Acta Limnologica Brasiliensia

Publication of the Brazilian Association of Limnology

Review Article
Acta Limnologica Brasiliensia, 2026, vol. 38, e13
https://doi.org/10.1590/S2179-975X7625
ISSN 2179-975X on-line version

Spatial and temporal patterns of *Lecane decipiens* (Murray, 1913) records: a global overview based on literature

Padrões espaciais e temporais dos registros de *Lecane decipiens* (Murray, 1913): uma visão geral global baseada na literatura

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Cite as: Santos-Cabral, L.C., Moreira, M.S. and Branco, C.W.C. Spatial and temporal patterns of *Lecane decipiens* (Murray, 1913) records: a global overview based on literature. *Acta Limnologica Brasiliensia*, 2026, vol. 38, e13. https://doi.org/10.1590/S2179-975X7625

Abstract: Aim: *Lecane decipiens* (Murray, 1913) was originally described from samples collected at a small lake in downtown Rio de Janeiro, Brazil. It is widely recorded in Central and South America, although the species has been found on other continents. *L. decipiens* is easily misidentified with other species of the same genus, differentiated only by small details on the lorica, a historical problem in the species occurrence records. This study aims to provide an update on the occurrence of *L. decipiens* worldwide, investigating its distribution and its potential to be considered cosmopolitan in the tropics and subtropics and invasive in temperate regions, as well as identifying gaps in current knowledge about the species. **Methods:** This study was conducted through a bibliographic survey in scientific databases (Web of Science, Scopus, Scielo, ScienceDirect and Google Scholar). **Results:** After screening and removing duplicates, 84 articles published between 1931 and 2025 were analyzed. The results indicate that *L. decipiens* can be considered as a cosmopolitan species, accumulating records in seven of the biogeographic regions, with a particular predominance in the countries India and Brazil, where the largest concentration of articles was found. Most studies were conducted in lakes and rivers, and only one article addressed the species' potential ecological impact, considering its negative influence negligible. Additionally, most studies focused on occurrence records rather than ecological interactions or population dynamics. **Conclusions:** Despite the widespread distribution of *L. decipiens*, the lack of articles on population densities, environmental interactions, and ecological effects hinders the determination of whether the species' presence outside its original range is due to natural expansion or a silent invasion.

Keywords: Rotifera; Lecanidae; distribution; silent invasion.

Resumo: Objetivo: *Lecane decipiens* (Murray, 1913) foi originalmente descrita a partir de amostras coletadas em um pequeno lago no centro da cidade do Rio de Janeiro, Brasil. É amplamente registrada na América Central e América do Sul, embora a espécie tenha sido encontrada em outros continentes. *L. decipiens* é facilmente confundida com outras espécies do mesmo gênero, diferenciadas apenas por pequenos detalhes na lórica, um problema histórico nos registros de ocorrência da espécie. Este estudo tem como objetivo fornecer uma atualização da ocorrência de *L. decipiens* em todo o mundo, investigando sua distribuição e seu potencial para ser considerada cosmopolita nos trópicos e subtrópicos e invasora em regiões temperadas, bem como identificar lacunas no conhecimento atual sobre a espécie. **Métodos:** Este estudo foi conduzido por meio de um levantamento bibliográfico em bases de dados científicas (Web of Science, Scopus, SciELO, ScienceDirect e Google Acadêmico). **Resultados:** Após a triagem e remoção de duplicatas, 84 artigos publicados entre 1931 e 2025 foram analisados. Os resultados indicam que *L. decipiens* pode ser considerada uma espécie cosmopolita, acumulando registros em sete das regiões biogeográficas, com predominância particular nos países Índia e Brasil, onde a maior concentração de artigos foi encontrada. A maioria dos estudos foi conduzida em lagos e rios, e apenas um artigo abordou o potencial impacto ecológico da espécie, considerando sua influência negativa negligenciável. Adicionalmente, a maioria dos estudos focou em registros de ocorrência em vez de interações ecológicas ou dinâmica populacional. **Conclusões:** Apesar da ampla distribuição de *L. decipiens*, a falta de artigos sobre densidades populacionais, interações ambientais e efeitos ecológicos dificulta a determinação de se a presença da espécie fora de sua área de distribuição original se deve à expansão natural ou a uma invasão silenciosa.

Palavras-chave: Rotifera; Lecanidae; distribuição; invasão silenciosa.

