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Brachionus leydigii (Monogononta: Ploima) reported from the western basin of Lake Erie

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ABSTRACT

Several species of non-indigenous planktonic invertebrates have historically been introduced to the Laurentian Great Lakes. Previous introductions of non-indigenous planktonic invertebrates to the Great Lakes have been crustacean zooplankton, specifically Cladocera and Copepoda. This report documents the first known occurrence of *Brachionus leydigii* var. *tridentatus* (Zernov, 1901) in Lake Erie and possibly the first detection of a non-indigenous rotifer species in the Laurentian Great Lakes. The specimen was collected from a U.S. EPA monitoring station in the western basin of Lake Erie on April 4, 2016.

Introduction

Brachionidae belongs to the Rotifera order Ploima and after Nottomatidae (with 23 genera) and Dicranophoridae (12 genera) is the third family with most numerous (eight) genera, and the fifth most specious family with 105 known species. Among the 8 genera of Brachionidae the genus *Brachionus* is the most specious with 37 known species. *Brachionus* is characterized by strong polymorphism resulting with many morphs in each species. *Brachionus leydigii* (Cohen, 1862) belongs to the sixth most polymorphic species of the genus and to the seventh largest species exceeding the length of 300 μm. *Brachionus leydigii* has four subspecies (*leydigii*, *quadratus*, *tridentatus*, *rotundus*) out of them *B. leydigii* var. *tridentatus* (Zernov, 1901) is known from the most diverse aquatic habitats including small and large reservoirs, large rivers, ponds, canals, ditches, polders, estuaries and in the littoral of lakes (Błędzki, 1989; De Ridder and Segers, 1997). The morphology of the Lake Erie *B. leydigii* specimen warrants assignment to the subspecies *B. leydigii* var. *tridentatus*. Reports regarding the introduction of non-indigenous rotfers in the western hemisphere are sparse (De Paggi, 2002; Bezerra-Neto et al., 2004; Nicholls, 2016). We hereby report the first known occurrence of *B. leydigii* from Lake Erie and possibly, the first documented detection of a non-indigenous rotifer species in the Laurentian Great Lakes.

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Methods

Sample collection and analysis

Zooplankton samples were collected across all five Laurentian Great Lakes aboard the U.S. Environmental Protection Agency's (U.S. EPA) *R/V Lake Guardian* as part of the U.S. EPA Great Lakes National Program Office's (GLNPO) long-term biological monitoring program. Samples were collected with 0.5 m diameter 63 μm and 153 μm mesh nets towed vertically through the water column following a standard operating procedure (EPA SOP, 2013) for field sampling. In the shallow western basin of Lake Erie, samples using both meshes were collected from 2 m above the lake bottom to the surface. Samples were preserved in a 4% buffered sugar formalin solution treated with rose bengal dye.

Rotifers are typically counted from the tow taken with the 63 μm mesh net as the larger 153 μm mesh net does not capture sufficient numbers of these small taxa. The single *B. leydigii* specimen was an exception, being found in the 153 μm mesh net sample during crustacean zooplankton enumeration. A Folsom plankton splitter was used to divide the sample in half and repeated until 200–400 individuals per subsample were reached. These two smallest subsamples were analyzed first. Second, two additional larger subsamples representing 2 and 4 times the split factor of the smallest subsample were analyzed for subdominant and rare taxa following a standard operating procedure (EPA SOP, 2016) for crustacean zooplankton sample analysis. After detecting *B. leydigi* in a subsample, the corresponding 63 μm mesh net

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sample from the same date and location was processed (methods below) for additional *B. leydigii* specimens without success.

In addition to the crustacean enumeration described above, the 63 μm mesh net sample was analyzed for microzooplankton following a different method. These organisms were counted from separate 1 mL aliquots withdrawn with a Hensen-Stempel pipette from the appropriate, thoroughly homogenized split. The goal is to enumerate 200–400 rotifers and copepod nauplii (dreissenid veliger are enumerated as well but are not included toward the 200–400 total) in an original count as well as a duplicate count. These are referred to as A and B counts. The 1 mL aliquot is placed in a Sedgwick-Rafter cell and covered with a glass coverslip. All microzooplankton are identified and enumerated under a compound microscope at 100× magnification following a standard operating procedure (EPA SOP, 2016) for microzooplankton sample analysis. Microphotographs were taken with an ACCU-SCOPE Excelis HD camera attached to an OLYMPUS CX41 compound microscope, extended depth of field images were created using CaptaVision PC Imaging Software. Specimen measurements were taken using an OLYMPUS CX41 compound microscope with a drawing tube and a GTCO CalComp DrawingBoard VI.

Results

A single female specimen of *B. leydigii* var. *tridentatus* was detected in a preserved plankton sample collected from the U.S. EPA monitoring station ER92 (41.951°N/82.68701°W) on April 4, 2016 at 01:36 AM Eastern Standard Time. Net tows at station ER92 were collected at a depth of 11 m to the water's surface. Twenty open water monitoring stations were sampled across Lake Erie and only one *B. leydigii* specimen was detected at a single station (Fig. 1). No additional *B. leydigii* specimens were detected at EPA monitoring stations in Lake Erie in the spring or summer of 2016. And no additional specimens of *B. leydigii* were collected from ER92 on April 5, 2017. Environmental conditions at the time of sample collection were as follows: water column was isothermal, water temperature was 5.3 °C, and chlorophyll-a concentration was 3.6 μg/L.

