

Temporal analysis of communities of aquatic oligochaeta (Annelida: Clitellata: Oligochaeta) in anthropic lakes

Oligochaeta (Annelida, Clitellata) em ambientes lânticos: um registro da comunidade em diferentes lagos antrópicos

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ABSTRACT

Oligochaetes are important components of energy flow in freshwater ecosystems. Even though of ecological significance, few studies are available about this group. Therefore, this study analyzed the diversity of Oligochaeta in three anthropic lakes and investigated their distribution over a seasonal cycle in a forest fragment at *Porto União, Santa Catarina, Brazil*. Sediment samples were obtained using an Ekman-Birge (15x15cm) grab in October (spring) and January 2011 (summer), March (autumn), and July (winter) 2012. We collected 305 individuals, belonging to 4 species, and 5 genera from the Tubificinae and Naidinae families. The highest density was in autumn, a period with greater climatic stability. *Limnodrilus hoffmeisteri* (Claparede, 1862) was the most abundant species, present in all sampling periods. Our results increase the knowledge on oligochaeta in Southern Brazil and provide the first record limnic oligochaetes to *Porto União, Santa Catarina*.

Key words: Atlantic Forest. Autumn. Diversity. Seasonality.

RESUMO

Os oligoquetas apresentam grande importância no fornecimento de energia em ecossistemas dulcícolas. Apesar de sua relevância ecológica, poucos estudos têm

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*sido feitos sobre o grupo. Este estudo objetivou analisar a diversidade e distribuição do táxon Oligochaeta ao longo de um ciclo sazonal, em três lagos antrópicos, num fragmento de Mata Atlântica no município de Porto União, Santa Catarina. Amostras do sedimento foram retiradas com uma draga do tipo Ekman-Birge (15x15cm) em outubro de 2011 (primavera) e janeiro (verão), março (outono) e julho (inverno) de 2012. Foram coletados 305 indivíduos representantes das subfamílias Tubificinae e Naidinae, e foram identificados quatro espécies e cinco gêneros. Houve maior densidade de organismos no outono, período com maior estabilidade climática. Entre as espécies, *Limnodrilus hoffmeisteri* (Claparede, 1862) teve maior abundância e esteve presente em todas as estações. Os resultados obtidos no presente estudo aumentam o conhecimento de espécies de oligoquetas encontradas no sul do Brasil e fornecem o primeiro registro de espécies de oligoquetas límnicos em ambientes lênticos da Região de Porto União, Santa Catarina.*

Palavras-chave: Mata Atlântica. Outono. Diversidade. Sazonal.

INTRODUCTION

Sand extraction usually creates lakes in large holes dug on the ground, which after the end of activities are drained by the catchment area and form waters mirrors (Lelles *et al.*, 2005). Oligochaetes inhabit all types of freshwater habitats, but they are most abundant in sediments (Suriani-Affonso *et al.*, 2011) of the littoral zone of lakes (Rupert & Barnes, 2006). They are also important components in the flow of energy and organic matter in freshwater ecosystems (Kasprzak, 1984). Oligochaetes are generally the most abundant taxon in freshwater environments (Corbi, 2001; Baturina, 2010; Cortelezzi *et al.*, 2012; Krawczyk *et al.*, 2013). However, they are commonly identified to the class or family levels, due to difficulty in visualizing diagnostic morphological characters.

Despite its significance on the dynamics of aquatic ecosystems, there are still knowledge gaps about limnic oligochaetes in Brazil (Gorni & Alves, 2008) and other regions (Rocha, 2003). Furthermore, their distribution and habitat use is poorly known compared to other benthic macroinvertebrates (Alves *et al.*, 2006). Gathering more information about limnic oligochaetes is essential, since there are several groups that could be used for bioprospection. Furthermore, basic knowledge about habitat use and temporal occurrence are essential to set up conservation strategies (Rocha, 2003).

There are known about 70 species of aquatic oligochaetes in Brazil (Righi, 2002), and studies focusing on this group in Southern Brazil have been conducted mainly in *Paraná* State (Fujita, 2005; Behrend *et al.*, 2009; Behrend, 2010; Ragonha *et al.*, 2010). Here, we analyzed oligochaete diversity and distribution over a seasonal cycle in three anthropic lakes from *Porto União, Santa Catarina*, Southern Brazil, providing the first records of genera of limnic oligochaete to this region.

