The sampling of benthic macroinvertebrates using two different methods: Waiting Trays and an Ekman Collector.

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ABSTRACT: The sampling of benthic macroinvertebrates using two different methodologies: Waiting Trays and an Ekman Collector. **The aim of this study was to compare the structure and composition of the benthic macroinvertebrate community in the sediment of the Diogo Lake, in samples obtained using two different methodologies. Metal trays with a total surface area of 0.1m² were deposited directly onto the sediment of the lake. Also simultaneous samplings (total: 4, one per month) were done with an Ekman grab, having an area of 0.025m². The sediment in the interior of the trays was characterized by an absence of the > 1mm fraction and also by average values of organic material and nitrogen higher to those found in sediments collected by the Ekman grab. The numeric density values of *Polypedilum* and *Cricotopus* obtained using the two collection methods presented significant differences. The elevated abundance of *Cricotopus* in the waiting trays contributed to the fact that the diversity index value of Chironomidae was inferior and significantly different from the value obtained from the sediment. *Campsurus*, which was the macro-invertebrate of greatest numerical density in the collected sediment using the Ekman grab, was not significantly high in the trays. Among the Oligochaeta, *B. sowerbyi* was the most abundant species in the sediment, while *L. hoffmeisteri* was the most abundant in the trays. The structure and the composition of the macro-benthic community obtained using the two collection methods presented a low percentage of similarity (PSC equal to 27.25%), suggesting that the distinct collection methods are capable of generating different information about the structure of the local fauna.**

Key-words: **Artificial substrate, Ekman, Chironomidae, Polymitarcyidae, Oligochaeta.**

RESUMO: Coleta de macroinvertebrados bentônicos através de duas metodologias: bandejas de espera e coletor de Ekman. **Esse estudo teve como objetivo comparar a estrutura e a composição da comunidade dos macroinvertebrados bentônicos do sedimento da Lagoa do Diogo, obtidas através de duas metodologias diferentes. Para tanto, nas amostragens utilizou-se bandejas de estrutura metálica com área total de 0,1m², depositadas diretamente sobre o sedimento da lagoa, e também coletas simultâneas (4 coletas mensais) com um pegador Ekman com área de 0,025m². O sedimento no interior das bandejas foi caracterizado pela ausência da fração > 1mm e por apresentar valores médios de matéria orgânica e nitrogênio superiores aos do sedimento coletado pela pegador de Ekman. Os valores de densidade numérica de *Polypedilum* e *Cricotopus* obtidos através dos dois métodos de coleta apresentaram diferenças significativas. A elevada abundância de *Cricotopus* nas bandejas de espera contribuiu para que o valor do índice de diversidade de Chironomidae fosse inferior e significativamente diferente ao valor obtido no sedimento. *Campsurus* foi o macroinvertebrado de maior densidade numérica no sedimento coletado pelo pegador Ekman, e não foi expressivo nas bandejas. Entre os Oligochaeta, *B. sowerbyi* foi a espécie mais abundante no sedimento enquanto *L. hoffmeisteri* foi mais abundante nas bandejas. A estrutura e a composição da comunidade macrobentônica obtida através dos dois métodos de coleta, apresentaram uma baixa porcentagem de similaridade (PSC igual a 27,25%), sugerindo que métodos distintos de coletas podem gerar informações diferentes sobre a estrutura da biota local.**

Palavras-chave: **Substrato artificial, Ekman, Chironomidae, Polymitarcyidae, Oligochaeta.**

Introduction

The most diverse types of artificial substrates have been frequently utilized for sampling benthic macroinvertebrates (Khalaf & Tachet, 1980; Grzybkowska, 1989; Rodrigues et al., 1998), in studies concerning ecology, response to pollution, colonization and macro-distribution of these organisms (Shaw & Minshall, 1980). These substrates provide alternative methods which make a standardized sampling effort possible (De Pauw et al., 1986), reducing, according to Meier et al. (1979), the subjectivity of traditional samplings.

Even though the Ekman type grab proves to be effective in collecting benthic macro-fauna in environments of aquatic clay sediment, it is convenient to study other types of collectors that can also be efficiently utilized to collect macroinvertebrates.

