Temporal variation of Chironomidae larvae (Insecta, Diptera) in the Batalha River, Midwestern São Paulo State, Brazil

Variação temporal de larvas de Chironomidae (Insecta, Diptera) no Rio Batalha, região centro oeste do Estado de São Paulo, Brasil

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Resumo: Neste estudo foi analisada a composição e a estrutura da fauna de Chironomidae (Insecta, Diptera) do Rio Batalha, região centro-oeste do Estado de São Paulo, correlacionando-a com características ambientais dos pontos de amostragem. As coletas de sedimento foram realizadas de abril de 1996 a março de 1997, em 10 pontos de amostragem. 1.625 larvas de Chironomidae pertencentes a 29 táxons foram processadas e identificadas. Os gêneros *Caladomyia*, *Chironomus*, *Djalmabatista* e *Polypedilum* foram os mais abundantes. *Polypedilum* ocorreu praticamente em todos os meses durante o estudo. Os resultados indicaram maiores valores de riqueza durante a estação seca e que a composição de Chironomidae variou durante o ano.
Palavras-chave: Insetos aquáticos; Rio Batalha; riqueza; diversidade; ecologia.

Abstract: In this study was analyzed the composition and structure of Chironomidae fauna (Insecta, Diptera) of Batalha River, Midwestern São Paulo State, correlating them with the environmental conditions of the sampling points. The sediment samples were carried out from April 1996 to March 1997, in 10 sampling points. 1,625 Chironomidae larvae belonging to 29 taxa were processed and identified. The genera *Caladomyia*, *Chironomus*, *Djalmabatista*, and *Polypedilum* were the most abundant. *Polypedilum* occurred almost every month during the study. The results indicated higher richness during the dry season and that the composition of Chironomidae variation during the year.
Keywords: Aquatic insects; Batalha River; richness; diversity; ecology.

INTRODUCTION

In recent years, the aquatic ecosystems have been altered at different scales, due to anthropogenic activities, such as: mining, dam construction, artificial eutrophication, river canalization and recreation (Dudgeon, 1994). The result of these environmental alterations represent an accentuated decline in aquatic biodiversity, in function of destabilization of chemical and physical environment and modifications in dynamic and structure of biological communities (CALLISTO *et al*., 2005).

In this context the use of macroinvertebrates as bioindicators of water quality, mainly for assessment of environmental impacts resulting from discharges of domestic sewage and industrial effluents is extremely useful. Within the organisms utilized in environmental assessments as tool for detection of disturbances in the water bodies, the Chironomidae family highlighting as an important component of aquatic communities, both in density as well as in diversity, it colonizing several types of biotopes and living in a wide variety of environmental conditions (PINDER, 1986). Through the chironomids is possible to obtain records of ecologic process resulting from alterations occasioned by hydrologic variations. In this way, the study these organisms provide valuable information to the comprehension of the structure e functioning of aquatic communities (MOULTON, 1998).

The Chironomidae community suffers important seasonal alterations during the year, showing elevated abundances during dry season. Spatial and temporal variation of Chironomidae assemblages has been observed in stream, rivers and lakes (BROOKS, 2000; MARQUES *et al*., 1999; ROBINSON *et al*., 2001). Within recent decades, the group has been widely studied in all world (ARMITAGE *et al*., 1995), being this interest due mainly to importance of the chironomids in aquatic and terrestrial environments (PINDER, 1986), in agriculture (FERRARESE, 1993), in the environmental monitoring (ROSENBERG, 1992; ARMITAGE *et al*., 1995), in paleoecological researches (WALKER, 1995), in the public health (CRANSTON, 1995) and as food of other groups of animals (ARMITAGE, 1995, COFFMAN & FERRINGTON, 1996).

The Batalha River is responsible for water capitation for supply of the city of Bauru. The occupation and improper soil use, as well as other anthropogenic activities developed in the drainage basin of this aquatic system (deforestation of riparian vegetation, implantation of monocultures and reforestation economic) has been responsible for alterations in water quality and exposure of the spring areas to erosive processes, which lead to formation of deposition areas in the environment (TALAMONI *et al*., 1999).

