Composition and biomass of larval chironomid (Insecta, Diptera) as potential indicator of trophic conditions in southern Brazil reservoirs

Composição e biomassa de larvas de quironomídeos (Insecta, Diptera) como potenciais indicadores de condições tróficas em reservatórios no sul do Brasil

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Abstract: The aim of this study was to evaluate the composition and biomass of chironomid larvae as possible indicators of trophic conditions in reservoirs. The samples were collected in the dry and rainy seasons of the year 2001 in three reservoirs with distinct trophic states (eutrophic, mesotrophic and oligotrophic). Eighteen taxa of Chironomidae were identified, belonging to the Tanypodinae and Chironominae subfamilies. The most represented taxa, in terms of biomass, were *Chironomus decorus* and *Goeldichironomus pictus* groups in the eutrophic reservoir, *Coelotanypu*s sp. and *Tanypus* sp. in the mesotrophic reservoir, and *Tanytarsus* sp. in the oligotrophic reservoir. The higher biomass values were recorded in the eutrophic reservoir, while the lower values were recorded in the oligotrophic reservoir. The results of a Spearman correlation test showed significant and positive correlations for *C. decorus* group and total-P, total-N, turbidity and chlorophyll-*a*. On the other hand, no correlation was observed for *G. pictus* group. However, both taxa were strongly influenced by the eutrophic characteristics of the reservoirs. The results obtained suggest that biomass and composition of chironomid taxocenosis constitute an important tool for predicting the trophic conditions of reservoirs.

Keywords: aquatic insects, biomonitoring, lentic systems, eutrophication.

Resumo: Este trabalho objetivou avaliar a composição e a biomassa das larvas de quironomídeos como possíveis indicadores de condições tróficas em reservatórios. As amostras foram coletadas nas estações seca e chuvosa de 2001, em três reservatórios com distintos graus de trofia (eutrófico, mesotrófico e oligotrófico). Foram identificados 18 táxons de Chironomidae, representados pelas subfamílias Tanypodinae e Chironominae. Os táxons mais representativos em termos de biomassa foram *Chironomus* gr. *decorus* e *Goeldichironomus* gr. *pictus* no reservatório eutrófico, *Coelotanypu*s sp. e *Tanypus* sp. no reservatório mesotrófico e *Tanytarsus* sp. no reservatório oligotrófico. Maiores valores de biomassa foram registrados no reservatório eutrófico, enquanto os menores foram registrados no reservatório oligotrófico. Os resultados da correlação de Spearman evidenciaram correlações significativas e positivas para *C.* gr. *decorus* e P-total, N-total, turbidez e clorofila-*a*. Por outro lado, nenhuma correlação foi observada para *G.* gr. *pictus*. No entanto, ambos os táxons foram fortemente influenciados pelas características eutróficas do reservatório. Os resultados obtidos sugerem que a biomassa de quironomídeos aliada à composição da taxocenose, constitui uma ferramenta relevante para predição das condições tróficas de reservatórios.

Palavras-chave: insetos aquáticos, biomonitoramento, sistemas lênticos, eutrofização.

1. Introduction

Eutrophication in aquatic environments occurs mainly due to human activities, for example, through domestic, agricultural and industrial drainage systems, causing problems in aquatic ecosystems, especially in reservoirs, which supply multiple uses water to urban centers. Characterized by a high concentration of dissolved nutrients in the water (especially phosphorus and nitrogen), one of the consequences of eutrophication is an increase in the biomass of the producers and consumers of these environments (Velho et al., 2005). An increase in phytoplanktonic biomass, mainly by toxigenic cyanobacteria, often causes degradation in water quality (Carmichael, 1997; Codd, 2000). Conversely, oligotrophic aquatic environments are characterized by low concentrations of dissolved nutrients, lower productivity and lower organism biomass.

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Studies on the influence of eutrophication in continental water systems have been carried out for many decades (Ney, 1996; Frost et al., 2003; Wu et al., 2004). Several aquatic communities, among them bacteria (Canosa and Pinilla, 1999), phytoplankton (Boëchat and Giana, 2000), zooplankton (Hessen et al., 2006), periphyton (Jöbgen et al., 2004) and benthic invertebrates (Brooks et al., 2001), have been indicated as predictors of altered aquatic environments. Many benthic macro and microfauna species have short lifecycles and sedentary habits, making them more sensitive to pollution and physical and chemical variations in the water (Wu et al., 2004). For this reason, these organisms have been used in studies to evaluate the degree of alteration of these environments.

