OCCURRENCE OF Oligochaeta species (Annelida: Clitellata) IN RIVERS IN THE STATE OF SÃO PAULO (BRAZIL)

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PALAVRAS-CHAVE

Classe Oligochaeta
Corpos hídricos
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KEYWORDS

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Species Record
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RESUMO: O conhecimento da diversidade e distribuição da fauna em ecossistemas tropicais de água doce é de extrema importância ecológica, contudo estudos sobre essa temática ainda são escassos. Organismos pertencentes à Classe Oligochaeta são considerados bioindicadores importantes para análise da qualidade ambiental em ecossistemas aquáticos, porém o conhecimento detalhado sobre esses organismos é insuficiente. Este estudo teve como objetivo promover uma lista de ocorrência de espécies Oligochaeta em oito rios do Estado de São Paulo (Brasil), com o intuito de ampliar o catálogo de espécies e identificar sua relação com o estado trófico dos ambientes amostrados. As amostras foram coletadas pela Companhia Ambiental do Estado de São Paulo (CETESB) no período de 2014 a 2016 e incluem áreas com diferentes usos do solo, variando entre áreas de conservação, agropecuária e industrial. Para avaliar a eficiência das amostras coletadas nos rios foi utilizado o estimador de riqueza de espécies (Bootstrap) e curvas de acumulação de espécies randomizadas (curva do coletor). Os rios foram classificados de acordo com seu estado trófico variando de oligotrófico a hiper-eutrófico. Como resultado, identificamos um total de 7.398 oligoquetos distribuídos em 25 táxons, os quais pertencem às famílias: Alluroididae, Naididae e Opistocystidae. A espécie mais frequente registrada nesta pesquisa, presente em seis dos oito rios amostrados foi Bothrioneurum sp., seguida de Pristina synclites registrada em sete dos oito rios amostrados.

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ABSTRACT: The knowledge about the diversity and fauna distribution in tropical freshwater ecosystems is of extreme ecological importance, however studies on this theme are still scarce. Organisms belonging to the Oligochaeta Class are considered important bioindicators for environmental quality analysis, but detailed knowledge about these organisms is still insufficient. This study aims to investigate the occurrence of oligochaeta species in eight rivers of the State of São Paulo (Brazil), to expand the species catalogue and identify their relationship with the trophic state of sampled environments. The samples were collected by the Environmental Company of the State of São Paulo (CETESB) from 2014 to 2016 and include areas with different land uses, ranging from conservation, agricultural and industrial. We used species richness estimator (Bootstrap) and accumulation curves of randomized species (collector curve), to evaluate the efficiency of samples collected. Rivers were classified according to the trophic state, ranging from oligotrophic to hypereutrophic. As a result, we identified a total of 7,398 oligochaetes distributed in 25 taxa, which belong to the families: Alluroididae, Naididae and Opistocystidae. The most frequent species registered in this research, present in seven of the eight sampled rivers, was Bothrioneurum sp., followed by Pristina synclites registered in six of the eight sampled rivers.
INTRODUCTION

The knowledge about the diversity and fauna distribution in tropical freshwater ecosystems still presents gaps, despite the importance of these groups in processes of biomonitoring of environmental quality (HARPER, 1992). One of the most common and abundant groups in the benthic community is oligochaetes, which generally has a wide geographic distribution and can reach numerous populations (WETZEL, 1992; BRINKHURST; JAMIESON, 1971). In addition, oligochaetes are recognized as bioindicators of water and sediment quality, because they are sensitive to chemical pollution and eutrophication (MASSON et al. 2010).

Currently, environmental monitoring programs such as the Environmental Company of the State of São Paulo (CETESB), use the calculation of the Trophic State Index (TSI; LAMPARELLI, 2004) to evaluate the water quality in relation to nutrient enrichment. Thus, considering the degree of trophy, water bodies can be classified as: oligotrophic, mesotrophic, eutrophic and hypertrophic (CETESB, 2019).

In Brazil, we still know little about the actual number of species of the Oligochaeta Class in the continental systems. This scarcity of information occurs due to some factors, such as the large number of River basins not yet inventoried; the lack of researchers and adequate infrastructure to carry out the samplings; the loss of information that is often not available and the need for a taxonomic review for various oligochaete groups (AGOSTINHO; THOMAZ; GOMES, 2005).

