

Survey of zebra mussel (*Dreissena polymorpha*) veligers flowing down the  
Susquehanna River downstream of Goodyear Lake  
Summer 2005

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INTRODUCTION<sup>1</sup>

The zebra mussel (*Dreissena polymorpha*) was first thought to have colonized Canadargo lake in 2001 (Horvath and Lord 2003). Following their colonization there, the planktonic larva (veligers) are believed to have drifted passively via Oaks Creek, the lake's outlet, to the Susquehanna River and ultimately to Goodyear Lake (N42°30.8, W74°59.2). That water body is an impoundment of the Susquehanna River approximately 50 km south of Canadarago Lake. The zebra mussel larvae, which remain in the water column for 2-4 weeks, are subject to being carried by water currents during that time (Horvath et al. 2002).

Zebra mussels were reported in Goodyear Lake in 2004 (Armstrong 2005). The veligers produced by adult mussels within the lake are expected to passively drift from the outflow of Goodyear Lake. This study was conducted to estimate the export of veligers from Goodyear Lake into the upper reaches of the Susquehanna River.

METHODS

The site of sample collection was just down stream of the overpass on Route 28. Veligers were sampled on 10 and 22 June and 6 and 21 July 2005. River water was sampled in 90 liter batches by bucketing the water through 63µm mesh plankton net. The concentrated samples were transferred from the plankton cup into sterile, labeled Whirl Paks<sup>®</sup>. Each sample was thoroughly rinsed and preserved with 70% ethanol. Samples were collected in triplicate on each date.

Veligers were identified at the Biological Field Station using cross-polarized light microscopy (Johnson 1995). The volume of each sample was taken using a graduated cylinder to quantify veligers. Five individual rafter slides each with 1ml of sample were examined and veligers counted. The mean of the five rafter cells was multiplied by the volume of the concentrated sample (ml) and divided by 90 (volume of water sampled) in order to find the concentration of veliger per liter of water.

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$$\text{Veliger/L} = \text{mean count of 5 rafters slides} * \text{volume of sample (ml)} / 90 \text{ liters}$$

The discharge of the river was also measured on each sampling day. A tape measure was stretched across the river so that velocity could be measured in 1 m increments spanning the width of the river. At each section the depth was measured using a meter stick and the water velocity recorded with a Marsh-McBirney® flow meter set at 2/3 depth for each section of the river. The total discharge was calculated as the sum of discharges in each subsection:  $Q = \sum q$  where  $q$  (subsections) is equal to the area multiplied by velocity of the river. Area is calculated by multiplying depth of the section by the width of the section. The flux is estimated by multiplying  $Q$  by mean veliger concentration and extrapolating to a 24 hour period.

## RESULTS AND DISCUSSION

Reproduction of zebra mussels begins when temperatures exceed 12° C (Miller and Payne 1996). Studies show the appearance of veligers in late spring with a maximum density around mid summer (Garton and Wendell 1993, Armstrong 2004). Concentrations of veligers for each sampling date can be found in Figure 1. Veliger density flowing out of Goodyear Lake increased over the summer.

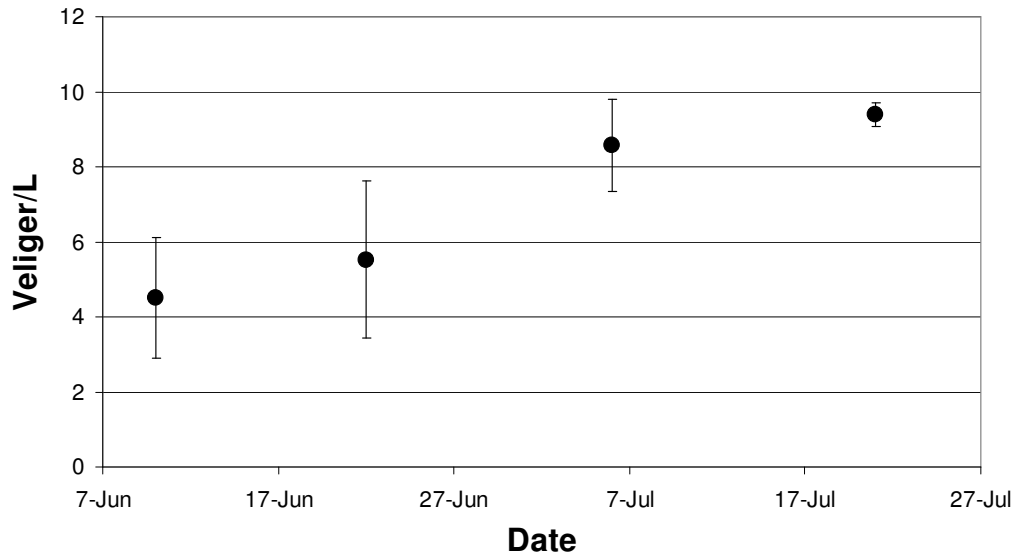


Figure 1. Mean number of veliger per liter of water summer 2005.

Discharge was recorded on each of the sampling dates to estimate veliger flux to the Susquehanna River. Since veligers are passive drifters they can be transported many kilometers downstream (Horvath et al. 2003). The distance traveled by veligers is affected by the velocity of water down the river. However, velocity is correlated with turbulence, which impacts survival rates of veligers. If the velocity of a river is too high,

turbulence may increase veliger mortality. Slower moving deep rivers with very low turbulence are more suitable for veliger survival transport (Horvath and Lamberti 1999). However, in the case of fast moving, turbulent water, even if a small percentage of veligers survive to a slower section or pool downstream, colonization may still occur. Table 1 summarizes the discharge for each sample date and provides an estimation of daily veliger flux. On 10 June and 21 July, when the discharge was highest, over 1 trillion veligers were passing by that particular section of the Susquehanna River per day. Though no attempt was made to differentiate between living and dead veligers, even if mortality of veligers is very high, given the influx of high numbers, downstream expansion seems likely.

Date	Q(L/s)	Q(m <sup>3</sup> /s)	Veliger/L	Veligers Per Day
10 Jun	3850	3.9	4.50	1,498,000,000
22 Jun	223	0.02	5.52	106,000,000
6 Jul	428	0.4	8.57	316,000,000
21 Jul	1844	1.8	9.38	1,495,000,000

Table 1. Discharge, mean veliger concentration, and daily veliger flux, below Goodyear Lake, summer 2005.

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