The Chironomidae family, one of the main representatives of the benthic community, is very diversified and abundant, and widely distributed (Oliver, 1971; Coffman and Ferrington, 1996) and can subsist in a wide range of water qualities (Saether, 1979; Lindergaard, 1995; Real et al., 2000; Callisto et al., 2002; Higuti et al., 2005). Several studies have revealed that physical and chemical factors strongly influence the composition and abundance of chironomids (Oliver, 1971; Botts, 1997; Callisto, 1997). These characteristics make them potential candidates in monitoring water for the presence of pollution and determining the lake trophic level.

During several decades, the chironomid community has been used in the biological typology of European lakes (Saether, 1979; Wiederholm, 1980). Nevertheless, studies emphasizing chironomid biomass in Neotropical regions are still scarce. So in this study we hypothesized that chironomid composition and biomass would differ in tropical reservoirs along a gradient of trophic conditions. To test this hypothesis we collected chironomids in three reservoirs in southern Brazil characterized by different phosphorous concentrations. We expect to find in the most productive environments a higher biomass of chironomid larvae as well as a distinct taxocenosis composition. In addition, we explore some aspects about chironomid habitat distribution in relation to the environmental variables.

2. Material and Methods

2.1. Study area

The reservoirs are located in the State of Paraná, and have the main purpose of supplying water to urban areas. Three reservoirs with distinct trophic states were selected from a pool of reservoirs studied in State of Paraná (Rodrigues et al., 2005), characterized according to phosphorus concentrations (Vollenweider, 1968 apud Lind et al., 1993).

Eutrophic reservoir: the Iraí reservoir (25° 25' 10" S and 049° 06' 49" W) is located in the municipality of Pinhais. It has an area of 15 km^2 and a mean depth of 5 m. It is responsible for part of the supply of drinking water to the metropolitan region of Curitiba and is fed by four small rivers (the Cercado, Curralinho, Timbu and Canguiri rivers), some of which receive domestic and industrial discharges.

Mesotrophic reservoir: the Harmonia reservoir (24° 18' 28" S and 50° 35' 49" W) is situated in the municipality of Telêmaco Borba. It has an area of 0.64 km^2 and water storage of 5 million m^3. Its banks have steep slopes and it is covered for most of its length by well-preserved native forest. However, a silting-up process is occurring in one of its two tributaries. This reservoir has a sinuous form with clear waters and the absence of aquatic macrophytes.

Oligotrophic reservoir: the Piraquara reservoir (25° 30' 29" S and 49° 01' 30" W) is located in the municipality of Piraquara. It has an area of 3.3 km^2, a mean depth of 7 m and a perimeter of 40 km. Its banks are covered by native vegetation and secondary forests (Júlio-Jr. et al., 2005) (Figure 1).

2.2. Sample collection and laboratory analysis

Samples were collected in the dry (July/August) and rainy (November/December) seasons of 2001, in the three reservoirs in the State of Paraná. The samples were collected in the littoral (1.5-2.8 m) and profundal zones (8.0-18 m) of each reservoir, close to the dam, using a modified Petersen grab (0.018 m^2). Three samples were collected for the analysis of the benthic organisms, and one for the granulometric analysis and the analysis of the organic matter content of the sediment.

The sediment was pre-sorted in a set of sieves with different mesh sizes (2, 1 and 0.2 mm), and the material retained in the sieve with the smallest mesh (0.2 mm) was fixed in 4% formaldehyde buffered with calcium carbonate, and later sorted under a stereoscopic microscope.

After the chironomid larvae had been identified (Trivinho-Strixino and Strixino, 1995), they were kept in distilled water for approximately 1 hour and then dried in ovens at 60 °C for 24 hours, and weighed with precision scales (Sartorius Ultramicro). Their biomass (mean biomass of three sampling units) was expressed in milligrams of dry weight (DW) per square meter.

