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Rapid Communication

Early invasion records of zebra mussels *Dreissena polymorpha* (Pallas, 1771) in Otsego Lake, New York

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Abstract

The zebra mussel, *Dreissena polymorpha* (Pallas, 1771) was first documented in North America in the 1980s. In 2007, it was found in Otsego Lake, New York, the headwaters of Susquehanna River which drains to the Chesapeake Bay. In 2008 they were found in five out of the 53 sampling sites in Otsego Lake. This study provides baseline data to be used for long term zebra mussels monitoring on this lake.

Key words: invasive species, zebra mussel, Otsego Lake, New York

Introduction

Dreissenid mussels including the zebra mussel (*Dreissena polymorpha* Pallas, 1771), originated from the Ponto-Caspian area (Black, Asov, and Caspian Sea (Van der Velde et al. 2010). They were accidently introduced into the Laurentian Great Lakes in North America in the 1980s, most likely in ballast water (Ludyanskiy et al. 1993; Carlton 2008; Van der Velde et al. 2010) and were first reported in North America in 1988 in Lake St. Clair (Hebert et al. 1989); A recent paper (Carlton 2008) provided convincing evidence that it was present as early as 1986 in Lake Erie. The zebra mussel's first passage beyond the Great Lakes Basin was in 1991 when the mussel crossed New York State through the Erie Canal and Mohawk River into the Hudson River (O'Neill and Dextrase 1994).

Otsego Lake in Otsego County, New York is a meso-trophic, dimictic lake formed by glacial over-deepening of the Susquehanna River Valley (Harman 1997). It is the headwaters of Susquehanna River, which passes through New York, Pennsylvania, and Maryland and drains to the Chesapeake Bay. *Dreissena polymorpha* were first found in Otsego Lake in 2007 (Waterfield 2009) (Figure 1A). The objective of this paper is to provide baseline data to be used for long term monitoring of zebra mussels in Otsego Lake.

Methods

In order to have a quantitative understanding of the abundance of zebra mussels in Otsego Lake, benthic samples were taken to provide baseline data for future surveys. They were collected on Otsego Lake from the research vessel *Anodontiodes* in July 2008. An Ekman dredge (sampling area of 0.0529 m^2) was used to collect samples along three transects (Figure 2). The range of sampling depths for Transects 2, 4, and 6, are 0.5 – 20 m, 0 – 40 m, and 0.5 – 15 m, respectively. Transects were sampled between 10 July 2008 and 21 July 2008. There are 18, 22, and 13 sampling sites for Transects 2, 4, and 6, respectively. Samples were preserved in jars in 70% ethanol and quantified later.

Results

Of the 53 samples surveyed, a total of eight zebra mussels were collected among five sites at depths of 2m, 4m, and 5m (Table 1 and Figure 1B). At site TR2E, 2 mussels were found at a depth of 2m and 3 mussels were found at 4m. At TR2W, 1 mussel was found at 5m. At sites TR4E and TR6W, one mussel was found at each site at a depth of 2m.

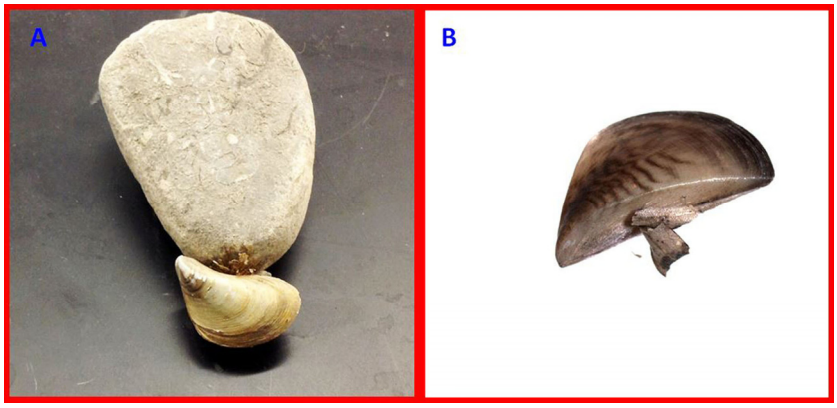

Figure 1. Otsego Lake zebra mussels found in 2007 (A, shell length 33.82 mm) by Paul Lord and in 2008 (B, shell length 13.67 mm) collected in the present study (Photo by Wai Hing Wong).