1. Introduction

Even with advances in monogonont rotifer surveys, species relationships with environmental conditions in aquatic ecosystems remain largely overlooked, with an even greater gap in biogeography. The Lecanidae is one of the most species-rich families of rotifers, with over 200 described species, mainly within the genus *Lecane* (Segers, 2007) predominantly distributed in tropical and subtropical regions (José de Paggi, 1996; Costa et al., 2022). These organisms occupy the niche of omnivorous microphages, feeding on small-sized algae, bacteria and detritus, and playing an important role in microbial food webs in various types of freshwater habitats (Segers, 2008). Despite this, little is known about the biogeography of the vast majority of its species.

Described for science from specimens collected in a pond located in a central square in the city of Rio de Janeiro, Brazil, *Lecane decipiens* (Murray, 1913) is cited in the literature as a species commonly found in Central and South America (Segers, 1995). There are some records of the species in Europe, where *L. decipiens* has been consistently misidentified (Segers, 1996). The species name comes from the Latin verb "dĕcipiŏ" that means to mislead, to deceive, suggesting that the author was mentioning a certain possible confusion in taxonomic identification due to similarity with other species. Murray (1913) had mentioned that *L. decipiens* might be confused with *L. arcuata* (Bryce, 1891). Furthermore, *L. decipiens* can be confused by non-experts in rotifer studies with two other species of the same genus: *L. hamata* (Stokes, 1896) and *L. serrata* (Hauer, 1933). *L. decipiens* seems to have a wide distribution, with records from all continents (Ovie et al., 2011; Collins, 2015; Pajdak-Stós et al., 2017; Kuczyńska-Kippen & Ejsmont-Karabin, 2020; González-Gutiérrez et al., 2023; Pardo et al., 2023; Yusuf & Sash, 2025).

Most organisms of the zooplankton community are highly dispersive due to their small size, high reproductive rate, production of resistant stages, and can be easily transported by various biotic and abiotic vectors, with anthropogenic activities being one of the main factors enhancing this process (De Meester et al., 2002; Havel & Shurin, 2004; Dexter & Bollens, 2019). The biogeography of rotifers, a diversity group in the zooplankton community of the freshwater environments, results from a complex interplay of ecological, historical, and evolutionary factors, shaping distribution patterns that range from true cosmopolitanism to regionally restricted endemism (Segers, 2008; Fontaneto, 2019; Smolak et al., 2023). Classical studies, such as Green (1972), highlighted latitudinal variations in the composition of planktonic communities, indicating that the abundance and dominance of certain rotifer genera, such as *Brachionus*, tend to decline toward temperate zones, whereas *Notholca* becomes predominant in these regions. Conversely, the existence of a defined biogeography in rotifers has been questioned, largely due to uneven sampling efforts, their remarkable dispersal capabilities (Dumont, 1983; Fontaneto et al., 2012), dubious identification and the existence of complex of species (e.g., *Lecane bulla*, *L curvicornis*) (Walsh et al., 2009; García-Morales & Elías-Gutiérrez, 2013). Nevertheless, compelling evidence indicates that the group possesses its own biogeographic structure, similar to that observed in cladocerans (De Ridder, 1982; Dumont, 1983; Tausz et al., 2019). The broad biogeographic patterns observed in most rotifers can be attributed to the same dispersal mechanisms that enhance zooplankton mobility. According to Segers (2008), most freshwater rotifer species exhibit cosmopolitan distribution and are present on nearly all continents, with the exception of Antarctica.

Although some rotifer species exhibit a broad geographic distribution and are considered as cosmopolitan, this does not necessarily mean they could not be invasive in some areas. Cosmopolitan rotifer species occur naturally across multiple regions of the world as a result of their high dispersal ability, production of resistant stages, and ecological adaptations, without necessarily exerting harmful effects on local ecosystems (Gilbert & Reynolds, 2005; Wallace et al., 2006; Segers, 2008). According to Blackburn et al. (2011), the process of biological invasion involves a sequence of stages: introduction, establishment, spread, and impact, with not all species that cross geographical barriers becoming invasive. In many cases, these events represent merely a natural expansion of geographic distribution, without concrete evidence of ecological impact or persistence in the new habitat (Pardo et al., 2013; Daly et al., 2023; Pfadenhauer et al., 2024). In contrast, invasive species are those that occur outside their native range — typically most as a result of human activities — and whose presence produces significant negative impacts on biodiversity, community structure, and ecosystem functioning (Ricciardi, 2007; Lockwood et al., 2013; Simberloff et al., 2013). Regarding zooplankters, there is also the possibility of a silent invasion, in which introduction and establishment occur gradually and subtly, causing no apparent impacts but with the potential for subtle changes in local zooplankton communities (Miglietta & Lessios, 2009; Ricciardi & MacIsaac, 2011; Branco et al., 2023; Parry et al., 2024).

