

Naididae species (Oligochaeta) associated with submersed aquatic macrophytes in two reservoirs (São Paulo, Brazil).

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ABSTRACT: Naididae species (Oligochaeta) associated with submersed aquatic macrophytes in two reservoirs (São Paulo, Brazil). The presence and type of aquatic vegetation are the main factors that determine the distribution and abundance of the Naididae. The aim of the present study was to examine the occurrence of Naididae species on the submersed macrophytes in two reservoirs of the state of São Paulo (Brazil). Cluster analyses (UPGMA) based on the Shannon diversity index, richness of species and uniformity were used to assess the degree of similarity of the faunistic structure of the macrophytes amongst seasonal periods. The greatest average abundance of Naididae was found in the macrophytes Cabomba, Ipomoea, and Najas. These last macrophytes showed a higher number of species. Stylaria lacustris, Dero (D.) nivea, and Allonais inaequalis were the most abundant species per unit dry weight of macrophyte. The species Dero (D.) nivea and Dero (D.) digitata were the ones that presented a higher occurrence frequency. The higher abundance of Naididae on the Cabomba, Ipomoea, and Najas macrophytes is possibly related to their architecture composed of small leaves, and branched thin stems, providing a bigger contact surface for the periphyton. The results showed that aquatic macrophytes provide an important habitat for naidids, allowing the establishment of a diversified and abundant fauna.

Key-words: Oligochaeta, aquatic macrophytes, Dourada Lagoon, Ribeirão de Anhumas Reservoir.

RESUMO: Espécies de Naididae (Oligochaeta) associadas à macrófitas aquáticas submersas em dois reservatórios (São Paulo, Brasil). A presença e o tipo da vegetação aquática são os principais fatores determinantes na abundância e distribuição de Naididae. O objetivo do presente estudo foi examinar a ocorrência de espécies de Naididae associadas à macrófitas aquáticas submersas em dois reservatórios do estado de São Paulo (Brasil). A análise de Cluster (UPGMA), baseada no índice de diversidade de Shannon, riqueza de espécies e uniformidade, foi utilizado para detectar o grau de similaridade da estrutura faunística presentes nas macrófitas entre os períodos sazonais. O maior valor de abundância de Naididae foi encontrado nas macrófitas Cabomba, Ipomoea, e Najas. Stylaria lacustris, Dero (D.) nivea, e Allonais inaequalis foram as espécies mais abundantes por unidade de peso seco de macrófitas. As espécies Dero (D.) nivea e Dero (D.) digitata foram as espécies que apresentaram a maior frequência de ocorrência. A maior abundância de Naididae registrada nas macrófitas Cabomba, Ipomoea, e Najas está provavelmente relacionada à sua arquitetura composta de folhas pequenas, e galhos finos e ramificados, promovendo maior superfície de contato para o perífíton. Os resultados demonstraram que as macrófitas aquáticas constituem um importante habitat para os naidídeos, permitindo o estabelecimento de uma fauna abundante e diversificada.

Palavras-chave: Oligochaeta, macrófitas aquáticas, Lagoa Dourada, Represa do Ribeirão de Anhumas.

Introduction

The colonization of littoral regions of lakes, ponds, and reservoirs by different species of aquatic macrophytes (Wetzel, 1983) provide microhabitats for an abundant

and diversified associated fauna (Rosine, 1955; Hann, 1995).

The aquatic macrophytes provide substrate, shelter, a place to lay eggs (Glowacka et al., 1976), and food (Hann, 1995) for many groups of invertebrates

(Mastrantuono, 1986; Hann, 1995; Correia & Trivinho-Strixino, 1998; Jones et al., 2000).

Species of Naididae are free swimmers, show a great ability to move about (Verdonschot et al., 1982), and can exploit a diversity of macrophytes. The presence and type of aquatic vegetation are the main factors that determine the distribution and abundance of the Naididae (Learner et al., 1978).

The aim of the present study was to examine the occurrence of Naididae species on the submersed macrophytes in two lentic environments of the state of São Paulo (Brazil).

