

## Microturbellarians (Platyhelminthes and Acoelomorpha) in Brazil: invisible organisms?

*J. A. L. Braccini<sup>a,b</sup>, S. V. Amaral<sup>a,b</sup> and A. M. Leal-Zanchet<sup>a,b\*</sup>*

<sup>a</sup>Instituto de Pesquisas de Planárias, Universidade do Vale do Rio dos Sinos – UNISINOS, Avenida Unisinos, 950, CEP 93022-000, São Leopoldo, RS, Brazil

<sup>b</sup>Programa de Pós-graduação em Biologia, Universidade do Vale do Rio dos Sinos – UNISINOS, Avenida Unisinos, 950, CEP 93022-000, São Leopoldo, RS, Brazil

\*e-mail: zanchet@unisinos.br

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### Abstract

Microturbellarians typically belong to the benthos and may occur in a wide variety of environments. They are abundant in freshwater and marine ecosystems and may occur in moist terrestrial habitats. However, turbellarians are seldom taken into account in studies of biodiversity. Most studies on Brazilian microturbellarians had taxonomical purposes and were done in the years 1940-1950. Thus, information on their occurrence and ecological aspects are dispersed throughout several papers. We intend here to summarize the biogeographical distribution and ecological aspects of microturbellarians recorded for Brazil, indicating the main gaps in their knowledge and possible actions to enhance studies on this group. There are 239 species of microturbellarians registered for Brazil, with records distributed in 12 states. However, just three states located in southern Brazil have records of 94% of microturbellarian species. Thus, knowledge on the systematics and geographical distribution of Brazilian microturbellarians clearly reflect the scientific activity over many years or decades in two states of southeastern and southern Brazil. Considering the scant information on this group in Brazil, which is also the situation of the Neotropical microturbellarians in general, some actions should be proposed. First, it would be necessary to sample in the diverse biomes, as well as in the various river and sea basins, based on standardized sampling protocols. Second, it would be necessary to encourage diverse research groups to include microturbellarians and/or turbellarians in general into biodiversity inventories and studies on community structure of invertebrates. Third, it is necessary to increase the number of research groups on microturbellarians, in order to augment the studies on their morphology, systematics, and ecology. Considering their abundance, species richness and ecological importance in aquatic environments, despite some peculiarities regarding their sampling, sorting and identification procedures, the challenge to study microturbellarians and enhance knowledge about them in Brazilian ecosystems should be faced.

*Keywords:* Platyhelminthes, species diversity, Neotropical region, systematics, ecology.

## Microturbelários (Platyhelminthes e Acoelomorpha) no Brasil: organismos invisíveis?

### Resumo

Microturbelários são tipicamente bentônicos e podem ocorrer em uma ampla variedade de ambientes. São abundantes em ecossistemas marinhos e de água doce, podendo ocorrer em ambientes terrestres úmidos. Entretanto, turbelários raramente são considerados em estudos de diversidade. A maioria dos estudos sobre microturbelários brasileiros tiveram propósito taxonômico e foram realizados nos anos 1940-1950. Assim, informações sobre ocorrência e aspectos ecológicos estão dispersos em diversos artigos. O objetivo deste trabalho é sumarizar a distribuição biogeográfica e aspectos ecológicos dos microturbelários registrados para o Brasil, indicando as principais lacunas do conhecimento e possíveis ações para ampliar estudos sobre esse grupo. Há 239 espécies de microturbelários registradas no Brasil, com registros distribuídos em 12 estados. No entanto, 94% das espécies de microturbelários foram registradas em apenas três estados localizados no sul e sudeste do Brasil. Assim, o conhecimento sobre a sistemática e distribuição geográfica dos microturbelários claramente reflete as atividades científicas realizadas por muitos anos ou mesmo décadas em dois estados do sudeste e sul do Brasil. Considerando as escassas informações existentes sobre esse grupo no Brasil, assim como a situação dos microturbelários neotropicais em geral, algumas ações devem ser propostas. Primeiramente, é necessário realizar amostragens em diversos biomas, assim como nas várias bacias e regiões hidrográficas marinhas, baseadas em protocolos de amostragem padronizados. Em segundo lugar, faz-se necessário incentivar diversos grupos de pesquisa a incluir

microturbelários e/ou turbelários em geral em inventários da biodiversidade e estudos de estrutura de comunidades de invertebrados. Em terceiro lugar, é necessário ampliar o número de grupos de pesquisa em microturbelários, para aumentar os estudos sobre sua morfologia, sistemática e ecologia. Considerando sua abundância, riqueza de espécies e importância ecológica em ambientes aquáticos, apesar de suas peculiaridades de amostragem, triagem e identificação, o desafio de estudar e ampliar o conhecimento sobre microturbelários em ecossistemas brasileiros deve ser enfrentado.

*Palavras-chave:* Platyhelminthes, diversidade de espécies, região Neotropical, sistemática, ecologia.

## 1. Introduction

Turbellarians are acoelomate, soft-bodied worms that have a sac-like gut and typically ciliated epidermal cells. Most turbellarians are hermaphrodites with cross fertilization following copulation, showing a complex reproductive system (Cannon, 1986; Rieger et al., 1991). Traditionally, flatworms used to belong to the phylum Platyhelminthes, which can be subdivided into three clades, viz. Acoelomorpha, Catenulida e Rhabditophora (Rieger et al., 1991), since Rhabditophora also includes the parasitic forms. The Acoelomorpha, however, has been removed from the Platyhelminthes into its own phylum (Baguña and Riutort, 2004; Tyler et al., 2014; Littlewood, 2006; Larsson and Jondelius, 2008; Boll et al., 2013). The term turbellarians continues to be used and will be applied here without taxonomic connotation.

There are about 6,500 species of turbellarians worldwide (Schockaert et al., 2008). They are distributed into the following taxa: Acoela, Nemertodermatida, Catenulida, Macrostomida, Polycladida, Prolethophora, Lecithoepitheliata, Revertospermatata, Proseriata, Tricladida, Dalytyphloplanida and Kalyptorhynchia (Schockaert et al., 2008; Van Steenkiste et al., 2013). The later two constitute the rhabdocoels. Turbellarians can be divided into two major groups, with no taxonomical association: the macroturbellarians or large worms, which include triclads and polyclads, and the microturbellarians including the other turbellarian groups, the members of which are smaller.

Turbellarians may occur in a wide variety of environments. They are abundant in freshwater and marine ecosystems and may occur in moist terrestrial habitats. They are, however, mainly marine animals, with only 1/5 of the known species occurring in freshwater (Hyman, 1951; Schockaert et al., 2008). Turbellarians typically belong to the benthos. Triclads and polyclads occur generally on hard bottom, under stones, or associated with macrophytes, algae or gravel (Hyman, 1951; Du-Bois Reymond Marcus and Marcus, 1968). Microturbellarians usually occur on sandy or muddy bottom. Most marine turbellarians are limited to the littoral zone of the ocean (Hyman, 1951). Freshwater forms may occur in temporary or permanent wetlands, such as lakes, natural or artificial ponds, pools, ditches, streams and rivers (Kolasa, 1991; Noreña-Janssen, 1995; Young, 2001), as well as in agroecosystems (Bambaradeniya et al., 2004; Vara and Leal-Zanchet, 2013). Some marine flatworms, such as acoels and polyclads, and freshwater rhabdocoels are planctonic (Hyman, 1951; Rocha et al., 1990; Dumont et al., 2014). Some microturbellarians may occur in humid terrestrial environments (Hyman, 1951; Tessens et al., 2014); land

triclads may be a species-rich group in tropical and subtropical ecosystems (Carbayo et al., 2009). The temnocephalids, a group of the taxon Dalytyphloplanida, and some members of other taxonomic groups of microturbellarians live in association with other invertebrates or with turtles, usually as ectosymbionts (Hyman, 1951; Jennings, 1997). In addition, some acoels and rhabdocoels are parasites of molluscs, echinoderms and other invertebrates (Hyman, 1951; Bush, 1981).