Many authors carry out research on the diversity and ecology of benthic macroinvertebrates and oligochaeta in Brazilian Rivers and Lakes (TRIVINHO-STRIXINO; CORREIA; SONODA, 2000; CORBI et al., 2004; PAMPLIN; ROCHA; MARCHESE, 2005; GORNİ, 2007; BEHREND et al., 2012; SALES et al., 2014; SANCHES et al., 2016; AMO et al., 2017; GOMES et al., 2017; TAKEDA et al., 2017; GORNİ et al., 2018), Reservoirs (DORNFELD et al., 2006; JORCIN; NOGUEIRA, 2008; MOLOZZI et al., 2011; GIROLLI et al., 2018; GIROLLI, 2019; GIROLLI et al., 2020) and conservation areas (GORNİ, 2007; ALVES; MARCHESE; MARTINS, 2008; GORNİ; ALVES, 2008; SANCHES et al., 2021).

Studies concerning taxonomy and faunal survey present important information about the biodiversity of each group, as well increase the knowledge about their distribution and habitat preference. Ecological information is used in the development of environmental monitoring and biodiversity conservation programs (AGOSTINHO; THOMAZ; GOMES, 2005). In the case of the Oligochaeta assemblages, the studies are still insufficient (SILVA, 2017; GORNİ; ALVES, 2008). Despite efforts of a few experts (MARCUS, 1942; RIGHI, 1984; BRINKHURST; MARCHESE, 1989; PAMPLIN; ROCHA; MARCHESE, 2005), it is necessary to carry out new research and update information on oligochaetes in Brazil. In this context, it is necessary to emphasize the importance of bioindicator organisms, such as those belonging to the Oligochaeta Class, which can indicate the impacts resulting from industrial urban development (SILVA, 2017).

This information can aid as a basis for environmental management and for decision making on the preservation and / or recovery of Brazilian aquatic ecosystems (GIROLLI, 2019). Studies on the ecology and taxonomy of these organisms should be advanced, in order to obtain knowledge of the diversity of freshwater species in Brazil (SURIANI et al., 2007).

OBJECTIVE

This study aims to investigate the occurrence of Oligochaeta species in eight rivers of the State of São Paulo (Brazil), and to expand the species catalogue, identifying the as relationship with the trophic state of sampled environments.

METHODOLOGY

Samplings were performed by CETESB, within the sediment Quality Monitoring Network Project, in eight rivers in the State of São Paulo during the years 2014, 2015 and 2016 (Table 1 and Figure 1).
Table 1 - Location of sampling points in rivers in the State of São Paulo, Brazil. TSI: Trophic State Index.

| Water body                  | Municipality | Coordinate          | Predominant Activity | TSI (Categories) |
|-----------------------------|--------------|---------------------|----------------------|------------------|
| Jundiaí River - JUN         | Indaiatuba   | 23°08’25”S 47°13’11”W | Industrial           | Hypereutrophic   |
| Tietê River - TIE           | Biritiba Mirim | 23°33’57.84”S 46°1’17.18”W | Industrial           | Hypereutrophic   |
| Moji Guaçu River - MOJ      | Cubatão      | 23°30’08”S 46°22’17”W | Industrial           | Mesotrophic      |
| Sorocaba River - SOR        | Cerquilho    | 23°9’33.23”S 47°47’42.53”W | Industrial           | Hypereutrophic   |
| Ribeira River - RIB         | Iporanga     | 24°32’47”S 48°29’58”W | Conservation         | Oligotrophic     |
| Betari River - BET          | Iporanga     | 24°36’14”S 48°36’41”W | Conservation         | Oligotrophic     |
| Batalha River - BAT         | Indaiatuba   | 22°14’25”S 49°20’04”W | Farming              | Hypereutrophic   |
| Aguapeí River - AGUA        | Lins         | 21°44’43”S 49°51’27”W | Farming              | Hypereutrophic   |

Fonte: Dados de pesquisa 2021.

Figure 1- Map containing location of sampling points in rivers in the State of São Paulo.

