Original Article

Nauplius

The Journal of The Brazilian Crustacean Society

e-ISSN 2358-2936
www.scielo.br/nau
www.crustacea.org.br

More on the distribution of cladoceran species: gaps and perspectives in Rio de Janeiro State, southeastern Brazil

Rafael Lacerda Macêdo[1,2] orcid.org/0000-0001-5086-0170

Francisco Diogo R. Sousa[3,4] orcid.org/0000-0003-4389-8140

Vinicius Veras[2,5] orcid.org/0000-0002-4882-7045

Lourdes M. A. Elmoor-Loureiro[3] orcid.org/0000-0001-7439-9753

Christina Wyss Castelo Branco[2] orcid.org/0000-0002-0509-171X

1 Universidade Federal de São Carlos, Departamento de Ecologia e Biologia Evolutiva, (UFSCAR). Rodovia Washington Luís, Km 235, 13565-905, São Carlos, São Paulo, Brazil.
RLM E-mail: rafaell261@hotmail.com

2 Universidade Federal do Estado do Rio de Janeiro (UNIRIO), Núcleo de Estudos Limnológicos, Departamento de Zoologia. Av. Pasteur, 458, 22290-240, Rio de Janeiro, Rio de Janeiro, Brazil.
VVS E-mail: vinicius.silveras@gmail.com
CWCB E-mail: cbranco.unirio@gmail.com

3 Universidade Federal de Jataí (UFJ), Unidade Acadêmica Especial de Ciências Biológicas, Laboratório de Taxonomia Animal. BR 364 km 195, n° 3800, 75801-615, Jataí, Goiás, Brazil.
FDRS E-mail: fdiogo.rs@gmail.com
LMAEL E-mail: elmoor.loureiro@gmail.com

4 Universidade de Brasília (UnB), Campus Universitário Darcy Ribeiro, Programa de Pós-Graduação em Zoologia. 70910-900, Brasília, DF, Brazil.

5 Laboratório de Avaliação e Promoção da Saúde Ambiental, Instituto Oswaldo Cruz, FIOCRUZ, Av. Brasil, 4365 - Manguinhos, Rio de Janeiro, RJ 21040-360, Brazil.

ZOOBANK: http://zoobank.org/urn:lsid:zoobank.org:pub: 2C48EA9A-4356-4174-8153-BAD95B0FBEF1

Corresponding Author
Rafael Lacerda Macêdo
rafaell261@hotmail.com

SUBMITTED 17 August 2021
ACCEPTED 09 March 2022
PUBLISHED 28 November 2022

DOI 10.1590/2358-2936e2022032

Abstract

Our knowledge of cladoceran species composition and distribution of Neotropical taxa is incomplete, therefore misleading the basic understanding of biodiversity processes and biogeographical patterns of this ecologically relevant group. We present new records and an updated checklist of the cladocerans of Rio de Janeiro State (Brazil) based on a critical review of their known distribution throughout the different freshwater ecoregions. Nine marine species were recorded, and 80 non-marine cladocerans were counted from two of the four ecoregions of Rio de Janeiro State. We estimate species richness applying the interpolation and extrapolation method, using iNEXT function. With this approach we compute diversity estimates for rarefied and extrapolated samples up to double the reference sample size (number of studies). Four new records of rare species were included from surveys in the Paraiba do Sul ecoregion. The Fluminense ecoregion shows a higher richness with a more asymptotic curve and thus a lower expected richness in comparison to the Paraiba do Sul ecoregion. *Ceriodaphnia cornuta* Sars, 1886 was the most frequently found species whilst *Moina macrocopa* Straus, 1820 was the only non-native species encountered. Our study can contribute to developing a biogeographical understanding of this diverse group in a heterogeneous territory in terms of inland waters. Future studies are suggested to prioritize novel ecoregions and unexplored habitats *e.g.* littoral zones with high macrophyte and periphyton coverage, brackish waters, saline and high-altitude lakes, as more diverse and heterogeneous habitats will undoubtedly reveal additional records.

Keywords

Brazil, Cladocera, distribution records, neotropical ecoregions, richness, water fleas.

Introduction

The superorder Cladocera is represented by aquatic invertebrates inhabiting both marine and inland waters, and reproducing by cyclical parthenogenesis: alternating clone production, which constitutes a population of all females, with sexual reproduction when the environmental conditions are unfavorable (presence of predators, limited food resources, temperature variations) (Brooks and Dodson, 1965; Lynch, 1980; Pijanowska and Stolpe, 1996; Elmoor-Loureiro, 1997; Rocha *et al*., 2011). The class Branchiopoda of the Subphylum Crustacea is composed of thirteen orders including nine extant orders (Anostraca, Notostraca, Cyclestherida, Laevicaudata, Spinicaudata, Anomopoda, Ctenopoda, Haplopoda and Onychopoda, and also extinct taxa, only know from fossils (Lipostraca†, Kazacharthra†, Cryptopoda† and Proanomopoda†) (Van Damme and Kotov, 2016). Monophyly of the Cladocera was suggested from analyses based on morphological and molecular data (Fryer, 1987; Olesen, 2002; De Waard *et al*., 2006; Kotov, 2013), however, the phylogenetic relationships within the Cladocera are still a matter of debate and, from a general perspective, a continuous update of their biogeography, phylogeography and ecological attributes is urgent on a global scale (Forró *et al*., 2008).

Accordingly, the geographic distribution of cladocerans is largely unknown in most of the biogeographic regions (Forró *et al.,* 2008), being a fruitful field for future studies. In the Neotropical mega-diverse region, taxonomic and distributional resolutions have been following international collaborative work of specialists, through new species descriptions (Paggi and Herrera-Martinez, 2020; Garibian *et al*., 2021; Sousa *et al*., 2021), new records (Elmoor-Loureiro *et al*., 2010a; Farias *et al*., 2017), evidence of non-native species (Zanata *et al*., 2003; Elmoor-Loureiro *et al*., 2010b) and endemic taxa (Kotov *et al*., 2010; Elmoor-Loureiro, 2014; Sousa *et al*., 2016). Moreover, several gaps in the Neotropical region have been continuously filled through revisions of species groups, *e.g. Anthalona* Van Damme, Sinev and Dumont, 2011 (Sousa *et al*., 2015a), and regional checklists such as in Chile (De los Ríos and Kotov, 2015), Colombia (Kotov and Fuentes-Reines, 2015), Ecuador (Lopéz *et al.,* 2018), México (Elías-Gutiérrez *et al.,* 1999; 2008), and Venezuela (Zoppi de Roa and López, 2008).

In Brazil, specialists have revised the distribution of Cladocera, mainly from inland waters while marine taxa information is restricted. Since the critical analysis of the state of the art of Brazilian Cladocera by Elmoor-Loureiro (2000), the geographic gaps and sampling bias became clear, as well as the greater importance of non-planktonic taxa. Since then, the increasing sampling effort in shallow water bodies and the littoral zone has been evident, however, a geographical hiatus persists at national and regional scales (*e.g.,* Forró *et al.,* 2008; Macêdo *et al.,* 2021). Increasing efforts have shown to support potentially higher richness of cladocerans (Santos-Wisniewski *et al*., 2001; 2002; Zanata *et al*., 2003; Lopes *et al*., 2006; Elmoor-Loureiro *et al*., 2010a; 2010b; Sousa and Elmoor-Loureiro, 2011) along with local faunistic surveys that have considerably improved our biogeographic perception of this group (*e.g.* Santos-Wisniewski *et al.*, 2008; Elmoor-Loureiro, 2007; Ghidini and Santos-Silva, 2011; Sousa and Elmoor-Loureiro, 2013; Sousa *et al.*, 2014; Maia-Barbosa *et al.*, 2014).

Another approach found in the literature is based on updates in geographic distribution of cladocerans using published data, plus new records from additional samplings to summarize regional knowledge on their composition and distribution. Such studies deal with large geographic ranges, generally with a focus on artificial geographic boundaries (*e.g.* Santos-Wisniewski *et al.*, 2011; Zanata *et al.*, 2017; Santos *et al.*, 2021; Santos *et al.*, 2022). These studies have been presented as checklists (Rocha *et al.,* 2011), short faunistic updates (Sousa *et al.*, 2009), and contextualized composition with biogeographic features considering hydrographic basins (Sousa and Elmoor-Loureiro, 2012; Diniz *et al.,* 2020; Brito *et al.,* 2020; Macêdo *et al.*, 2021). This approach seems to be a good strategy to consolidate reports of species occurring in Brazil, indicating the actual use of correct nomenclature and taxonomy, suggesting new perspectives for future studies and monitoring-support materials (Forró *et al.,* 2008; Gazulha, 2012).

Here, we present a critical updated inventory of cladocerans from the Neotropical inland waters of Rio de Janeiro State. We also examine biodiversity from studied freshwater ecoregions by computing richness estimates for extrapolated samples up to double the reference sample size. We briefly comment on records of marine taxa. We provide new records of freshwater species, as well as comments on biogeography, endemism and recommendations for future studies in the State.

Material and Methods

Environmental Background

We define Neotropical freshwater ecoregions after Abell *et al.* (2008). Considering this ecogeographic arrangement, the localities were - a priori - restricted to Paraiba do Sul (PBS), Fluminense (FLU), Ribeira do Iguape (RIG) and Northwestern Mata Atlântica (NMA) (Tab. 1, Fig. 1). The PBS ecoregion encompasses the greatest portions of Rio de Janeiro State's territory and includes the drainage basin of the Paraíba do Sul River, which starts at the confluence of the Paraitinga and Paraibuna rivers. The upper-middle and lower stretches of Paraíba do Sul River have an economic regional relevancy due to the presence of multiple-use reservoirs, diversion of waters into another river basin (Guandu River), and a navigable low course flowing to the Atlantic Ocean. The FLU is the only ecoregion entirely contained within Rio de Janeiro territory and includes all of the coastal drainages in the state of Rio de Janeiro, mainly following into Guanabara Bay, coastal lagoons (freshwater or brackish) and marshes. Furthermore, it is where the majority of urban inland waters occurs but unraveling some great opportunities for novel records of native and invasive cladocerans from urban ponds and hypereutrophic lakes. The RIG and NMA ecoregions are restricted to its southeastern and northeastern portions, respectively. RIG has coastal environments extending across Sepetiba Bay in Rio de Janeiro State, although its major areas are in São Paulo State. Conversely, NMA is formed by coastal drainage basins in eastern Brazil from Sergipe, Bahia and Espírito Santo to Rio de Janeiro following the Itabapoana drainage in the south (Abell *et al.*, 2008; FEOW, 2019 – http://www.feow.org).