Material and methods

The macrophytes *Najas* sp. L. (Najadaceae) and *Mayaca fluviatilis* Aubl. (Mayacaceae) were collected in the Dourada Lagoon, a little reservoir (Brotas, São Paulo, Brazil, 22°11'33"S and 47°55'2"W); while *Ipomoea* sp. L. (Convolvulaceae), *Egeria* sp. Planch. (Hydrocharitaceae), *Utricularia* sp. L. (Lentibulariaceae), *Cabomba* sp. Aubl. (Cabombaceae), *Potamogeton* sp. L. (Potamogetonaceae) were collected in the Ribeirão de Anhumas Reservoir (Américo Brasiliense, São Paulo, Brazil, 21°42' 23"S and 48°0'33"W), in May, July, and October of 2003, and January of 2004. Submersed structures of *Eleocharis* sp. R. Br. (Cyperaceae) were collected in this last reservoir since these structures can provide additional information on the submersed habitats potentially colonized by Naididae.

The macrophytes were carefully collected with a hand net with 0.21 mm mesh and 100 grams of biomass (moist weight) of each specimen were weighed separately. Small amounts of each plant were transferred to a 1000 mL beaker containing water, and then agitated to detach the material adhered to the macrophytes (Lohlein, 1996). Once removed from the macrophytes, the material was then filtered in a nylon strainer with 0.21 mm mesh to retain the organisms. Subsequently the macrophytes were dried (105° C for 24 hours) and weighed. The Naididae were fixed in 4% formalin for later identification. The criterion adopted by Brinkhurst & Jamieson (1971), Righi (1984), and Brinkhurst & Marchese (1989) was followed for the identification of the Oligochaeta species. The results were expressed in number of

individuals per grams of dry weight.

The aquatic plants were identified according to Hoehne (1979), and Pott & Pott (2000).

Cluster analyses (UPGMA) based on the Shannon diversity index, the number of species and uniformity, were used to assess the degree similarity of the faunistic structure among both the macrophytes and the months of sampling. The cophenetic analysis was performed in order to measure data adjustment, considering the value higher than 0.8 as well adjusted (Rohlf & Fisher, 1968). Data were analysed using NTSYS software

Results

The numerical abundance (number of organisms/gram of macrophyte dry weight) of the species of Naididae can be seen in Fig. 1.

The greatest average abundance of Naididae was found in the macrophytes *Cabomba*, *Ipomoea*, and *Najas* (Fig. 2). *Ipomoea* and *Najas* presented the greatest number of species. The *Utricularia* wasn't present in the samples on May of 2003 and there were no organisms found in the sample of *Egeria* on July of 2003.

Eighteen species of Naididae were identified, being *Stylaria lacustris*, *Dero* (*Dero*) *nivea* and *Allonais inaequalis* the most abundant ones per unit dry weight of macrophyte. The species *Dero* (*D.*) *nivea* and *Dero* (*Dero*) *digitata* were the ones that presented a higher occurrence frequency, with 76% and 50%, in the macrophytes respectively.

The dendrogram of the faunistic association of the months of sampling showed the formation of two groups: one formed by May of 2003, October of 2003, and January of 2004; and another by July of 2003, indicating that the faunistic structure present in the macrophytes in the latter month differed from the others (Fig. 2). The smaller number of species found in July helps to explain the obtained result (Tab. 1).

Values of both the diversity and uniformity indices as well as the richness of Oligochaeta species recorded for the macrophytes (Tab. 1) led us to consider three different groups; one consisting of macrophytes such as *Naja*, *Ipomoea* and *Potamogeton*, another group consisting of *Egeria*, *Eleocharis*, *Utricularia* and *Cabomba*,

and a third group, which consisted solely of *Mayaca* (Fig. 4). The cophenetic relation of 0.76 indicates that the dendrogram

experienced only slight distortion, which did not interfere in the interpretation of the results