The sediment samples were collected in triplicate, with Van Veen or Ponar grab samplers in the depositional riverbanks, according to the CETESB L5.309 (Technical Standard). Aiming to complement the analysis of the sampled points, the Trophic State Index (TSI) were calculated (LAMPARELLI, 2004). This index aims to classify water bodies in different degrees of trophy, evaluating the quality of the water in terms of nutrient enrichment.

Faunal identification was made using the taxonomic criteria (BRINKHURST; JAMIESON, 1971;
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RIGHI, 1984; BRINKHURST; MARCHESE, 1989; TIMM, 2009). After identification, the organisms were deposited in the collection of the Water Communities Sector of CETESB.

In order to evaluate the coverage of the sample design, the Bootstrap species richness estimator was used. For calculations we use the Vegan package (OKSANEN et al., 2019), software “R” version 3.1.1 (R CORE TEAM, 2017).

**Results and Discussion**

The oligochaete fauna found in the eight sampled rivers in the State of São Paulo is distributed within three families (Alluroididae, Naididae, Opistocystidae) and 25 species, totalizing 7,398 individuals sampled (Table 2). The result obtained by the Bootstrap richness estimator (29.9 ± 1.9), indicates that the sample design adopted in this study was satisfactory, considering that the recorded species richness is very close to the estimated range.

**Table 2 - Occurrence of species of oligochaetes sampled in eight rivers in the State of São Paulo, Brazil.**

| Taxa                                      | Rivers      | JUN | TIE | MOJ | SORO | BET | RIB | AGUA | BAT |
|-------------------------------------------|-------------|-----|-----|-----|------|-----|-----|------|-----|
| Family Alluroididae                        |             |     |     |     |      |     |     |      |     |
| Alluroididae sp. (Michaelsen, 1900)        |             | 0   | 0   | 0   | 0    | +   | 0   | 0    | 0   |
| Family Opistocystida                       |             |     |     |     |      |     |     |      |     |
| Opistocysta funiculus (Cordero, 1948)      |             | 0   | +   | 0   | +    | 0   | +   | +    | 0   |
| Family Naididae                            |             |     |     |     |      |     |     |      |     |
| Subfamily Naidinae                         |             |     |     |     |      |     |     |      |     |
| Allonais chelata (Marcus, 1944)            |             | +   | 0   | 0   | 0    | 0   | 0   | 0    | 0   |
| Aulophorus borelli (Michaelsen, 1900)      |             | 0   | 0   | +   | 0    | 0   | 0   | 0    | 0   |
| Aulophorus furcatus (Müller, 1774)         |             | +   | 0   | +   | 0    | 0   | 0   | 0    | 0   |
| Chaetogaster diaphanus (Gruithuisen, 1828) |             | +   | +   | +   | 0    | 0   | 0   | 0    | +   |
| Dero digitata (Müller, 1773)               |             | 0   | +   | 0   | 0    | 0   | 0   | 0    | 0   |
| Dero nivea (Aiyer, 1930)                   |             | 0   | 0   | 0   | 0    | +   | 0   | 0    | 0   |
| Dero sawayai (Marcus, 1943)                |             | 0   | +   | +   | +    | 0   | 0   | 0    | 0   |
| Nais communis (Piguet, 1906)               |             | +   | +   | +   | 0    | 0   | +   | +    | 0   |
| Nais variabilis (Piguet, 1906)             |             | 0   | +   | 0   | 0    | 0   | 0   | 0    | 0   |
| Slavina appendiculata (D’Udekem, 1855)     |             | 0   | +   | 0   | 0    | 0   | +   | +    | 0   |
| Slavina evelinae (Marcus, 1942)            |             | 0   | +   | 0   | +    | 0   | 0   | +    | 0   |
| Stephensoniana trivandrana (Aiyer, 1926)   |             | 0   | 0   | 0   | 0    | 0   | 0   | 0    | +   |
| Stylaria lacustres (Linnaeus, 1767)        |             | 0   | 0   | 0   | +    | 0   | 0   | 0    | 0   |
| Subfamily Pristininae                      |             |     |     |     |      |     |     |      |     |
| Pristina americana (Černosvitov, 1937)     |             | 0   | +   | +   | 0    | 0   | 0   | 0    | 0   |
| Pristina menoni (Aiyer, 1929)              |             | 0   | +   | 0   | 0    | 0   | 0   | 0    | 0   |
The Naididae family was considered the most representative of this assemblage of Oligochaetes, presenting 92.3% of the taxa found, being divided into four subfamilies: Naidinae, Pristininae, Rhyacodrilinae and Tubificinae. See Table 2 for more details on species occurrence in the analyzed sites.

