



First record of the freshwater clam *Eupera klappenbachi* (Bivalvia: Sphaeriidae) from southeastern Brazil

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Abstract: This study brings the first record of the freshwater clam *Eupera klappenbachi* Mansur & Veitenheimer, 1975 from the state of São Paulo, southeastern Brazil, representing a vast extension to the known distribution of this species, which was previously restricted to southern Brazil, northeastern Argentina and Uruguay.

Key words: distribution, freshwater bivalve, Mollusca, Upper Paraná River Basin.

Primeiro registro do bivalve dulcícola *Eupera klappenbachi* (Bivalvia: Sphaeriidae) no sudeste do Brasil. Resumo: Este estudo traz o primeiro registro do bivalve dulcícola *Eupera klappenbachi* Mansur & Veitenheimer, 1975 para o estado de São Paulo, sudeste do Brasil, representando uma grande expansão da área de ocorrência conhecida desta espécie, que antes era restrita ao sul do Brasil, nordeste da Argentina e Uruguai.

Palavras-chave: distribuição, bivalve dulcícola, Mollusca, Bacia Hidrográfica do Alto Paraná.

Despite exhibiting a high diversity and playing important roles in their ecosystems, freshwater bivalves are still poorly studied in Brazil. Several gaps in knowledge concerning the taxonomy, distribution and natural history of these animals diminish our understanding of their biology and hamper conservation efforts (Graf, 2013; Pereira *et al.*, 2014; Miyahira *et al.*, 2017; Miyahira *et al.*, 2022). Recently, most studies on this issue focused primarily on the freshwater mussels of the clade Unionida (Miyahira *et al.*, 2017; Pfeiffer *et al.*, 2019; Graf & Cummings, 2021; Miyahira *et al.*, 2022), but studies concerning other native freshwater bivalves are still lacking. Among the

lesser-known freshwater bivalves, we highlight the Sphaeriidae Deshayes, 1855 (1820), a family with cosmopolitan distribution that is remarkable for including the smallest freshwater bivalves. They can be found in all kinds of freshwater habitats, in which they play important roles in energy and nutrient cycling (Cummings & Graf, 2009; Lee, 2019). The taxonomy and phylogenetic relationships of sphaeriid clams are still poorly understood and have been a topic of discussion in recent years (Graf, 2013). Currently, Sphaeriidae is divided into eight extant genera, with six being classified in the subfamily Sphaeriinae and two in the subfamily Euperinae (Lee, 2019; Bernalaya *et al.*, 2023). In

this context, *Eupera* Bourguignat, 1854 is by far the most speciose genus in Euperinae, with 33 valid species distributed across the Americas and Africa (Lee, 2019; MolluscaBase, 2023). One such species is *Eupera klappenbachi* Mansur & Veitenheimer, 1975, a small freshwater clam described from a few specimens collected among the roots of freshwater plants from the Guaíba Lake and nearby rivers in Rio Grande do Sul, the southernmost state of Brazil (Mansur & Veitenheimer, 1975). In addition to its type locality, *E. klappenbachi* was later recorded in a few additional localities in the hydrographic regions of southern Brazil, northern Argentina and Uruguay (Mansur & Pereira, 2006; Rumi *et al.*, 2008; Pereira *et al.*, 2014; Ituarte, 2020).

In this study, two specimens collected in the municipality of Monte Alto in southeastern Brazil are identified as *E. klappenbachi*, representing the new northernmost record of this species and vastly extending its known distribution range. The specimens are deposited in the Coleção Malacológica de Ribeirão Preto (CMRP) at the Departamento de Biologia of the Faculdade de Filosofia, Ciências e Letras de Ribeirão Preto (FFCLRP), University of São Paulo, Brazil. Information about specimen collection was taken from the specimen labels and associated collection data. Species identification was based on external morphology after Ituarte (2020), Simone (2006) and the original description by Mansur & Veitenheimer (1975). The specimens were examined and photographed using a Leica M205C stereomicroscope equipped with a camera at the Centro para Documentação da Biodiversidade (CDB), FFCLRP-USP. The distribution map for the species was created with the QGIS program (Geographic Information System; <http://www.qgis.org>). The

following abbreviations are used for shell measurements: H = shell height; L = shell length.