The family Lecanidae is comprised mostly by cosmopolitan species, but a considerable number of species have restricted range (Segers, 1995). In the context, some questions can be raised: first, does the distribution of *L. decipiens* indicate a natural expansion of its native range, or is it an example of global bioinvasion possibly facilitated by human activities? Second, eighteen years ago, the taxonomy of rotifers was considered "all but adequate" (Segers, 2008). Given the existing taxonomic gaps, including the scarcity of taxonomy experts, can we focus on differentiating between natural and introduced distributions of *L. decipiens*?

The present study primarily aims to explore the worldwide distribution of *L. decipiens*, as well as to assess its potential as an invasive species. Based on this objective, we discuss the possibility that anthropogenic factors may influence the observed distribution of the species in temperate regions.

2. Material and Methods

2.1. Data collection

Searches were performed using full-text searches in major scientific databases, including Web of Science (Clarivate), Scielo, Scopus, ScienceDirect (Elsevier), and Google Scholar, to collect studies on the species *Lecane decipiens*. All searches were conducted on October 10, 2025; therefore, articles published after this date were not included in the study. For consistency and comprehensiveness, the search terms "*Lecane decipiens*", "*Lecane (Monostyla) decipiens*", and "*Monostyla decipiens*" were exclusively used to retrieve all records of the species regardless of changes in its taxonomic classification. All retrieved records were screened for relevance, and duplicates were removed before the bibliographic survey.

2.2. Data processing

Articles were classified according to "Country of study", "Year of collection", and "Type of sampling site", and, when possible, the following information was extracted: data on the species density, relationships of the species with environmental conditions, cited as exotic or invasive, and, if considered as exotic or causes sufficient impact to be considered invasive, if the article investigates the impacts caused by the species. In addition to these categories, information obtained directly from the database exports, such as authors and year of publication, was also included. In the present paper, we use the term "study(ies)" to refer to all results identified in our bibliographic survey, including both peer-reviewed papers and gray literature.

About the type of sampling site, we categorized the studies in the present review as: lakes, rivers, reservoirs, wetlands, phytotelma, small freshwater habitats, and multiple environments. The category "multiple environments" includes studies conducted in two or more of the habitat types listed above. Wetlands include permanently or seasonally inundated areas, natural or artificial, such as floodplains, swamps, and rice fields. Small freshwater habitats comprise smaller water bodies, such as ephemeral ponds, tanks, wells, shallow depressions, and artificial fountains. Phytotelma correspond to water-filled plant structures (Bromeliaceae), and lakes, rivers, and reservoirs refer to common freshwater systems. The classification provides a comprehensive framework to show the full diversity of habitats where *Lecane decipiens* occurs.

Following Azémar et al. (2007), all records of *Lecane decipiens* in Europe prior to 2007 should be regarded with caution, as they were likely misidentifications of *L. hamata* or *L. serrata*. Their article represents the first confirmed occurrence of *L. decipiens* on the continent, highlighting the importance of careful taxonomic verification in historical and contemporary records. These authors explained that the differences between the species can be easily visualized since *L. decipiens* differs from *L. hamata* by the lateral margin of the dorsal plate which does not reach the head aperture, and from *L. serrata* by its lorica without any ornamentation. Accordingly, two articles before Azémar et al. (2007) were identified in Europe: one from Hungary in 1962 (Nogrady, 1962) and another from Spain in 2000 (Ortega-Mayagoitia et al., 2000). These records were therefore disregarded.

In total, the searches produced approximately 280 results. After removing duplicates across databases and studies outside the study's scope, the final dataset for analysis included 84 studies (Table 1).

Table 1. Number of studies extracted by each indexer (before *vs* after data processing).

Index	Number of Studies (before data processing)	Number of Studies (after data processing)
Google Scholar	188	72
Scielo	14	5
Science Direct	49	3
Scopus	19	3
Web of Science	8	1

3. Results

After the original species description (Murray, 1913), the oldest study found dates to 1931 and, the most recent studies were published in 2025 (Figure 1). The highest number of publications occurred in 2011 and 2021, with six studies reported in each year.