Cladoceran surveys and collections

We searched the body of literature (mostly papers) concerning the Cladocera fauna from Rio de Janeiro State using keywords ("cladocer*" AND "Rio de Janeiro") in *Scopus* and *Web of Science*. We also included master's dissertations and doctoral theses considering the importance of gray literature in the construction of more complete inventories of this group (*e.g.,* Elmoor-Loureiro, 2000; Macêdo *et al.*, 2021). We used Google maps to check the geographic records of all studies and to estimate latitude and longitude when not provided by the authors. New records were included from samples deposited in the Elmoor-Loureiro personal collection (LMAEL) and in the Museu Nacional, Universidade Federal do Rio de Janeiro (MNRJ).

Sampling localities relied on previously surveyed reservoirs with contrasting limnological and morphometric features (Klippel *et al.*, 2020) and coastal urban and peri-urban lagoons and ponds

(Branco *et al.*, 2000, 2007; Kozlowsky-Suzuki and Bozelli, 2004; Elmoor-Loureiro *et al.*, 2010b; Farias *et al.*, 2017). Sampling followed different strategies according to particular features of the environment and were mostly conducted by two strategies. In the first, by filtration of 20L of water taken by bucket at sub-surface through a net of 68µm mesh size and, in the second, by vertical hauls in the euphotic zone, which was estimated through the measure of the Secchi disk depth multiplied by 2.7 (Esteves, 2011). All samples were preserved with a sugar-formalin (Haney and Hall, 1973) at 4 % final concentration. Specimens were examined for identification at × 200 and × 400 magnification under a microscope (Olympus BX51). Cladocerans were identified to the species level whenever possible using specific literature (Elmoor-Loureiro, 2007; Sousa *et al.*, 2015b) in addition to the World checklist of freshwater Cladocera species (Kotov *et al.*, 2013). A fraction of the species catalogued in this checklist underwent correction of nomenclature, while the others were kept in the original names found in the analyzed materials.

Table 1. Sampling localities with geographical coordinates of the records gathered from literature and from our surveys.

Localities	Latitude	Longitude	Reference
Paraiba do Sul Ecoregion			
1. Paracambi Reservoir	-22.676	-43.763	Branco *et al.*, 2019
2. Tocos Reservoir	-22.736	-44.124	This study
3. Santana Reservoir	-22.577	-43.838	This study
4. Vigário Reservoir	-22.639	-43.895	This study
5. Ponte Coberta Reservoir	-22.685	-43.835	This study
6. Ilha dos Pombos Reservoir	-22.034	-43.000	This study
7. Ribeirão das Lajes Reservoir	-22.719	-43.896	Macêdo *et al.*, 2018; Lopes *et al.*, 2018
8. Funil Reservoir	-22.563	-44.603	Branco *et al.*, 2002; Ferrão-Filho *et al.*, 2008; Rocha *et al.*, 2011; Picapedra *et al.*, 2021
9. Parque Nacional do Itatiaia			Sousa *et al.*, 2014
10. Paraiba do Sul Estuary	-21.616 -21.629	-41.000 -41.050	Sterza and Fernandes, 2006
11. Fish tanks	Several systems		Loureiro *et al.*, 2011
12. Tijuca River, Tijuca National Park	-22.953	-43.281	Sousa *et al.*, 2016
13.Solidão River, Tijuca National Park	-22.960	-43.288	Sousa *et al.*, 2015a
Fluminense Ecoregion			
14. Lagoinha das Tachas	-22.201	-43.493	Farias *et al.*, 2017
15. Atoleiro pond, Restinga de Jurubatiba National Park	-22.227	-41.539	Elmoor-Loureiro *et al.*, 2010a; Nova *et al.*, 2021
16. Camorim Reservoir	-22.957	-43.446	Ferrão-Filho *et al.*, 2019
17. Comprida Lagoon	-22.267	-41.650	Branco *et al.*, 2000; Araújo *et al.*, 2013; Nova *et al.*, 2021
18. Carapebus Lagoon	-22.251	-41.593	Attayde and Bozelli, 1998; Santangelo *et al.*, 2010; Araújo *et al.*, 2013; Vargas *et al.*, 2019
19. Cabiúnas Lagoon	-22.294	-41.691	Lopes *et al.*, 2006; Kotov and Elmoor-Loureiro, 2008; Santangelo *et al.*, 2008; Branco *et al.*, 2008; Setubal *et al.*, 2013; Araújo *et al.*, 2013; Sousa *et al.*, 2015; Nova *et al.*, 2021
20. Imboassica Lagoon	-22.411	-41.826	Kozlowsky-Suzuki and Bozelli, 2002; 2004; Branco *et al.*, 2007; Santangelo *et al.*, 2007; Setubal *et al.*, 2013; Araújo *et al.*, 2013;
21. Jacarepaguá Lagoon	-22.987	-43.404	Ferrão-Filho *et al.*, 2002
22. Urban temporary pond	-22.903	-43.172	Elmoor-Loureiro *et al.*, 2010b
23. Paulista	-22.234	-41.544	Nova *et al.*, 2021
24. Pitanga	-22.160	-41.299	Nova *et al.*, 2021
25. Bezerra	-22.197	-41.449	Nova *et al.*, 2021
26. Amarra-Boi	-22.192	-41.432	Nova *et al.*, 2021
27. Garça lagoon	-22.217	-41.505	Araújo *et al.*, 2015

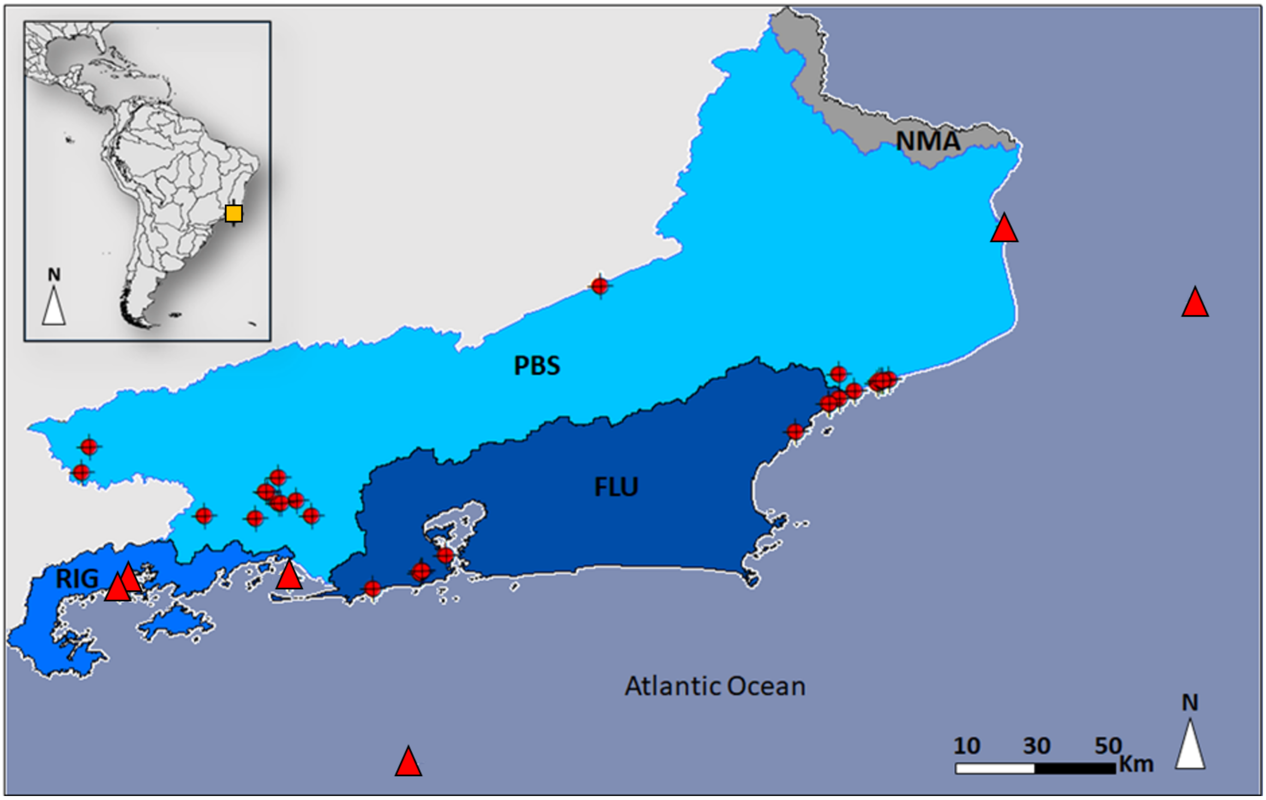

Figure 1. Map of the current known distribution of cladocerans in Rio de Janeiro State, Brazil. Background colors represent the four freshwater ecoregions in the state – RIG; Ribeira do Iguape, PBS; Paraiba do Sul, FLU; Fluminense and NMA for Northeastern Mata Atlantica. Distribution of non-marine taxa are described for PBS and FLU solely (red circles). Marine records are represented by red triangles.

Data analysis

From mapping the distribution records and revising updated checklists of Cladocera of Rio de Janeiro State, we provide comments on the records of alien and potentially invasive species. Additionally, analysis of endemism and a descriptive differentiation of cladocerans between the previously delimited freshwater ecoregions were conducted (Abell *et al.*, 2008).

We also built an extrapolation curve, based on the number of studies (Rio de Janeiro State; N = 42, PBS; N= 18, FLU; N=24), using iNEXT function, focusing on species richness measures of Hill numbers (q = 0). For this, we used all gathered studies from the literature and the samplings from this study together to compare the richness between ecoregions. We assumed each of the sampled reservoirs in this study (Tocos, Santana, Vigário, Ponte Coberta and Ilha dos Pombos; Tab. 1) as a unique separate study for richness estimation analysis. This analysis was performed through the iNEXT package software R which uses Chao 2 to estimate the number of undetected species in the reference samples from a given region (Hsieh *et al.,* 2016; R core Team, 2020). Only non-marine species were included in this analysis.

Results

We listed the cladoceran fauna, followed by its frequency considering the study locations conducted in the state of Rio de Janeiro (Tab. 2, Fig. 1). The middle stretches of Paraíba do Sul and Guandu rivers as well as Rio Macaé and Rio das Ostras showed a higher sampling effort in terms of different systems and long-term investigations. No study was found considering inland waters in the portion of the RIG and NMA ecoregions. Some records of marine species followed campaigns in the offshore platform. In general, cladocerans were mainly sampled in several different inland water bodies, including nine freshwater reservoirs, several shallow lakes, ponds and brackish environments.

Table 2. List of Cladocera species and frequency of their occurrence considering all studies. FR = first report, DI = doubtful identification.