The specimens (Fig. 1) can be identified as *E. klappenbachi* due to the following shell characters: outer surface with dark spots, outline rounded-ovate, posterior end higher than anterior end, umbo displaced anteriorly, dorsal margin sharply sloping toward anterior end, periostracum lamellate, marked angle at the joining of dorsal and posterior margins, posterior margin short and subrect (Mansur & Veitenheimer, 1975; Ituarte, 2020). Furthermore, *E. klappenbachi* is the only *Eupera* species reported in southern Brazil, with the other Brazilian species being found in the states of Bahia and Tocantins (Simone & Ferreira, 2022; Ituarte, 2020).

The specimens were collected in a small and shallow artificial lake near the central region of Monte Alto (21°16'10.6"S 48°29'38.3"W; Fig. 2). This lake is isolated from nearby streams and it is unclear how the species was able to disperse into it, but sphaeriid clams are known for their ability to disperse across drainage divides and are commonly found in isolated and unstable freshwater environments (Graf, 2013). The new record vastly extends the distribution of *E. klappenbachi* to the northern region of the state of São Paulo. This record is hundreds of kilometers to the north of the previous northernmost record for this species in the state of Santa Catarina. It also represents the first record of this species in the Upper Paraná River Basin. Although the resulting distribution is very discontinuous (Fig. 2), this might be a result of under-sampling and lack of studies, as sphaeriid clams and freshwater bivalves in general are severely understudied in Brazil (Pereira *et al.*, 2014; Ituarte, 2020; Machado *et al.*, 2023). Thus, it is likely that the



Figure 1. *Eupera klappenbachi* (CMRP 1074), collected in artificial lake in Upper Paraná River Basin in the municipality of Monte Alto, state of São Paulo, southeastern Brazil. A: Lateral left view; B: Lateral right view; C: Dorsal view.



Figure 2. Distribution of *Eupera klappenbachii* based on literature records (green dots) and the specimens from Monte Alto, São Paulo (red dot). Coordinates for literature records were taken from the original source or estimated based on the locality described.

species has a continuous distribution across the hydrographic regions from southeastern Brazil to northeastern Argentina, with additional surveys being necessary to fill the gaps and create a more complete understanding of its occurrence range.

Overall, the new record reinforces the need to improve our knowledge about *E. klappenbachii* and other native freshwater bivalves from Brazil. Although taxonomic revisions of Sphaeriidae are available for other regions of South America, a revision of the Brazilian species is still extremely

needed (Ituarte, 2020; Machado *et al.*, 2023). Their status as the smallest freshwater bivalves, while a distinctive and interesting feature of the group, has been suggested to be a hindrance to their study (Machado *et al.*, 2023). Remarkably, *Eupera* is among the most problematic genera in the family, with very little information available for most species (Ituarte, 2020). As previously highlighted by other studies, the most pressing needs in freshwater bivalve research are to improve distribution data, taxonomic revisions and ecological studies (Pereira

et al., 2014; Miyahira *et al.*, 2017; Ferreira-Rodríguez *et al.*, 2019; Böhm *et al.*, 2020; Miyahira *et al.*, 2022). This knowledge is crucial to assess and make informed decisions on the conservation of these organisms, which are among the most threatened animal taxa worldwide (Ferreira-Rodríguez *et al.*, 2019; Böhm *et al.*, 2020; Miyahira *et al.*, 2022). Although *E. klappenbachi* is revealed herein to be a widely distributed species, its conservation should not be overlooked and more data on its biology, ecology and distribution are still needed for a formal assessment of its status.