The geographic distribution of studies indicates that *Lecane decipiens* occur on all continents (Table 2). India (21) and Brazil (15) account for the highest number of records, followed by Nigeria (5), Thailand, and Mexico (4). Overall, the 84 articles analyzed reported occurrences in 31 countries (Figure 2).

Segers, H. was the most recurrent author found by the present analysis, participating in six of the retrieved studies, either as the main author or co-author. Koste, W. and Sharma, B.K. have four and Bhandarkar, S.V., Green, J. and Sanoamuang, L.O. each have three studies, making them the authors with the next highest number of studies on the species.

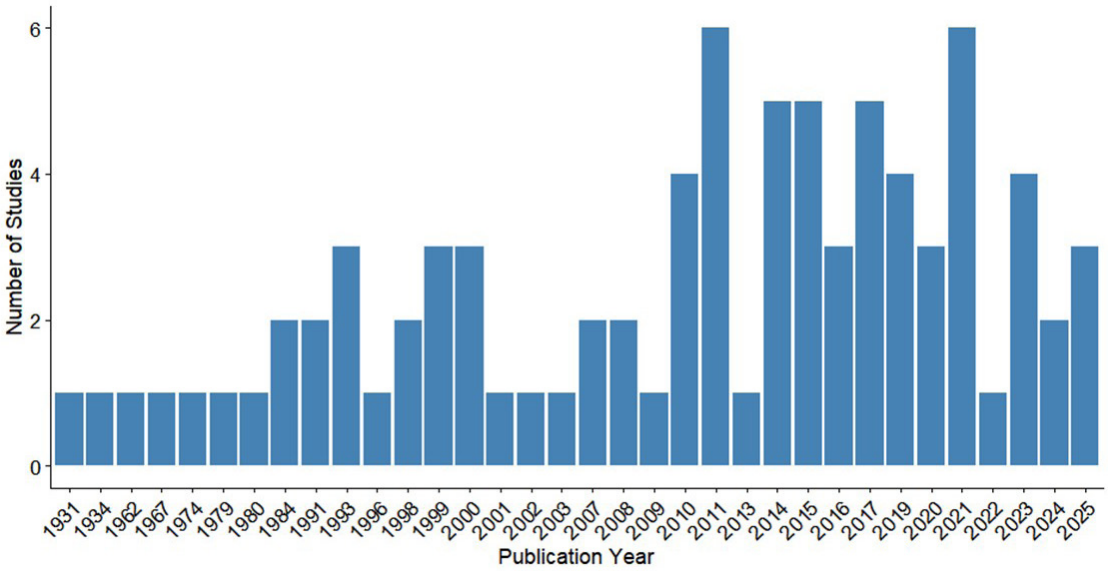

Figure 1. Number of studies citing *Lecane decipiens* over the years.

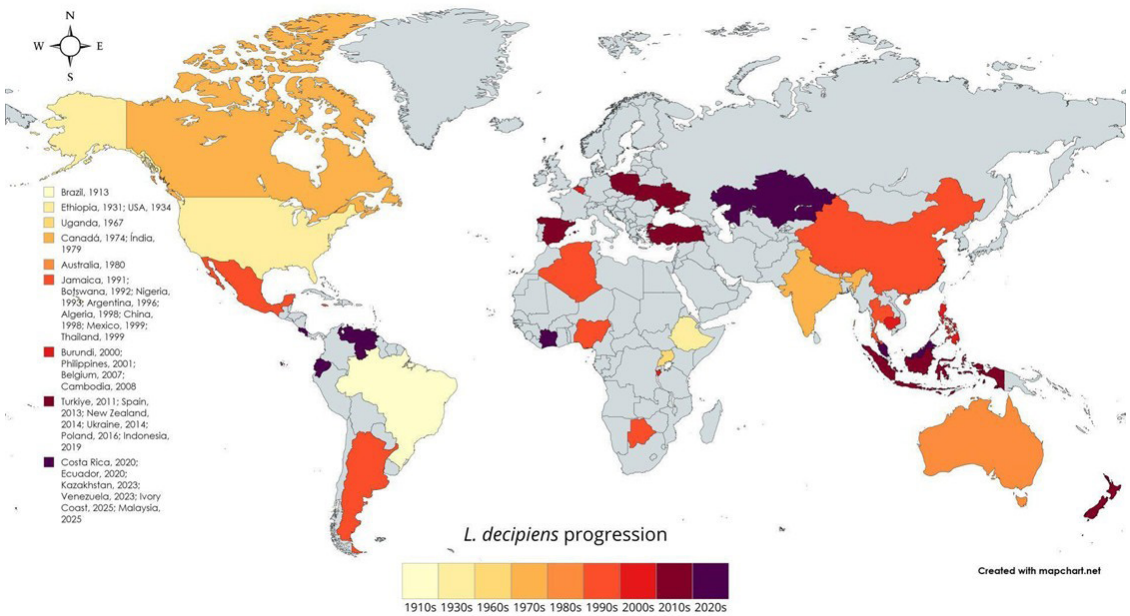

Figure 2. Records per decade of the global distribution of *Lecane decipiens* (all countries with at least one study). The year refers to the first record. Map created with MapChart (2025).