The measurements and analyses of the environmental variables, such as depth, water temperature, dissolved oxygen (Horiba oximeter), pH and electrical conductivity (portable Digimed meters), turbidity (portable LaMotte turbidimeter), nitrogen (Zagatto et al., 1981), and phosphorous and chlorophyll-*a* (Golterman et al., 1978) were carried out in the Laboratory of Basic Limnology of the Nupélia (Center for Research in Limnology, Ichthyology and Aquiculture) at the Universidade Estadual de Maringá. Granulometric composition was determined using the Wentworth scale (Wentworth, 1922), as described in Suguio (1973). Pebbles, granules and very coarse sand were grouped as coarse sediment; coarse, medium and fine sand

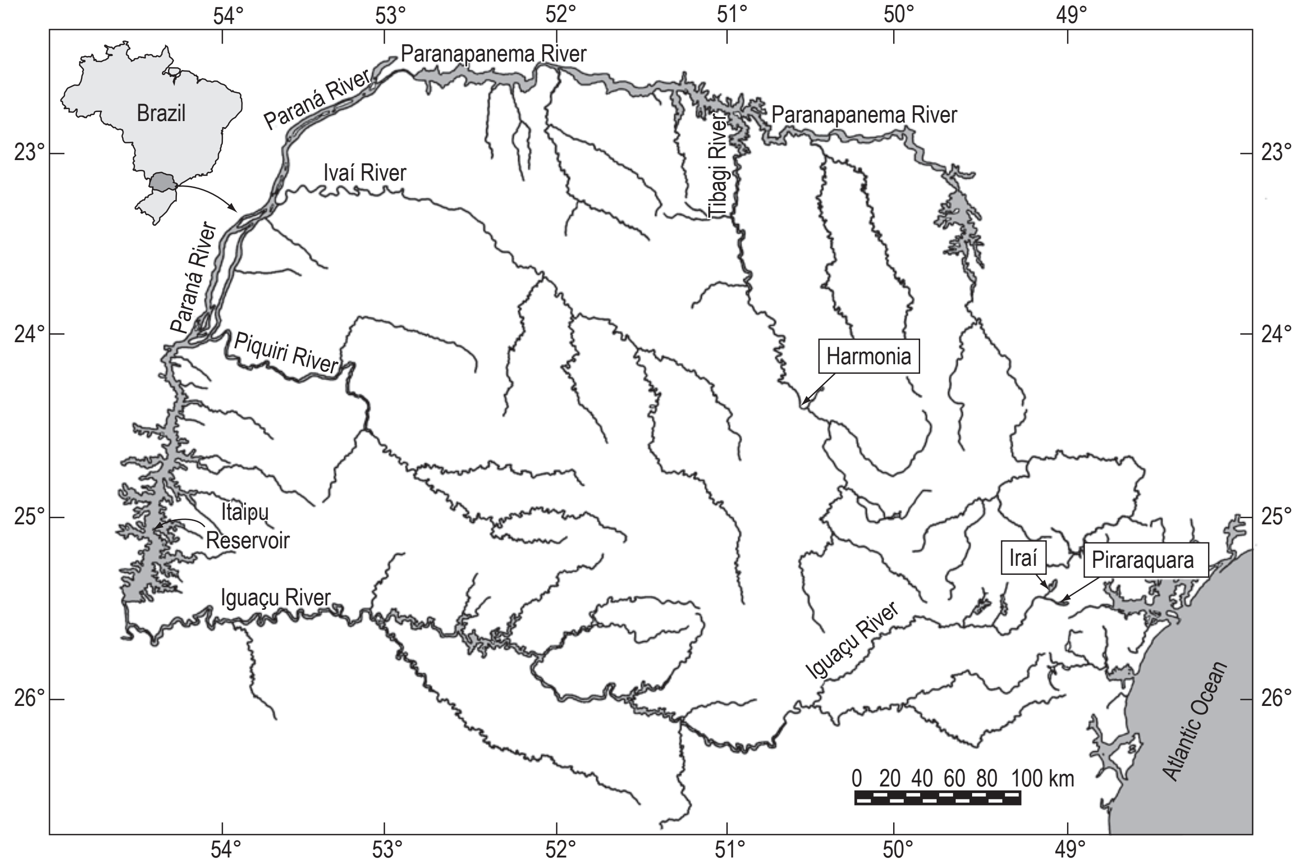

Figure 1. Location of the three reservoirs in the State of Paraná.

as medium sediment; and very fine sand and mud as fine sediment. To estimate the organic matter in the sediment, a sub-sample was burnt in a muffle furnace at 560 °C for four hours.