MATERIAL AND METHODS

Our sampling points were three anthropic lakes in a forest fragment in *Porto União*, Northern *Santa Catarina* State. The climate of the region is classified as *Cfb* (Humid Subtropical Climat) according to the Köppen system.

The three lakes originated from sand extraction for recreation and army training. Lake 1 (L1; 26°15'32.6" S; 51°03'57.4" W) is about 73 years old. The age of Lake 2 (L2; 26°15'33.4" S; 51°03'56.7" W) is uncertain. Lake 3 (L3; 26°15'44.0" S; 51°04'03.0" W) is about 23 years old (Figure 1).

Oligochaetes were sampled in October and January 2011, and March and July 2012. Sediment samples were obtained in lake's margin using an Ekman-Birge grab (15x15cm), with three replicates for each sampling point. Samples were fixed in 10%

formaldehyde in the field and washed in mesh sieve 0.05 mm in the laboratory. Specimen sorting was performed using light plastic trays and individuals were preserved in 70% ethanol.

Specimens were mounted on optical microscopy slides with Lactophenol Ammans (Brinkhurst & Marchese, 1991); identification followed Righi (1984) and Brinkhurst & Marchese (1991). Specimens are housed in the Zoology laboratory collection of the *Universidade Estadual do Paraná* (Unespar), campus *Faculdade Estadual de Filosofia, Ciências e Letras de União da Vitória* (FAFIUV).

We categorized the percentage of macrophyte cover on the water surface of sampling sites into

bins, as follows: between 1 and 20% was given score of 1; between 21 and 40% score 2; between 41 and 70% score 3; and between 71 and 100% score 4. The surrounding vegetation was also categorized as follows: 1 for shrub with predominance of grass, 2 for shrubs that allow little shading, and 3 for intact vegetation (Krawczyk *et al.*, 2013).

RESULTS AND DISCUSSION

Although water mirrors are characteristic of altered environments, the vegetation allows macroinvertebrate colonization (Moletta *et al.*,



Figure 1. Map of the study area in Northern *Santa Catarina*. L1-L3 are the sampled lakes. Dotted area are grasslands, dark gray represent forest area, and light gray represents built area. *Porto União* (SC), Brazil, 2011-2012.

2005). The lakes we sampled had macrophytes year-round, with greater proportion in autumn. L1 had macrophytes between 0%-10%, L2 had 41%-50% of water surface covered by macrophytes (mainly in autumn), and L3 had macrophytes between 21%-30%. Complex vegetation (grass, shrubs, and trees) was observed only in L3 (50%), the others lakes had only grass and trees (Table 1).

We sampled 305 specimens belonging to Naidinae and Tubificinae (Erséus *et al.*, 2008). Tubificinae is cosmopolitan (Martin, 1996), occurring in various types of lakes, and was represented by two genera (*Limnodrilus* sp. and *Branchiura* sp). Naidinae was represented by three genera (*Dero* sp., *Slavina* sp., and *Pristina* sp.).

Seasonality promotes complex changes in lakes, such as stagnation and circulation of water (Collado & Schmelz, 2001). Water circulation occurs in the autumn and spring and may renovate mineral nutrients, which causes an increase in primary

production in spring (Müller, 1994). This could explain the occurrence of Naidinae in the autumn and spring, since there were macrophytes during these periods (Alves & Gorni, 2007). Tubificinae was also very common in autumn, which could be explained by the great flush of organic matter, since members of this subfamily consume fine organic matter (Alves *et al.*, 2008) (Table 2).

Naidinae species is a key element in energy transfer in higher trophic levels (Armendáriz, 2007). *Slavina appendiculata* (d'Udekem, 1855) occurred only in spring in L3, with a frequency of 23.1%. Individuals of this species occur on leaves in the littoral of lentic systems (Verdonschot, 2001), and seem to be intolerant to environmental disturbance (Cortelezzi *et al.*, 2012).