Non-marine taxa		FLU	PBS	LMAEL	MNRJ	%
Chydoridae						
Aloninae (subfamily)						
Acroperus tupinamba Sinev and Elmoor-Loureiro, 2010		X	X			1.11
Ovalona cf cambouei (Guerne and Richard, 1893) (as *Alona cambouei*)	DI	X	X			1.39
Coronatella cf. poppei Richard, 1897 (as *Alona poppei*)	DI	X	X			1.39
Alona guttata (Sars, 1862)		X	X	X		3.06
Alona yara Sinev and Elmoor-Loureiro, 2010		X	X		X	1.11
Anthalona neotropica Sousa, Elmoor-Loureiro and Debastiani-Júnior 2015		X		X		<1
Anthalona verrucosa (Sars, 1901)		X		X		2.79
Biapertura ossiani (Sinev, 1998)		X	X	X		1.11
Bryospilus repens Frey, 1980			X	X	X	<1
Coronatella monacantha (Sars, 1901)		X				<1
Coronatella paulinae Sousa, Elmoor-Loureiro and Santos, 2015		X				<1
Coronatella rectangula (Sars, 1861)	DI	X				<1
Euryalona brasiliensis Brehm and Thomsen, 1936	DI	X		X		<1
Flavalona iheringula (Kotov and Sinev, 2004)		X	X	X	X	1.11
Graptoleberis occidentalis Sars, 1901		X		X		<1
Karualona muelleri Richard, 1897		X			X	<1
Kurzia latissima (Kurz, 1875)	DI	X				<1
Kurzia polyspina Hudec, 2000		X				<1
Leberis davidi (Richard, 1895)		X				<1
Leydigia ipojucae Brehm, 1938			X			<1
Leydigia schubarti Brehm and Thomsen, 1936	DI		X			<1
Leydigiopsis brevirostris Brehm, 1938		X				<1
Leydigiopsis curvirostris Sars, 1901		X				<1
Leydigiopsis megalops Sars, 1901	FR			X		<1
Magnospina dentifera (Sars, 1901)		X				<1
Nicsmirnovius paggii Sousa and Elmoor-Loureiro, 2017		X				<1
Ovalona glabra (Sars, 1901)		X	X		X	<1
Oxyurella longicaudis (Birge, 1910)					X	<1
Alonella clathratula Sars, 1896		X				<1
Chydorus eurynotus Sars, 1901		X	X		X	1.67
Chydorus pubescens Sars, 1901		X			X	<1
Chydorus sphaericus (O.F. Müller, 1776)	DI	X				<1
Disparalona leptorhyncha Smirnov, 1996		X				<1
Dunhevedia colombiensis Stingelin, 1913		X		X		<1
Dunhevedia odontoplax Sars, 1901		X				<1
Ephemeroporus cf. barroisi (Richard, 1894)	DI	X				<1
Ephemeroporus hybridus (Daday, 1905)		X			X	<1
Ephemeroporus tridentatus (Bergamin, 1939)					X	<1
Pleuroxus (Picripleuroxus) similis (Vávra, 1900)	DI	X				<1
Macrothricidae						<1
Grimaldina freyi Neretina and Kotov, 2017					X	<1
Guernella raphaelis Richard 1892		X		X		<1
Macrothrix elegans Sars, 1901		X		X	X	1.11
Macrothrix laticornis (Jurine, 1820)	DI	X	X			<1
Macrothrix paulensis (Sars,1901)		X	X	X		<1
Macrothrix squamosa Sars, 1901		X	X	X		<1
Macrothrix superculeata (Brandorff, Koste and Smirnov, 1982)		X				<1

Table 2. Cont.

Non-marine taxa		FLU	PBS	LMAEL	MNRJ	%
Macrothrix triserialis Brady, 1886	DI	X	X			1.39
Streblocerus pygmaeus Sars, 1901	FR			X		<1
Ilyocryptidae						<1
Ilyocryptus spinifer Herrick, 1882		X	X	X	X	4.46
Bosminidae						<1
Bosmina cf. *tubicen* Brehm, 1953		X	X			1.39
Bosmina freyi De Melo and Hebert, 1994		X				<1
Bosmina hagmanni Stingelin, 1904		X	X		X	4.18
Bosmina longirostris (O.F.Müller, 1776)		X	X			3.34
Bosminopsis deitersi Richard, 1895		X	X			4.74
Moinidae						<1
Moina dumonti Kotov, Elías-Gutiérrez and Granado-Ramírez, 2005		X		X		<1
Moina macrocopa (Straus, 1820)		X		X		<1
Moina micrura Kurz, 1875		X	X	X		3.06
Moina minuta Hansen, 1899		X	X			4.18
Moina reticulata (Daday, 1905)		X				1.11
Moinodaphnia macleayi (King, 1853)		X		X	X	<1
Daphniidae						<1
Ceriodaphnia cornuta Sars, 1885		X	X	X	X	5.85
Ceriodaphnia laticaudata P. E. Müller, 1867		X				<1
Ceriodaphnia paradoxa Spandl, 1926 (probably *C. cornuta*)	DI		X			1.95
Ceriodaphnia reticulata (Jurine, 1820)		X				<1
Ceriodaphnia richardi Sars, 1901		X	X	X		1.11
Ceriodaphnia silvestrii Daday, 1902		X	X	X	X	3.06
Daphnia gessneri Herbst, 1967		X	X		X	4.46
Daphnia laevis Birge, 1878			X			1.39
Scapholeberis freyi Dumont and Pensaert, 1983		X	X	X		1.11
Simocephalus serrulatus (Koch, 1841)		X	X	X	X	2.23
Simochephalus latirostris Stingelin, 1906		X	X			1.67
Simochephalus acutirostratus (King, 1853)				X	X	<1
Sididae						<1
Diaphanosoma birgei Koříneck, 1981		X	X	X		4.46
Diaphanosoma brevireme Sars, 1901		X	X			1.95
Diaphanosoma fluviatile Hansen, 1899		X	X			<1
Diaphanosoma spinulosum Herbst, 1967		X	X	X		2.79
Latonopsis australis-group Sars, 1888	FR			X		<1
Pseudosida ramosa (Daday, 1904)	FR			X		<1
Sarsilatona serricauda (Sars, 1901)				X	X	<1
Marine taxa						
Podonidae						
Pleopis polyphemoides (Leuckart, 1859)						
Pleopis schmackeri Poppe, 1889						
Podon intermedius Lilljeborg, 1853						
Podon leuckarti G.O. Sars, 1862						
Evadne nordmanni Lovén, 1836						
Evadne spinifera P.E. Müller, 1867						
Pseudoevadne tergestina (Claus, 1877)						
Sididae						
Penilia avirostris Dana, 1849						

Considering all the data obtained from the literature and the samples collected in more than 30 inland waters of the Rio de Janeiro State (Tab. 2), we recorded 80 cladoceran taxa, distributed in eight families: Chydoridae (40), Moinidae (6), Macrothricidae (9), Sididae (7), Daphniidae (12), Bosminidae (5), Ilyocryptidae (1). When the representative species in sampling localities were considered, the most common taxa were: *Ceriodaphnia cornuta* Sars, 1886, *Bosminopsis deitersi* Richard, 1895*, Diaphanosoma birgei* Korinek, 1981*, Daphnia gessneri* Herbst, 1967, *Ilyocryptus spinifer* Herrick, 1882, *Moina minuta* Hansen, 1899*,* and *Bosmina hagmanni* Stingelin, 1904. Our study further allowed us to identify species with a rare status with particular niche requirements that can be considered as new records for Rio de Janeiro State, such as *Coronatella paulinae* Sousa, Elmoor-Loureiro and Santos, 2015, *Nicsmirnovius paggii* Sousa and Elmoor-Loureiro, 2017.

The sample-size-based extrapolation curves estimated a higher richness than observed, both for each of the ecoregions (FLU and PBS), as well as for both together (Fig. 2A, B, C). However, the FLU ecoregion showed higher richness than PBS at both current and projected values. The estimated richness obtained from twice the known sampling units was 51 for PBS and 91 species for FLU (Fig. 2B, C). Yet, the PBS curve showed a linear tendency while FLU showed an asymptotic curve and stabilizing tendency from twice the analyzed studies. These different patterns may be influenced by the number of studies but also the different types of environments pertaining to each ecoregion.

Chydoridae (Aloninae and Chydorinae) showed a higher number of representatives in the FLU. Specifically, of the total richness from Aloninae, 60 % were exclusively from FLU and 7.4 % from PBS. Considering Chydorinae 69 % were exclusively from FLU while 7.6 % from PBS. *Moina macrocopa* Straus 1820, a stress tolerant cladoceran from Palearctic regions, was the only non-native species recorded exclusively in urban ponds from FLU. As far as we know, Cladoceran alien species are absent from other ecoregions of Rio de Janeiro State from traditional morphological studies.

Marine cladocerans were sampled in the pelagic zone of the continental shelf (Fig. 1) and accounted for

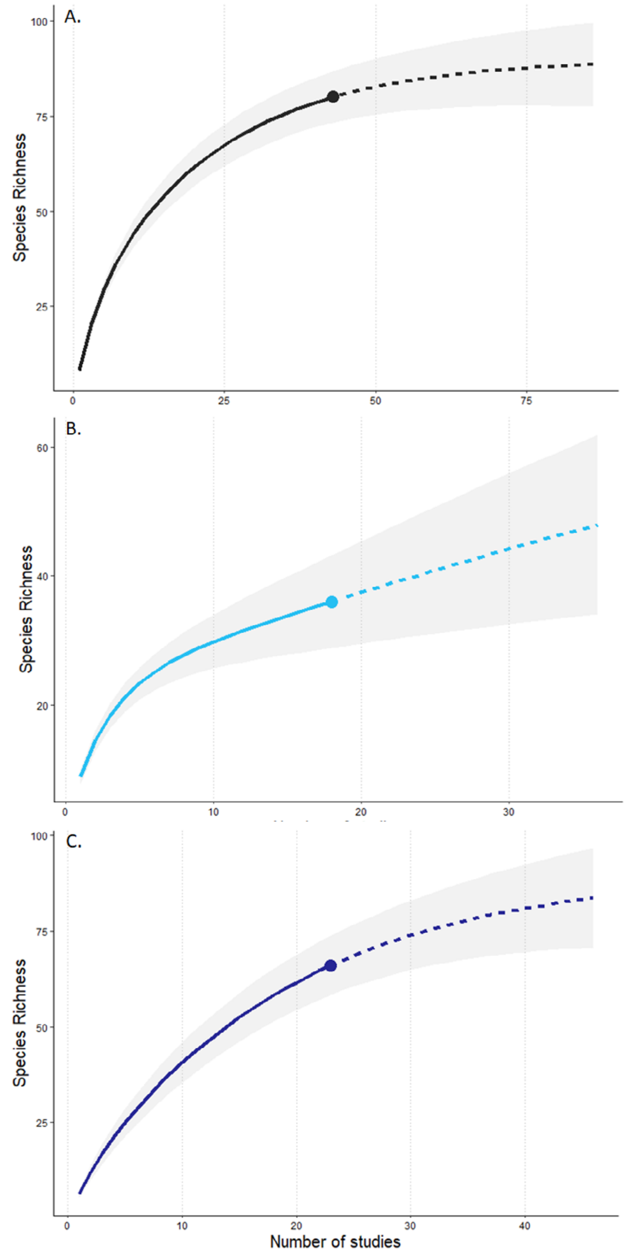

Figure 2. Observed richness (OS, full line) and extrapolated richness (ES, dashed line) using the Hill number (q = 0 species richness) of the Cladoceran fauna observed, considering the number of studies, in Rio de Janeiro State (A; OS=80, ES=90), Paraiba do Sul (B; OS=36, ES=51) and Fluminense (C; OS=66, ES=91). Confidence interval of 95 % was obtained by the bootstrap method and represented by the shaded area of the fitted curve.