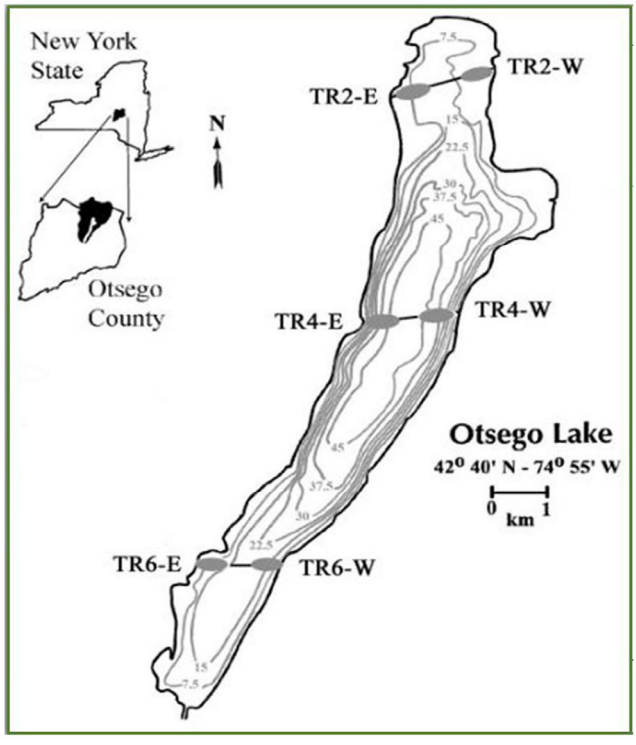

Figure 2. Transects and sites that were sampled in Otsego Lake, New York during July 2008. Original transects from Iannuzzi (1991). Contours are given in meters. Collections were made within the shaded areas.

Table 1. Zebra mussels recorded in Otsego Lake, New York in 2008.

Site	Latitude	Longitude	# of zebra mussels	Shell length of zebra mussels
TR2-E	42°48'18N	74°53'42W	2 at 2 m	10.01 mm, 14.13 mm
			3 at 4 m	13.67 mm, 9.17 mm, 7.88 mm
TR2-W	42°48'21N	74°53'07W	1 at 5 m	4.50 mm
TR4-E	42°45'52N	74°53'45W	1 at 2 m	16.02 mm
TR4-W	42°45'55N	74°53'18W	None	-
TR6-E	42°43'26N	74°55'00W	None	-
TR6-W	42°43'26N	74°54'40W	1 at 2 m	10.20 mm

Discussion

At the time of sampling in 2008, lake-wide zebra mussel abundance was low. However, the large size range of these mussels (from 4.50 to 16.02 mm, Table 1) in 2008 indicated that zebra mussels were reproducing in Otsego Lake. Based on anecdotal observations, zebra mussels have become dominant in the benthic community (Anonymous 2009; Anonymous 2010a, b).

It has been shown that in the Great Lakes region, the Hudson River, Lake Mead, and many other lakes and rivers, zebra mussels can have significant impacts on invaded ecosystems (Nalepa and Schloesser 1993, 2013; Karatayev et al. 1997; Strayer et al. 1998; Lucy et al. 2013).

Zebra mussels have local and system-wide impacts on the waters they inhabit (Botts et al. 1996; Karatayev et al. 2002). System-wide changes such as increased water clarity, nutrient concentrations, and oxygen levels may be difficult to predict; however, local effects on community structure and food greatly affect local species composition (Karatayev et al. 2002). Zebra mussels deposit pseudofeces and provide shelter for many benthic invertebrates and thus change the species composition of the impacted area (Atalah et al. 2010; Hecky et al. 2004; Karatayev et al. 2002). Increases in surface area, complexity, and heterogeneity of the substrate provide more refuges for macroinvertebrates to hide from predators and more surface habitat to live in (Horvath et al. 1999; Ozersky et al. 2011), while feces and pseudofeces released by zebra mussels provide a source of food for some macroinvertebrates (Hecky et al. 2004). Populations of scrapers and deposit feeders have experienced increases in response to the introduction of zebra mussels (González and Downing 1999; Haynes et al. 2005; Mayer et al. 2002).

Many species respond to the physical structure provided by mussels, such as chironomid fly larvae which experience significant increases in abundance in response to mussel colonization (Botts et al. 1996). *Dreissena polymorpha* colonization may negatively affect other species such as mollusks (Bivalvia: Unionidae) and populations, which have been in decline since the mid-1800s and now are experiencing further declines in the presence of zebra mussels (Cope et al. 2003). Other taxa that have experienced declines after zebra mussel introductions include the mollusk family Pisidiidae and the amphipod genus *Diporeia* (Strayer et al. 1998; Nalepa et al. 2009; Ward and Ricciardi 2010). Filter and suspension feeders in particular are negatively impacted due to competition with *D. polymorpha* for resources. Populations of fish that do not have flexible diets may also be negatively impacted if prey species are displaced (Owens and Dittman 2003).

The influence from zebra mussels in 2008 was assumed to be minimal because of their lake-wide low abundance. However, it has been observed that zebra mussels have become dominant in the benthic community of Otsego Lake in recent years (Anonymous 2009; Anonymous 2010a, b). As a result, the zebra mussel invasion of Otsego Lake will most likely result in changes in the benthic community. A systematic survey of zebra mussel abundance and benthic community structure is needed to help determine how *D. polymorpha* has affected the benthos.

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