Microturbellarians in general were studied mainly in Brazil in the years 1940-1950 (Marcus, 1943, 1944, 1945a, b, 1946, 1948, 1949, 1950, 1951, 1952, 1954; Du-Bois Reymond Marcus, 1951; Marcus and Macnae, 1954), based on samplings in the northern littoral of the state of São Paulo and lentic environments of São Paulo city and its neighbourhood. Later, Rocha et al. (1990) and Hooge and Rocha (2006) studied, respectively, freshwater rhabdocoels and acoels from the state of São Paulo. In addition, a new species of marine rhabdocoel was recently described (Reygel et al., 2014). Freshwater turbellarians from southern Brazil were investigated by Gamo and Leal-Zanchet (2004), Vara and Leal-Zanchet (2013) and Braccini and Leal-Zanchet (2013) in natural wetlands and agroecosystems. Temnocephalids from various Brazilian regions were studied by Monticelli (1899), Pereira and Cuocolo (1940, 1941), Amato et al. (2003, 2005, 2006, 2007, 2010, 2011), Amato and Amato (2005) and Seixas et al. (2010a, b, c, 2011, 2014).

Freshwater and land triclads were studied mainly in the Brazilian states of São Paulo and Rio Grande do Sul (Carbayo and Froehlich, 2008; Baptista et al. 2010; Leal-Zanchet et al., 2011; Amaral et al., 2014). Polyclads were mainly known from the coast of the states of São Paulo and Rio de Janeiro, as well as the northeastern coast of Brazil (Carbayo and Froehlich, 2008; Bahia and Padula, 2009; Bahia et al., 2012; Bulnes and Torres, 2014).

In contrast to triclads and polyclads, which are collected directly, microturbellarians should be sampled with some substratum using a fine-meshed sweep-net (Young, 2001). Material collected by the net should be transferred to plastic vials containing water from the sampling site. The vials should be transported to the laboratory and carefully examined under a stereomicroscope (Braccini and Leal-Zanchet, 2013; Vara and Leal-Zanchet, 2013). For sorting, samples may be treated by the method of reduction of oxygen (Schockaert, 1996) or by examining all sampling water under the stereomicroscope (Brusa et al., 2003). Live turbellarians should be transferred by a pipette to a petri dish and be examined alive for observation of general shape, size and colour pattern. After that, the

internal morphology should be examined using a “squeeze preparation” technique (Gamo, 1987; Young, 2001).

Considering that the macroturbellarians are the best known group among turbellarians and that their study in Brazil was summarized by Carbayo and Froehlich (2008), we will focus on Brazilian microturbellarians herein. We intend to summarize the biogeographical distribution and ecological aspects of microturbellarians recorded for Brazil, by pointing out main gaps in the knowledge about them and possible actions to enhance studies on this group.

## 2. Methods

Original research articles were searched in the databases Thomson Reuters (ISI) and Scielo, between August 2014 and February 2015, and in the bibliographical assets of our laboratory in the Universidade do Vale do Rio dos Sinos (UNISINOS). The following key-words were used: *Platyhelminthes*, *Acoela*, *Nemertodermatida*, *Catenulida*, *Prolecithophora*, *Rhabdocoela*, *Temnocephalida*, *Macrostomida*, *Lecithoepitheliata* or *Revertospermata* and *Brazil*.

We organized the data thus obtained in order to summarize the following information: species, order or other representative taxonomic group, sampling place (city and state), and type of environment where the occurrence was recorded. Regarding the environment, the following data were considered: type of substratum (sand, mud, algae etc.), type of ecosystem (marine, freshwater or brackish water) and hydric regime (lentic or lotic). In the case of temnocephalids, the associated organism was informed. The classification of marine ecoregions follows Spalding et al. (2007).

## 3. Geographical Distribution and Ecological Aspects

A total of 44 articles with records of microturbellarians in Brazil was found, 26 of which were available on the online databases Thomson Reuters (ISI) and Scielo. Eighteen other articles were found in the bibliographical assets of our laboratory (UNISINOS).

There are 239 species of microturbellarians registered for Brazil, with records distributed in 12 states. The highest number of species was recorded for the state of São Paulo, followed by Rio Grande do Sul and Paraná (Table 1). The central, northern and northeastern regions of Brazil have no or just a few records (Figure 1).

Brazilian microturbellarians are distributed among 10 taxonomical groups. Dalytyphloplanida and Catenulida are the most species-rich, with about 28% and 18% of the recorded species, respectively, followed by Acoela (15%), Prolecithophora (11%), Proseriata (10%), Kalyptorhynchia (9%), and Macrostomida (7%). Lecithoepitheliata and Revertospermata are taxons with only few known species (Tables 1 and 2). The taxon Nemertodermatida has no records in Brazil.

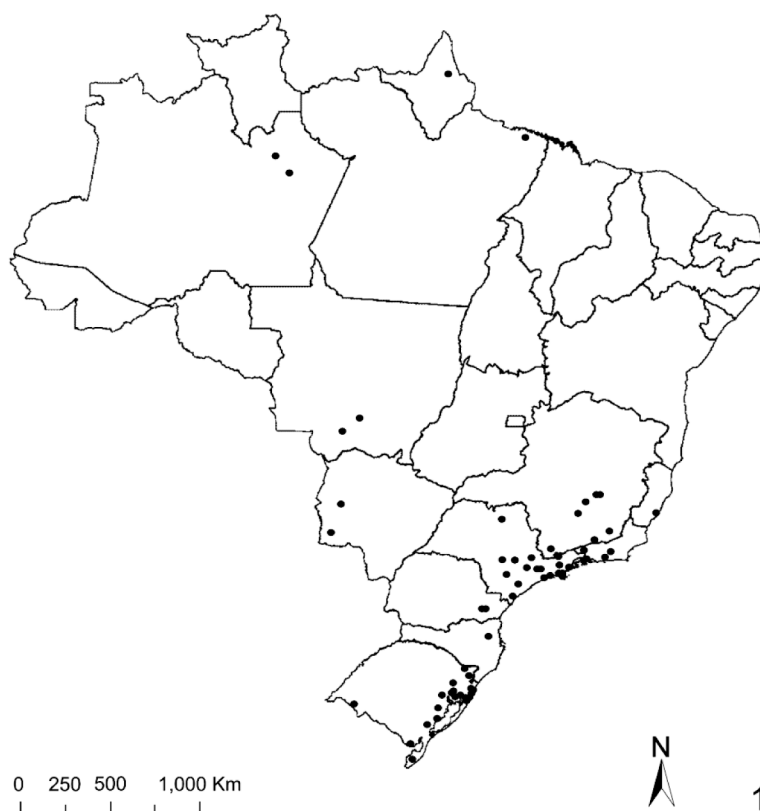
Acoels, a group of marine flatworms, are represented by specimens sampled only in the state of São Paulo, mainly in sandy beaches, on algae or rock coasts (Tables 1 and 2). A few specimens were found on beach ponds.

Catenulids, which are mainly freshwater inhabitants, were registered in various continental environments, mainly in southeastern and southern Brazil (Table 1). They were frequently found in lentic environments, including rice fields and their canals, or in humid terrestrial environments. Six species were found in lotic environments and two species in water accumulated among leaves of Bromeliaceae (Table 3).

**Table 1.** Brazilian states with records of microturbellarians and number of species recorded per taxonomical group and state.