9 species: the sidid *Penilia avirostris* Dana, 1849 and the podonids *Pleopis schmackeri* Poppe, 1889, *Podon intermedius* Lilljeborg, 1853, *Pleopis polyphemoides* Leuckart, 1859, *Podon leuckarti* Sars, 1862, *Pseudevadne tergestina* Claus, 1877, *Evadne nordmanni* Lovén, 1836, and *Evadne spinifera* P.E. Müller, 1867.

Discussion

Despite the increase in cladoceran surveys in the Neotropics in recent years (*e.g.,* Padovesi-Fonseca *et al.,* 2016; Elmoor-Loureiro *et al.,* 2018; Brito *et al.,* 2020; Diniz *et al.*, 2020; Macêdo *et al.,* 2021; Santos *et al.*, 2021; Santos *et al.*, 2022), our study revealed that there are still very few studies focused on the composition and distribution of cladocerans in Rio de Janeiro State. We observed representatives of the seven cladoceran families in Rio de Janeiro State, encompassing 80 non-marine and 9 marine taxa. Nevertheless, up to thirteen taxa have not previously been identified to the species level, particularly in the genera *Macrothrix*, *Disparalona*, *Alona* and *Diaphanosoma*. The total richness found in this State, including dubious identifications, was higher than the majority of the current checklists for other Brazilian states (RS, CE, DF, PE, BA < RJ < MG, SP, MS, MT). However, these faunistic comparisons could be more adequately addressed between States by considering the differences in both temporal and spatial efforts employed.

As expected, we found higher estimated richness than the actual values for the State and for both the FLU and PBS ecoregions. In general, these results were influenced by the lack of sampling in the RIG and NMA (Fig. 1) and several studies with sampling throughout similar or nearby environments *e.g.*, coastal lakes and lagoons located in Macaé plain in the FLU ecoregion or connected reservoirs in the PBS ecoregion. In the PBS ecoregion, sampling localities were mainly from artificial environments such as freshwater reservoirs (*e.g.*, Branco *et al.,* 2002; Macêdo *et al.,* 2018; Branco *et al.,* 2019) and fish tanks (Loureiro *et al.,* 2011). Conversely, in the FLU, cladocerans were sampled in natural coastal lagoons (*e.g.*, Branco *et al.*, 2000; 2007; Kozlowsky-Suzuki and Bozelli, 2004; Araújo *et al.,* 2015; Vargas *et al.,* 2019), shallow ponds (Elmoor-Loureiro, 2010a; 2010b; Araújo *et al.,* 2013), and estuaries (Sterza and Fernandes, 2006). These habitats are distinguished by several morphometric and environmental differences (water depth, water volume, habitat complexity), which in part explains the higher number of representatives of the subfamilies Aloninae (representing the most speciose Cladoceran family; Smirnov, 1996a) and Macrothricidae in the FLU since most species are benthic or phytophilous (Smirnov, 1974). Despite this, we did not closely examine the microhabitats from where samples were collected in the literature, and the redundancy and spatial homogeneity of artificial reservoirs and fish tanks are a concern in many studies regarding the assessment of cladoceran diversity (Meschiatti *et al.*, 2000; Elmoor-Loureiro, 2007; Chatterjee *et al.*, 2013; Debastiani-Júnior *et al.*, 2016). In addition, as suggested by other annotated checklists (Zanata *et al.*, 2017; Macêdo *et al.,* 2021), assessing heterogeneous habitats proved to enhance diversity of cladocerans in inland water ecosystems by adding specialized species *e.g., Bryospilus repens* Smirnov, 1980, reported by Sousa *et al.* (2014).

Moreover, the composition of microcrustaceans can be significantly underestimated considering the choice of the sampling strategies in these ecosystems, which are often non-standardized and dependent on the habitat type and on the aims of the studies (Macêdo *et al.*, 2018). It is also possible that the underestimated richness of cladoceran species was influenced by the lack of sampling in central and northward portions of the PBS ecoregion, which encompasses several less-studied aquatic ecosystems such as rivers and small ponds surrounded by tropical forests, and shallow lakes of the lower course of the Paraíba do Sul River.

In the specific case of the FLU ecoregion, the estimation curve approaches an asymptote as the number of studies increases. Also, the observed richness represented more than 50 % of the estimated value, thus showing a higher adequacy and usefulness in estimating richness than in PBS (Toti *et al.*, 2000; Williams *et al.*, 2007). The more rapid stabilization in the FLU is comparable to the curve for the entire State of Rio de Janeiro (Fig. 2A) and Bahia (Macêdo *et al.*, 2021), as well as the findings in the Brazilian semi-arid, despite both groups of microcrustaceans (Cladocera and Copepoda) being considered by Diniz *et al.* (2020). Although seasonal variation is of great importance for zooplankton structure (*e.g.,* Branco *et al.,* 2007; Santangelo *et al.,* 2007) with consequences for a more realistic assessment of the community composition, aquatic ecosystems are still overlooked in terms of temporal efforts in the FLU ecoregion (Elmoor-Loureiro *et al.*, 2010a; 2010b; Farias *et al.*, 2017; Nova *et al.*, 2021).

Considering the PBS, areas with higher sampling efforts were at the middle reaches of the Paraíba do Sul River and its connectivity through water diversion with Guandu basin. This is due to several cascading reservoirs along the Piraí, Guandu and Paraíba do Sul rivers that have been the target of monitoring programs for domestic water supply and hydroelectric power generation (*e.g.*, Branco *et al.*, 2002; Rocha *et al.*, 2002; Lopes *et al.*, 2018). Even with the increase in new records from the sampling performed in the PBS in this study, the rarefaction curve showed no asymptotic tendency for this ecoregion (Fig. 2B), possibly attributable to the great temporal effort in contrast to the narrow spatial diversity of systems. In other words, these studies were not enough to cover all aquatic habitats within reservoirs, which have spatial and temporal heterogeneity regarding abiotic variables and biological communities. These sampling campaigns were predominantly carried out in the limnetic zone, neglecting the more diverse areas such as littoral zones and macrophytic banks that increase environmental complexity (Villabona-González *et al.,* 2011; Choi *et al.,* 2014).

Similar to other surveys from tropical and subtropical regions, the total number of species remain underestimated regarding morphological and taxonomic difficulties and geographical and temporal restricted samplings *e.g.*: Thailand (99 species) (Maiphae *et al.*, 2005; 2008), Southern India – Maharashtra (22 species) (Padhye and Victor, 2015) or in the Republic of South Africa (112 species) (Smirnov, 2008). However, without considering the possible differences in sampling methods and surveyed area, the reported number of species in this study is much higher than that reported by Coronel *et al.* (2007) in Bolivia (21), by Frisch *et al.* (2006) in Spain (21), or by Rajapaksa and Fernando (1982) in Sri Lanka (62). Therefore, we suggest some new areas to be potentially explored: São João, Piabanha, Rio Dois rivers, and estuarine systems and coastal lagoons, lower Paraiba do Sul and Itabapoana rivers and the most elevated areas of the state, such as Serra da Mantiqueira. Also, some studies in different localities did not mention species lists (Gonçalves Jr. *et al.*, 2004), which may include taxonomic surprises and new records (*e.g.,* Sousa *et al.*, 2015b; Farias *et al.*, 2017).

Ceriodaphnia cornuta G.O. Sars, 1886 was the most commonly found species considering all studies (Tab. 2). This can be explained by its wide distribution in other tropical and Neotropical environments as well as its high feeding adaptability (Dumont and Tundisi, 1984; Korinek, 2002; Sampaio *et al.,* 2002; Villalobos and González, 2006; Rocha *et al.,* 2011). Except for *Moina macrocopa,* which was found in an intermittent urban pond in the Rio de Janeiro vicinity (Elmoor-Loureiro *et al.,* 2010b), all species were considered native. This raises a concern on the lack of investigations in urban areas, where new occurrences were added to the State (Elmoor-Loureiro *et al.,* 2010b) and to South America; as in the case of *Moina dumonti*, first reported by Farias *et al.* (2017) in a perennial hypereutrophic lagoon in Rio de Janeiro.

All marine species herein described occur on the Brazilian coast (Marazzo and Valentin, 2004; Miyashita *et al.,* 2011; Rosa *et al.,* 2021), and were accordingly less diverse than inland water cladocerans (Egloff *et al.,* 1997; Onbé, 1999). However, *Pleopis schmackeri* is a Palearctic species and, as well as *Moina macrocopa,* and *Podon intermedius* is a species typically described from Nearctic regions (Egloff *et al.*, 1997).

In summary, this work provides: i) technical material for supporting environmental monitoring analysis and ecological investigations in the area, ii) makes future studies possible to compare diversity parameters at local and regional scales, and iii) indicates areas where sampling efforts should be intensified, such as small waterbodies, semi-terrestrial ecosystems and protected areas such as the Parque Nacional do Itatiaia, strategically important for housing a large part of the Mata Atlântica biome. This study was entirely based on morphological data, which in part could explain some of the misidentifications (see Tab. 2 for all suggested doubtful identifications). Looking at current taxonomic knowledge about Cladocera, some dubious reports emerge from the literature, especially regarding the chydorines. Therefore, close taxonomic attention should be given to studies in the region using an integrative approach to assist in refining taxonomic resolution. Such procedures are useful in the identification of cryptic invasions and early detections from genetic material obtained directly from environmental samples. This first overview on the distribution of cladocerans in Rio de Janeiro may have implications for the conservation of the fauna and environments as well as for the understanding of their biogeography in Brazil and South America.