The water temperature, dissolved oxygen, pH and electrical conductivity measurements were obtained in the hypolimnic layer of the littoral and profundal zones of the reservoirs, while the turbidity, total-P, total-N and chlorophyll-*a* values were determined from the epilimnic layer, and only in the limnetic zone.

2.3. Data analysis

A principal components analysis (PCA), based on the abiotic variables and chlorophyll-*a*, was carried out to examine for the distribution pattern of these variables in the different reservoirs. All of the data had previously been transformed into log (except for pH) and the axes of the PCA were selected according to the Broken-Stick criterion (Jackson, 1993). A parametric ANOVA was then carried out with the scores of axes 1 and 2 to test the significance of the variables that contributed to the formation of these axes. When there was a significant difference, a posteriori Tukey test was carried out. When the hypothesis of homoscedasticity was not reached, the non-parametric Kruskal-Wallis test was used to evaluate possible significant differences.

In addition, a parametric ANOVA was also carried out to test the difference in chironomid biomass among the different reservoirs.

Spearman correlation analyses were carried out to verify possible associations between 1) the biomass of the five most abundant chironomid taxa and 2) total chironomid biomass and the abiotic variables (water temperature, depth, pH, electrical conductivity, dissolved oxygen, organic matter, turbidity, total phosphorous, total nitrogen, chlorophyll-*a* and sediment texture).

A multiple response proceeding was performed, using the Euclidian distance, to test differences on chironomid larvae composition among the reservoirs trophic states. The MRPP is a non parametric analysis to test differences in the structure of the assemblages among previously defined sample groups (Zimmerman et al., 1985).

The program Statistica 7.1 (Stat Soft, Inc., 2005) was used to carry out the analyses of variance and the Spearman correlations, and the program PC-ORD (McCune and Mefford, 1999) was used for the principal components analysis.

3. Results

The minimum water temperature was 13.6 °C in the dry season and 24.5 °C in the rainy season. The reservoirs, in general, can be characterized as being slightly acidic to neutral (pH 5.9 to 7.1). The higher values for electrical conductivity, turbidity, total-N, total-P and chlorophyll-*a* were found in the eutrophic reservoir, while the lower values were found in the oligotrophic reservoir. The percentage of organic matter was higher in the profundal zones of the reservoirs, especially in the eutrophic reservoir. The substrate was predominately constituted of fine sediment in the eutrophic reservoir and medium sediment in the mesotrophic and oligotrophic reservoirs (Table 1).

Axes 1 and 2 of the principal components analysis (PCA) explained 58.32% of the variability of the data. The result of the analysis discriminates (by principal component 1) the eutrophic reservoir from the others, due to higher values for P, N, turbidity and chlorophyll-*a*, and also to a predominance of mud in the substrate. Organic matter and depth were positively correlated to principal component 2, and negatively to pH, dissolved oxygen and fine sand (Figure 2a). The result of the ANOVA showed a significant difference only for axis 1 (F = 14.41 and p = 0.0016), where the eutrophic reservoir was significantly different to the mesotrophic and oligotrophic reservoirs (Figure 2b).

The faunal survey recorded the occurrence of 18 taxa of Chironomidae, belonging to two subfamilies: Tanypodinae and Chironominae. Considering the trophic state of the reservoirs, a clear alteration in the composition and biomass was observed. The highest mean biomass was recorded to *Goeldichironomus pictus* and *Chironomus decorus* groups in the eutrophic reservoir, to *Coelotanypus* sp. and *Tanypus* sp. in the mesotrophic, and to *Tanytarsus* sp. in the oligotrophic reservoir (Table 2).