Systematics

Class Bivalvia Linnaeus, 1758

Subclass Autobranchia Grobben, 1894

Order Sphaeriida Lemer, Bieler & Giribet, 2019

Family Sphaeriidae Deshayes, 1855 (1820)

Genus *Eupera* Bourguignat, 1854

***Eupera klappenbachi* Mansur & Veitenheimer, 1975**
(Figs. 1, 2)

Eupera klappenbachi Mansur & Veitenheimer, 1975: 23 (pl. 1, fig. 1-3); Olazarri, 1980: 20; Lanzer & Schafer, 1985: 538 (fig. 3-5, table 2); Di Persia *et al.*, 1986: 625 (table 2); Lanzer & Schafer, 1987: 48 (fig. 2-5, table 2); Pereira *et al.*, 2000: 142; Mansur & Meier-Brook, 2000: 3 (fig. 5, 13-17, 39-51, 98-99, 104, 116, 121, 129, 137-150, table 1-3); Medeiros *et al.*, 2002: 72 (table 1-3); Pfeiffer & Pitoni, 2003: 148 (table 1-4); Agudo-Padrón, 2004: 21; Korniuschin & Glaubrecht, 2006: 191 (fig. 5G); Mansur & Pereira, 2006: 1140 (fig. 25, table 2); Martello *et al.*, 2006: 457 (fig. 16-17, table 2-3); Simone, 2006: 303 (fig. 1065); Scarabino & Mansur, 2007: 95; Martello *et al.*, 2008: 33 (table 1); Rumi *et al.*, 2008: 86 (table 1-2); Agudo-Padrón, 2009: 9; Maltchik *et al.*, 2010: 476 (table 2); Agudo-Padrón, 2011: 23 (fig. 1-2); Agudo-Padrón & Lenhard, 2011: 169; Erthal *et al.*, 2011: 435 (table 1); Pereira *et al.*, 2012: 93 (table 3); Sá *et al.*, 2013: 216 (fig. 5i-j, table 1); Kotzian *et al.*, 2014: 624 (table 1); Martello *et al.*, 2014: 38 (table 2-3); Pereira *et al.*, 2014: 12 (table 2); Darrigran *et al.*, 2015: 245; Heydrich, 2016: 30; Agudo-Padrón, 2018^a: 57 (table 1); Agudo-Padrón, 2018^b: 39 (table 1); Ituarte, 2020: 406 (fig. 11.118E); Agudo-Padrón, 2022: 3114.

Type locality: Saco do Ferraz, Pólvora Island, Lake Guaíba, Porto Alegre, Rio Grande do Sul, Brazil (Mansur & Veitenheimer, 1975).

Previously known records: Brazil (Santa Catarina and Rio Grande do Sul), Argentina (Corrientes and Entre Ríos) and Uruguay (Salto) (Fig. 2). This area is included within the hydrographic regions of the rivers of the South and Southeast Atlantic in Brazil, the Uruguay River Basin and the Misionero and Paranoplatense systems in Argentina (Pereira *et al.*, 2014).

New record: Artificial lake related to the Upper Paraná River Basin in the municipality of Monte Alto, state of São Paulo, southeastern Brazil (Fig. 2). **Habitat:** Reported in a variety of water bodies, including lakes, rivers, streams, ponds and artificial reservoirs. Typically found in association with freshwater plants, such as water hyacinths of the genus *Pontederia* L. (Mansur & Veitenheimer, 1975).

Measurements (in mm): CMRP 1074: H = 3.2, 4.7; L = 4, 6.5.

Material examined: BRAZIL, São Paulo: Monte Alto (artificial lake near a pasture, 21°16'10.6"S 48°29'38.3"W), 26/II/2023, 2 spm (CMRP 1074).

Ethical statement

The present investigation did not involve regulated animals and did not require approval by an Ethical Committee. Furthermore, a license to collect biological material was not required, as specimens from a scientific collection were used.

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