Acknowledgments

Rafael L Macêdo would like to thank the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior-Brasil (CAPES) for the PhD scholarship in Ecology and Natural Resources at Federal University of São Carlos. The authors also thank the Neotropical Limnology Group (NEL/UNIRIO) for laboratory facilities. Elmoor-Loureiro is grateful to Paulo C. Young, *in memoriam*, who made access to the Cladoceran collection of the National Museum of Rio de Janeiro possible. All the authors are grateful to the anonymous reviewers for their careful and constructive reviews of our paper.

Additional Information and Declarations

Author Contributions

Rafael Lacerda Macedo: Conceptualization, Data curation, Methodology, Writing – original draft. Francisco Diogo R. Sousa: Writing – original draft. Vinicius Veras: Data curation, Writing – review. Lourdes M. A. Elmoor-Loureiro: Data curation, Writing – review & editing, Validation, Supervision. Christina W. C. Branco: Writing – review & editing, Supervision.

Consent for publication

All authors approved the manuscript and gave their consent for submission and publication in Nauplius. We also guarantee that the research findings have not been previously published.

Competing interests

No potential conflict of interest was reported by the authors.

Funding and grant disclosures

RLM was funded by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior-Brazil (CAPES, doctorate scholarship). VV was funded by the National Council for Scientific and Technological Development (Bolsista do CNPq - Brazil).

References

Abell, R.; Thieme, M.L.; Revenga, C.; Bryer, M.; Kottelat, M.; Bogutskaya, N.; Coad, B.; Mandrak, N.; Balderas, S.C.; Bussing, W.; Stiassny, M.L.J.; Skelton, P.; Allen, G.R.; Unmack, P.; Naseka, A.; Ng, R.; Sindorf, N.; Robertson, J.; Armijo, E.; Higgins, J.V.; Heibel, T.J.; Wikramanayake, E.; Olson, D.; Lopez, H.L.; Reis, R.E.; Lundberg, J.G.; Perez, M.H.S. and Petry, P. 2008. Freshwater ecoregions of the world: a new map of biogeographic units for freshwater biodiversity conservation. *Bioscience*, 58: 403–414.

Araújo, L.R.; Lopes, P.M.; Santangelo, J.M.; Petry, A.C. and Bozelli, R.L. 2013. Zooplankton resting egg banks in permanent and temporary tropical aquatic systems. *Acta Limnologica Brasiliensia*, 25: 235–245.

Araújo, L.R.; Lopes, P.M.; Santangelo, J.M.; Esteves, F.A. and Bozelli, R.L. 2015. Long-term dynamics of the zooplankton community during large salinity fluctuations in a coastal lagoon. *Marine and Freshwater Research,* 66(4): 352.

Attayde, J.L. and Bozelli, R.L. 1998. Assessing the indicator properties of zooplankton assemblages to disturbance gradients by canonical correspondence analysis. *Canadian Journal of Fisheries and Aquatic Sciences* 55: 1789e1797.

Birge, E.A. 1910. Notes on Cladocera IV. *Transactions of the Wisconsin Academy*, 16: 1017–1066.

Birge, E.A. 1878. Notes on Cladocera. *Transactions of the Wisconsin Academy of Science, Arts and Letters,* 4: 77–109.

Bergamin, F. 1939. Os Cladocera. 3. *Revista da Indústria Animal*, 2(4): 8782.

Brady, G.S. 1886. Notes on Entomostraca collected by Mr. A. Haly in Ceylon. *Journal of the Linnean Society (Zoology),* 19: 293–317. Pls. 37 a 40.

Branco, C.W.C.; Esteves, F.de A. and Kozlowsky-Suzuki, B. 2000. The zooplankton and other limnological features of a humic coastal lagoon (Lagoa Comprida, Mace, R.J.) in Brazil. *Hydrobiologia*, 437: 71–81.

Branco, C.W.C.; Rocha, M.I.A.; Pinto, G.F.S.; Gômara, G.A. and De Filippo, R. 2002. Limnological features of Funil reservoir (RJ, Brazil) and indicator properties of rotifers and cladocerans of the zooplankton community. *Lakes and Reservoirs: Research and Management*, 7: 87–92.

Branco, C.W.C; Kozlowsky-Suzuki, B. and Esteves, F. 2007. Environmental changes and zooplankton temporal and spatial variation in a disturbed Brazilian coastal lagoon. *Brazilian Journal of Biology*, 67(2): 251–262.

Branco, C.W.C; Kozlowsky-Suzuki, B.; Esteves, F.A. and Aguiaro, T. 2008. Zooplankton distribution and community structure in a Brazilian coastal lagoon. *Vie et Milieu/Life and Environment* 58 (1): 1–9.

Branco, C.W.C.; Leal, J.J.F.; Huszar, V.L.M.; Farias, D.D.S.; Saint'Pierre, T.D.; Sousa-Filho, I.F.; de Palermo, E.F.A.; Guarino, A.W.S.; Gomes, A.R. and Kozlowsky-Suzuki, B. 2019. New lake in a changing world: the construction and filling of a small hydropower reservoir in the tropics (Rio de Janeiro, Brazil). *Environmental Science Pollution Research International*, 26(35): 36007–36022.

Brandorff, G.O.; Koste, W. and Smirnov, N.N. 1982. Structure of rotiferan and crustacean communities of the lower Rio Nhamundá, Amazonas, Brazil. *Studies on Neotropical Fauna and Environment*, 17: 69–121.

Brehm, V. 1953. Eine eigenartige *Bosmina* aus Venezuela. *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften. Mathematisch-naturwissenschaftliche Classe, Abteilung I*, 90: 214–217.

Brehm, V. and R. Thomsen. 1936. Brasilianische Phyllopoden und Arguliden gesammelt von Herrn Dr. O. Schubart. *Zoologischer Anzeiger*, 166: 211–218.

Brehm, V. 1938. Dritter Bericht über die von Dr. O. Schubart in Brasilien gesammelten Onychura. *Zoologischer Anzeiger*, 122: 94–103.

Brito, M.T.S.; Diniz, L.P.; Pozzobom, U.M.; Landeiro, V.L. and Sousa, F.D.R. 2020. Cladocera (Crustacea: Branchiopoda) from the state of Mato Grosso, Brazil. *Annales de Limnologie - International Journal of Limnology*, 56: 7.

Brooks JL, Dodson SI. 1965. Predation, body size, and composition of plankton. *Science,* 150: 2835.

Chatterjee, T.; Kotov, A.A.; Damme, K.V.; Chandrasekhar, S.V.A. and Padhye, S. 2013. An annotated checklist of the Cladocera (Crustacea: Branchiopoda) from India. *Zootaxa*, 3667(1): 1.

Choi, J.Y.; Jeong, K.S.; Kim, S.K.; La, G.H.; Chang, K.H. and Joo, G.J. 2014. Role of macrophytes as microhabitats for zooplankton community in lentic freshwater ecosystems of South Korea. *Ecological Informatics,* 24: 177–185.

Claus, C. 1877. Zur Kentnnis des feineren Baues und der Organisation der Polyphemiden. *Denkschriften der königlichen Akademie der Wissenschaften, Wien*, 37: 137–160.

Coronel J.S.; Declerck, S. and Brendonck, L. 2007. High-altitude peatland temporary pools in Bolivia house a high cladoceran diversity. *Wetlands,* 27: 1166–1174.

Daday, E.V. 1902. Mikroskopische Süsswasserthiere aus Patagonien, gesammelt von Dr. Filippo Silvestri. *Természtrajzi Füzetek*, 25: 201–310.

Daday, E.V. 1904. Ein neues Cladoceren-Genus der Fam. Sididae. *Rovartani Lapok*, 11: 111–112.

Daday, E.V. 1905. Untersuchungen über die Süsswasser-Mikrofauna Paraguays. *Zoologica*, 18 (44): 1–375.

Dana, J.D. 1849. Conspectus crustaceorum, quae in orbis terrarum circumnavigatione, Carolo Wilkes, e classe Reipublicae foederatae duce, lexit et descripsit Jacobus D. Dana. *The American Journal of Science and Arts,* 8(2): 276–285.

De los Ríos Escalante, P. and Kotov, A.A. 2015. A checklist of Branchiopoda (Anostraca and Cladocera) of Chilean continental waters. *Zootaxa*, 4027 (3): 366–388.

de Melo, R. and Hebert, P.D.N. 1994. A taxonomic reevaluation of North American Bosminidae. *Canadian Journal of Zoology*, 72: 1808–1825.

De Waard, J.R.; Sacherova, V.; Cristescu, M.E.A.; Remigio, E.A.; Crease, T.J. and Hebert, P. D.N. 2006. Probing the relationships of the branchiopod crustaceans. *Molecular Phylogenetics and Evolution,* 39(2): 491–502.

Debastiani-Júnior, J.R.; Elmoor-Loureiro, L.M.A. and Nogueira, M.G. 2016. Habitat architecture influencing microcrustaceans composition: a case study on freshwater Cladocera (Crustacea Branchiopoda). *Brazilian Journal of Biology*, 76(1): 93–100.

Diniz, L.P.; Morais Junior, C.S.; Medeiros, I.L.S.; Silva, A.J.; Araújo, A.P.; Silva, T.A. and Melo-Júnior, M. 2020. Distribution of planktonic microcrustaceans (Cladocera and Copepoda) in lentic and lotic environments from the semiarid region in northeastern Brazil. *Iheringia, Série Zoologia*, 110: e2020002.

Dumont, H.J. and J. Pensaert. 1983. A revision of the Scapholeberinae (Crustacea, Cladocera). *Hydrobiologia*, 100: 3–45.

Dumont, H.J. and Tundisi, J. 1984. Epilogue: The future of tropical zooplankton studies. pp. 331–333. In: H. Dumont and J. Tundisi (eds), Tropical Zooplankton. Junk. Netherlands.

Egloff, D.A.; Fofonoff, P.W. and Onbé, T. 1997. Reproductive biology of marine cladocerans, *Advances in Marine Biology*, 31: 79–168.

Elías-Gutiérrez, M.; Martínez-Jerónimo, F.; Ivanova, N.V.; Valdez Moreno, M. and Hebert, P.D.N. 2008. DNA barcodes for Cladocera and Copepoda from Mexico and Guatemala, highlights and new discoveries. *Zootaxa*, 1839, 1–42.

Elías-Guitiérrez, M.; Ciros-Pérez, J.; Suárez-Morales, E. and Silva-Briano, M., 1999. The freshwater Cladocera (orders Ctenopoda and Anomopoda) of Mexico, with comments on selected taxa. *Crustaceana*, 72(2): 1–16.

Elmoor-Loureiro, L.M.A. 1997. Manual de Identificação de Cladóceros Límnicos do Brasil. Brasília, Universa. 156p.