The Alluroididae was represented by only one individual identified at the family level and the Opistocystidae was represented by the species *Opistocysta funiculus*. Studies suggest that the *O. funiculus* is able to inhabit environments with low oxygen availability and a higher concentration of organic matter, characteristics generally associated with low environmental quality (PAMPLIN; ALMEIDA; ROCHA, 2006; SANCHES, 2016; GIROLLI, 2019). Thus, our results corroborate previous studies, since *O. funiculus* was registered in the Tietê River, which is inserted in an area with predominantly industrial activity and was classified as hypereutrophic according to the TSI.

The most frequent species registered in this study, present in seven of the eight rivers sampled was *Bothrioneurum* sp. According to Brinkhurst and Marchese (1989), this species has a wide geographical distribution. However, in the studies by the authors Alves and Lucca (2000), MARTINS and ALVES (2008), BEHREND *et al.* (2012), SANCHES (2016) and GIROLLI (2019), *Bothrioneurum* sp. demonstrated ability to tolerate polluted environments, organically enriched and with high levels of electrical conductivity. In this study, *Bothrioneurum* sp. was recorded in the Moji Guaçu River, which corroborates the results found by the authors mentioned above, since it is a river inserted in an area with predominantly industrial activity, located in the Municipality of Cubatão (microregion of Santos, State coast) and was classified as mesotrophic.

The second most frequent species recorded was *Pristina synclites* present in six of the eight rivers sampled. According to Davis (1982), this species can inhabit several habitats, from clean waters to degraded waters with industrial discharges. Similarly, authors Lin and Yo (2008) also reported that *P. synclites* is able to tolerate polluted habitats. In this research it was found in the Aguapeí River, located in the Municipality of Lins (Midwest region), which has predominantly farming and was classified as hypereutrophic according to the TSI.

**Conclusion**

In general, this study points out the importance of biomonitoring using Oligochaeta organisms, since it is possible to correlate certain species with characteristics of the environmental quality of water bodies. Additionally, these results are of great importance for the knowledge of the taxonomic distribution of

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**Table 2** - Occurrence of species of oligochaetes sampled in eight rivers in the State of São Paulo, Brazil (cont.).

| Species                              | 0 | 0 | 0 | 0 | + | 0 | 0 | 0 |
|--------------------------------------|---|---|---|---|---|---|---|---|
| *Pristina osborni* (Walton, 1906)    |   |   |   |   | + | 0 | 0 | 0 |
| *Pristina rosea* (Piguet, 1906)      |   | + | 0 | 0 | 0 | 0 | 0 | 0 |
| *Pristina synclites* (Stephenson, 1925) | + | + | 0 | + | + | + | + | + |

| Subfamily Rhyacodrilinae             |   |   |   |   |   |   |   |   |
|--------------------------------------|---|---|---|---|---|---|---|---|
| *Bothrioneurum* sp. (Stolc, 1886)    | + | + | + | + | 0 | + | + | + |
| *Branchiura sowerbyi* (Beddard, 1892) | 0 | 0 | 0 | + | + | + | + | 0 |

| Subfamily Tubificinae                |   |   |   |   |   |   |   |   |
|--------------------------------------|---|---|---|---|---|---|---|---|
| *Aulodrilus pigueti* (Kowalewski, 1914) | 0 | + | 0 | + | 0 | + | 0 | + |
| *Limnodrilus hoffmeisteri* (Claparède, 1862) | + | + | + | + | 0 | + | 0 | 0 |
| *Limnodrilus neotropicus* (Černosvitov, 1939) | 0 | 0 | 0 | 0 | 0 | 0 | 0 | + |

**Fonte:** Dados de pesquisa 2021.
Occurrence of Oligochaeta species (Annelida: Clitellata) in aquatic oligochaetes in Brazilian lotic systems, assisting in water quality monitoring programs in Brazil.