Even considering that the distinct methodologies may generate different information about the fauna of the environment, the few observations have comparatively appraised the fauna of artificial substrates in relation to the natural substrate, (Shaw & Minshall, 1980; Casey & Kendall, 1996).The aim of our study, is to compare the structure and composition of the sedimentary macrobenthic community, using two distinct sampling methodologies.

Material and methods

The study was carried out in the Diogo Lake, one of the lakes that borders the Mogi-Guaçu River (São Paulo). This lake occupies an area of 0.69 Km^2, it has an average depth of 1.35 meters (Krusche, 1989), and is permanently connected to the Mogi-Guaçu River, receiving at the same time a contribution from the Cafundó stream (Krusche, 1989; Pinto, 1992; Barroso, 1994).

To collect the sediment fauna, trays having a metallic structure with bottom made of a fine sieve of nylon (1.0 mm) were used. Each tray had a total area of 0.1 m^2. Each month a tray was placed directly onto the lake sediment and it was retrieved the following month, when a new tray would substitute the one being removed from the previous month. This process of monthly substitution of the trays occurred between the months of May and October of 1994. Simultaneously, four sedimentary collection were carried out monthly, using an Ekman grab, which had an area of 0.025m^2. These collections were carried out near the site where the trays were placed.

The organisms retained in a sieve with a 0.21mm mesh were retrieved and conserved in formol 4% and after 48 hours were transfered to alcohol 70% (Brinkhurst & Marchese, 1989). To identify the organisms, taxonomic criteria was utilized as set out by Brinkhurst & Marchese (1989), Epler (1992) and Trivinho-Strixino & Strixino (1995).

To determine the percentages of the fine and gross fractions of the sediment, sieves having mesh sizes of 1.00 mm and 0.21 mm were used.

The organic material content of the sediment was determined after ignition at 550°C for 4 hours and expressed as a percentage of the dry weight. The granulometric analysis of the sediment was undertaken using the methodology described by Medina (1972). The concentration of nitrogen was expressed as a percentage of the dry weight and was obtained using the Kjeldhal method.

The index of Shannon & Weaver (Odum, 1985) was used to determine the diversity index of the macroinvertebrate community, Oligochaeta and Chironomidae. The "t" test of Hutcheson" for the H' (Zar, 1999) was used to evaluate the difference between the data of the fauna diversity index obtained by two methodologies.

Considering the samples obtained by two methodologies in each month as a pair, the "test of Wilcoxon" (Zar, 1999) was used to examine possible significant differences between the numeric densities of the fauna obtained by the two methodologies.

The similarity between the faunistic composition obtained by the two methodologies was analyzed using the Percentage Similarity Coefficient (PSC) (Whittaker & Fairbanks, 1958) and using Euclidian distance (complete linkage) taken from monthly values of the Diversity Index.

Result and Discussion

Table I shows the physical and chemical characteristics of the sediment collected using the waiting trays and the Ekman grab. The sediment collected using the trays was characterized by the absence of the >1mm fraction and also by average values of organic material and nitrogen higher to that of the sediment collected by the Ekman grab.

Table I: Physical and chemical characteristics of the Diogo Lake sediment collected using the waiting trays and Ekman grab.

	Fraction >1mm %	Fraction < 0.21mm %	Organic Material %	Total Nitrogen %
Waiting trays				
May	**ND**	**100.00**	**9.50**	**0.35**
June	**ND**	**100.00**	**8.70**	**0.36**
July	**ND**	**100.00**	**9.50**	**0.34**
August	**ND**	**100.00**	**11.00**	**0.41**
September	**ND**	**100.00**	**9.50**	**0.41**
October	**ND**	**100.00**	**7.90**	**0.34**
Average	**ND**	**100.00**	**9.30**	**0.40**
Ekman grab				
May	**0.50**	**90.45**	**4.70**	**0.16**
June	**0.75**	**98.55**	**6.20**	**0.18**
July	**1.27**	**95.14**	**6.20**	**0.21**
August	**0.35**	**97.56**	**6.20**	**0.23**
September	**0.18**	**98.95**	**5.40**	**0.22**
October	**0.27**	**98.12**	**4.70**	**0.21**
Average	**0.55**	**96.50**	**5.60**	**0.20**

ND: Not determinated

The numeric abundance of total fauna was greater in the trays (Wilcoxon, P< 0.05). Considering Chironomidae and Oligochaeta, only the first group showed greater abundance for the trays (Wilcoxon, P< 0.05). The samples obtained from the waiting trays showed that among the Chironomidae, *Polypedilum* and *Cricotopus* were the most abundant organisms (Tab. II). The numerical density values for these two genus presented significant differences between the trays and the grab (P < 0.05). In spite of *Polypedilum* having been numerically higher in the waiting trays, the presence of this genus was also considerable in the sediment of the lake.