Elmoor-Loureiro, LMA. 2000. Brazilian cladoceran studies: where do we stand? *Nauplius,* 8: 117–131.

Elmoor–Loureiro, L.M.A. 2007. *Phytophilous cladocerans* (Crustacea, Anomopoda and Ctenopoda) from Paraná River Valley, Goiás, Brazil. *Brazilian Journal of Biology*, 24: 344–352.

Elmoor-Loureiro, L.M.A. 2014. *Ephemeroporus quasimodo* sp. nov. (Crustacea: Cladocera: Chydoridae), a new species from the Brazilian Cerrado. *Zootaxa,* 3821: 88–100.

Elmoor-Loureiro, L.M.; Lopes, P.M.; Jesus, S.B.; Bozelli, R.L. and Aleluia, F.T. 2010a. New records of *Guernella* Richard 1892 (Cladocera, Macrothricidae) from Brazil. *Brazilian Journal of Biology*, 70(3): 687–688.

Elmoor-Loureiro, L.M.; Santangelo, J.M.; Lopes, P.M. and Bozelli, R.L. 2010b. A new report of *Moina macrocopa* (Straus, 1820) (Cladocera, Anomopoda) in South America. *Brazilian Journal of Biology*, 70(1): 225–226.

Elmoor-Loureiro, L.M.A.; Sousa, F.D.R.; Rocha, G.M.; Féres, J.de C. and Sterza, J.M. 2018. A new record of *Kisakiellus aweti* (Cladocera, Chydoridae) from the Amazon region. *Nauplius,* 26: e2018033.

Esteves, F.A. 2011. Gênese dos ecossistemas lacustres Fundamentos de Limnologia. Rio de Janeiro, Editora Interciência, 3ª ed., p. 83–112.

Farias, D.S.; Elmoor-Loureiro, L.M.A. and Branco, C.W.C. 2017. First record of *Moina dumonti* Kotov, Elías-Gutiérrez and Granado-Ramírez, 2005 (Branchiopoda: Anomopoda) in Brazil. *Check List*, 13: 2144.

FEOW – Freshwater Ecoregions of the World – WWF/TNC 2019. Available at http://www.feow.org. Accessed on 20 January 2020.

Ferrão-Filho, A.D.; Kozlowsky-Suzuki, B. and Azevedo, S. 2002. Accumulation of microcystins by a tropical zooplankton community. *Aquatic Toxicology*, 59: 201–208.

Ferrão-Filho, A.S; da Cota, S.M.; Ribeiro, M.G. and Azevedo, S.M. 2008. Effects of a saxitoxin-producer strain of *Cylindrospermopsis raciborskii* (cyanobacteria) on the swimming movements of cladocerans. *Environmental Toxicology*, 23(2): 161–168.

Ferrão-Filho, A.S.; Dias, T.M.; Pereira, U.J.; Dos Santos, J.A.A. and Kozlowsky-Suzuki, B. 2019. Nutritional and toxicity constraints of phytoplankton from a Brazilian reservoir to the fitness of cladoceran species. *Environmental Science and Pollution Research International*, 26(13): 12881–12893.

Forró, L.; Korovchinsky, N.M.; Kotov, A.A. and Petrusek, A. 2008. Global diversity of cladocerans (Cladocera; Crustacea) in freshwater. *Hydrobiologia,* 595: 177–184.

Frey, D.G. 1980. The non-swimming Chydorid Cladocera of wet forest, with description of a new genus and two new species. *Internationale Revue der Gesamten Hydrobiologie,* 65(5): 613–641.

Frisch, D.; Moreno-Ostos, E. and Green A.J. 2006. Species richness and distribution of copepods and cladocerans and their relation to hydroperiod and other environmental variables in Doñana, south-west Spain. *Hydrobiologia,* 556, 327–40.

Garibian, P.G.; Karabanov, D.P.; Neretina, A.N.; Taylor, D.J. and Kotov, A.A. 2021. *Bosminopsis deitersi* (Crustacea: Cladocera) as an ancient species group: a revision. *PeerJ,* 9: e11310.

Gazulha, V. 2012. Zooplâncton Límnico Manual Ilustrado. Rio de Janeiro, Technical Books, 1ª ed., 156p.

Ghidini, A.R. and Santos Silva, E.M. 2011. Composition, species richness and patterns of nycthemeral vertical distribution of planktonic cladocerans in a black water Amazonian lake. *Nauplius,* 19(2): 109–122.

Gonçalves Jr., J.F.; Santos, A.M. and Esteves, F.A. 2004. The influence of the chemical composition of *Typha Domingensis* and *Nymphaea ampla* detritus on invertebrate colonization during decomposition in a Brazilian coastal lagoon. *Hydrobiologia*, 527(1): 125–137.

Guerne, J. and Richard, J. 1893. *Cantocamptus grandidieri*, *Alona cambouei*, nouveaux entromostracé d'eau douce de Madagascar. *Mémoires de la Société Zoologique de France,* 6: 234–244.

Haney, J.F. and Hall, D.J. 1973. Sugar-coated *Daphnia*: A preservation technique for Cladocera. *Limnology and Oceanography,* 18: 331–333.

Hansen, H.I. 1899. Die Cladoceren und Cirripedien der Plankton-Expedition. *Ergebnisse der Plankton-Expedition der Humboldt-Stiftung*, 2: 3–7.

Herbst, H.V. 1967. Copepoda und Cladocera (Crustacea) aus Südamerika. *Gewässer und Abwässer*, 44(45): 96-108.

Herrick, C.L. 1882. Notes on some Minnesota Cladocera. *The Geological and Natural History Survey of Minnesota, 10th Annual Report:* 235–252.

Hsieh, T.C.; Ma, K.H. and Chao, A. 2016. iNEXT: An R package for rarefaction and extrapolation of species diversity (Hill numbers). *Methods in Ecology and Evolution*, 7: 1451–1456.

Hudec, I. 2000. Subgeneric differentiation within *Kurzia* (Crustacea: Anomopoda: Chydoridae) and a new species from Central America. *Hydrobiologia*, 421: 165–178.

Jurine, L. 1820. Histoire des Monocles, qui se trouvent aux environs de Genève. J.J. Paschoud, Genève, 260 p.

King, R. 1853. On some Australian Entomostracans - in continuation. *Papers and proceedings of the Royal Society of Tasmania*, 2: 253–263.

Klippel, G.; Macêdo, R.L. and Branco, C.W.C. 2020. Comparison of different trophic state indices applied to tropical reservoirs. *Lakes and Reservoirs: Research and Management,* 25(2): 214–229.

Koch, C.L. 1841. *Deutschlands Crustaceen, Myriapoden und Arachniden*. Regensburg, p. 31–32.

Kořínek, V. 1981. *Diaphanosoma birgei* n. sp. (Crustacea, Cladocera). A new species from America and its widely distributed subspecies *Diaphanosoma birgei* ssp *lacustris* n. ssp. *Canadian Journal of Zoology*, 59(6): 1115–1121.

Kořinek, V. 2002. Cladocera. p. 69–122. In: C. H. Fernando (ed). A guide to tropical freshwater zooplankton. Backhuys Publishers, Leiden, Netherlands.

Kotov, A.A. 2013. Morphology and phylogeny of the Anomopoda (Crustacea: Cladocera). KMK, Moscow (in Russian). 636p.

Kotov, A.A. and Fuentes-Reinés, J.M. 2015. An annotated checklist of the Cladocera (Crustacea: Branchiopoda) of Colombia. *Zootaxa*, 4044(4): 493–510.

Kotov, A.A. and Sinev, A.Y. 2004. Notes on Aloninae Dybowski and Grochowski, 1894 emend. Frey, 1967 (Cladocera: Anomopoda: Chydoridae): 3. *Alona iheringula* nom. nov. instead of *A. iheringi* Sars, 1901, with comments on this taxon. *Arthropoda Selecta*, 13 (3): 95–98.

Kotov, A.A.; Elías-Gutiérrez, M. and Granados-Ramírez, J.G. 2005. *Moina dumonti* sp. nov. (Cladocera, Anomopoda, Moinidae) from southern Mexico and Cuba, with comments on moinid limbs. *Crustaceana*, 78(1): 41–57.

Kotov, A.A. and Elmoor-Loureiro, L.M.A. 2008. Revision of *Ilyocryptus* Sars, 1862 (Cladocera: Ilyocryptidae) of Brazil with description of two new subspecies. *Zootaxa* 1962: 49–64.

Kotov, A.A.; Sinev, A.Y. and Berrios, V.L. 2010. The Cladocera (Crustacea: Branchiopoda) of six high altitude water bodies in the North Chilean Andes, with discussion of Andean endemism. *Zootaxa*, 2430:1–66.

Kotov, A.; Forró, L.; Korovchinsky, N.M. and Petrusek, A. 2013. World checklist of freshwater Cladocera species. World Wide Web electronic publication. Available at http://fada.biodiversity.be/ group/show/17. Accessed 20 April 2021

Kozlowsky-Suzuki, B. and Bozelli, R.L. 2002. Experimental evidence on the effects of nutrient enrichment on the zooplankton in a Brazilian coastal lagoon. *Brazilian Journal of Biology,* 62: 835e846.

Kozlowsky-Suzuki, B. and Bozelli, R.L. 2004. Resilience of a zooplankton community subjected to marine intrusion in a tropical coastal lagoon. *Hydrobiologia,* 522: 165–177.

Kurz, W. 1875. Dodekas neuer Cladoceren nebst einer kurzen Übersicht der Cladocerenfauna Böhmens. *Sitzungsberichte der Akademie der Wissenschaften in Wien. Mathematisch-Naturwissenschaftliche Klasse*, 70: 7-88.

Leuckart, R. 1859. Über das Vorkommen eines saugnapfartigen Haftapparates bei den Daphniaden und verwandten Krebsen. *Archiv für Naturgeschichte,* 25(1): 262-265.

Lilljenorg, W. 1853. De crustaceis ex ordinibus tribus: Cladocera, Ostracoda et Copepoda in Scania Ocurrentibus. Lund. 222p.

Lynch, M. 1980. The evolution of cladoceran life histories. *The Quarterly Review of Biology*, 55(1): 23–42.

Lopes, P.M.; Elmoor-Loureiro, L.M.A. and Bozelli, R.L. 2006. First record of *Dunhevedia colombiensis* Stingelin, 1913 (Cladocera, Anamopoda, Chydoridae) from Brazil. *Brazilian Journal of Biology*, 66(4): 1141–1142.

Lopes, V.G.; Branco, C.W.C.; Kozlowsky-Suzuki, B.; Sousa-Filho, I.F.; Souza, L.C. and Bini, L.M. 2018. Environmental distances are more important than geographic distances when predicting spatial synchrony of zooplankton populations in a tropical reservoir. *Freshwater Biology,* 63(12): 1592–1601.

