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# *Kellicottia bostoniensis* (Rousselet, 1908) is spreading in Brazil: new occurrence in water reservoir in Campos Gerais (Paraná)

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## Abstract

*Kellicottia bostoniensis* is a natural planktonic species from North America. This has already been identified as alien/invasive in Europe, South America and Asia, having a relationship between the size of the rotifer and the trophic states, depths, and pH values of the water body. This work aims to describe a new occurrence of *K. bostoniensis* in a dam for recreational activities and urban water supply in southern Brazil. Sampling was carried out using oblique hauling, with a 68 µm cylindrical-conical net close to buildings in the water supply catchment area and the hydroelectric plant at the Alagados Reservoir. The occurrence of *K. bostoniensis* in this area of the dam described as having a lentic environment dominance, and subject to Cyanophyceae blooms raises the alert for the arrival of this rotifer in Campos Gerais. In addition to encouraging the need for studies on the impact of this species on native zooplankton and its potential to be an indicator species of aquatic environments.

**Key words:** alien species, exotic rotifer, freshwater invertebrate, indicator human, bioindicator

## Introduction

Large organisms such as mollusks, decapods, and fish are usually the focus of aquatic invasive alien species studies (Tricarico et al. 2016; Pereira et al. 2018), with smaller sized organisms such as zooplankton organisms being scantly addressed (Lopes et al. 1997; Paggi 2002; Simões et al. 2009). Due to the difficulty in identifying species and the use of improper sampling methods (Macêdo et al. 2019), some zooplankton groups are still poorly documented (Peixoto et al. 2010; Ferreira Jr et al. 2022), especially microzooplanktonic organisms such as rotifers (Chick et al. 2010; Thomas et al. 2017). However, they are important in aquaculture, ecotoxicology, and environmental monitoring studies. Such organisms are known to have distinct mechanisms of food acquisition, sexual reproduction (parthenogenetic), and dormant

stages, and play a prominent role in the aquatic food web, being fundamental in the microbial food web (Wallace and Snell 2010).

Thus, alien plankton organisms may be of concern in ecosystems that they do not naturally inhabit, although no socioeconomic impacts have been reported up to now. Possible ecological effects have been identified in relation to reduction/alteration of native zooplankton populations as well harmful toxic algal blooms (Irigoien et al. 2005). It was also recorded alien species already established in tropical systems, such as the zooplankton *Lamproglena monodi*, *Mesocyclops ogunnus* (Copepods), and phytoplankton (toxic Cyanobacteria) *Raphidiopsis raciborskii* (= *Cylindrospermopsis raciborskii*) (Azevedo et al. 2012; Branco and Senna 1991; Huszar et al. 2000; Peixoto et al. 2010).

Among the alien/invasive rotifer species, *Kellicottia bostoniensis* (Rousselet, 1908) has been already reported in Europe (Zhdanova et al. 2019), Asia (Yang and Min 2020) and South America: like in Araguaia River (Gomes et al. 2022); in reservoir and affluent in River Iguazú and Uruguay, respectively (Paggi 2002); in hydroelectric reservoirs and freshwater ecoregions (Macêdo et al. 2020); and La Plata River basin (Martins et al. 2020). This species seems to affect the zooplankton community (Paggi 2002; Bayanov 2014; Bomfim et al. 2016), strongly suggesting competition and effects on the use of food resources in the water column (Oliveira et al. 2019).

Some authors reported *K. bostoniensis* it as euryecious specie (Bayanov 2014; Paggi 2002), Paggi (2002) reported the occurrence of the species in Argentina, and Bayanov (2014) studying the invasion of *K. bostoniensis* in Russia concluded that *Kellicottia longispina* (Kellicott, 1879) did not sustain a competition to the invader. Oliveira et al. (2019) investigated the effect of *K. bostoniensis* on different components of the microbial food web suggesting that the impact in the ecosystem could be substantial since it can be a sink of energy and matter.