Considering the diversity index of for the total fauna and for Chironomidae and Oligochaeta, there was significant difference only for the Chironomidae fauna. The high abundance of *Cricotopus* in the waiting trays probably contributed to the fact that the diversity index value of Chironomidae was low and significantly different (P < 0.05) from the value of this index in the sediment (Tab. III).

The trays deposited onto the sediment promoted favorable conditions for the colonization of the *Cricotopus*. The presence of organic food in fine fractions inside the trays may have been an important factor for the colonization of this genus. According to Baker & Mclachlan (1979), small Chironomidae larvae (e. g., Orthocladiinae) prefer to consume miniscule particles of food (debris and diatoms) in comparison with larger sized larvae.

The Ephemeroptera *Campsurus*, expressive as to its numeric density and frequency in the sediment of the lake, had a non-representative presence in the waiting trays. According to Ferreira (1990), *Campsurus* larvae construct "U" shaped burrows in sludgy sediment. The bottom of the waiting trays made up of a fine sieve of nylon probably made the construction of these tubes difficult, interfering negatively with the numerical density of these Ephemeroptera.

Among the Oligochaeta, *Branchiura sowerbyi* was the most abundant species in the sediment, while *Limnodrilus hoffmeisteri* was the most abundant in the trays. *L. hoffmeisteri* lives commonly in fine fraction sediment (Bingham & Muller, 1989), with high concentration of organic matter. This could explain the higher numeric abundance of the specie in the trays (Tab. I).

Table II: Average values of estimated numerical density (individuals/m²) and relative abundance (%) of benthic macroinvertebrates collected in waiting trays and with the Ekman grab.

	Waiting Trays		Ekman	
	Ind./m²	%	Ind./m²	%
INSECTA				
Ceratopogonidae	**23.00**	**0.99**	**32.34**	**3.97**
Polycentropodidae	**30.00**	**1.27**	**0.00**	**0.00**
Polymitarcyidae				
Campsurus	**198.00**	**8.38**	**361.20**	**44.32**
Chironomidae				
Tanypodinae				
Ablabesmyia	**81.67**	**3.45**	**80.24**	**9.85**
Labrundinia	**5.00**	**0.21**	**0.99**	**0.12**
Procladius	**3.00**	**0.14**	**3.70**	**0.45**
Djalmabatista	**2.00**	**0.07**	**5.31**	**0.65**
Coelotanypus	**2.00**	**0.07**	**3.70**	**0.45**
Chironominae				
Chironomus	**3.00**	**0.14**	**49.81**	**6.11**
Aedokritus	**3.00**	**0.14**	**44.56**	**5.47**
Beardius	**5.00**	**0.21**	**0.00**	**0.00**
Cladopelma	**30.00**	**1.27**	**37.16**	**4.56**
Polypedilum	**480.00**	**20.27**	**64.50**	**7.91**
Harnischia	**7.00**	**0.28**	**18.27**	**2.24**
Paralauterborniella	**8.00**	**0.35**	**4.20**	**0.51**
Cryptochironomus	**0.00**	**0.00**	**5.50**	**0.67**
Nilothauma	**10.00**	**0.42**	**0.00**	**0.00**
Fissimentum	**0.00**	**0.00**	**12.04**	**1.48**
Asheum	**8.00**	**0.35**	**0.00**	**0.00**
Stempellina	**5.00**	**0.21**	**9.26**	**1.14**
Tanytarsini Gênero C	**0.00**	**0.00**	**2.35**	**0.29**
Tanytarsus	**0.00**	**0.00**	**13.46**	**1.65**
Dicrotendipes	**3.00**	**0.14**	**0.00**	**0.00**
Cladotanytarsus	**3.00**	**0.14**	**0.00**	**0.00**
Orthocladiinae				
Cricotopus	**1,168.00**	**49.34**	**1.85**	**0.23**
Nanocladius	**0.00**	**0.00**	**1.85**	**0.23**
Thienemanniella	**98.00**	**4.15**	**1.85**	**0.23**
ANNELIDA				
Oligochaeta				
Tubificidae				
Branchiura sowerbyi	**27.00**	**1.13**	**44.07**	**5.41**
Limnodrilus hoffmeisteri	**113.00**	**4.79**	**7.41**	**0.91**
Aulodrilus pigueti	**2.00**	**0.07**	**1.85**	**0.23**
Opistocystidae				
Opistocysta funiculus	**7.00**	**0.28**	**1.98**	**0.24**
Naididae				
Pristina leidyi	**2.00**	**0.07**	**0.00**	**0.00**
Slavina isochaeta	**2.00**	**0.07**	**0.00**	**0.00**
Hirudinea	**5.00**	**0.21**	**0.00**	**0.00**