Given the economic meaning of this hydric system and the importance of chironomids as biologic indica-

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tors, the objective this study was to analyze the composition and structure of Chironomidae larvae (Insecta, Diptera) of Batalha River, Midwestern São Paulo State (Brazil), correlating them with the environmental characteristics of the sampling points, beyond to observe the dynamic temporal of the Chironomidae larvae.

MATERIALS AND METHODS

This study was carried out at Batalha River (Figure 1), located at central west region of São Paulo State (22º 20' S e 49º 00' W). This water body belonging to Médio Tietê Superior hydrographic basin, have their springs at Serra da Jacuntiga (Agudos) and in it's way, through the cities of Agudos, Bauru, Piratininga, Avaí, Duartina, Gália, Presidente Alves, Reginópolis and Uru, reach the Tietê River with 167 km of extension, receiving discharges of domestic sewage and industrial effluents in different points.

The sediment samples were carried out from April 1996 to March 1997 in 10 sampling points with different characteristics: Points 1, 2 and 3 (P1, P2 and P3), spring areas with sandy substrate surrounded by pasture land; Point 4, 5 and 6 (P4, P5 and P6), stretch without riparian vegetation, heterogeneous substrate (sandy and stone), impacted by pasture land. Point 7 (P7), water capitation dam of the Water Treatment Station (ETA DAE/Bauru), sandy substrate. Point 8 (P8), pasture land, without riparian vegetation, sandy substrate, the site receive discharge of domestic sewage from city of Piratininga. Point 9 (P9), beside Bauru-Marília highway, also presents sandy substrate, there is a balneary on site. Point 10 (P10), near Marechal Rondon highway, deep stretch with sandy substrate and riparian vegetation.

The sediment was sampled monthly (3 subsampling in each sample site) using an Ekman-Birge grab (0,0225m^2 area) and immediately fixed in a 10% formalin solution. In the laboratory, the samples were washed using 0.250 mm sieves, sorted and preserved in 70% ethanol. The organisms, belonging to Chironomidae family, were subsequently identified, under stereomicroscope, using appropriate literature (EPLER, 1995; TRIVINHO-STRIXINO & STRIXINO, 1995) and counted.

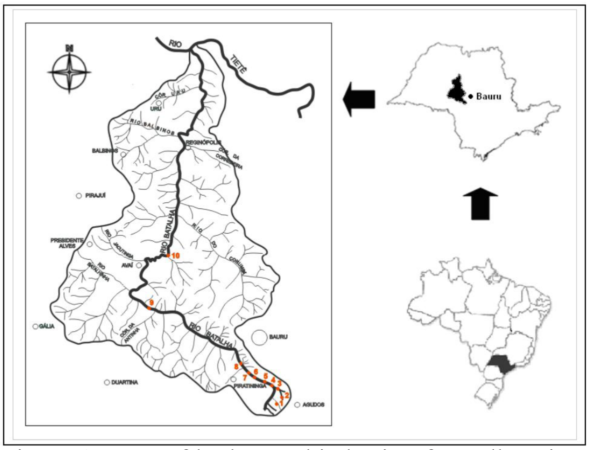


Figure 1: Map of hydrographic basin of Batalha River (SP, Brazil), evidencing the sampling points.

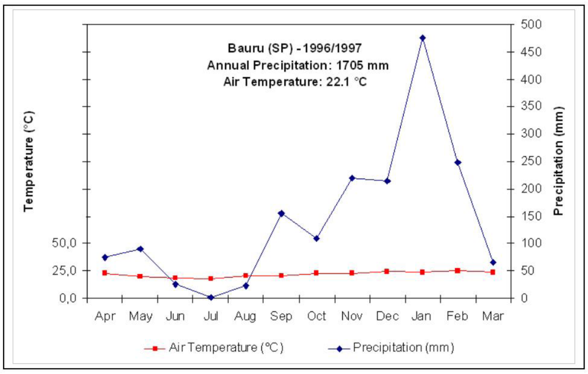


Figure 2: Mean air temperature and total precipitation values recorded to city of Bauru (SP), by Instituto de Pesquisas Meteorológicas (IPMet), from April 1996 to March 1997

The relative participation of each taxon was calculated separately for months. The structure of the Chironomidae fauna was analyzed by means of its taxonomic composition, species richness (S), Shannon-Wiener diversity index (H'), Pielou evenness index (equitability) (J) and Simpson dominance index (D) Pinto-Coelho (2002). The UPGMA analysis (cluster analysis), using Bray-Curtis distance, was performed to verify the similarity among different sampling points of Batalha River (KREBS, 1989). Pluviosity data were provided by the Meteorological Research Institute (IPMet) and taken from the Automatic Meteorological Station, near the studied area.