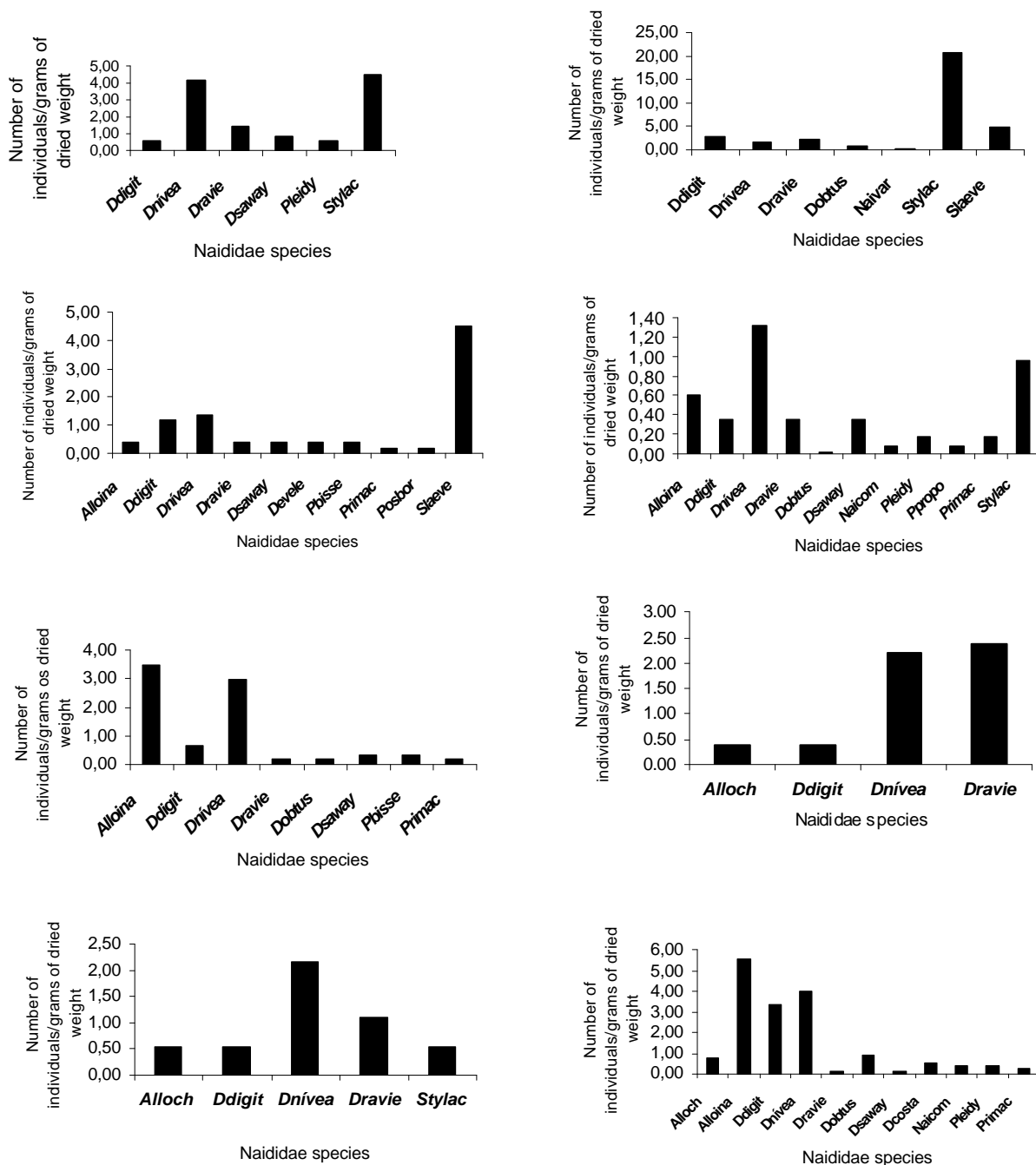


Figura 1: Numerical abundance (average number of organisms/gram of macrophyte dry weight) of the species of Naididae associated with the macrophytes.

Alloch (*Allonais chelata* (Marcus, 1944)) *Alloina* (*Allonais inaequalis* (Stephenson, 1911)) *Ddigit* (*Dero* (D.) *digitata* (Müller, 1773)) *Dnivea* (*Dero* (D.) *nivea* Aiyer, 1929) *Dravie* (*Dero* (D.) *raviensis* (Stephenson, 1914)) *Dobtus* (*Dero* (D.) *obtusa* d'Udekem, 1885) *Dsaway* (*Dero* (D.) *sawayai* Marcus, 1943) *Devele* (*Dero* (D.) *evelinae* Marcus, 1943) *Dcosta* (*Dero* (A.) *costatus* (Marcus, 1944)) *Naivar* (*Nais variabilis* Piguët, 1906) *Naicom* (*Nais communis* Piguët, 1906) *Pleidy* (*Pristina leidy* Smith, 1886) *Pbiser* (*Pristina biserrata* Chen, 1940) *Pprobo* (*Pristina proboscidea* Beddard, 1896) *Primac* (*Pristina macrochaeta* Stephenson, 1931) *Posbo* (*Pristinella osborni* (Walton, 1906)) *Stylac* (*Stylaria lacustris* (Linnaeus, 1767) *Slaeve* (*Slavina evelinae* (Marcus, 1942))