Taxon	Northern region			Central region		Southeastern region			Southern region			Number of species*	
	Amapá	Amazonas	Pará	Mato Grosso	Mato Grosso do Sul	Minas Gerais	Espírito Santo	Rio de Janeiro	São Paulo	Paraná	Santa Catarina		Rio Grande do Sul
Acoela	-	-	-	-	-	-	-	-	36	-	-	-	36
Catenulida	-	-	1	-	-	-	-	-	41	13	-	21	42
Dalytyphloplanida	2	1	1	1	1	7	1	1	45	3	1	24	68
Kalyptorhynchia	-	-	-	-	-	-	-	-	20	-	-	1	21
Lecithoepitheliata	-	-	-	-	-	-	-	-	2	2	-	1	2
Macrostomida	-	-	-	-	-	-	-	-	15	-	-	4	17
Prolecithophora	-	-	-	-	-	-	-	-	27	-	-	-	27
Proseriata	-	-	-	-	-	-	-	2	24	-	-	1	25
Revertospermata	-	-	-	-	-	-	-	-	1	-	-	-	1
Number of species	2	1	2	1	1	7	1	3	211	18	1	52	239

- No data. \*Species may occur in more than one locality.



**Figure 1.** Records of microturbellarians in Brazil. Dots represent localities where microturbellarians were sampled.

Macrostomids inhabit marine and freshwater environments. They occur associated to the bottom or to the vegetation. In Brazil, 11 species were recorded in marine environments of the north coast of the state of São Paulo. Six other species were sampled in lentic continental ecosystems or in brackish water in various regions (Tables 1 and 4).

Rhabdocoels (Dalytyphloplanida and Kalyptorhynchia) inhabit mainly marine and freshwater environments, but some species are terrestrial. In Brazil, marine species were recorded in the north coast of the state of São Paulo, on algae, sand or mud. Freshwater species were found in lentic ecosystems, including rice fields and their canals, or lotic environments of southeastern and/or southern Brazil. Temnocephalids occur only in freshwater environments, with most species recorded in Brazil. They were found in the north, center, southeast and south of Brazil, as ectosymbiotes in turtles, decapods, insects and molluscs (Tables 1 and 5).

Lecithopitheliates may occur in freshwater, terrestrial and marine environments, but they are represented in Brazil by only two freshwater species, *Prorhynchus stagnalis* Schultze, 1851 and *Geocentrophora applanata* (Kennel, 1888). *Prorhynchus stagnalis*, considered worldwide distributed, was recorded in various localities in

southeastern and southern Brazil, whereas *G. applanata* was sampled in two localities of central and southeastern Brazil (Tables 1 and 6).

Prolethophorans inhabit freshwater and marine environments, but they have no records in Brazilian freshwater ecosystems (Vara and Leal-Zanchet, 2013; Braccini and Leal-Zanchet, 2013). The members of this taxon were sampled in marine environments on coastal areas of the state of São Paulo (Table 1). They were found on algae (*Padina* and *Ulva*) or on sandy and rocky coasts (Tables 1 and 6).

Revertospermatids are exclusively marine flatworms. They are represented in Brazil by a single species, *Urastoma cyprinae* (Graff, 1882), found on the coast of the state of São Paulo (Tables 1 and 6). It is a parasite which inhabits the gills of bivalves.

Proseriates may occur in marine and freshwater environments, but almost all Brazilian species were sampled mainly in the north coast of the state of São Paulo (Table 1). They were found mainly in small ponds with high organic matter content. Only *Bothrioplana semperi* Braun, 1881 was sampled in freshwater environments of southeastern and southern Brazil (Table 7).

**Table 2.** Species of Acoela recorded for Brazil, with localities of occurrence and type of environment and/or substratum where the microturbellarians were found.

Species	Locality	Environment	Substratum
<i>Amphiscolops evelinae</i> Marcus, 1947	Santos/SP; Ubatuba/SP	Marine	Among algae
<i>Archaphanostoma marcus</i> Hooge and Rocha, 2006	Ilhabela/SP	Marine	Sand
<i>Avagina marci</i> Dörjes e Karling, 1975	São Sebastião/SP; Ilhabela/SP	Marine	Sand
<i>Childia etium</i> (Marcus, 1954)	São Sebastião/SP	Marine	Coarse sand
<i>Childia groenlandica</i> (Levinsen, 1879)	Bertioga/SP	Mangrove	Mud
<i>Childia westbladi</i> (Marcus, 1950)	Santos/SP; São Sebastião/SP	Marine	Among algae
<i>Convoluta henseni</i> Bohmig, 1895	Cananéia/SP; São Sebastião/SP	Marine	*
<i>Deuteronaria thauma</i> (Marcus, 1952)	Santos/SP; São Sebastião/SP		Among algae
<i>Eumecynostomum evelinae</i> (Marcus, 1948)	Guarujá/SP; Santos/SP; São Sebastião/SP	Marine	Among <i>Ulva</i> and Enteromorpha/ mud
<i>Faerlea antora</i> Marcus, 1952	São Sebastião/SP	Marine	Mud
<i>Haplocelis dichona</i> (Marcus, 1954)	São Sebastião/SP	Marine	Sand
<i>Haplogonaria pellita</i> (Marcus, 1951)	São Sebastião/SP	Marine	Fine sand
<i>Haplogonaria sophiae</i> Hooge and Rocha, 2006	São Sebastião/SP	Marine	Muddy sand
<i>Haploposthia microphoca</i> Marcus, 1950	São Sebastião/SP	Marine	Among algae
<i>Heterochaerus carvalhoi</i> (Marcus, 1952)	Santos/SP	Brackish water	Muddy sand
<i>Heterochaerus sargassi</i> (Hyman, 1939)	São Sebastião/SP	Marine	Among algae <i>Sargassum</i> sp./ on rock coasts
<i>Isodiametra divae</i> (Marcus, 1950)	São Sebastião/SP; Ilhabela/SP	Marine	Muddy sand/coarse sand
<i>Isodiametra westbladi</i> (Marcus, 1949)	Santos/SP; São Sebastião/SP; Ubatuba/SP; Caraguatatuba/SP; Ilhabela/SP	Marine	Sand
<i>Isodiametra vexillaria</i> (Marcus, 1948)	Santos/SP; São Sebastião/SP; Ilha das Palmas/SP	Marine	Sand
<i>Kuma albiventer</i> (Marcus, 1954)	São Sebastião/SP	Marine	Muddy sand
<i>Kuma asilhas</i> Hooge and Rocha, 2006	São Sebastião/SP	Marine	Sand
<i>Kuma belca</i> Marcus, 1952	Ubatuba/SP	Marine	Sand
<i>Kuma brevicauda</i> Marcus, 1950	Cananéia/SP	Marine	Muddy sand
<i>Mecynostomum tenuissimum</i> (Westblad, 1946)	São Sebastião/SP	Marine	Mud
<i>Nadina evelinae</i> (Marcus, 1952)	São Sebastião/SP	Marine	Among algae
<i>Otocelis erinae</i> Hooge and Rocha, 2006	São Sebastião/SP; Ilhabela/SP	Marine	Fine sand
<i>Paraproporus xanthus</i> Marcus, 1950	São Sebastião/SP	Marine	Mud
<i>Paratomella rubra</i> Rieger and Ott, 1971	São Sebastião/SP	Marine	Fine sand

\*Planctonic organism.



Table 2. Continued...

Species	Locality	Environment	Substratum
<i>Philactinoposthia coneyi</i> Hooge and Rocha, 2006	Ilhabela/SP	Marine	Sand
<i>Philactinoposthia stylifera</i> (Westblad, 1946)	São Sebastião/SP	Marine	Sand
<i>Philocelis robochaei</i> Hooge and Rocha, 2006	Ilhabela/SP	Marine	Sand
<i>Pseudactinoposthia daena</i> (Marcus, 1954)	Itanhaém/SP	Mangrove	Mud
<i>Pseudanaperus tinctus</i> (Marcus, 1952)	São Sebastião/SP	Marine	Among algae
<i>Pseudaphanostoma divae</i> Marcus, 1952	Ubatuba/SP; São Sebastião/SP	Marine	Sand
<i>Pseudaphanostoma herringi</i> Hooge and Rocha, 2006	Ilhabela/SP	Marine	Sand
<i>Pseudokuma orphinum</i> (Marcus, 1950)	São Sebastião/SP	Marine	Among <i>Sargassum stenophyllum</i> on rock coasts

\*Planctonic organism.