The increasing occurrence of *K. bostoniensis* in Brazilian reservoirs can be expected due to: (i) ubiquity of these systems in Brazilian watersheds, (ii) the apparent adaptation of *K. bostoniensis* to different environmental conditions (lotic and lentic), (iii) tolerance to eutrophication, (iv) reproduction throughout the year, (v) size increase as a possible response to predation by invertebrates, and (vi) propagation through upstream-downstream or vice versa by waterfowl or alien fish and aquaculture practices (Matsumura-Tundisi 1999). The confirmation of the occurrence of *K. bostoniensis* is of paramount importance in the evaluation of possible pathways of introduction into the several aquatic ecosystems characterizing countries like Brazil.

Furthermore, the biological invasion processes of small zooplankton microorganisms should be further investigated, and can contribute to species diversity conservation actions in tropical regions and aquatic ecosystems (Macêdo et al. 2020). The scarcity of pre-invasion data from alien rotifers in most Brazilian freshwaters hampers efforts to measure the

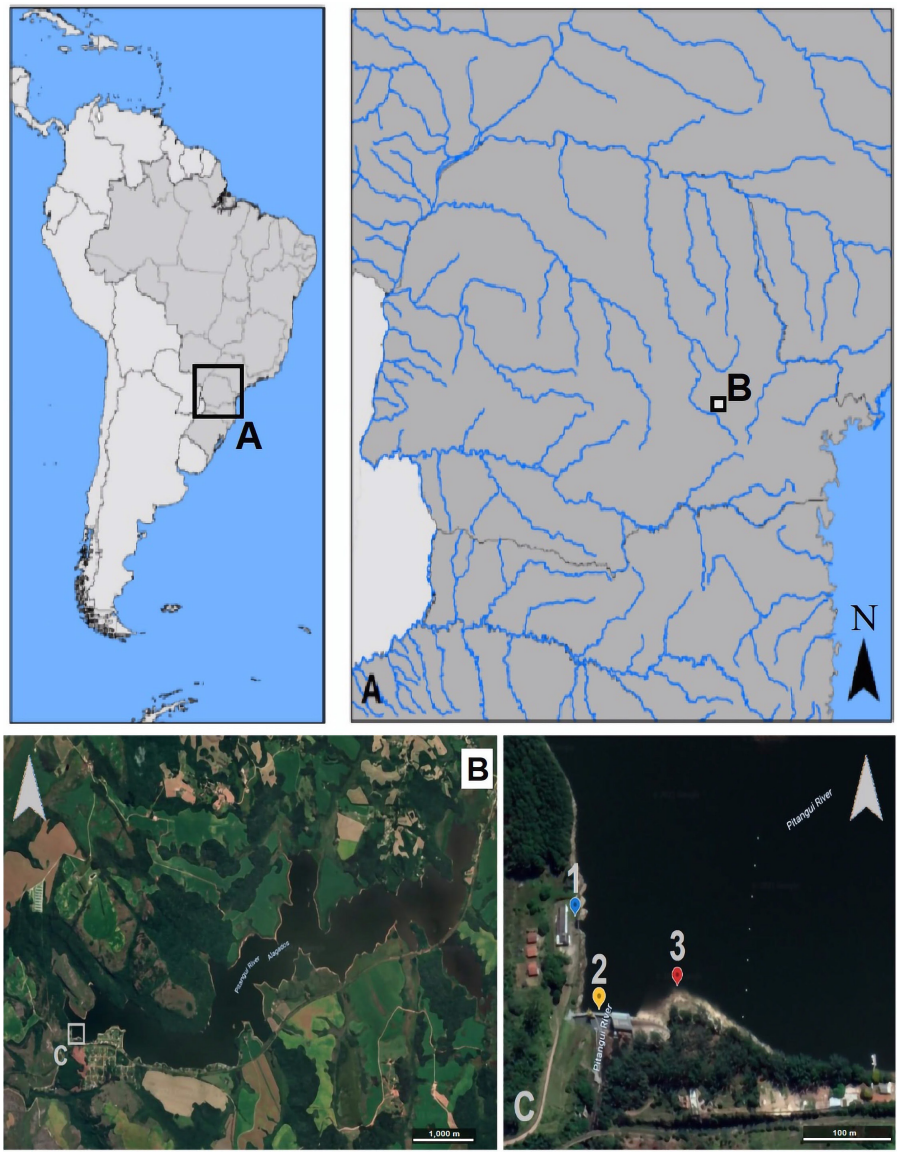


**Figure 1.** Sampling location of *Kellicottia bostoniensis* in Ponta Grossa, Paraná, Brazil. Black square: Indicates region sampled in South America. A: Location of the Alagados dam in relation to the hydrography of Brazil. B: Alagados Dam on the Pitangui River. C: area of occurrence of *K. bostoniensis*; blue balloon (1): water catchment location; yellow balloon (2): São Jorge river dam; red balloon (3): alien rotifer sampling site. Source: Google Maps®.