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References

AGOSTINHO, A. A.; THOMAZ, S. M.; GOMES, L. C. Conservação da biodiversidade em águas continentais do Brasil. Megadiversidade, v.1, n. 1, p.70-78, 2005.

ALVES, R. G.; LUCCA, J. V. Oligochaeta (Annelida: Clitellata) como indicador de poluição orgânica em dois córregos pertencentes à Bacia do Ribeirão do Ouro - Araraquara (São Paulo - Brasil). Brazilian Journal of Ecology, v. 4, n. 1-2, p 112-117, 2000.

ALVES, R. G.; MARCHESE, M. R.; MARTINS, R. T. Oligochaeta (Annelida, Clitellata) of lotic environments at Parque Estadual Intervales (São Paulo, Brasil). Biota Neotropica, v. 8, n. 1, p. 69-72, 2008.

AMO, V. F.; SILVA, J. E.; PINHA, G. D.; RAGONHA, F. H.; MORMUL, R. P. Factors affecting assemblage attributes of freshwater Oligochaeta in Neotropical shallow floodplain Lakes. Acta Limnologica Brasiliensia, v. 29, e 114, 2017.

BEHREND, R. D. L.; TAKEDA, A. M.; GOMES, L. C.; FERNANDES, S. E. P. Using Oligochaeta assemblages as an indicator of environmental changes. Brazilian Journal of Biology, v. 72, n. 4, p. 873-884, 2012.

BRINKHURST, R. O.; JAMIESON, B. G. M. Aquatic Oligochaeta of the world. University of Toronto Press, p. 860, 1971.

BRINKHURST, R. O.; MARCHESE, M. R. Guia para la identificación de oligoquetos acuáticos continentales de Sud y Centroamerica. Santa Fé: Asociación de ciencias naturales del litoral, 1989. v. 6, 179p.

CETESB - Companhia Ambiental do Estado de São Paulo. L5.309.2003 Determinação de bentos de água doce - Macroinvertebrados: Métodos qualitativo e quantitativo. São Paulo, 2003, 16p.

CETESB – Companhia Ambiental do Estado de São Paulo. Relatório de qualidade das águas interiores no Estado de São Paulo 2019. São Paulo, 2019. (Série Relatórios). Disponível em: <https://cetesb.sp.gov.br/aguas-interiores/wp-content/uploads/sites/12/2020/09/Apendice-D-Indices-de-Qualidade-das-Aguas.pdf>. Acesso em: 15 mar. 2021.

CORBI, J. J.; JANCSEO, M. A.; TRIVINHO-STRIXINO, S.; FRAGOSO, E. N. Occurrence of Oligochaeta living on larvae of Odonata from Ipeúna (São Paulo State, Brazil). Biota Neotropica, v. 4, n. 2, p. 1-3, 2004.

DAVIS, J. R. New records of aquatic Oligochaeta from Texas, with observations on their ecological characteristics. Hydrobiologia, v.96, p15-29, 1982.

DORNFELD, C. B.; ALVES, R. G.; LEITE, M. A.; ESPÍNDOLA, E. L. G. Oligochaeta in eutrophic Re-
servoir: the case of Salto Grande Reservoir and their main affluent (Americana, São Paulo, Brazil). *Acta Limnologica Brasiliensa*, v. 18, n. 2, p. 189-197 2006.

GIROLLI, D. A. **Oligochaeta (Annelida: Clitellata) como Indicadores da Qualidade da Água e Sedimento em Reservatórios no estado de São Paulo.** 2019. Dissertação (Mestrado - Programa de Pós-Graduação em Desenvolvimento Territorial e Meio Ambiente) da Universidade de Araraquara - UNIARA, Araraquara, 2019.

GIROLLI, D. A.; GORNÍ, G. R.; COLOMBO-CORBI, V.; CORBI, J. J. First record of *Stephensoniania trivandrana* Aiyer, 1926 (Oligochaeta: Naididae), in southeastern Brazil. *Brazilian Journal of Biology*, v. 80, n. 2, p. 476-478, 2020.