The higher mean total chironomid biomass values were found in the littoral zones of the three reservoirs, with the higher biomass occurring mainly in the eutrophic reservoir (Table 2, Figure 3). The results of the ANOVA showed significant differences between the eutrophic and oligotrophic reservoirs (F = 3.56 and p = 0.03). According to the MRPP, the chironomid composition differed significantly among reservoirs with distinct trophic state (T = –7,48; A = 0,15; p < 0,001).

Table 1. Abiotic variable and chlorophyll-*a* values in the different reservoirs during the dry and rainy seasons of 2001 (WT = water temperature, De = depth, EC = electrical conductivity, DO = dissolved oxygen, OM = organic matter, Tu = turbidity, TP = total phosphorus, TN = total nitrogen, Ca = chlorophyll-*a*, CS = coarse sediment, MS = medium sediment and FS = fine sediment).

		Eutrophic		Mesotrophic		Oligotrophic	
Variables	Period	Littoral	Profundal	Littoral	Profundal	Littoral	Profundal
WT (ºC)	Dry	15.6	15.8	17.0	13.6	16.3	15.4
	Rainy	24.5	20.1	23.7	15.2	24.0	17.2
De (m)	Dry	1.8	8.5	1.5	12.0	2.8	18.0
	Rainy	1.5	8.0	3.0	13.5	1.5	18.0
pH	Dry	6.7	6.7	6.4	5.5	6.1	5.9
	Rainy	7.0	6.5	7.9	6.3	6.8	6.0
EC (µS.cm^{-1})	Dry	51.9	47.5	26.7	29.3	22.9	24.1
	Rainy	49.9	53.2	31.0	61.0	23.9	27.8
DO (mg.L^{-1})	Dry	8.6	7.6	10.9	2.2	9.2	6.0
	Rainy	6.5	0.1	9.3	0.0	7.0	1.0
Tu (NTU)	Dry	nd	30.9	nd	3.3	nd	1.9
	Rainy	nd	9.7	nd	3.7	nd	2.0
TP (µg.L^{-1})	Dry	nd	55.2	nd	14.4	nd	9.6
	Rainy	nd	53.4	nd	8.6	nd	4.5
TN (µg.L^{-1})	Dry	nd	1483.1	nd	326.2	nd	480.9
	Rainy	nd	821.5	nd	290.0	nd	312.5
Ca (µg.L^{-1})	Dry	nd	82.9	nd	9.6	nd	4.0
	Rainy	nd	71.2	nd	36.9	nd	3.7
OM (%)	Dry	13.9	39.0	3.9	17.5	7.0	23.2
	Rainy	17.3	34.8	3.5	17.5	13.8	25.5
CS (%)	Dry	1.2	0.0	0.9	5.7	9.7	0.7
	Rainy	20.2	1.2	7.2	31.1	37.3	9.5
MS (%)	Dry	35.3	46.9	59.6	59.1	73.7	41.4
	Rainy	46.6	35.3	47.0	54.6	46.0	58.3
FS (%)	Dry	63.3	53.5	39.5	35.3	16.7	57.8
	Rainy	33.3	63.3	45.8	14.4	17.4	32.1