level of these impacts (Macêdo et al. 2020). Moreover, stemming from this, alien rotifers are generally classed as not harmful (O'Connor et al. 2008) and impacts on the food web or disruptions in the trophic cascade are still inconclusive, although predation of *K. bostoniensis* on microbial loop communities has been evidenced (Oliveira et al. 2019). In this paper, we report the new occurrence of the rotifer *Kellicottia bostoniensis* in a recreational and urban water supply dam in Southern Brazil.

## Materials and methods

### *Collection area*

The Alagados Dam (50°04′W; 25°01′S) was built during the construction of the São Jorge hydroelectric plant (Figure 1); inaugurated in 1945, with a

generating capacity of 2.3 MW, it is located on the left bank of the Pitangui River, approximately 18 km from the center of Ponta Grossa (Companhia Paranaense de Energia Elétrica – COPEL in http://www.copel.com, accessed March 2022), Paraná. This aquatic system originates from the damming of the Pitangui and Jotuva rivers, with 375.7 km² of surface area, has a predominantly lentic habitat with approximately 10 km length characterized by a riparian environment and eutrophic waters (Moro et al. 2003; Companhia Paranaense de Energia Elétrica (COPEL). http://www.copel.com (accessed March 2022)); Clemente 2009; De Julio et al. 2009). This environment is of great importance for the region, providing approximately 40% of the water to the municipality of Ponta Grossa-Paraná, Brazil (358,838 inhabitants in Population Count; Instituto Brasileiro de Geografia e Estatística – IBGE in https://www.ibge.gov.br/institucional/o-ibge.html, accessed January 2022) and being a leisure and tourism attraction (Silva et al. 2007; Rogoski et al. 2016).

### *Sampling and Data Analyses*

Sampling in the Alagados Reservoir was carried out using a plankton net with a mouth diameter of 20 cm and a mesh size of 150 µm. One minute netting was conducted on the superficial water level near the shore. Samples were fixed in the field in two ways (1) using 10% formaldehyde, previously neutralized with sodium tetraborate and preserved in 70% alcohol, and (2) using 70% ethyl alcohol. Sorting of the biological material was done under a stereoscopic microscope in the Laboratory of Invertebrate Zoology and Laboratory of Evolutionary Genetics of UEPG, photo-documented using an Olympus® BX42 microscope equipped with a DP71 real-time digital camera (Olympus®) using low light and 20.0x objective, and a Leica® M205 C optical stereomicroscope using 16.0x objective equipped with an MC170 HD real-time digital camera (Leica®), LAS 4.8.0 software (Leica®). Species was identified following Zhdanova et al. (2019) in Olympus® microscope, and qualitative analyzing several morphological characteristics, such as body shape, total body lengths, lorica, anterior and posterior spines.

## Results and discussion

The rotifer *Kellicottia bostoniensis* (Figure 2) was identified at Alagados Dam: this is a North American planktonic species considered alien in Brazil, having been found in 28 Brazilian freshwater reservoirs, including two in Paraná, Iraí and Segredo municipalities (Landa 2002; Macêdo et al. 2020). The possible causes of its introduction have been related to the accidental transport of dormant eggs through fish stocking and ballast water, leading to a rapid spread in the Neotropical region (Macêdo et al. 2020). In addition, its occurrence and establishment have been related to waters rich in organic matter (Landa 2002), because the presence of bacteria and other phytoplankton species favors the proliferation of *K. bostoniensis*, as well as its high adaptability to tropical environments (Macêdo et al. 2020).