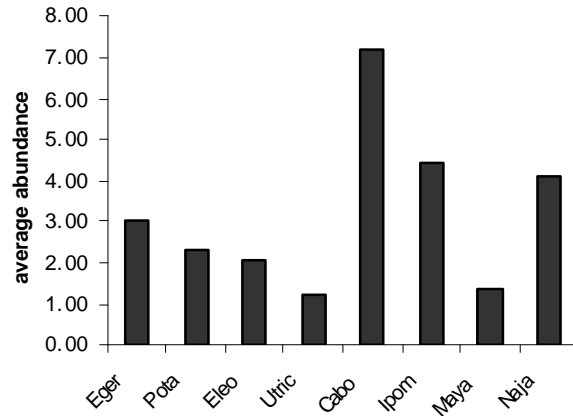


Figure 2: Mean abundance of Oligochaeta (individual per gram of dry weight of macrophyte). Eger=Egeria; Pota=Potamogeton; Eleo=Eleocharis; Utric=Utricularia; Ipom=Ipomoea; Maya=Mayaca; Naja=Najas.

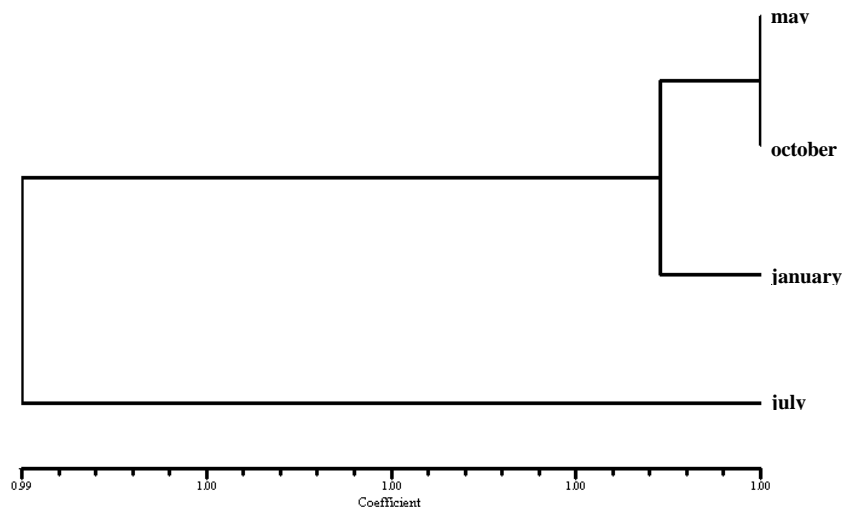


Figure 3: Multivariate cluster analysis (UPGMA) based on the Shannon diversity index, the number of species and uniformity on the macrophytes, in the May, July and October of 2003 and January of 2004. Cophenetic correlation coefficient $r = 0.88221$.

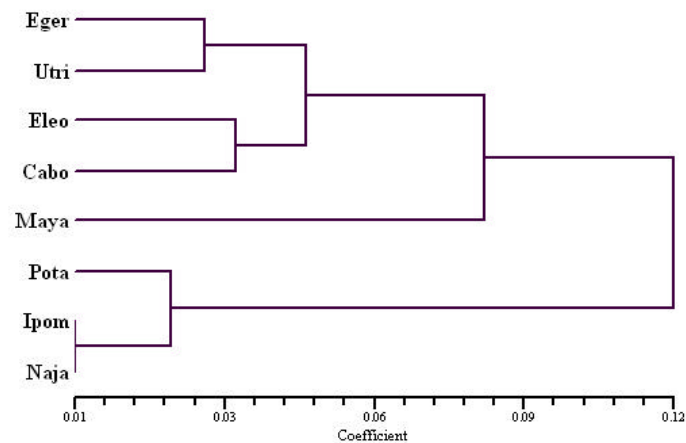


Figure 4: Multivariate cluster analysis (UPGMA) based on the Shannon diversity index, the number of species and uniformity to each macrophytes. Cophenetic correlation coefficient $r = 0.76283$

Table I: Values of the diversity indices of Shannon (H'), Evenness (J), and species richness (R) of Oligochaeta in the aquatic macrophytes, for the months of May, July, and October of 2003, and January of 2004.