Table 3. Species of Catenulida recorded for Brazil, with localities of occurrence and type of environment and/or substratum where the microturbellarians were found.

Species	Locality	Environment	Substratum
<i>Catenula alitha</i> Marcus, 1945	São Paulo/SP; Paraná/PR	Freshwater (lentic)	-
<i>Catenula evelinae</i> (Marcus, 1945)	São Paulo/SP	Freshwater (lentic)	-
<i>Catenula lemnae</i> Duges, 1832	São Paulo/SP; Paraná/PR; São Leopoldo/RS; Santo Antônio da Patrulha/RS; Terra de Areia/RS; Osório/RS; Capivari do Sul/RS; Balneário Pinhal/RS; Tramandaí/RS; Cachoeirinha/RS; Santo Antônio da Patrulha/RS; Camaquã/RS	Freshwater (lentic)	Sand and mud/ on macrophyte roots
<i>Catenula leuca</i> Marcus, 1945	São Paulo/SP	Freshwater (lentic)	-
<i>Catenula macrura</i> Marcus, 1945	São Paulo/SP	Freshwater (lentic)	-
<i>Catenula sawayai</i> (Marcus, 1945)	São Paulo/SP; Paraná/PR	Freshwater (lentic and lotic)	-
<i>Catenula turgida</i> (Zacharias, 1902)	São Paulo/SP	Freshwater (lentic)	-
<i>Chordarium cryptum</i> Marcus, 1945	São Paulo/SP	Freshwater (lentic)	-
<i>Chordarium evelinae</i> Marcus, 1945	São Paulo/SP; Paraná/PR	Freshwater (lentic)	-
<i>Chordarium leucanthum</i> Marcus, 1945	São Paulo/SP; Paraná/PR; Santo Antônio da Patrulha/RS	Freshwater (lentic)	Mud
<i>Chordarium philum</i> Marcus, 1945	São Paulo/SP	Freshwater (lentic)	-

- No information.

Table 3. Continued...

Species	Locality	Environment	Substratum
<i>Dasyhormus lasius</i> Marcus, 1945	São Paulo/SP; Paraná/PR	Freshwater (lentic)	-
<i>Dasyhormus lithophorus</i> Marcus, 1945	São Paulo/SP; Paraná/PR; Santo Antônio da Patrulha/RS; Camaquã/RS	Freshwater (lentic)	Mud
<i>Myostenostomum tauricum</i> Nasonov, 1924	São Paulo/SP; Cachoeirinha/RS; Santo Antônio da Patrulha/RS; Camaquã/RS	Humid terrestrial environment/ Freshwater (lentic)	Mud
<i>Rhynchoscolex evelinae</i> Marcus, 1945	São Paulo/SP	Freshwater (lentic and lotic)	On humid macrophyte leaves ( <i>Dumortiera</i> sp.)
<i>Rhynchoscolex nanus</i> Marcus, 1945	São Paulo/SP; Curitiba/PR; Santo Antônio da Patrulha/RS; Camaquã/RS	Freshwater (lentic)	Mud
<i>Rhynchoscolex platypus</i> Marcus, 1945	São Paulo/SP; Santo Antônio da Patrulha/RS	Freshwater (lentic)	Mud
<i>Rhynchoscolex pusillus</i> Marcus, 1945	São Paulo/SP	Freshwater (lentic)	Mud
<i>Rhynchoscolex simplex</i> Leidy, 1851	São Paulo/SP; Terra de Areia/RS; Osório/RS; Capivari do Sul/RS; Tramandaí/RS; Cachoeirinha/RS; Santo Antônio da Patrulha/RS; Camaquã/RS	Humid terrestrial environment/ Freshwater (lentic)	Sand/ mud
<i>Stenostomum anatirostrum</i> Marcus, 1945	São Paulo/SP; Santo Antônio da Patrulha/RS; Camaquã/RS	Freshwater (lentic and lotic)	Mud
<i>Stenostomum arevaloi</i> Gieysztor, 1931	São Paulo/SP; Cachoeirinha/RS; Santo Antônio da Patrulha/RS; Camaquã/RS	Humid terrestrial environment/ Freshwater (lentic)	Mud
<i>Stenostomum amphotum</i> Marcus, 1945	São Paulo/SP; Capivari do Sul/RS; Cachoeirinha/RS; Santo Antônio da Patrulha/RS; Camaquã/RS	Humid terrestrial environment/ Freshwater (lentic)	Mud
<i>Stenostomum bicaudatum</i> Kennel, 1888	São Paulo/SP; São Leopoldo/RS; Novo Hamburgo/RS; Nova Tramandaí/RS; Santo Antônio da Patrulha/RS; Terra de Areia/RS; Osório/RS; Capivari do Sul/RS; Cachoeirinha/RS; Santo Antônio da Patrulha/RS; Camaquã/RS	Humid terrestrial environment/ Freshwater (lentic)	Mud and sand/ on macrophyte roots
<i>Stenostomum ciliatum</i> Kepner and Carter, 1931	São Paulo/SP; Paraná/PR; Cachoeirinha/RS; Santo Antônio da Patrulha/RS; Camaquã/RS	Humid terrestrial environment/ Freshwater (lentic)	Mud
<i>Stenostomum corderoi</i> Marcus, 1945	São Paulo/SP	Freshwater (lentic)	-
<i>Stenostomum cryptops</i> Nuttycombe and Waters, 1935	São Paulo/SP	Freshwater (lentic)	Bromeliaceae
<i>Stenostomum glandulosum</i> Kepner and Carter, 1931	São Paulo/SP; Curitiba/PR; Cachoeirinha/RS.	Freshwater (lentic)	Mud

- No information.

Table 3. Continued...

Species	Locality	Environment	Substratum
<i>Stenostomum grande</i> Child, 1902	São Paulo/SP; Curitiba/PR; São Leopoldo/RS; Novo Hamburgo/RS; Terra de Areia/RS; Capivari do Sul/RS; Cachoeirinha/RS; Santo Antônio da Patrulha/RS; Camaquã/RS	Freshwater (lentic)	Mud and sand/ on macrophyte roots
<i>Stenostomum hemisphericum</i> Nasonov, 1924	Belém/PA	Aquarium	-
<i>Stenostomum leucops</i> (Duges, 1828)	São Paulo/SP; São Leopoldo/RS; Novo Hamburgo/RS; Nova Tramandaí/RS; Terra de Areia/RS; Osório/RS; Tramandaí/RS; Balneário Pinhal/RS; Capivari do Sul/RS; Cachoeirinha/RS; Santo Antônio da Patrulha/RS; Camaquã/RS	Humid terrestrial environment/ Freshwater (lentic)	Mud and sand/ on macrophyte roots
<i>Stenostomum materazzoii</i> Marcus, 1949	São Paulo/SP	Freshwater (lentic)	Dry pools
<i>Stenostomum membranosum</i> Kepner and Carter, 1931	São Paulo/SP; Cachoeirinha/RS	Freshwater (lentic)	Mud
<i>Stenostomum paraguayense</i> (Martin, 1908)	São Paulo/SP; Cachoeirinha/RS; Cachoeirinha/RS; Santo Antônio da Patrulha/RS; Camaquã/RS	Humid terrestrial environment/ Freshwater (lentic)	Mud
<i>Stenostomum pegephilum</i> (Nuttymcombe and Waters, 1938)	São Paulo/SP	Freshwater (lotic)	-
<i>Stenostomum pseudoacetabulum</i> Nuttycombe and Waters, 1938	São Paulo/SP; Cachoeirinha/RS; Santo Antônio da Patrulha/RS; Camaquã/RS	Freshwater (lentic)	Mud
<i>Stenostomum rosulatum</i> Marcus, 1945	São Paulo/SP	Freshwater (lentic)	Mud
<i>Stenostomum saliens</i> Kepner and Carter, 1931	São Paulo/SP; Curitiba/PR; Caiobá/PR; Cachoeirinha/RS; Camaquã/RS	Freshwater (lentic)	Mud
<i>Stenostomum simplex</i> Kepner and Carter, 1931	São Paulo/SP	Freshwater (lentic)	Mud
<i>Stenostomum tuberculosum</i> Nuttycombe and Waters, 1938	São Paulo/SP; Campinas/SP; Cachoeirinha/RS; Santo Antônio da Patrulha/RS; Camaquã/RS	Freshwater (lentic and lotic)	Mud
<i>Stenostomum uronephrium</i> Nuttycombe, 1931	São Paulo/SP; Cachoeirinha/RS	Freshwater (lentic)	Mud
<i>Stenostomum ventronephrium</i> Nuttycombe, 1932	São Paulo/SP	Freshwater (lentic)	-
<i>Stenostomum virginianum</i> Nuttycombe, 1931	São Paulo/SP; Santa Rita do Passa Quatro/SP; Paraná/PR	Humid terrestrial environment/ Freshwater (lentic)	On humid leaves of Bromeliaceae/sand

- No information.



