Brachionus leydigii

Ecological Risk Screening Summary

U.S. Fish & Wildlife Service, Web Version – June 2017

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1 Native Range and Status in the United States

Native Range

From Baker et al. (2015):

"Cosmopolitan [i.e., range extends across all or much of the world]"

From Kaya and Altindağ (2007):

"It is cosmopolitan in alkaline waters in cold season."

From Jersabek and Bolortsetseg (2010):

"Eastern hemisphere, including PAL [Palearctic zoogeographic region], ORI [Oriental zoogeographic region], AUS [Australian zoogeographic region]."

Status in the United States

Within the U.S., there are reports of the species from multiple locations in the early to mid-twentieth century, but no recent records have been published and a contemporary source describes the species as not native to North America.

From Ahlstrom (1934):

"A total of 279 species and varieties of rotatoria from Florida have been identified [including] *Brachionus leydigii* Cohn"

From Ahlstrom (1940):

"DISTRIBUTION.—I have seen material from […] ? Ohio."

"[…] Kofoid, 1908, reports it as occurring from May until August in the Illinois River."

From Baker et al. (2015):

"Status: Not established in North America, including the Great Lakes"

Means of Introductions in the United States

From Baker et al. (2015):

"*Brachionus ledygii* has been identified as having high probability of introduction to the Great Lakes via residual ballast sediment, where its resting stage is able to survive high salinities during ballast water exchange (Bailey et al. 2004, 2005a, 2005b; Johengen et al. 2005). In a survey of the ballast water of 35 different vessels entering the Great Lakes, this species was found hatched from diapausing eggs in residual ballast sediment in four of the ships. Additionally, it was isolated from the sediment of those ships with a mean density of 3 individuals/40 g sediment (Bailey et al. 2005a, Johengen et al. 2005). It is likely that these resting stages are deposited by reproducing females taken in with ballast water rather than being brought in with disturbed sediments. Diapausing eggs present in sediment can pose an invasion risk if they are discharged during ballast operations or if they hatch during a voyage and the young rotifers are subsequently introduced during vessel deballasting (Gray and MacIsaac 2010)."

2 Biology and Ecology

Taxonomic Hierarchy and Taxonomic Standing

From ITIS (2017):

"Kingdom Animalia
Subkingdom Bilateria
Infrakingdom Protostomia
Superphylum Platyzoa
Phylum Rotifera
Class Monogonta
Subclass Monogononta
Superorder Pseudotrocha
Order Ploima
Family Brachionidae

Genus *Brachionus*
Species *Brachionus leydigi* Cohn, 1862"

From Jersabek (2017):

"Species: *Brachionus leydigii* Cohn, 1862 […]
Nomenclatural status: name in current use […]
Validity: valid"

Size, Weight, and Age Range

From Baker et al. (2015):

"Total length 220-280 µm; maximum width 165 µm"

Environment

From Fontaneto et al. (2006):

"Species	Inland	Marine	Haloxenous	Strictly haline	Euryhaline	Benthic-periphytic	Plankton	[…]	Bibliographic references (in alphabetical order)
[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]
Brachionus leydigii Cohn, 1862	x	x			x		x	[…]	Althaus ([1957]), De Ridder (1968), Wibaut-Isebree Moens (1954)"

From Jersabek and Bolortsetseg (2010):

"Planktonic, epibenthic, and among aquatic vegetation in predominantly ephemeral freshwater lakes, ponds and pools; also in athalassic salt ponds (oligo- to mesosaline), preferably of higher trophic degree; eurythermic, euryhaline."

From Azémar et al. (2010):

"*Brachionus leydigii* Cohn, 1862 […] are correlated to high SiO_2, NO_3^- and NH_4^+ concentrations […]"

From Paturej et al. (2017):

"[…] *Brachionus leydigii* were negatively correlated with pH […]"

Climate/Range
From Ahlstrom (1940):

"*B. leydigii* […] is confined apparently to cold waters (hibernal and vernal)."