Table 2. All studies included in this bibliographic survey from 1913 to 2025, classified by country, continent, first record (in the country) and type of sampling site. "Multiple environments" was used when a study sampled two or more types of habitat.

Country	Continent	First record	Type of sampling site	Article (s)
Brazil	South America	1913	Lake, Reservoir, River and Multiple environments	Murray (1913); Koste (2000); Bini et al. (2007); Pinese (2008); Casanova et al. (2009); Alves (2011); Portinho (2011); Abra (2012); da Silva et al. (2014); Orikassa (2015); Pinese et al. (2015); Costa et al. (2016); Portinho & Nogueira (2017); Braghin (2019); Diniz (2021)
Ethiopia	Africa	1931	Lake	Bryce (1931); Green & Mengestou (1991)
United States of America	North America	1934	Lake and Multiple environments	Ahlstrom (1934); Wilde (1984)
Uganda	Africa	1967	Lake	Green (1967)
Canada	North America	1974	Wetlands	Chengalath & Mulamoottil (1974)
India	Asia	1979	Lake, Wetlands, River, Small freshwater habitats and Multiple environments	Jyoti & Sehgal (1979); Sharma (1980); Sharma (1993); Raina & Vass (1993); Tayade & Dabhade (2011); Yamini & Kumar (2011); Tayade & Dabhade (2013); Bhatnagar & Devi (2014); Mallick et al. (2014); Bhandarkar (2015); Chopra et al. (2014); Bhandarkar & Paliwal (2017, 2019); Sharma & Hatimuria (2017); Vanjare et al. (2017); Chavan & Murkute (2020); Devi & Bhatnagar (2021); Gadwe & Tijare (2021); John & Kumar (2021); Sharma & Sharma (2021); Shir et al. (2023)
Australia	Oceania	1984	River	Tait et al. (1984)
Jamaica	Central America	1991	Phytotelma	Koste et al. (1991)
Nigeria	Africa	1993	Lake, River, Reservoir and Small freshwater habitats	Segers et al. (1993); Iloba & Egborge (2002); Arimoro & Oganah (2010); Khan (2010); Ovie et al. (2011)
Argentina	South America	1996	Lake	José de Paggi (1996); Andrade (2021)
Algeria	Africa	1998	Wetlands	Samraoui et al. (1998)
China	Asia	1998	Multiple environments	Zhuge et al. (1998)
Mexico	North America	1999	Lake and Multiple environments	Sarma & Elías-Gutiérrez (1999); Jiménez Nigo (2019); Trejo-Albarrán et al. (2022); González-Gutiérrez et al. (2023)
Thailand	Asia	1999	Multiple environments	Sanoamuang & Savatenalinton (1999); Chittapun et al. (1999); Pacharapol & Srifa (2024); Jaturapruek & Maiphae (2025)
Burundi	Africa	2000	River	Baribwegure & Segers (2000)
Philippines	Asia	2001	Lake	Mamaril (2001); Camacho & Villaruel (2024)
Botswana	Africa	2003	Wetlands	Green (2003)
Belgium	Europe	2007	River	Azémar et al. (2007, 2010)
Cambodia	Asia	2008	River	Seanghun & Sanoamuang (2008, 2010)
Turkiye	Europe/Asia	2011	River	Bekleyen et al. (2011)
Spain	Europe	2013	Wetlands	Pardo et al. (2013)
New Zealand	Oceania	2014	Multiple environments	Watson et al. (2014); Collins (2015)
Ukraine	Europe	2014	Reservoir	Trokhymets (2014, 2016)
Poland	Europe	2016	Phytotelma and Small freshwater habitats	Kolicka et al. (2016); Pajdak-Stós et al. (2017)
Indonesia	Asia	2019	Small freshwater habitats	Mawarni et al. (2019)
Costa Rica	Central America	2020	Phytotelma	Kuczynska-Kippen & Ejsmont-Karabin (2020)
Ecuador	South America	2020	Multiple environments	López et al. (2020)
Kazakhstan	Europe/Asia	2023	Reservoir	Krupa et al. (2023)
Venezuela	South America	2023	Wetlands	Pardo et al. (2023)
Ivory Coast	Africa	2025	Wetlands	Traoré et al. (2025)
Malaysia	Asia	2025	River	Yusuf & Sash (2025)

