21/2013	0	3
3/27/2013	0	3
4/19/2013	0	3
5/16/2013	0	8.9
6/6/2013	0	13.8
6/13/2013	0	16.5
6/18/2013	7.75	19.1
7/1/2013	62.80	23.7
7/17/2013	18.00	22.9
7/29/2013	35.00	22.2
8/12/2013	8.38	22.1
8/26/2013	2.70	24.4
10/3/2013	0	16.7

**2014 Results**

In 2014, the ice-out date was April 27. Veliger samples were collected every 2-3 weeks from May through September. Veligers were first recorded on June 13, 2014 when the water temperature was 19.44 C (67 F). Like 2012-2013, the highest veliger densities occurred in early July (Figure 4, Table 3).



**Figure 4. Zebra mussel veliger densities in the ice-off period of 2014.**



## Discussion

The Zebra mussel veliger densities in Pelican Lake appeared to follow the water temperature at the beginning of the summer, but not later in summer (Figures 2-4). Zebra mussels begin reproduction when water temperature is above 12 C, but ideal reproduction temperature occurs above 17-18 C (McMahon 1996). Veligers first showed up in 2012 when water temperatures reached 18 C (64F) and in 2013 when water temperatures reached 19 C (66F) and in 2014 when water temperatures reached 19.4 C (67F) (Tables 1-3). In 2014, water temperatures were cooler overall than 2012-2013, but veliger densities followed similar patterns (Tables 1-3). The data show that water temperatures need to be over 18C for veligers to be present, but once the water reaches that temperature high veliger production is possible.

The upper thermal limit for North American Zebra mussels occurs somewhere around 30 C (McMahon 1996), and temperatures in Pelican Lake did not reach that level in 2012- 2016. Peak veliger densities in Pelican Lake in 2012 - 2016 occurred between June 23- July 16 when the water temperature was over 20 C. In 2012 - 2016, surface water temperature was very high in late August (24.4 C - 25.2 C, Tables 1-3), but veliger densities were not high like they were in July. There may be some other factor limiting veliger densities or adult reproduction at that time of year. Research into these factors would be helpful in understanding Zebra mussel reproduction in Minnesota lakes.

The overall implications of these three years of data show that the highest risk month for Zebra mussel veliger transfer is early July because densities are five to ten times greater in July than the rest of the ice-free season. More specifically, in Pelican Lake Zebra mussel veliger densities are highest in early July around the July 4<sup>th</sup> holiday. Pelican Lake has a very large fireworks show on 4<sup>th</sup> of July every year that draws crowds from the whole geographic region. Therefore, this is a very high risk time for Zebra mussel spread in the region.

The 2013 data show that there were no veligers in the water during the ice covered season, which shows that ice fishing is likely not a high risk for Zebra mussel transfer.

There were some limitations to this study. The initial study design planned a sample every other week during the ice-free season, but due to weather and schedule interference, there were some 3-4 week gaps in sample time. This study will be repeated again in 2017 with the goals of more finely documenting when the veligers first show up in the spring, when they are at peak densities, and if they are at low densities in late August again despite high temperatures.

## Acknowledgements

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## References

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