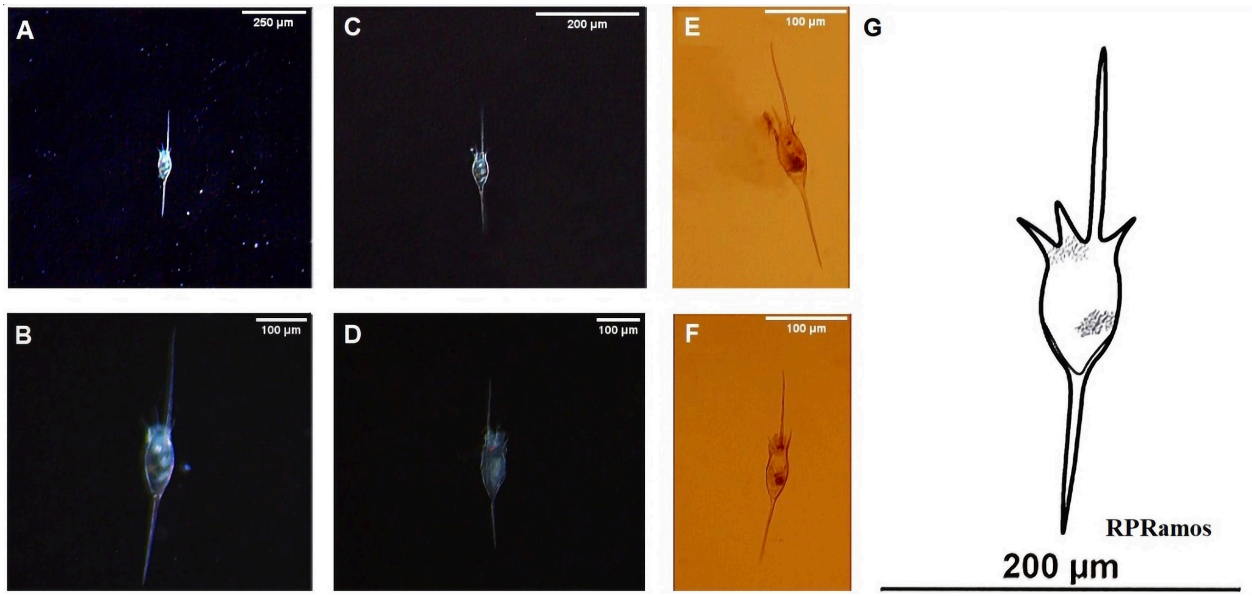


**Figure 2.** *Kellicottia bostoniensis* in Alagados, Ponta Grossa, Paraná, Brazil. A–D: Pictures of the samples of obtained with Leica® M205 C optical stereomicroscope with low light and 16.0x objective. E–F: Pictures of the samples obteined with Olympus® BX42 microscope with 20.0x objective. G: Illustration of *Kellicottia bostoniensis* with illustrative thorns. Source: Raylen Ramos.

*Kellicottia bostoniensis* has been found in the present work together with other toxic alien species (phytoplankton – *Raphidiopsis raciborskii* = *Cylindrospermopsis raciborskii*) and this is the first report for the Alagados Dam, Ponta Grossa (PR) (Clemente 2009; De Julio et al. 2009; Bittencourt-Oliveira and Molica 2003). The pre-dam area (São Jorge hydroelectric plant) is characterized by a high presence of lacustrine organisms and eutrophication process, due to the human activities around the watershed (Moro et al. 2003). The area of the Alagados Dam is dominated by lentic waters and is subject to Cyanophyceae blooms, especially from January to April when there is greater stability of the water column in a period of high temperatures and little wind (Moro et al. 2003; Clemente 2009; Bittencourt-Oliveira and Molica 2003). Similar conditions relating the presence of *K. bostoniensis* to environments rich in organic matter have been reported elsewhere in South America, Europe and Asia (Paggi 2002; Zhdanova et al. 2019; Macêdo et al. 2020; Yang and Min 2020; Arcifa et al. 2020; Picapedra et al. 2021; Gomes et al. 2022). This information coupled with the new occurrence of *K. bostoniensis* raises the alert for the arrival of the species in the Campos Gerais region and dams with water reservoir/hydroelectric plant, as well as the need for studies on its impact on native zooplankton and its potential to be an indicator species of aquatic environments.

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## Authors' contribution

ALFJ: write-up, data analysis, data collection, draft editing. ET: draft editing and supervision. RPR: data analysis, write-up, and draft editing. RFA: data collection, draft editing, and supervision. SWC: draft editing and supervision.

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