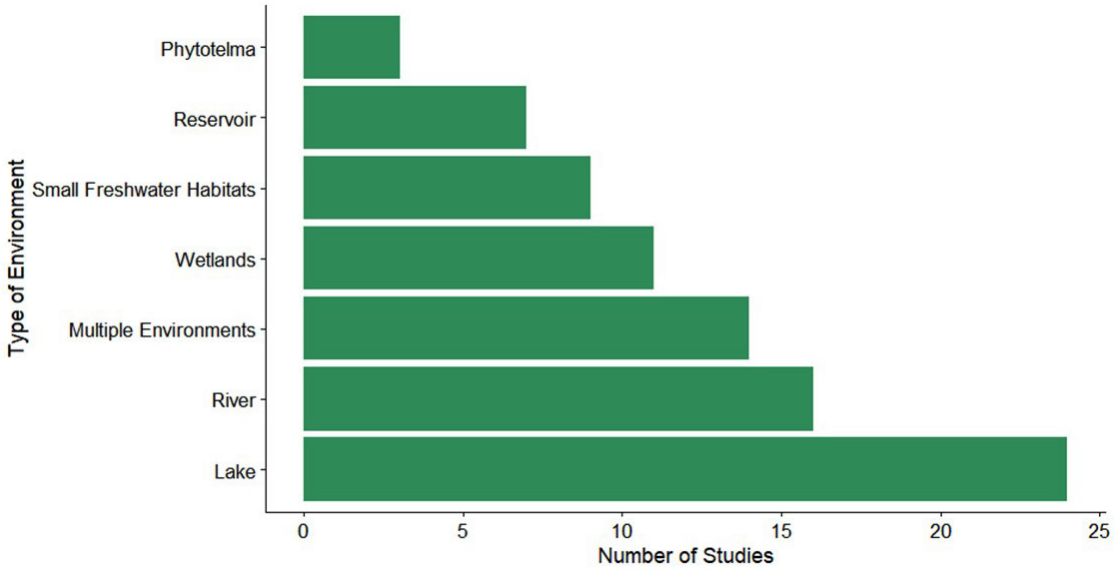

Figure 3. Number of studies by type of sampled environment.

Regarding the type of sampling site, *Lecane decipiens* have been recorded in a wide variety of freshwater habitats (Table 2). The majority of studies were conducted in lakes (24), followed by rivers (16), while 14 studies were categorized as "multiple environments" (Figure 3). Additional records were reported for wetlands (11), small freshwater habitats (9), reservoirs (7), and phytotelma (3).

Regarding density analyses, very few articles (only seven) provided quantitative counts of the species in their samples. Among those that reported density data, maximum values ranged from 0.006 ind·L^{-1} to 18 ind·L^{-1}. Due to the limited availability of density data, a robust quantitative analysis was not possible. Only one article (González-Gutiérrez et al., 2023) presented information correlating species density with environmental factors, reporting a positive correlation between *L. decipiens* density and water temperature. Only three studies (Segers et al., 1993; Azémar et al., 2007, 2010) mentioned the species as potentially introduced or exotic; however, none explicitly classified it as invasive.

4. Discussion

Since its description in 1913, there were scarce records of *Lecane decipiens* occurrence until the beginning of this century when a tendency towards more frequent records was shown. This panorama was associated with the expansion of studies with rotifers and probably with the effect of the presence of rotiferologists, as reported by Fontaneto et al. (2012). However, it must be highlighted that the increase in articles over time reflects an increasing scientific interest in aquatic biodiversity. The use of the term 'biodiversity' in the aquatic bibliography has expanded after the beginning of this century, formed mainly from research carried out in countries of the Northern Hemisphere (Moustakas & Karakassis, 2005). In the history of *L. decipiens* occurrences, one can note studies carried out by European and American scientists in countries in Africa, Asia and South America (e.g., Bryce, 1931; Green, 1967; Koste, 2000) in parallel with the growth of studies conducted by scientists from various countries within their own geographic region (e.g., José de Paggi, 1996; Iloba & Egborge, 2002; Bhandarkar, 2015; Portinho & Nogueira, 2017). This new situation was probably also helped by the expanding research networks among rotiferologists (Špoljar et al., 2024), the use of rotifers in environmental monitoring (Ejsmont-Karabin, 2012; Liang et al., 2020; Kolarova & Napiórkowski, 2023) and online tools for taxonomic analysis such as the Rotifer World Catalog (Jersabek et al., 2026) that have a cumulative effect fostering new research on rotifer biodiversity and expanding scientific output.