Table III: Average values of diversity index of benthic macroinvertebrates in waiting trays and in the sediment of the Diogo Lake.

	Waiting Trays	Ekman
Total fauna	**2.55**	**3.05**
Chironomidae	**1.89**	**4.25**
Oligochaeta	**1.19**	**1.99**

Two species of Naididae, *Pristina leidyi* and *Slavina isochaeta* were found only in the trays and with low numeric density.

The benthic macroinvertebrates obtained using the two collection methods presented a low similarity percentage coefficient (PSC equal to 27.25%), indicating quantitative and qualitative differences in the fauna collected by the Ekman grab and the waiting trays.

The results of the grouping analysis show the formation of two distinct groups (Fig. 1). One made up of the fauna collected in the trays, and the other made up of the material collected with the Ekman grab (except the grab 2 that steady together the trays).

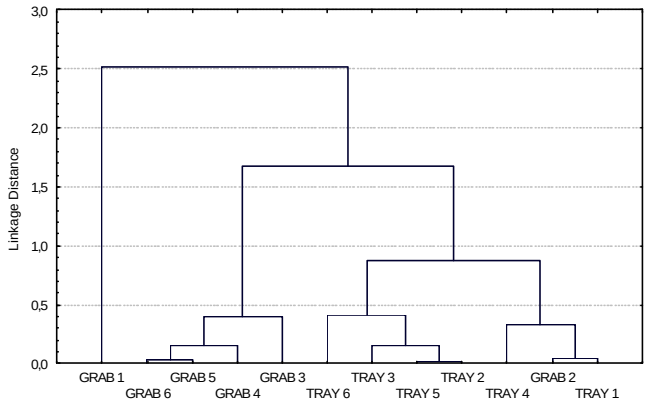

Figure 1: Grouping analysis of the monthly Shannon-Weaver diversity index values of the macrobenthic community collected using the Ekman grab and the waiting trays over the period of May to October, 1998.

This result confirms that different methodologies can provide distinct information about the structure of a community in the same environment.

Casey & Kendall (1996) compared the fauna on artificial substrate to the one on natural substrate and stated that the physical heterogeneity and the organic material quantity were responsible for the difference in the fauna obtained by the two methods. The presence in the trays of the finer fraction, average values of organic material and nitrogen levels higher to those collected by the Ekman grab, are factors that contributed to the difference in the structure of the associations obtained using the two sampling methods.

As for the effort and sampling time, the waiting trays were highly efficient as, the time taken in the field to achieve the samples is much less than that taken with the traditional method. However, it is important to point out that for this study, as for Meier et al. (1979), vandalism was an unforeseen and negative factor which served to postpone the conclusion of the experiment.

According to Khalaf & Tachet (1980), the artificial substrate such as the waiting trays used in the present study represent a selective method of sampling. In this way, based on the low similarity index, the significant difference in the diversity index for the Chironomidae and the difference in the dominant Oligochaeta species obtained using the two different collection methods, it can be suggested that the trays exercised an influence on the selectivity of the organisms presence since they were selective of the type of substrate that became present within the tray itself.

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