Month	H'	J	R
May	1.74	0.89	12.00
July	1.66	0.80	6.00
October	1.76	0.85	12.00
January	1.81	0.87	10.00

Table II: Values of the diversity indices of Shannon (H'), Evenness (J), and species richness (R) of Oligochaeta in the aquatic macrophytes.

Species	H'	J	R
Egeria sp.	0.63	0.78	6.00
Potamogeton sp.	0.75	0.75	10.00
Eleocharis sp.	0.62	0.69	8.00
Utricularia sp.	0.62	0.69	5.00
Cabomba sp.	0.55	0.85	7.00
Ipomoea sp.	0.86	0.97	11.00
Mayaca sp.	0.48	0.6	4.00
Najas sp.	0.77	0.91	11.00

Discussion

In the present study, the number of species associated with the macrophytes indicated that naidids found good conditions to establish themselves on these plants. In fact, these invertebrates are commonly reported as inhabitants of aquatic macrophytes (Pennak, 1978). In submersed macrophytes in the Mikolajskie Lake (Poland) the Oligochaeta were represented mainly by the Naididae (Glowacka et al., 1976).

The smaller number of species in July can be related to the lesser availability of periphyton. The temperature fall and the light reduction during this month are causal mechanisms dominant in the limitation of the photosynthesis (Wetzel, 1983). The warmer temperatures in October and January, on the other hand, may have contributed to the increase in the abundance of benthic algae species. Botts & Cowell (1993) suggest the importance of the algae in the distribution of the Oligochaeta species on the macrophyte surface. A major food resource for the Naididae is probably the microorganisms associated with plant and detrital material (Brinkhurst & Jamieson, 1971). The likely explanation for the higher

abundance of Naididae on the Cabomba, Ipomoea, and Najas is possibly related to their architecture composed of small leaves, and branched thin stems, providing ample contact surface for the periphyton.

The similarity of the faunistic structure recorded for Najas, Ipomoea and Potamogeton macrophytes was found to be closely related to the high values recorded for both the diversity and richness indices of these species. Comparatively, intermediate values of these indices were recorded for Egeria, Eleocharis, Utricularia and Cabomba. The submersed floating habit of the Utricularia could have hindered the colonization process by decreasing the number of Naididae species. The low values of the indices recorded for the Mayaca macrophyte strongly influenced its dissimilarity in comparison to the other species. Although the submerged branches of Mayaca and Najas were close to each other in the environment, the latter showed greater similarity with Ipomoea and Potamogeton, both present in the Ribeirão de Anhumas Reservoir.

Dero (D.) *nivea*, which had an important numerical participation, seems to inhabit a considerable range of habitats, being found

on emergent, floating, and submersed macrophytes (Correia & Trivinho-Strixino, 1998), in clay sediments (Alves & Strixino, 2000), sandy sediments (Corbi & Trivinho-Strixino, 2002), and streams with rocky substrates (Pinder, 2001).

The other species with important numerical participation in macrophytes was *A. inaequalis*. This species was obtained by Smock & Stoneburner (1980) by decomposing *Nelumbo* Adans. (*Nelumbonaceae*) leaves. The authors of the present study have found various specimens of this species associated with filamentous algae in a stream (Pinheirinho stream) in the state of São Paulo.

Although *Stylaria lacustris* is a typically epiphytic species (Strayer et al., 2003), it may also associate with other types of substrates, such as sand banks with silt deposits (Kudryavtsev, 1977), and fine sand with medium organic material (Verdonschot, 1999). Possibly it is the only species that presents a closer physical contact with plants, due to its pseudominers habit of macrophytes, temporally utilizing mines made by other invertebrates (Glowacka et al., 1976).

The results showed that aquatic macrophytes provide an important habitat for naidids, allowing the establishment of a diversified, abundant fauna, besides they can also be considered one more aquatic habitat that can be used by these invertebrates.

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