Based on the condition of the specimen's internal anatomy it is our judgement that this animal was alive at the time of collection. Lorica length of the specimen as measured from the anterior margin of the dorsal plate (not including the anterior spines) to the posterior margin of the dorsal plate (not including the posterior spines) was 222 μm. Lorica width of the specimen as measured at the widest point of the lorica was 215 μm. The lengths of the anterior spines as measured from the base to the distal ends were as follows; anteriomedian spines measured 37 μm (left) and 43 μm (right), anteriointermediate spines measured 24 μm (left) and 25 μm (right), anteriolateral spines measured 17 μm (left) and 22 μm (right). The length of the medial posterior spine as measured from the base to the distal end was 14 μm. The foot while only partly extended measured 86 μm long and the toes measured 14 μm (left) and 19 μm (right) long.

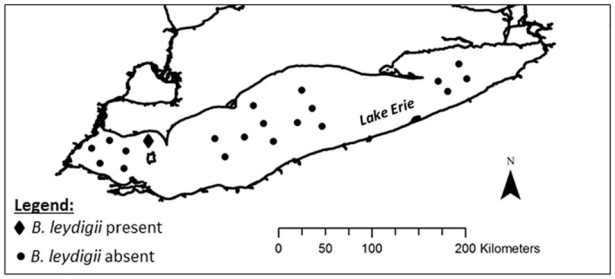

Fig. 1. U.S. EPA GLNPO long-term monitoring stations in Lake Erie.

Morphological description

The morphology of *B. leydigii* is fairly unique and recognizable within the Great Lakes *Brachionus* assemblage. In comparison to native Great Lakes *Brachionus* species, *B. leydigii* var. *tridentatus* has a somewhat square lorica (Fig. 2a), comprised of 3 plates: dorsal, ventral, and basal. The lorica surface is finely textured with a distinctive but relatively subtle polygonal pattern which may also help distinguish it from the nominal form (Fig. 2b). The anteriodorsal margin is characterized by 6 spines (Fig. 3a) with the anteriomedian spines longest and curved somewhat outward. The anterioventral margin is characterized by a relatively shallow medially placed U-shaped sinus (Fig. 3b). The posterior margin is characterized by small posteriolaterally placed spines (Fig. 4a). The ventral foot opening is relatively large and club-shaped (Fig. 4b). Three broad based posterior spines are placed directly below the foot opening, the medial spine being the shortest (Fig. 5). The foot is annulated and fairly long if fully extended and terminates in two toes (Fig. 5).

Discussion

The Lake Erie specimen was initially identified as *B. leydigii* (Cohen, 1862) based on Ahlstrom (1940). Subsequently, the specimen was determined to be the infrasubspecific variant *B. leydigii* var. *tridentatus* based on Kutikova (1970) and Koste (1978). The nomenclature *B.* var. *tridentatus* (Zernov, 1901) was assigned to the specimen in question in reference to the Rotifer World Catalog website (Jersabek and Leitner, 2013) and Segers et al. (2015) which both noted *Brachionus leydigii* var. *tridentatus* as a "junior subjective synonym" of *Brachionus leydigii* (Cohn, 1862). The genus *Brachionus* is large, specious and well known for morphological variability; in the Laurentian Great Lakes 12 species have previously been reported (Grothe and Grothe, 1977; Stemberger, 1979; Jersabek et al., 2003). The Great Lakes native *B. variabilis* could potentially be mistaken for *B. leydigii* based on the 6 anterior spines, somewhat similar shaped lorica, and posterior protuberance placed dorsally to the foot opening. But *B. variabilis* is characterized by a flattened or rounded posterior protuberance rather than pointed or triangular broad based posterior spines (Fig. 5) as present in *B. leydigii*. In open water areas of the Great Lakes, *Brachionus* species are most abundant during summer months in the western basin of Lake Erie (Barbiero and Warren, 2011). Members of the genus are primarily littoral and often associated with eutrophic environments (Stemberger, 1979). Only a single female specimen of *B. leydigii* var. *tridentatus* was detected from Lake Erie in 2016 and no evidence of reproduction such as carried eggs were observed associated with the specimen. If the species is newly introduced it is likely that planktonic densities are still very low and may elude detection with most

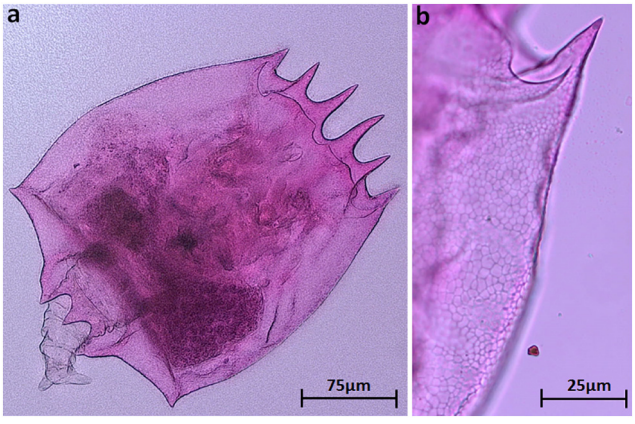

Fig. 2. (a) Extended depth of field image of Lake Erie *B. leydigii* var. *tridentatus* specimen. (b) Polygonal pattern on lorica surface of *B. leydigii* var. *tridentatus*.

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