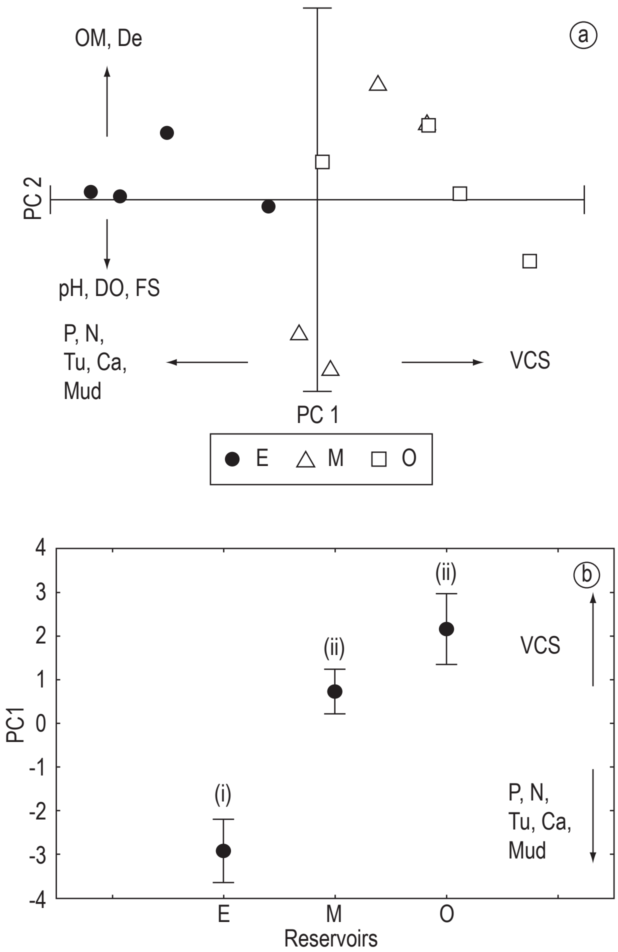

Figure 2. a) Principal component analysis derived from abiotic data and chlorophyll-*a* in the different reservoirs during the dry and rainy seasons of 2001; b) whiskers plots giving means and standard errors from the scores of axis 1 of the PCA (De = depth, DO = dissolved oxygen, OM = organic matter, Tu = turbidity, Ca = chlorophyll-*a*, VCS = very coarse sand, FS = fine sand, E = eutrophic, M = mesotrophic and O = oligotrophic). Different codes (i and ii) show significant differences between reservoirs in subsequent Tukey tests ($P < 0.05$).

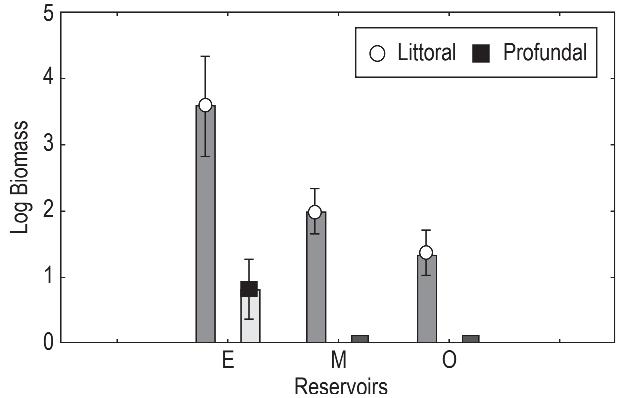

Figure 3. Mean values and standard errors of chironomid biomass ($mg.m^{-2}$) in the three reservoirs during the dry and rainy seasons of 2001 (E = eutrophic, M = mesotrophic and O = oligotrophic).

The results of the Spearman correlation showed a strong positive correlation between *C. decorus* group and turbidity, phosphorous, nitrogen and chlorophyll-*a*, and a negative correlation between *Tanytarsus* sp. and electrical conductivity and mud. *Tanypus* sp. biomass was positively correlated to the percentage of pebbles. Positive correlations were also observed between the mean total chironomid biomass and pH and dissolved oxygen, and negative correlations with depth (Table 3).

4. Discussion

In the present study were recorded 18 chironomid taxa. In a survey in thirty reservoirs of Paraná State, including the three reservoirs analyzed here, Higuti et al. (2005) recorded 68 chironomid taxa. However, a revision carried out by Roque et al. (2004) on chironomid from lentic systems in São Paulo State listed 260 chironomid taxa in 41 environments. Thus, a greater sampling effort probably should lead to higher chironomid richness in the Paraná reservoirs.

Some authors has used the chironomid larvae as indicators of water qualities (Saether, 1979, Verneaux and Aleya, 1998, Ruse, 2002), because their close relationship with the environmental variables. Thus, there are several reasons to explain why chironomids, mainly their composition and biomass, respond to the environmental variables and trophic condition in our reservoirs.

The higher chironomid biomass was recorded in the eutrophic reservoir, and was mainly represented by *Chironomus decorus* and *Goeldichironomus pictus* groups. Both of these taxa are known for being very successful in conditions that can be considered critical for other organisms, such as those with low concentrations of dissolved oxygen. The presence of *C. decorus* group has been associated to locations with high concentrations of nutrients, as well as low values for dissolved oxygen (Epler, 1992). Callisto et al. (2002) also associated *C. decorus* group to the eutrophic conditions of Lake Imboassica in the State of Rio de Janeiro.