Distribution Outside the United States
Native
From Baker et al. (2015):

"Cosmopolitan"

From Kaya and Altindağ (2007):

"It is cosmopolitan in alkaline waters in cold season."

From Jersabek and Bolortsetseg (2010):

"Eastern hemisphere, including PAL [Palearctic zoogeographic region], ORI [Oriental zoogeographic region], AUS [Australian zoogeographic region]."

Introduced
From Baker et al. (2015):

"Johengen et al. (2005) report observing one *B. leydigii* individual in an upper-wing ballast tank of a surveyed vessel, leading the authors to suggest that this may have been the result of a previous transoceanic ballast introduction to Hamilton Harbor [Ontario, Canada], as residual sediments generally do not accumulate in upper-wing tanks. Because only a single individual was recorded, the status of establishment cannot be determined, but this finding may indicate that *B. leydigii* has been introduced previously to this location (Johengen et al. 2005)."

Means of Introduction Outside the United States
From Baker et al. (2015):

"[…] may have been the result of a previous transoceanic ballast introduction […]"

Short Description
From Baker et al. (2015):

"*Brachionus leydigii* is a nearly square rotifer, with a body divided into three dorsal, ventral, and basal plates. The anterior dorsal margin has six spines of nearly equal length, with median spines slightly longer and curving somewhat ventrally. Small spines are usually present at the joint of the dorsal and basal plates. A large circular or club shaped foot opening is visible on the dorsal surface. The body wall of *B. leydigii* is firm and slightly raised toward the center (Leasi 2012)."

Biology

From Baker et al. (2015):

"Rotifers live mainly among aquatic vegetation in the littoral zone of lakes, ponds, rivers, canals, pools, and other small water bodies. Due to the absence of respiratory organs, this species uses its entire body surface to respire and is therefore unable to live in anaerobic conditions (Sladecek 1983). Most communities contain 50 to 500 individuals per liter, with the densest population reported in unpolluted water reaching 5,800 individuals per liter (Smith 2001). *Brachionus ledygii* filter feeds on small material such as bacteria and detritus and is able to selectively filter particles by size with a corona of cilia surrounding its mouth (Wallace 2002)."

"With large population sizes and high turnover rates, rotifers are significant contributors to lake food webs (Herzig 1987, Starkweather 1987, Walz 1997). Additionally, rotifers are the first food of fish fry and are eaten by a variety of invertebrate predators, leading to the assimilation of their energy into higher trophic levels (Wallace 2002). Rotifers may also play a role in microplankton community structure, although the magnitude of their importance is unknown (Arndt 1993, Berninger et al. 1993, Rublee 1998). The study of rotifer population dynamics is challenging, as annual species abundance across a variety of habitats can vary greatly (Herzig 1987)."

"Rotifers' annual reproductive cycle involves both sexual and asexual stages. The asexual phase involves amictic (parthenogenic) females who produce mitic haploid eggs in autumn, from which males hatch without fertilization. Males typically only live for a few hours, dying immediately after reproduction (Sladecek 1983). The sexual phase results in resting stage "winter eggs" that develop with a thick protective cover resistant to desiccation and extreme thermal conditions (Clement and Wurdak 1991, Sladecek 1983, Wurdak et al. 1978). After production, these diapausing eggs sink to the sediment where they can remain viable for several decades (Kotani et al. 2001, Marcus et al. 1994). When favorable conditions return, eggs complete their development; however, a fraction will remain viable and accumulate in the sediment, forming resting egg banks (Garcia-Roger et al. 2005). These egg banks may help to ensure survival through unfavorable environmental conditions as well as possibly act as a dispersal device (Fryer 1996, Garcia-Roger et al. 2005, Hairston 1996, 1998, Ortells et al. 2000, Templeton and Levin 1979). Anoxia or low oxygen levels in the sediment, however, may lead to low viability of diapausing eggs (Lutz et al. 1994, Uye et al. 1984)."