Among the authors who have documented the occurrence of *L. decipiens*, Segers H. stands out, with his extensive effort and studies on the taxonomy and distribution of rotifers, being the most recurrent author in this review. This author has conducted rotifer surveys in several continents, developed important guides for rotifer taxonomic studies (Segers, 1995), and provided technical support for the Rotifer World Catalog site (Jersabek et al., 2026).

Notwithstanding, the data on the biogeography of *L. decipiens* demonstrate the species' extensive dispersal records as a result from limited research efforts on rotifer surveys worldwide. Tropical and subtropical countries that have shown more rotifer surveys, as Brazil and India, have produced a comparatively high number of occurrences of *L. decipiens*. In contrast, many other areas, especially in Africa, and regions of Asia, Oceania and South America that have not been thoroughly surveyed (José de Paggi et al., 2020; Smolak et al., 2023) led to significant gaps in our knowledge of the species' current range. This unequal records of *L. decipiens* based on articles may reveal more an imbalanced research intensity in some areas of interest than distributional patterns, and again they seemed more a reflection of the presence of rotiferologists as previously stressed by Fontaneto et al. (2012) than the real biogeographical distribution.

Nevertheless, our results show that *L. decipiens* has a vast geographic distribution, with records on all continents. According to the biogeographical framework proposed by Segers (2007, 2008), *L. decipiens* is considered a cosmopolitan species, with confirmed records from seven major regions: Afrotropical, Australian, Nearctic, Neotropical, Oriental, Pacific, and Palearctic. On the other hand, looking at the distribution map of occurrences, we observe a predominance of records in tropical and subtropical countries, where the *rotiferologist effect* is often not intense. However, a closer look at countries in the tropical region reveals that studies are concentrated in areas close to research institutions, where the *rotiferologist effect* is indeed more localized and intense.

Important questions remain regarding the dispersal capacity and biogeographical status of *L. decipiens*. Although the species was first recorded in tropical and subtropical regions (South and Central America), its presence in various parts of the world suggests that *L. decipiens* may have attained a global distribution through natural and human-mediated dispersal, or a combination of both. In reality, there is still a lack of studies to delineate a true distribution of the species, and comments in older articles may confuse the precise establishment of its occurrences. For example, it should be noted that Murray, in the article that first describes *L decipiens,* reported that this new species at that time was also known in Australia (Murray, 1913). The occurrence in Australia was further reported in the books of Voigt (1957) and Koste (1998), and by Koste & Shiel (1990). However, according to Shiel (pers. comm.), this species was not registered in Australia before 1980, and it was probably introduced by human activities.

The occurrence of *L. decipiens* in tropical and subtropical countries, particularly with higher records in India and Brazil as mentioned before, could reflect favorable environmental conditions for the species distribution as well as sampling bias. This latter is supported by the large number of studies conducted by Sharma, B.K. and Bhandarkar, S.V., the two of the most prolific authors on the species records, exclusively in India. In contrast, Segers H., the author with the highest number of studies reporting *L. decipiens*, is involved in many articles reporting first records of *L. decipiens* in specific countries (Nigeria, Thailand) (Segers et al., 1993; Chittapun et al., 1999). This author also authored research in which the species was recorded in only a single study in that country (Burundi, Algeria) (Samraoui et al., 1998; Baribwegure & Segers, 2000).

In Brazil, which is the type locality of the species, a substantial number of studies have also been conducted, as reflected by our bibliographic survey. However, these records are not evenly distributed across the country. As discussed by some authors (Garraffoni & Lourenço, 2012; Costa et al., 2022) 78% of the studies on rotifer fauna are concentrated in six out of 27 Brazilian States. Although historical records of *L. decipiens* in Brazil were documented by Garraffoni & Lourenço (2012), the reexamination of the same journals used in the survey these authors — now indexed in the Clarivate database — retrieved few of the records recorded by them. This underscores significant limitations in studies of species distribution and invasiveness: historical records may be underestimated if assessments rely solely on contemporary digital platforms, potentially leading to misinterpretations of occurrence patterns. Here we see the need for training taxonomists, implementing genomic analyses, and undertaking a broad effort to survey rotifer biodiversity.