López, C.; Mosquera, P.V.; Hampel, H.; Neretina, A.N.; Alonso, M.; Van, D.K. and Kotov, A.A. 2018. An annotated checklist of the freshwater cladocerans (Crustacea: Branchiopoda: Cladocera) of Ecuador and the Galápagos Islands. *Invertebrates Zoology*, 15(3): 277–291.

Loureiro, B.R.; Costa, S.M.; Macedo, C.F.; Huszar, V.L.deM. and Branco, C.W.C. 2011. Comunidades zooplanctônicas em sistemas de criação de peixes. *Boletim do Instituto de Pesca, São Paulo*, 37(1): 47–60.

Lovén, S. 1838. Evadne Nordmanni, ein bisher unbekanntes Entomostracon. *Arch Naturgesch*, 4: 143–166.

Macêdo, R.L.; Lopes, V.G.; Kozlowsky-Suzuki, B. and Branco, C.W.C. 2018. Zooplankton community attributes in an oligo-mesotrophic reservoir: a comparative study of two sampling strategies. *Annals of the Brazilian Academy of Sciences*, 91: e20170807.

Macêdo, R.L.; Sousa, F.D.R; Jesus, S.B.; Nunesmaia, B.J.B.; Branco, C.W.C. and Elmoor-Loureiro, L.M.A. 2021. Cladocera (Crustacea, Branchiopoda) species of Bahia State, Brazil: a critical update on species descriptions, distributions, and new records. *Nauplius* 29(4): e2021011.

Maia-Barbosa, P.M.; Menendez, R.M.; Pujoni, D.G.F.; Brito, S.L.; Aoki, A. and Barbosa, F.A.R. 2014. Zooplankton (Copepoda, Rotifera, Cladocera and Protozoa: Amoeba Testacea) from natural lakes of the middle Rio Doce basin, Minas Gerais, Brazil. *Biota Neotropica*, 14 (1): 1–20.

Marazzo, A. and Valentin, J.L. 2004. Reproductive aspects of marine cladocerans *Penilia avirostris* and *Pseudevadne tergestina* (Crustacea, Branchiopoda) in the outer part of Guanabara Bay, Brazil. *Brazilian Journal of Biology*, 64(3A): 543–549.

Miyashita, L.K.; Gaeta, S.A. and Lopes, R.M. 2011. Life cycle and reproductive traits of marine podonids (Cladocera, Onychopoda) in a coastal subtropical area. *Journal of Plankton Research*, 33(5): 779–792.

Maiphae, S.; Pholpunthin, P. and Dumont, H.J. 2005. — Species richness of the Cladocera (Branchiopoda: Anomopoda and Ctenopoda) in southern Thailand, and its complementarity with neighboring regions. *Hydrobiologia*, 537: 147–156.

Maiphae, S.; Pholpunthin, P. and Dumont, H. J. 2008. Taxon richness and biogeography of the Cladocera (Crustacea: Ctenopoda, Anomopoda) of Thailand. *Annales de Limnologie - International Journal of Limnology*, 44(1): 33–43.

Müller, O.F. 1776. Zoologiæ Dan Prodromus, seu Animalium Daniæ et Norvegiæ indigenarum characteres, nomina, et synonyma imprimis popularium. Havniæ [Copenhagen]: Hallageri. xxxii + 274 pp.

Müller, P.E. 1867. Denmarks Cladocera. *Naturhistorisk Tidsskrift*, 3: 53–240.

Neretina, A.N. and Kotov, A.A. 2017. Old World-New World differentiation of so-called "circumtropical" taxa: the case of rare genus *Grimaldina* Richard, 1892 (Branchiopoda: Cladocera: Macrothricidae). *Zootaxa*, 4291(2): 295–323.

Meschiatti, A.J.; Arcifa, M.S. and Fenerich-Verani, N. 2000. Fish communities associated with macrophytes in Brazilian floodplain lakes. *Environmental Biology of Fishes*, 58(2): 133–143.

Nova, C.C.; Rocha, A.M.; Branco, C.W.C. and Bozelli, R.L. 2021. New insights on the relation between zooplankton and humic substances in tropical freshwater ecosystems. *Anais da Academia Brasileira de Ciências,* 93(4): e20190409.

Olesen, J. 2002. Branchiopod phylogeny - continued morphological support for higher taxa like the Diplostraca and Cladocera and for paraphyly of 'Conchostraca' and 'Spinicaudata'. *Crustaceana*, 75, 77–84.

Onbé, T. 1999. Ctenopoda and Onychopoda (= Cladocera). p. 797–813. In: D. Boltovskoy (ed), South Atlantic Zooplankton. Backhuys Publishers, Leiden.

Padovesi-Fonseca, C.; Saraiva, M.F. and Fernandes, C.L.S. 2016. First record of cladocerans from the headwaters of the Cerrado–Amazon boundary, central Brazil. *Biodiversity,* 17(3): 1–3.

Paggi, J.C. and Herrera-Martinez ,Y. 2020. Presence of Acantholeberis Lilljeborg (Cladocera, Anomopoda) in South America, with Remarks on the Taxonomy and Geographic Distribution of the Genus. *Zoologicheskii Zhurnal*, 99(12): 1345–1362.

Padhye, S.M. and Victor, R. 2015. Diversity and distribution of Cladocera (Crustacea: Branchiopoda) in the rock pools of Western Ghats, Maharashtra, India. *Annales de Limnologie - International Journal of Limnology*, 51(4): 315–322.

Picapedra, P.; Fernandes, C.; Baumgartner, G. and Sanches, P.V. 2021. Zooplankton communities and their relationship with water quality in eight reservoirs from the Midwestern and Southeastern Regions of Brazil. *Brazilian. Journal of Biology,* 81(3): 701–713.

Pijanowska J. and Stolpe, G. 1996. Summer diapause in *Daphnia* as a reaction to the presence of fish. *Journal of Plankton Research*, 18: 1407–1412.

Poppe, S.A. 1889. Notizen zur Fauna der Süsswasserbecken des nordwestlichen Deutschland mit besonderer Berücksichtigung der Crustaceen, *Abhandlungen des Naturwissenschaftlichen Vereins zu Bremen*, 10: 517–551.

Rajapaksa, R. and Fernando, C.H. 1982. The Cladocera of Sri Lanka (Ceylon), with remarks on some species. *Hydrobiologia,* 94: 49–69.

Richard, J. 1892. *Grimaldina brazzai*, *Guernella raphaelis*, *Moinodaphnia mocquerysi*, cladocères nouveaus du Congo. *Mémoires de la Société Zoologique de France*, 5: 213–226.

Richard, J. 1894. Cladocères recueillis par le Dr. Théod. Barrois em Palestine, em Syrie et em Égypte. *Revue Biologique du Nord de la France*, 6: 360–378.

Richard, J. 1895. Sur quelques Entomostracé d'eau douce d'Haiti. *Mémoires de la Societe Zoologique de France*, 8(2): 189–199.

Richard, J. 1895. Description d'un nouveau cladocère *Bosminopsis deitersi* n. g. n. sp. *Bulletin de la Société Zoologique de France*, 20: 96–98.

Richard, J. 1897. Entomostracés de L'Amérique du Sud recueillis par M. N. Deiters, H. von Ihering, G. W. Müller e C. O. Poppe. *Mémoires de la Société Zoologique de France,* 10: 263–301.

R Core Team. 2020. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. Available at https://www.R-project.org/. Accessed on 10 May 2021.

Rocha, O.; Santos-Wisniewski, M.J. and Matsumura-Tundisi, T. 2011. Checklist of fresh-water Cladocera from São Paulo State, Brazil. *Biota Neotropica*, 11 (suppl. 1): 571–592.

Rocha, M.I.A.; Branco, C.W.C.; Sampaio, G.F.; Gômara, G.A. and De Filippo, R. 2002. Spatial and temporal variation of limnological features, *Microcystis aeruginosa* and zooplankton in an eutrophic reservoir (Funil Reservoir, Rio de Janeiro). *Acta Limnologica Brasilensia,* 14: 73–86.

Rosa, J.C.L.; Batista L.L. and Monteiro-Ribas, W.M. 2021. Spatio-temporal variability in the Cladocera assemblage of a subtropical hypersaline lagoon. *Brazilian Journal Biology*, 82: e236354.

Sampaio, E.; Rocha, O.; Matsumura-Tundisi, T. and Tundisi, J. 2002. Composition and abundance of zooplankton in the limnetic zone of seven reservoirs of the Paranapanema river, Brazil. *Brazilian Journal Biology*, 62: 525–545.

Santangelo, J.M.; de M. Rocha, A.; Bozelli, R.L.; Carneiro, L.S. and de A. Esteves, F. 2007. Zooplankton responses to sandbar opening in a tropical eutrophic coastal lagoon. *Estuarine, Coastal and Shelf Science*, 71(3-4): 657–668.

Santangelo, J.M.; Bozelli, R.L.; Rocha, A. de M. and Esteves, F.A. 2008. Effects of slight salinity increases on *Moina micrura* (Cladocera) populations: field and laboratory observations. *Marine and Freshwater Research*, 59(9): 808–816.

Santangelo, JM.; Bozelli, RL.; Esteves, FA. and Tollrian, R. 2010. Predation cues do not affect the induction and termination of diapause in small-bodied cladocerans. *Freshwater Biology*, 55: 1577–1586.

Santos, A.S.; Sousa, F.D.R.; Elmoor-Loureiro, L.M.A.; Andrade, D.S. and Mugnai, R. 2021. Richness and composition of the Cladocera community (Crustacea: Branchiopoda) from the Maranhão State, Northeast Brazil. *Zootaxa*, 5081(3): 420–432.

Santos, L.A.; Silva, A.C.S.; Pereira, P.P.; Araujo, R.M.G. and Ghidini, A.R. 2022. Zooplankton diversity in Acre State, Amazon, Brazil: an overview of previous studies. *Biota Neotropica*, 22(1): e20201132.

Santos-Wisniewski, M.J.; Rocha, O. and Matsumura-Tundisi, T. 2001. first record of *Alona setigera* Brehm (Cladocera: Chydoridae) in the neotropical region. *Brazilian Journal of Biology*, 61(4): 701–702.

Santos-Wisniewski, M.J.; Rocha, O.; Güntzel, A.M. and Matsumura-Tundisi, T. 2002. Cladocera Chydoridae of the high altitude water bodies (Serra da Mantiqueira), in Brazil. *Brazilian Journal of Biology*, 62(4a): 681–687.