**Table 4.** Species of Macrostromida recorded for Brazil, with localities of occurrence and type of environment and/or substratum where the microturbellarians were found.

Species	Locality	Environment	Substratum
<i>Archimacrostomum brasiliensis</i> (Marcus, 1952)	Caraguatatuba/SP; São Sebastião/SP	Marine	Humid sand
<i>Archimacrostomum beaufortense</i> (Ferguson, 1937)	Santos/SP; São Vicente/SP; Ilha das Palmas/SP	Marine	Among algae
<i>Austromacrostomum mortenseni</i> (Marcus, 1950)	São Sebastião/SP	Marine	Coarse sand with <i>Padina</i> sp. and other algae
<i>Karlingia lutheri</i> (Marcus, 1948)	Guarujá/SP; Santos/SP	Marine	Coarse sand with shell fragments
<i>Macrostomum appendiculatum</i> Fabricius, 1826	São Sebastião/SP; Caraguatatuba/SP	Mangrove	Mud
<i>Macrostomum delphax</i> Marcus, 1946	São Paulo/SP; Terra de Areia/RS	Freshwater (lentic)	On macrophyte ( <i>Eichhornia crassipes</i> ) roots
<i>Macrostomum evelinae</i> Marcus, 1946	São Sebastião/SP	Marine	Sand
<i>Macrostomum johni</i> Young, 1972	Santo Antônio da Patrulha/RS; Osório/RS; Terra de Areia/RS; Capivari do Sul/RS; Cachoeirinha/RS; Santo Antônio da Patrulha/RS	Freshwater (lentic)	Mud and sand/ on macrophyte roots
<i>Macrostomum tuba</i> Graff, 1882	São Paulo/SP; São Leopoldo/RS; Nova Petrópolis/RS; Terra de Areia/RS; Osório/RS; Balneário Pinhal/RS; Cachoeirinha/RS; Santo Antônio da Patrulha/RS; Camaquã/RS	Freshwater (lentic)	Mud and sand/ on macrophyte roots
<i>Macrostomum phocurum</i> Marcus, 1954	São Sebastião/SP;	Mangrove	Mud
<i>Microstomum gabriellae</i> Marcus, 1950	São Sebastião/SP	Marine	Among algae ( <i>Sargassum</i> sp.) on rocky coast
<i>Microstomum lineare</i> (Müller OF, 1773)	Terra de Areia/RS; Osório/RS; Tramandaí/RS; Capivari do Sul/RS; Cachoeirinha/RS; Santo Antônio da Patrulha/RS; Camaquã/RS	Freshwater (lentic)	Mud and sand/ on macrophyte roots
<i>Microstomum trichotum</i> Marcus, 1950	São Sebastião/SP	Marine	Among calcareous algae
<i>Microstomum ulum</i> Marcus, 1950	São Sebastião/SP	Marine	Coarse sand with algae ( <i>Padina</i> sp.)
<i>Microstomum breviceps</i> Marcus, 1951	São Sebastião/SP	Marine	Among algae ( <i>Sargassum</i> sp.) on rocky coast
<i>Microstomum rhabdotum</i> Marcus, 1951	São Sebastião/SP	Marine	Among algae ( <i>Sargassum</i> sp.) on rocky coast
<i>Myozona evelinae</i> Marcus, 1949	São Sebastião/SP	Marine	Fine and coarse sand

**Table 5.** Species of Rhabdoceola recorded for Brazil, with localities of occurrence and type of environment and/or substratum where the microturbellarians were found.

Species	Locality	Environment	Substratum*
<b>Dalatyphloplanida</b>			
<i>Anoplodium evelinae</i> Marcus, 1949	Santos/SP; São Sebastião/SP	Marine	Holoturoidea
<i>Artinga evelinae</i> Marcus, 1948	Santos/SP; Guarujá/SP	Marine	Among algae
<i>Baicalellia evelinae</i> Marcus, 1946	São Paulo/SP; Umuarama/SP; Campos do Jordão/SP	Freshwater (lentic)	Sand
<i>Brinkmanniella augusti</i> Marcus, 1951	São Sebastião/SP	Marine	Among algae
<i>Bothromesostoma evelinae</i> Marcus, 1946	São Paulo/SP; Osório/RS; Terra de Areia/RS.	Freshwater (lentic)	Mud
<i>Bothromesostoma personatum</i> (Schmidt, 1848)	Cachoeirinha/RS; Santo Antônio da Patrulha/RS; Camaquã/RS	Freshwater (lentic)	Mud
<i>Byrsophleps lutheri</i> (Marcus, 1952)	Cananéia/SP; São Sebastião/SP; São Vicente/SP	Marine	Among algae
<i>Daelja secuta</i> Marcus, 1951	Cananéia/SP	Marine	Areia lodosa
<i>Gieysztorina acariaia</i> (Marcus, 1946)	São Paulo/SP	Freshwater (lentic)	-
<i>Gieysztorina bellis</i> (Marcus, 1946)	São Paulo/SP	Freshwater (lotic)	On macrophyte roots ( <i>Eichhornia</i> sp.)
<i>Gieysztorina complicata</i> (Fuhrmann, 1912)	Curitiba/PR	Freshwater (lentic)	Mud
<i>Gieysztorina cypris</i> (Marcus, 1946)	São Paulo/SP	Freshwater (lotic)	On macrophytes ( <i>Myriophyllum</i> sp.) and grass
<i>Gieysztorina evelinae</i> (Marcus, 1946)	São Paulo/SP	Freshwater (lentic)	-
<i>Gieysztorina hymanae</i> (Marcus, 1946)	São Paulo/SP	Freshwater (lentic)	-
<i>Gieysztorina intricata</i> (Marcus, 1946)	São Paulo/SP	Freshwater (lentic)	Mud
<i>Gieysztorina ornata</i> (Hofsten N, 1907)	São Paulo/SP; Tramandaí/RS; Osório/RS; Capivari do Sul/RS; Cachoeirinha/RS	Freshwater (lentic)	Mud and sand
<i>Gieysztorina rubra</i> (Fuhrmann, 1894)	Cachoeirinha/RS	Freshwater (lentic)	Mud
<i>Gieysztorina therapaina</i> (Marcus, 1946)	Campos do Jordão/SP	Freshwater (lentic)	On riparian vegetation
<i>Gieysztorina thymara</i> (Marcus, 1946)	São Paulo/SP	Freshwater (lotic)	On macrophytes ( <i>Myriophyllum</i> sp.) and grass
<i>Gieysztorina tridesma</i> (Marcus, 1946)	São Paulo/SP; Tremembé/SP	Freshwater (lentic and lotic)	-
<i>Gieysztorina triquetra</i> (Fuhrmann, 1894)	Terra de Areia/RS	Freshwater (lentic)	Mud/ on macrophytes
<i>Gieysztorina trisolena</i> (Marcus, 1946)	São Paulo/SP; Cachoeirinha/RS	Freshwater (lentic)	Mud
<i>Gieysztorina uncia</i> (Marcus, 1946)	São Paulo/SP	Freshwater (lentic)	-
<i>Gyatrix hermaphroditus</i> Ehrenberg, 1831	São Paulo/SP; Curitiba/PR; Terra de Areia/RS; Balneário Pinhal/RS; Capivari do Sul/RS; Cachoeirinha/RS; Santo Antônio da Patrulha/RS; Camaquã/RS	Freshwater (lentic)	Mud and sand/ on macrophyte roots
<i>Haloplanella ibla</i> Marcus, 1952	São Sebastião/SP	Marine	Among algae
<i>Kalya gabriellae</i> Marcus, 1951	São Vicente/SP; Guarujá/SP	Marine	Sand
<i>Lenopharynx triops</i> Marcus, 1951	São Sebastião/SP	Marine	Among algae
<i>Lurus evelinae</i> Marcus, 1950	Santos/SP	Marine	Fine sand/ in intertidal areas

- No information. \* For temnocephalids, the host organism is indicated.