Lecane decipiens was found in a variety of freshwater habitats, being most frequently recorded in lakes. This pattern may partly reflect sampling bias, as some studies indicate that lakes are among the most intensively studied environments for freshwater zooplankton (Castilho-Noll et al., 2023). Ecological factors may also contribute, as low-flow systems typically present lower water velocity and longer residence time, conditions that favor rotifer establishment and persistence (Czerniawski & Sługocki, 2017). The great diversity of habitats indicates that the species exhibits high adaptability or can live in a wide range of ecological conditions, persisting in lentic systems or being limited to small or transient habitats. High reproductive capacity,

resistance to environmental changes, and effective dispersal mechanisms that enable colonization of a variety of habitats are among the general characteristics of rotifers that are consistent with this adaptability (Segers, 2007; Franch-Gras et al., 2017). However, we must highlight members of the Lecanidae family are substratum-dwellers, living mainly in littoral habitats, and in considered exotic water bodies such as phytotelmata (Segers, 1995). These last features facilitate the presence and persistence of species of *Lecane* in different types of aquatic environments.

Few articles found by the present study address the presence of *L. decipiens* as exotic or artificially introduced. Examples include Segers et al. (1993), who suggest that the species presence in Nigeria may result from human-mediated introduction. Azémar et al. (2007, 2010) examined the species' environmental effects, referring to it as exotic (Azémar et al., 2010). These last authors were the unique found by us to provide a clear definition of the species potential invasiveness, categorizing it as established but numerically rare, stating that its potential impacts are "negligible". Therefore, although we have gaps regarding the natural distribution of *L. decipiens*, some records differentiated between natural and introduced distribution of *L. decipiens* indicating examples of bioinvasion possibly facilitated by human activities. With this, our hypothesis about anthropogenic factors influencing the distribution of species in temperate regions could be corroborated. But not only in temperate regions, as suggested by the study of Segers et al. (1993).

Nevertheless, the limited number of studies on population densities, ecological interactions, and environmental factors relationships shows that little is known about ecology of *L. decipiens*. Considering that rotifers exhibit a great richness of species in freshwater environments (Rodríguez & Matsumura-Tundisi, 2000; José de Paggi et al., 2020; Elmoor-Loureiro et al., 2022), it is noted that little is known about most of the species present. Only taxa with wide occurrence and densities or explored in aquaculture and in toxicological essays (e.g., *Brachionus* spp.), or recognized as exotic species in expansion (e.g., *Kellicottia bostoniensis*) have their ecology more thoroughly investigated. The lack of data on *L. decipiens* makes it difficult to distinguish between a possible silent invasion and natural range of occurrence, especially in areas with sparse or inconsistent records. Furthermore, the evaluation of both natural distribution and invasive status is impaired by historical and misidentified records, as well as inconsistent sampling efforts across continents. Because of this, it is still challenging to distinguish whether observed occurrences outside of the tropical and subtropical are low-density establishments, transient introductions, or having subtle ecological impacts that might go undetected without focused research.

5. Conclusion

In summary, *Lecane decipiens*, with its type locality in southeast Brazil, is widely distributed and confirmed as a cosmopolitan species. Despite the temporal increase in the number of articles seen in the present study, a comprehensive view of the species' geographic distribution is obscured by a lack of articles on occurrence data across most continents. In a few locations, it was already considered an exotic species, but outlining the extent of its invasion would be speculative. Unfortunately, there is a lack of studies on population densities, environmental relationships, and possible ecological impacts as possible invader. This study highlights that the presence of rotifer specialists makes a difference in recording *L. decipiens* occurrences, showing critical regional gaps of knowledge in most parts of the world. Finally, we hope to have provided a basis for further investigations into the species' dispersal, biogeography, and potential invasiveness.

Acknowledgements

We would like to thank Dr Russell Shiel for the help in clarifying occurrences of the species in Australia. We also thank CAPES for the master's scholarship awarded to Santos-Cabral, L.C. and Moreira, M.S., respectively under process numbers 88887.153986/2025-00 and 88887.212391/2025-00.

Data availability

The entire dataset supporting the results of this study has been published in the article itself.

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Received: 28 October 2025
Accepted: 05 May 2026

Associate Editor: Danielle Katharine Petsch.