GIROLLI, D. A.; GORNÍ, G. R.; CORBI, V. C.; CORBI, J. J. First record of *Nais schubarti* Marcus, 1944 (Oligochaeta: Naididae) in the State of São Paulo. *Brazilian Journal of Biology*, v. 19, n. 3, p. 552-553, 2018.

GOMES, D. F.; SANCHES, N. A.; SAHM, L. H.; GORNÍ, G. R. Aquatic Oligochaeta (Annelida: Clitellata) in Extractive Reserve Lake Cuniã - RO - Brazilian Amazon. *Biota Neotropica*, v. 17, n. 1 e20160232, p.1-7, 2017.

GORNÍ, G. R. **Oligochaeta (Annelida: Clitellata) em córregos de baixa ordem do Parque Estadual de Campos do Jordão (São Paulo, Brasil).** 2007. Dissertação de Mestrado - Instituto de Ciências Biológicas da Universidade Federal de Juiz de Fora, Juiz de Fora, 2007.

GORNÍ, G. R.; ALVES, R. G. Oligochaeta (Annelida: Clitellata) em córregos de baixa ordem do Parque Estadual de Campos do Jordão (São Paulo - Brasil). *Biota Neotropica*, v. 8, n. 4, p. 1-6, 2008.

GORNÍ, G. R.; SANCHES, N. A. O.; COLOMBO-CORBI, V.; CORBI, J. J. Oligochaeta (Annelida: Clitellata) in the Juruena River, MT, Brasil: espécies indicadoras em diferentes substratos. *Biota Neotropica*, v. 18, n. 4, e2018056, p.1-9, 2018.

HARPER, D. *Eutrophication of freshwaters: principles, problems and restoration*. Londres: Chapman e Hall, 1992. p.372. 1st ed.

JORCIN, A.; NOGUEIRA, M. G. Benthic macroinvertebrates in the Paranapanema Reservoir cascade (southeast Brazil). *Brazilian Journal of Biology*, v. 68, n. 4, p. 1013-1024, 2008.

LAMPARELLI, M. C. **Graus de trofia em corpos d'água do Estado de São Paulo: avaliação dos métodos de monitoramento.** 2004. 238p. Tese (Doutorado) - Instituto de Biociências da Universidade de São Paulo. Departamento de Ecologia, Universidade de São Paulo, São Paulo. 2004.

LIN, K. J.; YO, S. P. The effect of organic pollution on the abundance and distribution of aquatic oligochaetes in na urban water basin, Taiwan. *Hydrobiologia*, v. 596, n 1, p. 213-223, 2008.

MARCUS, E. Sobre algumas Tubificidae do Brasil. *Boletim da faculdade de Filosofia, Ciências e Letras da Universidade de São Paulo Zoologia*, v. 25, n. 6, p.153-228, 1942.
MARTINS, R. T.; ALVES, R. G. Occurrence of Naididae (Annelida: Oligochaeta) from three gastropod species in irrigation fields in southeastern Brazil. *Biota Neotropica*, v. 8, n. 3, 2008.

MASSON, M.; DESROSIERS, M.; PINEL-ALLOUI, B.; MARTEL, L. Relating macroinvertebrate community structure to environmental characteristics and sediment contamination at the scale of the St Lawrence River. *Hydrobiologia*, 647 (1), p. 35-50, 2010.

MOLOZZI, J.; FRANÇA, J. S.; ARAUJO, T. L.; VIANA, T. H.; HUGHES, R. M.; CALLISTO, M. Diversidade de habitats físicos e sua relação com macroinvertebrados bentônicos em reservatórios urbanos em Minas Gerais. *Iheringia, Série Zoologia*, v. 101, n 3, p. 191-199, 2011.

OKSANEN, J.; BLANCHET, F. G.; FRIENDLY, M.; KINDT, R.; LEGENDRE, P.; MCGLINN, D.; MINCHIN, P. R.; O’HARA, R. B.; SIMPSON, G. L.; SOLYMOS, P.; STEVENS, M. H. H.; SZOECS, E.; WAGNER, H; VEGAN. *Community Ecology Package. R package version*, v. 2., p. 5 - 4, 2019.