Despite the fact that there was no evidence of a correlation between *G. pictus* group biomass and the abiotic variables and chlorophyll-*a*, its elevated biomass may be related to the high primary productivity of the reservoir, as this group is considered by some authors as being an indicator of eutrophic conditions (Marques et al., 1999; Callisto et al., 2001; Higuti et al., 2005). Furthermore, according to Armitage et al. (1995) and Callisto et al. (1997), *Goeldichironomus* it is found in high densities in areas that are rich in decomposing organic matter.

The *Chironomus* and *Goeldichironomus* genera have detritivorous habits (Callisto et al., 2001), and environments with high concentrations of organic detritus, of animal or vegetal origin, favor them. Therefore, the higher quantity of organic matter found in the eutrophic reservoir probably favored the development of both of these taxa. Silver and

Table 2. Chironomid mean biomass (mg.m^{-2}) of the three sampling units in the different reservoirs, during the dry and rainy seasons of 2001 (DL = dry season/littoral zone, DP = dry season/profundal zone, RL= rainy season/littoral zone, RP = rainy season/profundal zone).

	Eutrophic				Mesotrophic				Oligotrophic			
	DL	DP	RL	RP	DL	DP	RL	RP	DL	DP	RL	RP
Tanypodinae												
Ablabesmyia (Karelia)	-	-	-	-	0.74	-	-	-	-	-	-	-
Coelotanypus sp.	-	-	-	-	36.50	-	-	-	-	-	-	-
Procladius sp.	-	-	-	-	1.33	-	-	-	-	-	-	-
Tanypus sp.	-	-	-	-	-	-	22.76	-	-	-	-	-
Chironominae												
Caladomyia ortoni Säwedal, 1981	1.89	-	-	-	0.38	-	-	-	1.13	-	1.89	-
Chironomus gr. *decorus*	41.85	52.31	41.85	-	-	-	-	-	-	-	-	-
Chironomus gr. *salinarius*	-	-	-	-	0.82	-	-	-	-	-	-	-
Cladopelma sp.	1.53	-	-	-	-	-	-	-	-	-	-	-
Dicrotendipes sp. 3	0.88	1.77	-	-	-	-	-	-	-	-	-	-
Goeldichironomus gr. *pictus*	28.75	-	237.17	-	-	-	-	-	-	-	-	-
Fissimentum desiccatum Cranston and Nolte, 1996	-	-	-	-	0.44	-	-	-	-	-	-	-
Harnischia complex sp. 1	-	-	-	-	-	-	-	-	-	-	1.07	-
Harnischia complex sp. 2	-	-	-	-	-	-	-	-	-	-	0.38	-
Parachironomus sp. 1	-	-	-	-	-	-	-	-	-	-	0.73	-
Paralauterborniella sp.	-	-	-	-	-	-	-	-	-	-	0.39	-
Polypedilum (*Tripodura*) A	7.21	-	-	-	0.90	-	-	-	-	-	-	-
Tanytarsus sp.	-	-	-	-	2.74	-	-	-	18.26	-	6.39	-
Chironomini	-	-	0.11	-	-	-	-	-	-	-	-	-
Total biomass	82.12	54.08	279.13	0	43.84	0	22.76	0	19.39	0	10.85	0

Table 3. Spearman Rank Correlations between the 18 environmental variables and the five most abundant taxa and total chironomid biomass (De = depth, EC = electrical conductivity, DO = dissolved oxygen, Tu = turbidity, TP = total phosphorus, TN = total nitrogen, Ca = chlorophyll-*a* and Pe = pebbles).

	Coelotanypus sp.	*Tanypus* sp.	*C.* gr. *decorus*	*G.* gr. *pictus*	*Tanytarsus* sp.	Total biomass
De	–0.40	–0.04	–0.26	–0.47	–0.56	–0.72 **
pH	–0.04	0.48	0.53	0.40	–0.05	0.72 **
EC	–0.22	0.04	0.40	0.38	–0.72 **	0.09
DO	0.48	0.39	0.20	0.11	0.50	0.70 *
Tu	–0.09	0.09	0.74 **	0.51	–0.54	0.53
TP	0.09	–0.26	0.74 **	0.51	–0.30	0.54
TN	–0.09	–0.44	0.74 **	0.51	–0.15	0.48
Ca	–0.09	0.09	0.74 **	0.51	–0.52	0.54
Pe	–0.13	0.60 *	–0.25	–0.20	0.30	0.06
Mud	–0.22	–0.13	0.44	0.33	–0.60 *	0.08