Members of the genus *Dero* (Oken, 1815) occurred only in autumn. *Dero (Dero) digitata* (Müller, 1773) was recorded only in L2 during the autumn, with low frequency (0.10%). It is common in sites

Table 1. Descriptive characteristics of the three sampled Lakes (L1, L2, and L3). *Porto União* (SC), Brazil, 2011-2012.

	MF	RV	Depth (m)	Area (Km ²)
L1	Absent (10%) 1	Tree and grass (15%) 1	1.81	4.922
L2	All water surface (50%) 3	Trees (25%) 2	1.43	2.808
L3	Near the margins (30%) 2	Tree, bushes, and grass (50%) 3	1.80	1.235

Note: MF: Macrophytes; RV: Riparian Vegetation.

Table 2. Relative abundance of oligochaetes in the three sampled lakes during sampling periods. There was no specimens during summer and winter in L3. *Porto União* (SC), Brazil, 2011-2012.

Taxa	Spring			Summer		Autumm			Winter	
	L1	L2	L3	L1	L2	L1	L2	L3	L1	L2
Naididae										
Tubificinae										
<i>Tubificinae</i> juvenil	0.73	0.06	0.54	0.75	1	0.49	0.80	0.5	0.06	0.36
<i>Limnodrilus</i> sp.		0.11				0.01	0.01	0.22	0.19	0.11
<i>Limnodrilus hoffmeisteri</i>	0.27	0.44		0.25		0.11	0.03	0.11	0.56	0.35
<i>Branchiura</i> sp.							0.01			
<i>Branchiura sowerbyi</i>		0.39				0.01	0.07		0.19	0.17
Naidinae										
<i>Pristina</i> sp.						0.24		0.06		
<i>Slavina</i> sp.			0.23			0.03				
<i>Slavina appendiculata</i>			0.23							
<i>Dero</i> sp.						0.10	0.07	0.11		
<i>Dero (Dero) digitata</i>							0.01			

rich in nutrients and low dissolved oxygen (Cortelezzi *et al.*, 2012) and a cosmopolitan species (Righi, 1984; Pamplin *et al.*, 2005).

Periphyton is a key factor influencing Naidinae species distribution (Alves *et al.*, 2006; 2008), especially *Pristina* sp. (Ehrenberg, 1828), which uses it as food resource (Bingham & Miller, 1989). The autumn coincides with an increasing load of tree leaves and macrophytes in the littoral zone, providing a substrate for periphyton and bacteria establishment (Müller, 1994). We found *Pristina* sp. only in autumn in L1 and L3, with frequency of 23.94% and 5.56%, respectively.

Tubificidae species are commonly found in fine sediments, in which they play an important role in resource distribution (Lazim *et al.*, 1989). Immatures of Tubificinae were recorded in all seasons, with high frequency (summer=80.0%, autumn=65.8%, spring=38.1% and winter=29.4%).

Branchiura sowerbyi (Beddard, 1892) had frequency of 17.5% in winter, 16.7% in spring, and 4.2% in autumn. This species is cosmopolitan, have gill filaments in the posterior segments, and can reach large body sizes, inhabiting mainly organically enriched freshwater environments in tropical and temperate regions (Lobo & Alves, 2011).

L. hoffmeisteri (Claparede, 1862) is common in several habitats, reaching high densities in organically polluted waters bodies (Dornfeld *et al.*, 2006; Cortelezzi *et al.*, 2012). It can withstand environmental changes, such as low dissolved oxygen and high levels of organic matter (Dornfeld *et al.*, 2006). Thus, it seems to be well adapted to both preserved and polluted environments (Gorni & Alves, 2008). This species occurred in all sampling points and had a frequency of 39.7% in the winter, 26.2% in the spring, 20.0% in the summer, and 6.8% in the fall.

The Tubificinae was the most abundant group throughout sampling periods. Under organic stress, oligochaetes can exclude other benthic invertebrates (Qi, 1987). The exclusion or extinction of many benthic invertebrates can compromise the functioning of whole aquatic ecosystems (Pamplin *et al.*, 2006).

CONCLUSIONS

Our results expand the knowledge on oligochaete species from Southern Brazil, with the first record of limnic oligochaetes in lakes for *Porto União*. This study demonstrates the great importance of inventories, given the lack of information about this group in *Santa Catarina*.

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