Table 5. Continued...

Species	Locality	Environment	Substratum*
<i>Microdalyellia sawayai</i> Marcus, 1946	Botucatu/SP; São Paulo/SP	Freshwater (lotic and lentic)	On macrophytes
<i>Memyla phocanella</i> Marcus, 1952	Caraguatatuba/SP	Brackish water (lotic)	Muddy sand
<i>Mesostoma craci</i> Schmidt, 1858	Belo Horizonte/MG	Freshwater (lentic)	-
<i>Mesostoma ehrenbergii</i> (Focke, 1836)	São Paulo/SP; Novo Hamburgo/RS; Nova Tramandaí/RS; Terra de Areia/RS; Osório/RS; Balneário Pinhal/RS; Cachoeirinha/RS; Santo Antônio da Patrulha/RS; Camaquã/RS; Belo Horizonte/MG	Freshwater (lentic)	Mud and sand/ on macrophyte roots and grass
<i>Mesostoma lingua</i> (Abildgaard, 1789)	Osório/RS; Cachoeirinha/RS; Santo Antônio da Patrulha/RS; Camaquã/RS	Freshwater (lentic)	Mud
<i>Mesostoma platycephalum</i> Braun, 1885	Cachoeirinha/RS; Santo Antônio da Patrulha/RS; Camaquã/RS	Freshwater (lentic)	Mud
<i>Mesostoma productum</i> (Schmidt, 1848)	São Leopoldo/RS; Nova Tramandaí/RS; Nova Petrópolis/RS; Terra de Areia/RS; Osório/RS; Capivari do Sul/RS; Camaquã/RS	Freshwater (lentic)	Mud and sand/ on macrophyte roots
<i>Nygulgus evelinae</i> Marcus, 1954	Itanhaém/SP	Freshwater (lentic)	Mud
<i>Olisthanella opistomiformis</i> Nasonov, 1924	São Paulo/SP	Freshwater (lentic)	On macrophytes
<i>Phaenocora bresslaui</i> Marcus, 1946	São Paulo/SP	Freshwater (lentic and lotic)	On macrophyte roots ( <i>Eichhornia crassipes</i> )
<i>Phaenocora chloroxantha</i> Marcus, 1946	São Paulo/SP	Freshwater (lentic and lotic)	On macrophyte roots ( <i>Eichhornia crassipes</i> )
<i>Phaenocora evelinae</i> Marcus, 1946	São Paulo/SP	Freshwater (lentic and lotic)	On macrophyte roots ( <i>Eichhornia crassipes</i> )
<i>Phaenocora typhlops</i> Vejdovsky, 1880	Cachoeirinha/RS	Freshwater (lentic)	Mud
<i>Phaenocora unipunctata</i> (Ørsted, 1843)	Cachoeirinha/RS	Freshwater (lentic)	Mud
<i>Pogaina suslica</i> (Marcus, 1951)	São Sebastião/SP	Marine	Fine sand
<i>Pogaina tifa</i> Marcus, 1954	São Sebastião/SP	Marine	Fine and coarse sand
<i>Promesostoma scylax</i> Marcus, 1952	São Sebastião/SP	Marine	Among algae
<i>Ruanis pandula</i> Marcus, 1952	São Sebastião/SP	Marine	Among algae
<i>Strongylostoma dicorymbum</i> Marcus, 1946	São Paulo/SP	Freshwater (lentic and lotic)	-
<i>Temnocephala axenos</i> Monticelli, 1889	Blumenau/SC; Curitiba/PR; Porto Alegre/RS; Quaraí/RS; Rio Grande/RS	Freshwater	Decapoda
<i>Temnocephala brevicornis</i> Monticelli, 1889	Viçosa/MG; Juiz de Fora/MG; Teresópolis/RJ; Resende/RJ, Angra dos Reis/RJ; Varginha/SP; Santa Tereza/ES; Viamão/RS	Freshwater (lentic)	Pleurodira
<i>Temnocephala caddisflyi</i> Amato, Amato and Seixas, 2011	Jaboticatubas/MG	Freshwater (lotic)	Trichoptera

- No information. \* For temnocephalids, the host organism is indicated.

Table 5. Continued...

Species	Locality	Environment	Substratum*
<i>Temnocephala curvicirri</i> Amato and Amato, 2005	Eldorado do Sul/RS; Viamão/RS	Freshwater (lentic)	Hemiptera
<i>Temnocephala cyanoglandula</i> Amato et al., 2003	Cambará do Sul/RS	Freshwater (lentic)	Decapoda
<i>Temnocephala decarloi</i> Moretto, 1978	Serra do Cipó/MG; Brumadinho/MG	Freshwater (lentic)	Hemiptera
<i>Temnocephala haswelli</i> Ponce de Leon, 1989	Porto Alegre/RS; Guaíba/RS; Eldorado do Sul/RS; Barra do Ribeiro/RS; Maquiné/RS; Tramandaí/RS	Freshwater (lentic and lotic)	Mollusca
<i>Temnocephala iheringi</i> Haswell, 1893	Porto Alegre/RS; Barra do Ribeiro/RS; Santa Vitória do Palmar/RS; Guaíba/RS; Eldorado do Sul/RS; Maquiné/RS; Salobra/MS; Guaicurus/MS	Freshwater (lentic and lotic)	Mollusca
<i>Temnocephala kingsleyae</i> Damborenea, 1994	Pedra do Marcirio/AP	Freshwater (lotic)	Decapoda
<i>Temnocephala lanei</i> Pereira and Cuocolo, 1941	Santana do Riacho/MG; Juquiá/SP	Freshwater (lotic)	Hemiptera
<i>Temnocephala longivaginata</i> Seixas et al., 2011	Peixe Boi/PA	Freshwater (lotic)	Decapoda
<i>Temnocephala luzi</i> Monticelli, 1913	Guaíba/RS; Porto Alegre/RS; Maquiné/RS; São José dos Ausentes/RS; Rio Negro/AM; Lago do Prato/AM; Arquipélago das Anavilhanas/AM; Cachoeira Grande/AM Piracicaba/SP; Rio Amapá Grande/AP	Freshwater (lentic and lotic)	Decapoda
<i>Temnocephala microdactyla</i> Monticelli, 1903	MG	Freshwater (lotic)	Decapoda
<i>Temnocephala minutocirrus</i> Amato et al., 2007	Maquiné/RS; São José dos Ausentes/RS	Freshwater (lotic)	Hemiptera
<i>Temnocephala pereirai</i> Volonterio, 2010	Capão do Leão/RS	Freshwater (lentic)	Pleurodira
<i>Temnocephala pignalberiae</i> Dioni, 1967	Poconé/MT; Cuiabá/MT; Bebedouro/SP	Freshwater (lentic and lotic)	Decapoda
<i>Temnocephala rochensis</i> Ponce de Leon, 1979	Santa Vitória do Palmar/RS; Jaguarão/RS; São Lourenço do Sul/RS	Freshwater (lentic and lotic)	Mollusca
<i>Temnocephala trapeziformis</i> Amato et al., 2006	Maquiné/RS; São José dos Ausentes/RS	Freshwater (lotic)	Decapoda
<i>Temnocephala travassosfillioi</i> Pereira and Cuocolo, 1941	Serra da Cantareira/SP; São Bernardo do Cipó/SP	Freshwater (lotic)	Decapoda
<i>Trigonostomum lilliei</i> (Graff, 1911)	Santos/SP; São Vicente/SP	Marine	Among green algae
<i>Trisaccopharynx pusa</i> (Marcus, 1952)	São Sebastião/SP	Marine	Among algae
<b>Kalyptorhynchia</b>			
<i>Alcha evelinae</i> Marcus, 1949	Santos/SP; São Sebastião/SP	Marine	Among algae
<i>Carcharodorhynchus brasiliensis</i> Reygel, Schockaert and Artois, 2014	São Sebastião/SP	Marine	Sand
<i>Cheliplana asica</i> Marcus, 1952	Cananéia/SP; Caraguatatuba/SP	Brackish water	Sand/ mud
<i>Cheliplana targa</i> (Marcus, 1952)	Santos/SP	Marine	Fine sand