Human Uses

From Baker et al. (2015):

"Rotifers have been widely used as a bioindicator species in pollution monitoring, and due to their sensitivity to pollutants and ease of culture, they have become important tools in ecotoxicological testing (Wallace 2002). However, there is no evidence supporting that *B. leydigii* will offer any advantage as an ecological indicator as compared to rotifers already present in the Great Lakes."

Diseases

No information available.

Threat to Humans

From Baker et al. (2015):

"As a group, introduced rotifers are not known to generate significant socio-economic impacts (O'Connor et al. 2008) […]"

3 Impacts of Introductions

From Baker et al. (2015):

"While rotifers tend to be significant contributors to food web structure due to high abundances and rapid turnover rates, there is no species specific information currently available on the trophic effect of introduced populations of *B. ledygii*."

"As a group, introduced rotifers are not known to generate significant socio-economic impacts (O'Connor et al. 2008), and there are currently no reports of this species leading to negative impact in introduced areas."

4 Global Distribution

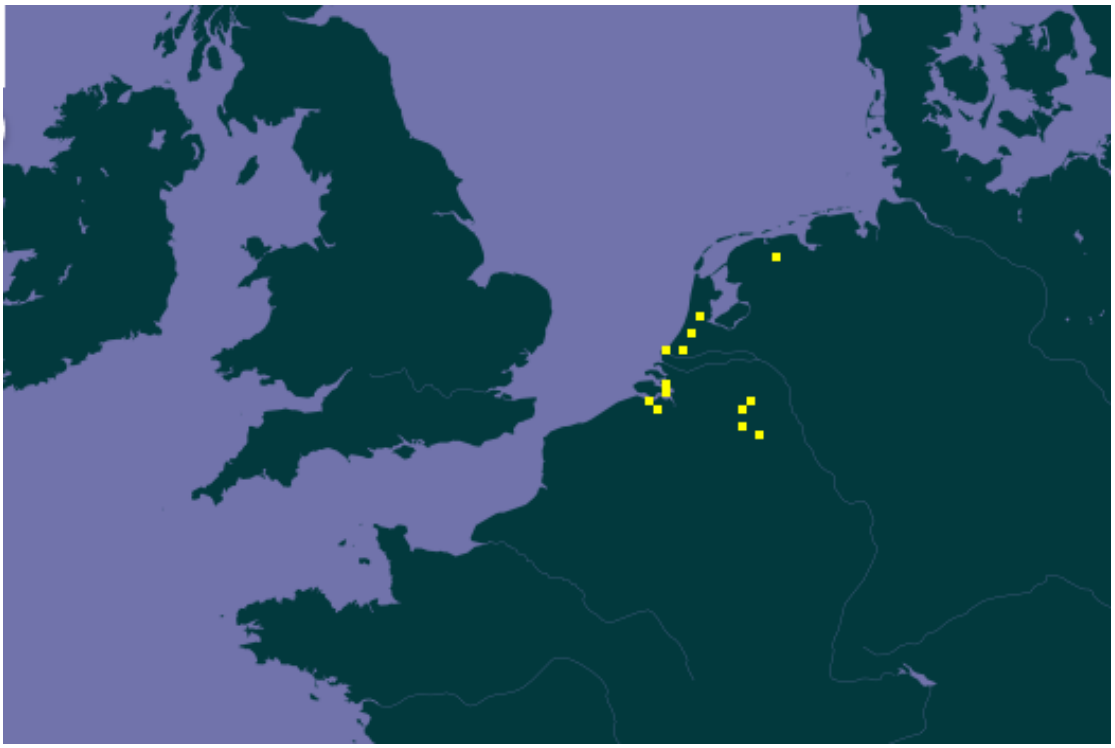

Figure 1. Known global established locations of *Brachionus leydigii*. Map from GBIF (2016). A more complete verbal description of the global distribution of *B. leydigii* is available in the sections "Native Range and Status in the United States" and "Biology and Ecology: Distribution Outside the United States".