Santos-Wisniewski, M.J.; Rocha, O.; Güntzel, A.M. and Matsumura-Tundisi, T. 2008. species richness and geographic distribution of the genera *Chydorus* and *Pseudochydorus* (cladocera; chydoridae) in São Paulo State. *Biota Neotropica*, 8(1): 21–23.

Santos-Wisniewski, M.J.; Matsumura-Tundisi, T.; Negreiros, N.F.; Silva, L.C.; Santos, R.M. and Rocha, O. 2011. Present knowledge on Cladocera (Crustacea, Branchiopoda) diversity of freshwaters in Minas Gerais State. *Biota Neotropica,* 11(3): 287–301.

Sars, G.O. 1861. Om de i omegnen af Christiania forekommende cladocerer. Saerskilt Aftryk (special separate) *Forhandlinger i Videnskabs–Selskabet i Christiania*, 1861: 1–25.

Sars, G.O. 1862. Hr. studios. Medic. G.O. Sars fortsatte sit Foredrag over de af ham i Omegnen af Christiania iagttagne Crustacea Cladocera. *Forhandlinger i Videnskabs–Selskabet i Christiania*, 1861: 250–302.

Sars, G.O. 1885. On Some Australian Cladocera, Raised from Dried Mud. *Videnskab-Selskabs Forhandlinger, Christiania,* 8: 1–46.

Sars, G.O. 1888. Additional notes on Australian Cladocera raised from dried mud. *Videnskab-Selskabs Forhandlinger Christiania,* 7: 1–74.

Sars, G.O. 1896. On some Freshwater Entomostraca from the neighborhood of Sydney. *Archiv for Mathematik og Naturvidenskab*, 18(2): 11–76.

Sars, G.O. 1901. Contribution to the knowledge of the fresh-water Entomostraca of South America. Part I. Cladocera. *Archiv for Mathematik og Naturvidenskab, Christiania,* 23(3): 1–102.

Setubal, R.B.; Santangelo, J.M.; de Rocha, A.M. and Bozelli, R.L. 2013. Effects of sandbar openings on the zooplankton community of coastal lagoons with different conservation status. *Acta Limnologica Brasiliensia,* 25: 246–256

Sinev, A.Y. 1998. *Alona ossiani* sp. n., a new species of the *Alona affinis* complex from Brazil, deriving from the collection of G. O. Sars (Anomopoda Chydoridae). *Arthropoda Selecta*, 7: 103–110.

Sinev, A.Y. and Elmoor-Loureiro, L.M.A. 2010. Three new species of chydorid cladocerans of subfamily Aloninae (Branchipoda: Anomopoda: Chydoridae) from Brazil. *Zootaxa*, 2390: 1–25.

Smirnov, N.N. 1974. Fauna of the USSR. Crustacea, Chydoridae. Jerusalem: Keter Publishing House. 644p.

Smirnov, N.N. 1996a. Cladocera the Chydorinae and Sayciinae (Chydoridae) of the World. p. 1–197. In: H.J.F. Dumont (ed), Guide to Identification of Macroinvertebrates of the Continental Waters of the World, Vol. 11. Amsterdam, Backhuys Publishers.

Smirnov, N.N. 1996b. New or rare species of Chydoridae (Crustacea, Anomopoda). *Arthropoda Selecta*, 5 (3–4): 3–17.

Smirnov, N.N. 2008. Check-list of the South-African Cladocera (Crustacea: Branchiopoda). *Zootaxa*, 1788: 47-56.

Sousa, F.D.R. and Elmoor-Loureiro, L.M.A. 2011. First report of *Ilyocryptus paranaensis* inarmatus Kotov, Elíaz-Gutiérrez and Gutiérrez-Aguirre, 2001(Cladocera, Anomopoda, Ilyocryptidae) in South America. *Brazilian Journal of Biology*, 71(4): 1025-1026.

Sousa, F.D.R. and Elmoor-Loureiro, L.M.A. 2012. How many species of cladocerans (Crustacea, Branchiopoda) are found in Brazilian Federal District? *Acta Limnologica Brasiliensia*, 24: 351–362.

Sousa, F.D.R. and Elmoor-Loureiro, L.M.A. 2013. Cladocerans (Crustacea: Anomopoda and Ctenopoda) of the Sempre Vivas National Park, Espinhaço Range, Minas Gerais, Brazil. *Check List*, 9(1): 4–8.

Sousa, F.D.R. and Elmoor-Loureiro, L.M.A. 2017. ZIP code matters: *Nicsmirnovius paggii*, a new species from *fitzpatriki*-complex (Cladocera: Chydoridae) does not co-occur with *Nicsmirnovius incredibilis*, *Journal of Natural History*, 51: 37–38.

Sousa, F.D.R.; Elmoor-Loureiro, L.M.A. and Santos, S. 2015b. Redescription of *Coronatella poppei* (Richard, 1897) (Crustacea, Branchiopoda, Chydoridae) and a revision of the genus in Brazil, with description of new taxa. *Zootaxa,* 3955: 211-244.

Sousa, F.D.R.; Elmoor-Loureiro, L.M.A. and Santos, S. 2016. New findings of *Hexalona*-branch representatives in Brazil, with a description of *Prenda* gen. nov. (Crustacea: Anomopoda: Aloninae). *Journal of Natural History*, 50(43-44), 2727–2768.

Sousa, F.D.R.; Elmoor-Loureiro, L.M.A. and Souza, M.B.G. 2009. A contribution to the fauna of Cladocera (Branchiopoda) from Ceará State, Brazil. *Nauplius,* 17(2): 101-105.

Sousa, F.D.R; Freitas, D.F.B.; Perbiche-Neves, G. and Bertini, G. 2021. A new species of *Macrothrix* (Crustacea, Branchiopoda, Macrothricidae) from the Neotropics with description of the *marthae*-group. *Zootaxa*, 4926(1): 93-104.

Sousa, F.D.R.; Elmoor-Loureiro, L.M.A.; Quadra, A. and Senna, A.R. 2014. First record of Cladocera (Crustacea: Chydoridae) from Parque Nacional do Itatiaia, Southeastern Brazil. *CheckList*, 10(3): 665–668.

Sousa, F.D.R; Elmoor-Loureiro, L.M.A.; Debastiani-Júnior, J.R.; Mugnai, R. and Senna, A. 2015a. New records of *Anthalona acuta* Van Damme, Sinev and Dumont 2011 and *Anthalona brandorffi* (Sinev and Hollwedel, 2002) in Brazil, with description of a new species of the *simplex*-branch (Crustacea: Cladocera: Chydoridae). *Zootaxa* 4044(2): 224–240.

Spandl, H. 1926. Das zooplankton des Paranaguas-Sees (Brazil). *Denkschriften der Akademie der Wissenschaften zu Wien. Mathematische-Naturwissenschaftliche Klasse*, 76: 101-105.

Sterza, J.M. and Fernandes, L.L. 2006. Distribution and abundance of cladocera (branchiopoda) in the Paraíba do Sul River estuary, Rio de Janeiro, Brazil. *Brazilian Journal of Oceanography*, 54(4): 193-204.

Stingelin, T. 1904. Entomostraken gesammelt von Dr. G. Hagmann in Mündungsgebiet des Amazones. *Zoologische Jahrbücher Systematik*, 20: 575-590.

Stingelin, T. 1906. Cladoceren aus Paraguay. Zweiter Beitrag zur Kenntnis südamerikanischer Entomostraken. *Annales de Biologie Lacustre*, 1: 181-192.

Stingelin, T. 1913. Cladoceren aus den Gebirge von Kolumbien. *Mémoires de la Societé Neuchateloise des Sciences Naturelles*, 5: 600–638.

Straus, H.E. 1820. Mémoire sur les Daphnia, de la classe des Crustacés (Secondi Partie). *Mémoires du Muséum d'histoire naturelle*, 6: 149–162.

Toti, D.S.; Coyle, F.A. and Miller, J.A. 2000. A structured inventory of Appalachian grass bald and heath bald spider assemblages and a test of species richness estimator performance. *Journal of Arachnology,* 28: 329–345.

Van Damme, K. and Kotov, A.A. 2016. The fossil record of the Cladocera (Crustacea: Branchiopoda): Evidence and hypotheses. *Earth-Science Reviews,* 163: 162–189.

Vargas, A.L.; Santangelo, J.M. and Bozelli, R.L. 2019. Recovery from drought: Viability and hatching patterns of hydrated and desiccated zooplankton resting eggs. *International Review of Hydrobiology,* 104(1–2): 26–33.

Vávra, W. 1900. Süsswasser Cladoceren. *Ergebnisse der Hamburger Magalhaensische Sammeheise*, 5: l–25.

Villabona-González, S.L.; Aguirre, N.J. and Estrada, A.L. 2011. Influencia de las macrófitas sobre la estructura poblacional de rotíferos y microscrustáceos en un plano de inundación tropical. *Revista de Biología Tropical*, 59(2): 853–870.

Villalobos, M.J. and Gonzalez, E.J. 2006. Estudios sobre la biología y ecología de *Ceriodaphnia cornuta* Sars: Una revisión. INCI, Caracas, 31(5): 351–357. Available at http://ve.scielo.org/scielo.php?script=sci_arttext&pid=S0378-18442006000500006&lng=es&nrm=iso. Accessed on 05 December 2021.

Williams, V.L.; Witkowski, E.T.F. and Balkwill, K. 2007. The use of incidence-based species richness estimators, species accumulation curves and similarity measures to appraise ethnobotanical inventories from South Africa. *Biodiversity and Conservation*, 16(9), 2495–2513.

Zanata, L.H.; Espíndola, E.L.G.; Rocha, O. and Pereira, R.H.G. 2003. First record of *Daphnia lumholtzi* (Sars, 1885), exotican cladoceran, in São Paulo State (Brazil). *Brazilian Journal of Biological*, 63(4): 717–720.

Zanata, L.H.; Güntzel, A.M.; Rodrigues, T.A.R.; Soares, M.P. and Silva, W.M. 2017. Checklist de Cladocera (Crustacea, Branchiopoda) do Estado de Mato Grosso do Sul, Brasil. *Iheringia. Série Zoologia,* 107(suppl): e2017113.

Zoppi de Roa, E.Z. and López, C. 2008. An updated checklist of inland Cladocera (Crustacea: Superorders Ctenopoda and Anomopoda) from Venezuela. *Zootaxa*, 1919(1): 45–57.

Erratum

In the article “More on the distribution of cladoceran species: gaps and perspectives in Rio de Janeiro State, southeastern Brazil”, with DOI number: 10.1590/2358-2936e2022032, published in the journal Nauplius, vol. 30, e2022032:

In the list of authors, where it reads:

Vinícius Veras e Silva

It should read:

Vinicius Veras