PAMPLIN, P. A. Z.; ALMEIDA, T. C. M.; ROCHA, O. Composition and distribution of benthic macroinvertebrados in Americanica Reservoir (SP, Brazil). *Acta Limnologica Brasiliensa* v.18, n. 2, p. 121-132, 2006.

PAMPLIN, P. A. Z.; ROCHA, O; MARCHESE, M. Riqueza de espécies de Oligochaeta (Annelida, Clitellata) em duas represas do rio Tietê (São Paulo). *Biota Neotropica*, v. 5, n. 1, p. 63-70, 2005.

R CORE TEAM, R.. A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria. 2017.

RIGHI, G. *Manual de identificação de invertebrados límnicos do Brasil*. CNPq/Coordenação Editorial, Brasília, 1984. p. 48.

SALES, P. C. L.; RAGONHA, F. H.; RODRIGUES, E. I.; DE DEUS, M. S. M.; LOPE, M. S.; TAKEDA, A. M. Primeiros registros de espécies de Oligochaeta aquática (Annelida - Clitellata) do Estado do Piauí (Nordeste – Brasil). *Arquivos do MUDI*, v. 18, n. 2, p. 1-4, 2014.

SANCHES, N. A. O. *Comunidade de oligochaeta (annelida: clitellata) em córregos urbanos do município de Bocaina - SP*. 2016. Dissertação de Mestrado - Programa de Pós-graduação em Desenvolvimento Territorial e Meio Ambiente da Universidade de Araraquara - UNIARA, Araraquara, 2016.

SANCHES, N. A. O.; GIROLLI, D. A.; GORN, G. R.; SAHM, L. H.; COLOMBO-CORBI, V. C.; CORBI, J. J. 2020. Record of Haplotaxis aedeochaeta Brinkhurst & Marchese, 1987 (Oligochaeta: Haplotaxidae) in a conservation unity in the state of São Paulo. *Brazilian Journal of Biology*, v. 81, n. 1, p 217-2019, 2021.

SANCHES, N. A.; SAHM, L. H.; GOMES, D. F.; CORBI, J. J.; RIBEIRO, M. L.; GORN, G. R. Inventário de Oligochaeta (Clitellata) em córregos urbanos de Bocaina-SP, Brasil. *Revista Brasileira Multidisciplinar - ReBraM*, v. 19, n.1, p. 27-46, 2016.

SILVA, C. C. Revisão de espécies de Oligochaeta (ANNELIDA: CLITELLATA) como bioindicadores: uma copilação dos dados para ecossistemas aquáticos brasileiros. 2017. Trabalho de Conclusão de Curso - Departamento de Ciências Biológicas e da Saúde da Universidade de Araraquara - UNIARA,
Araraquara, 2017.

SURIANI, A. L.; FRANÇA, R. S.; PAMPLIN, P. A. Z.; MARCHESE, M.; LUCCA, J. V.; ROCHA, O. Species richness and distribution of oligochaetes in six Reservoirs on Middle and Low Tietê River (SP, Brazil). Acta Limnologica Brasiliensia, v. 19, n 4, p. 415 - 426, 2007.

TAKEDA, A. M.; FUJITA, D. S.; RAGONHA, F. H.; PETSCHE, D. K.; MONTANHOLI-MARTINS, M. C. Oligochoeta (Annelida) de ambientes aquáticos continentais do Estado do Mato Grosso do Sul (Brasil). Iheringia, Série Zoologia, v. 107, e2017107, p. 1-5, 2017.

TIMM, T. A guide to the freshwater Oligochoeta and Polychaeta of Northern and Central Europe. Lauterbornia, v. 66, p 1-235, 2009.

TRIVINHO-STRIXINO, S.; CORREIA, L. C. S.; SONODA, K. Phytophilous Chironomidae (Diptera) and other Macroinvertebrates in the ox-bow Infernão Lake (Jataí Ecological Station, Luiz Antônio, SP, Brazil). Revista Brasileira de Biologia, v. 60, n.3, p. 527-535, 2000.

WETZEL, M. J. Aquatic Annelida of Illinois: introduction and Checklist of Species. Transaction of the Illinois State Academy of Science, v. 85, n. 1-2, p. 87-101, 1992.