5 Distribution Within the United States

No map available. See “Native Range and Status in the United States” for verbal description of known U.S. distribution.

6 Climate Matching

Summary of Climate Matching Analysis

The Climate 6 score (Sanders et al. 2014; 16 climate variables; Euclidean distance) for the contiguous U.S. was 0.155, which indicates a high climate match overall. The Interior West and the Great Lakes region showed medium to high climate matches, while most of the contiguous U.S. showed medium matches locally. Low matches occurred in the Pacific Northwest and in the Southeast. The results of this climate matching analysis likely underestimate the climate match of *B. leydigii* to the contiguous United States because georeferenced locations were not available for many places where *B. leydigii* has been reported to occur (see “Native Range and Status in the United States” and “Biology and Ecology: Distribution Outside the United States” for a verbal description of the global distribution of *B. leydigii*).

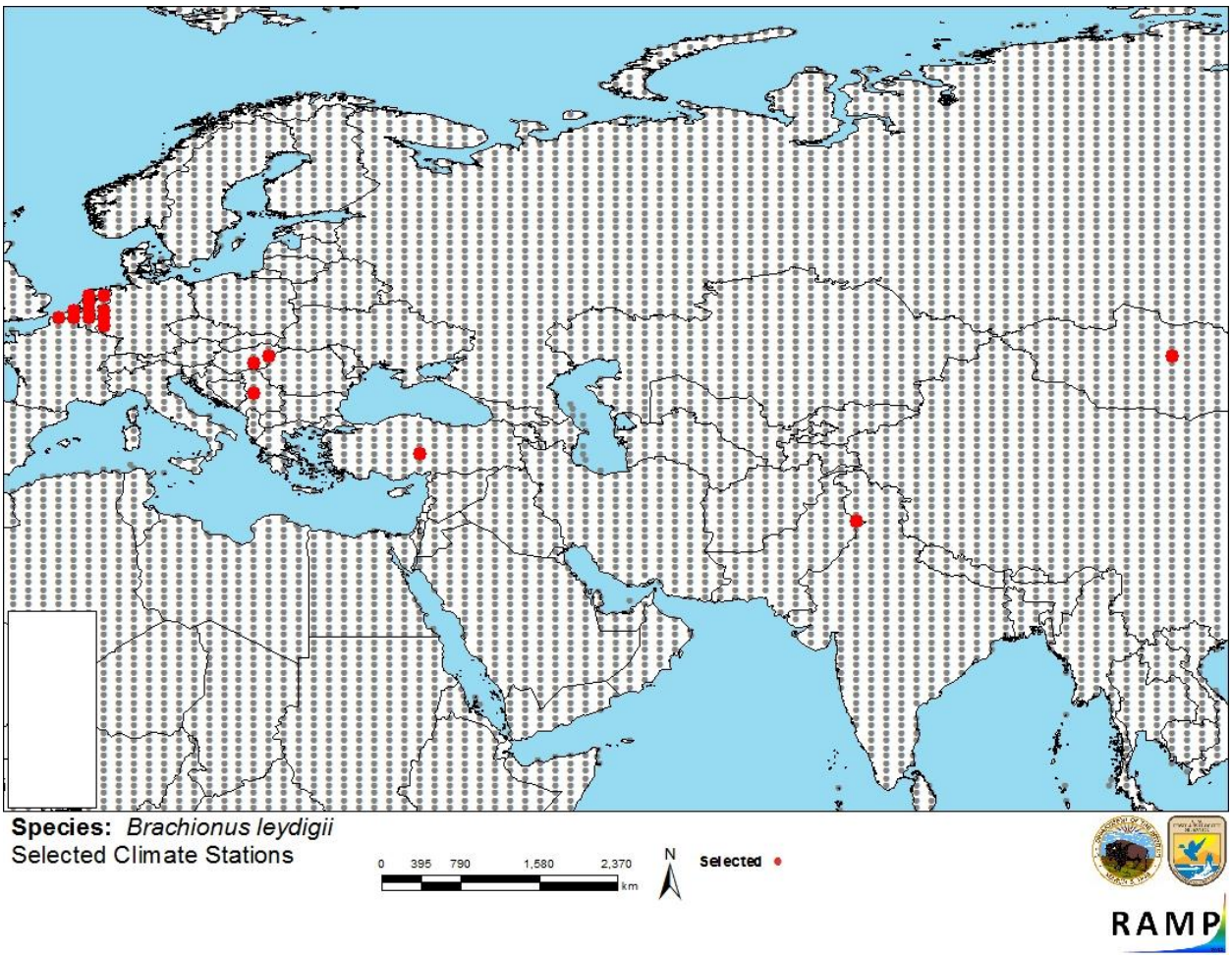

Figure 2. RAMP (Sanders et al. 2014) source map showing weather stations selected as source locations (red) and non-source locations (gray) for *B. leydigii* climate matching. Source locations from GBIF (2016), with additional locations from Kaya and Altindağ (2007; Turkey), Jersabek and Bolortsetseg (2010; Mongolia), Ostojić et al. (2012; Serbia), Tóth et al. (2014; Hungary), and Ejaz et al. (2016; Pakistan).