- No information. \* For temnocephalids, the host organism is indicated.

Table 5. Continued...

Species	Locality	Environment	Substratum*
<i>Harsa obnixa</i> Marcus, 1951	Cananéia/SP; Caraguatatuba/SP; São Sebastião/SP	Freshwater (lotic) and brackish water	Sand/ mud
<i>Itaipusa divae</i> Marcus, 1949	Santos/SP; Praia Grande/SP	Marine	Sand/ on algae
<i>Itaipusa evelinae</i> (Marcus, 1954)	São Sebastião/SP; Santos/SP	Marine	Coarse sand with algae
<i>Oneppus timius</i> Marcus, 1952	Caraguatatuba/SP; São Sebastião/SP	Marine	Sand/ mud
<i>Oneppus lacus</i> Marcus, 1954	Itanhaém/SP	Marine	Mud
<i>Opisthocystis goettei</i> (Bresslau, 1906)	Cachoeirinha/RS; Santo Antônio da Patrulha/RS; Camaquã/RS	Freshwater (lentic)	Mud
<i>Paulodora felis</i> (Marcus, 1954)	São Sebastião/SP	Marine	Coarse sand
<i>Paulodora fredelyna</i> (Marcus, 1948)	Santos/SP	Marine	Among green algae
<i>Paulodora matarazzoii</i> Marcus, 1948	Santos/SP	Marine	Among green algae
<i>Paraustorhynchus elixus</i> (Marcus, 1954)	Santos/SP; São Sebastião/SP	Marine	Coarse sand
<i>Polycystis gabriellae</i> (Marcus, 1948)	Santos/SP; Guarujá/SP	Marine	Among green algae
<i>Proschizorhynchella atopus</i> (Marcus, 1950)	São Sebastião/SP	Marine	Fine sand
<i>Rhinolasius sartus</i> Marcus, 1951	Cananéia/SP	Freshwater (lentic)/ brackish water	Sand
<i>Schizorhynchoides martae</i> Marcus, 1950	Cananéia/SP	Brackish	Sand/ mud
<i>Toia ycia</i> Marcus, 1952	São Sebastião/SP	Marine	Among algae
<i>Trapichorhynchus tapes</i> Marcus, 1949	Santos/SP; São Sebastião/SP	Marine	Coarse sand
<i>Utelga deina</i> Marcus, 1949	Santos/SP	Marine	Among green algae

- No information. \* For temnocephalids, the host organism is indicated.

Table 6. Species of Prolecithophora, Lecithoepitheliata and Revertospermata recorded for Brazil, with localities of occurrence and type of environment and/or substratum where the microturbellarians were found.

Species	Locality	Environment	Substratum
<b>Lecithoepitheliata</b>			
<i>Geocentrophora applanata</i> (Kennel, 1888)	Campinas/SP; Caiobá/PR	Humid terrestrial environment/ Freshwater (lotic)	In Bromeliaceae
<i>Prorhynchus stagnalis</i> Schultze, 1851	Curitiba/PR; São Paulo/SP; Terra de Areia/RS; Osório/RS; Capivari do Sul/RS; Balneário Pinhal/RS; Tramandaí/RS; Cachoeirinha/RS; Santo Antônio da Patrulha/RS; Camaquã/RS	Freshwater (lentic)	Mud and sand/on macrophyte roots
<b>Prolecithophora</b>			
<i>Acmostomum canarium</i> Marcus, 1947	Santos/SP	Marine	Among algae
<i>Cylindrostoma netsicum</i> Marcus, 1950	São Sebastião/SP	Marine	Among algae ( <i>Sargassum</i> sp.)
<i>Cylindrostoma ibeenum</i> Marcus, 1950	São Sebastião/SP	Marine	Among algae
<i>Cylindrostoma monotrochum</i> (Graff, 1882)	São Sebastião/SP	Marine	Coarse sand with <i>Padina</i> sp. and other algae
<i>Cylindrostoma hyljeum</i> Marcus, 1952	São Sebastião/SP	Marine	Among algae

- No information.

**Table 6.** Continued...

Species	Locality	Environment	Substratum
<i>Einarhelmis musta</i> (Marcus, 1952)	Ubatuba/SP	Marine	Among algae and bryozoans
<i>Monoophorum tigacum</i> Marcus, 1950	São Sebastião/SP	Marine	Among algae
<i>Plagiostomum acoluthum</i> Marcus, 1948	Santos/SP	Marine	Among algae
<i>Plagiostomum autectum</i> Marcus, 1948	Santos/SP	Marine	Among algae
<i>Plagiostomum clusum</i> Marcus, 1951	São Sebastião/SP	Marine	Coarse sand/
<i>Plagiostomum elachisterum</i> (Marcus, 1948)	Guarujá/SP; Santos/SP	Marine	Among algae
<i>Plagiostomum evelinae</i> Marcus, 1946	São Paulo/SP	Freshwater (lotic and lentic)	-
<i>Plagiostomum girardi girardi</i> Westblad, 1956	Guarujá/SP; Santos/SP	Marine	Among algae
<i>Plagiostomum kurrum</i> Marcus, 1951	São Sebastião/SP	Marine	Among algae
<i>Plagiostomum lapinum</i> Marcus, 1952	Caraguatatuba/SP; São Sebastião/SP	Marine	Among algae
<i>Plagiostomum nonatoi</i> Marcus, 1948	Santos/SP; São Vicente/SP	Marine	Among green algae ( <i>Ulva</i> sp.) on rocky coast
<i>Plagiostomum remanei</i> Marcus, 1954	São Sebastião/SP	Marine	Coarse sand with <i>Padina</i> sp.
<i>Plagiostomum sagax</i> Marcus, 1951	São Sebastião/SP	Marine	Coarse sand with <i>Padina</i> sp.
<i>Plagiostomum thelotrichum</i> Marcus, 1951	Santos/SP	Marine	Among algae
<i>Plicastoma astrum</i> Marcus, 1947	Santos/SP	Marine	Sand
<i>Plicastoma carvalhoi</i> Marcus, 1947	Santos/SP	Marine	Among algae
<i>Plicastoma phocae</i> Marcus, 1947	Santos/SP	Marine	Among algae
<i>Puzostoma evelinae</i> Marcus, 1950	Santos/SP; São Sebastião/SP	Marine	Among algae
<i>Rosmarium evelinae</i> Marcus, 1950	São Sebastião/SP	Marine	Among algae
<i>Thalagus divae</i> Marcus, 1951	São Sebastião/SP	Marine	Coarse sand
<i>Tuilica evelina</i> Marcus, 1951	São Sebastião/SP	Marine	Among algae
<i>Vorticeros cyrtum</i> Marcus, 1947	Santos/SP	Marine	Among algae
<b>Revertospermata</b>			
<i>Urastoma cyprinae</i> (Graff, 1882)	São Sebastião/SP	Marine	Among algae, parasiting a bivalve

- No information.