Significance levels: *P < 0.05, **P < 0.01

McCall (2004) demonstrated that the *Chironomus* genus was selective in relation to the decomposition time of the organic detritus. Vos et al. (2000) showed that detritus with high nitrogen, phosphorous, carbon and fatty acid values results in larvae of higher sizes. Although, it is not possible to discuss these particular relationships in the present study, it can be observed that detritus can be a determining factor in the composition and abundance of chironomid. Despite being regarded as gatherer-detritivores (Callisto et al., 2000), the *Chironomus* and *Goeldichironomus* genera can also demonstrate feeding flexibility, feeding on algae (especially diatomaceous algae) and bacteria (Pinder, 1986; Berg, 1995; Strixino and Trivinho-Strixino, 1998).

Coarse particle organic matter (CPOM) can also act as a shelter against predators, due of the size and the bright red color of the *C. decorus* and *G. pictus* groups, which can favor its predation, especially by aquatic vertebrates (Butler and Anderson, 1990). Associated to organic matter, fine particle sediment (mud), which is used in the construction of its tubes, can provide higher protection for chironomid larvae. Therefore, it is possible that the larvae that live in such shelter environments, even in the same stage, could present a greater biomass accumulation.

The main representatives of the mesotrophic reservoir, where fine and medium sediment particles predominated, were *Coelotanypus* sp. and *Tanypus* sp. Despite the results of the present study not showing a significant correlation, the fine sandy sediment may have favored the abundance of *Coelotanypus* sp., as this correlation was found in studies carried out by Di Persia (1986) and Higuti et al. (1993). *Tanypus* sp. shows preferences for fine particle sediment, lower quantities of organic matter and high concentrations of dissolved oxygen (Strixino and Trivinho-Strixino, 1998). However, in the present study, a high correlation between *Tanypus* sp. and pebbles was observed. This fact is probably due to the increase in microhabitat provided by this type of substrate, as well as to a higher level of oxygen in the water.

Tanytarsus sp. was the most abundant taxa in the oligotrophic reservoir, probably because of its more oxygenated waters and shallow littoral zones. This fact may be closely related to the low concentrations of hemoglobin present in this genus (Panis et al., 1996). Saether (1979) showed that different species of *Tanytarsus* and *Chironomus* occurred in a wide range of trophic conditions. However, Thienemann (1913) apud Esteves (1988) stated that the presence of *Tanytarsus* sp. is strongly related to oligotrophic and well oxygenated environments, while *Chironomus* sp. are associated to eutrophic environments and low concentrations of dissolved oxygen. This same pattern of shift in the fauna of chironomid driven by changes in the physical and chemical characteristics of the water has also been observed by other researchers (Dougherty and Morgan, 1991; Heinis and Davids, 1993).

With regard to the analyzed zones, higher values of biomass were observed in the littoral of the eutrophic reservoir. Moreover, only in the eutrophic reservoir were recorded chironomid larvae in the profundal zone. Our results were probably related to the high productivity and organic matter in this environment. Study carried out by Verneaux and Allie (1998) verified the importance of bathymetry utilizing chironomids to characterize the trophic states of temperate lakes. These authors also verified a decrease in the communities' complexity with the increase of the depth, emphasizing the importance of sampling in a wide range of depths.

The results obtained in the present study showed the significant influence of trophic state on the chironomid larvae biomass. Furthermore, it was observed that differences in limnological characteristics generally determined distinct faunal composition in each reservoir. These results confirmed our hypothesis of higher biomass and distinct taxocenosis composition in the most productive environments. It is therefore suggested that the biomass and composition of chironomid taxocenosis constitute an important tool for predicting the trophic conditions of reservoirs. Nevertheless, more studies contemplating a higher number of reservoirs, representing different gradients of conditions, are necessary to confirm the results obtained here and to establish models to chironomid community in Neotropical reservoirs.

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