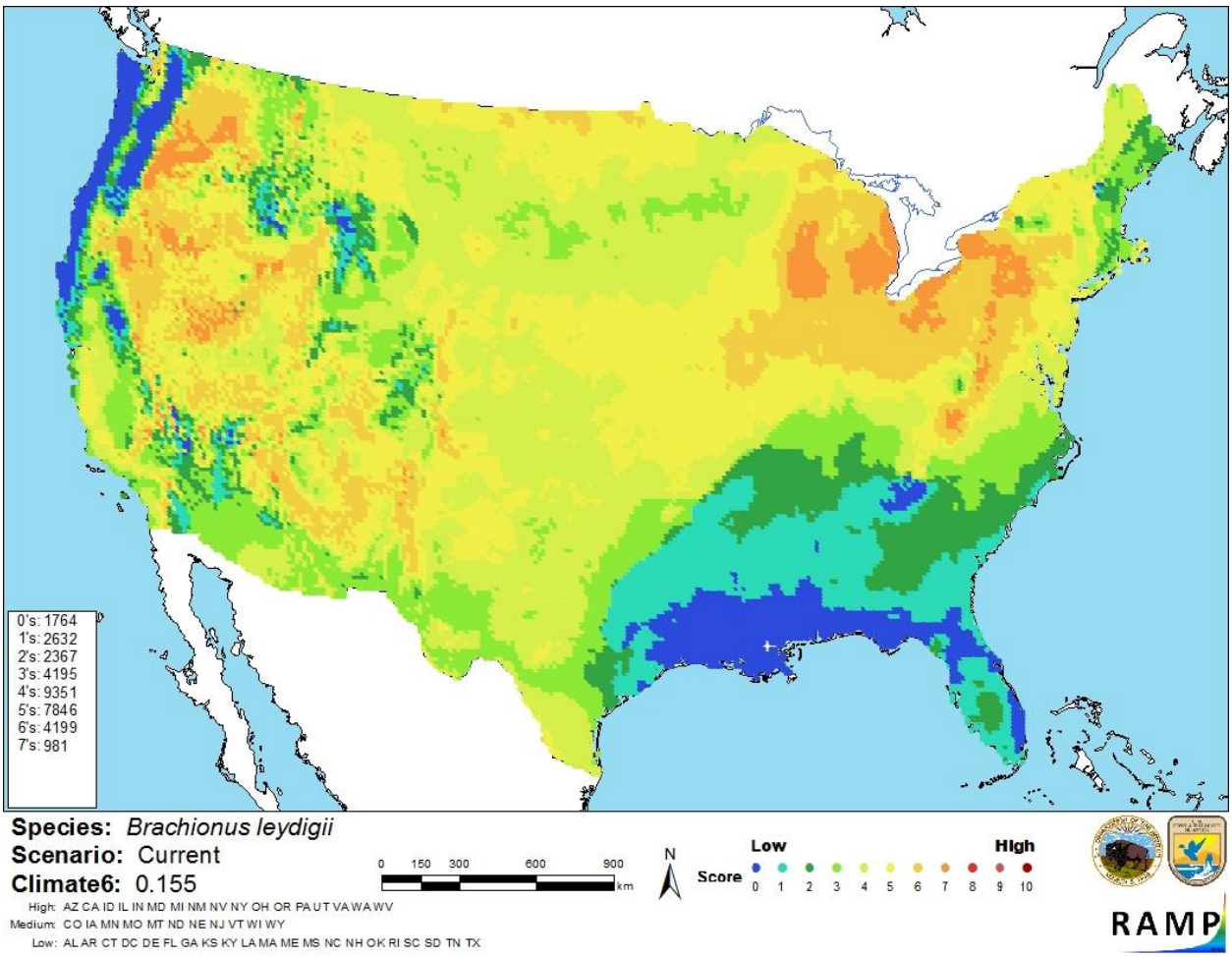

Figure 3. Map of RAMP (Sanders et al. 2014) climate matches for *B. leydigii* in the contiguous United States based on source locations reported by GBIF (2016), with additional locations from Kaya and Altindağ (2007; Turkey), Jersabek and Bolortsetseg (2010; Mongolia), Ostojić et al. (2012; Serbia), Tóth et al. (2014; Hungary), and Ejaz et al. (2016; Pakistan). 0= Lowest match, 10=Highest match. Counts of climate match scores are tabulated on the left.

The High, Medium, and Low Climate match Categories are based on the following table:

Climate 6: Proportion of (Sum of Climate Scores 6-10) / (Sum of total Climate Scores)	Climate Match Category
$0.000 \leq X \leq 0.005$	Low
$0.005 < X < 0.103$	Medium
≥ 0.103	High

7 Certainty of Assessment

Substantial uncertainty exists surrounding the distribution of *B. leydigii* globally and in the United States. Many sources cite the species as having a cosmopolitan distribution, but few georeferenced point locations are available to confirm such claims. Within the U.S., there are

reports of the species from multiple locations in the early to mid-twentieth century, but no recent records have been published and a contemporary source describes the species as not native to North America. With this distributional uncertainty, it is difficult to determine where *B. leydigii* may have been introduced, much less whether introductions of *B. leydigii* have resulted in impacts to native species or humans. The certainty of this assessment is low.

8 Risk Assessment

Summary of Risk to the Contiguous United States

Brachionus leydigii is a species of rotifer with a reported distribution across the Eastern Hemisphere and additional scattered reports from the Western Hemisphere. *B. leydigii* is able to tolerate a wide range of temperature and salinity conditions, appearing in both marine and freshwater environments. Transoceanic shipping is the most likely pathway of introduction, but no introductions of this species have been explicitly documented and therefore impacts of introduction are unknown. Climate match to the contiguous U.S. is high. Overall risk posed by *B. leydigii* is "Uncertain."

Assessment Elements

- **History of Invasiveness (Sec. 3): Uncertain**
- **Climate Match (Sec. 6): High**
- **Certainty of Assessment (Sec. 7): Low**
- **Overall Risk Assessment Category: Uncertain**

9 References

Note: The following references were accessed for this ERSS. References cited within quoted text but not accessed are included below in Section 10.

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10 References Quoted But Not Accessed

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