**Table 7.** Species of Proseriata recorded for Brazil, with localities of occurrence and type of environment and/or substratum where the microturbellarians were found.

Species	Locality	Environment	Substratum
<i>Bothrioplana semperi</i> Braun, 1881	São Paulo/SP; Santo Antônio da Patrulha/RS; Camaquã/RS	Freshwater (lentic)	Water with high organic matter content/ mud
<i>Duplominona mica</i> (Marcus, 1951)	São Sebastião/SP	Marine	Sand
<i>Duplominona tridens</i> (Marcus, 1954)	São Sebastião/SP	Marine	Coarse sand with <i>Padina</i> sp.
<i>Inaloea scalopura</i> (Marcus, 1949)	São Sebastião/SP; São Vicente/SP	Freshwater (lotic) and marine	Sand



Table 7. Continued...

Species	Locality	Environment	Substratum
<i>Itaspis evelinae</i> Marcus, 1952	Ubatuba/SP	Marine	Coarse or medium sand
<i>Kata evelinae</i> Marcus, 1949	São Sebastião/SP	Marine	Sand
<i>Kata leroda</i> Marcus, 1950	São Sebastião/SP	Marine	Fine sand
<i>Meidiama lutheri</i> Marcus, 1946	Guarujá/SP		Water with shell fragments
<i>Mesoda gabriellae</i> Marcus, 1949	São Sebastião/SP	Freshwater (lotic) and marine	Sand
<i>Mesoda thelura</i> (Marcus, 1951)	São Sebastião/SP	Marine	Fine sand
<i>Minona divae</i> Marcus, 1951	Rio de Janeiro/RJ	Marine	Fine sand with shell fragments
<i>Minona evelinae</i> Marcus, 1946	Guarujá/SP	Marine	Sand with shell fragments
<i>Monocelis tabira</i> Marcus, 1950	Santos/SP; São Sebastião/SP; Rio de Janeiro/RJ	Marine	Fine sand
<i>Necia sophia</i> Marcus, 1950	Santos/SP; São Sebastião/SP	Marine	Among algae
<i>Nematoplana asita</i> Marcus, 1950	São Sebastião/SP	Marine	Sand
<i>Nematoplana naia</i> Marcus, 1949	Santos/SP	Marine	Coarse sand
<i>Parotoplana moya</i> Marcus, 1949	São Sebastião/SP	Marine	Coarse sand
<i>Peraclistus itaipus</i> Marcus, 1950	Santos/SP	Marine	In tubes of Terebellidae
<i>Philosyrtis eumeca</i> Marcus, 1950	Santos/SP	Marine	Fine sand with shell fragments
<i>Promonotus erinaceus</i> Marcus, 1950	São Sebastião/SP	Marine	Sand on a river mouth
<i>Promonotus villacae</i> Marcus, 1949	São Vicente/SP	Freshwater (lotic) and brackish water	Sand/ mud
<i>Tabaota curiosa</i> Marcus, 1950	São Sebastião/SP	Marine	Medium sand
<i>Togarma evelinae</i> Marcus, 1949	São Sebastião/SP	Marine	Coarse sand
<i>Vannuccia martae</i> Marcus, 1948	Guarujá/SP	Marine	Sand with shell fragments
<i>Vannuccia talea</i> Marcus, 1954	São Sebastião/SP	Marine	Coarse sand in the intertidal zone

#### 4. Discussion and Conclusions

Just three Brazilian states, located in southeastern and southern Brazil, concentrate 94% of the microturbellarian species recorded for the country. Two of them, São Paulo and Rio Grande do Sul, house research groups on turbellarians, clearly reflecting the scientific activity over many years or decades.

Most marine microturbellarian diversity is known only in a small portion of the Warm Temperate Southwestern Atlantic, since the marine microturbellarian groups were almost exclusively studied in a small part of the northern littoral of the state of São Paulo (Marcus, 1948, 1949, 1950, 1952; Hooge and Rocha, 2006). Just scattered

records exist for the Tropical Southwestern Atlantic and Northern Brazil Shelf.

From twelve hydrographic regions, only the South Atlantic and Southern Atlantic regions have more than just occasional records of microturbellarians. Such records were mainly distributed among São Paulo, Rio Grande do Sul and Paraná (Marcus, 1943, 1944, 1945a, 1951, 1954; Gamo and Leal-Zanchet, 2004; Vara and Leal-Zanchet, 2013; Braccini and Leal-Zanchet, 2013). Considering the freshwater groups, the temnocephalids certainly constitute an exception, with species recorded for various regions in Brazil (Monticelli, 1899; Pereira and Cuocolo, 1940, 1941; Ferreira Yuki et al., 1993; Damborenea, 1994; Ernst and Lovich, 1996; Vianna and Melo, 2002; Amato et al., 2003,

2005, 2006, 2007, 2010, 2011; Amato and Amato, 2005; Seixas et al., 2010a, b, c, 2011, 2014). Microturbellarians occurring in terrestrial environments were known only by occasional records in the state of São Paulo (Marcus, 1945b). Considering the six Brazilian biomes, only a small part of the Atlantic Forest, mainly the one located in Southern and Southeastern regions, have records of microturbellarians. Scattered or no records were done for the Amazonian, Caatinga, Savanna, Pampa and Pantanal biomes.

In addition to taxonomical studies, freshwater microturbellarian diversity was also investigated through recent inventories and studies on community structure done in the state of Rio Grande do Sul (Gamo and Leal-Zanchet, 2004; Braccini and Leal-Zanchet, 2013; Vara and Leal-Zanchet, 2013). In these studies, many unidentified species of catenulids, lecithopithelates, macrostomids and rhabdocoels, among others, were recorded in agroecosystems and natural lentic environments of southern Brazil (Braccini and Leal-Zanchet, 2013; Vara and Leal-Zanchet, 2013). Thus, it is almost unnecessary to emphasize that the known microturbellarian diversity in Brazil represents only a very small part of the existing biodiversity.

Considering the scant information on the taxonomy and biogeography on Brazilian microturbellarians, which is also the situation of the Neotropical microturbellarians in general, some actions should be proposed. First, it would be necessary to sample in the diverse biomes, as well as in the various river and sea basins, following standardized sampling protocols, as for example, the guidelines of the Rapid Assessment Program, in order to quickly generate data about the local and regional diversity (Alonso et al., 2011). Second, it would be necessary to encourage diverse research groups to include microturbellarians and/or turbellarians in general in biodiversity inventories and studies on community structure of invertebrates. Third, it is necessary to increase the number of research groups on microturbellarians, in order to augment the studies on their morphology, systematic, and ecology.

There are, however, some problems for the inclusion of microturbellarians in ample biodiversity inventories. Microturbellarians should be sorted alive under the stereomicroscope and analyzed under the microscope to study their morphology with identification purposes (Young, 2001; Brusa et al., 2003). Thus, some adjustments in the sampling procedures used for other invertebrates are needed, such as the collection of water for sorting the live microturbellarians at the laboratory. Another problem is concerned with the identification of microturbellarians, because for the same reason mentioned above, it would be difficult to send live specimens for the identification at species level by specialists.

Besides the abundance and species richness of microturbellarians in freshwater and marine ecosystems, these organisms may feed on a wide range of benthic and planctonic invertebrates, such as oligochaetes, rotifers, cladocerans, copepods and nematodes, among other organisms including bacteria, algae and protozoans (Young, 2001). Thus, considering their abundance, species richness

and ecological importance in aquatic environments, the challenge to study these organisms and enhance their knowledge in Brazilian ecosystems should be faced.

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