RESULTS

A seasonal regime of precipitation, with concentration of rains in summer and a dry period in winter was observed (Figure 2). The peak of rains occurred in January, reaching 475.3 mm, while the driest month was July (1.6 mm). The annual precipitation in the city was 1,705.3 mm.

In this study, 1625 specimens belonging to 29 genera, 8 tribes and 3 subfamilies were collected (Table 1). The data obtained indicate that the values of absolute abundance (N) and richness (S) oscillated throughout the year (Table 2), being observed an increase of number of genera during the dry period (June/August). The month of June presented the highest richness with the occurrence of 18 genera, while January and March showed the smallest richness, with overall absence of genera.

The genera *Caladomyia*, *Chironomus*, *Djalmabatista*, and *Polypedilum* were the most abundant, being present almost every month during the study. While *Demicryptochironomus*, *Endotribelos*, *Paralauterborniella* and *Coelotanypus* were the genera of lower occurrence, being present only in the months of November, December, July and April, respectively (Table 1).

Table 1: Relative abundance of Chironomidae larvae (Insecta, Diptera) recorded in Batalha River (SP, Brazil), from April 1996 to March 1997

Genera	Sampling Period											
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	*Feb	Mar
Chironominae												
Chironomini												
Apedilum Townes, 1945		0,008						0,010		0	-	0
Chironomus Meigen, 1803		0.005			0.225	0.604	0.034	0.055		0	-	0
Cladopelma Kieffer, 1921	0.004	0.003	0.028	0.005		0.007				0	-	0
Cryptochironomus Kieffer, 1918	0.008	0.024	0.028	0.005	0.025	0.007		0.020		0	-	0
Demicryptochironomus Lenz, 1941								0.005		0	-	0
Endotribelos Grodhaus, 1987									0.050	0	-	0
Fissimentum Cranston & Nolte, 1996				0.029			0.022	0.005	0.050	0	-	0
Goeldichironomus Fittkau, 1965			0.007		0.013	0.007	0.011	0.035		0	-	0
Harnischia Complex Kieffer, 1921	0.068	0.008	0.021	0.024	0.013	0.007	0.011	0.005		0	-	0
Parachironomus Lenz, 1921			0.007		0.013		0.124		0.050	0	-	0
Paralauterborniella Lenz, 1941				0.005						0	-	0
Paratendipes Kieffer, 1911					0.013					0	-	0
Polypedilum Kieffer, 1912	0.475	0.640	0.306	0.329	0.138	0.333	0.236	0.144	0.350	0	-	0
Saetheria (?) Jackson, 1977	0.004	0.005								0	-	0
Tanytarsini												
Caladomyia Säwedal, 1981	0.004		0.056	0.019	0.088	0.011		0.582	0.050	0	-	0
Rheotanytarsus Thienemann & Bause in Bause, 1913	0.233						0.045			0	-	0
Tanytarsus van der Wulp, 1874	0.025	0.008	0.014	0.063		0.004			0.050	0	-	0
Orthocladiinae												
Corynoneurini												
Corynoneura Winnertz, 1846	0.008	0.005	0.014							0	-	0
Thienemanniella Kieffer, 1911	0.025		0.021	0.106			0.022			0	-	0
Orthocladiini												
Cricotopus van der Vulp, 1874	0.068	0.013	0.014	0.010	0.050		0.011			0	-	0
Lopescladius Oliveira, 1967	0.008	0.056	0.201	0.029	0.125	0.011	0.067	0.005	0.050	0	-	0
Nanocladius Kieffer, 1913	0.008		0.021	0.014						0	-	0
Tanypodinae												
Pentaneurini												
Ablabesmyia Johannsen, 1905			0.007	0.005						0	-	0
Larsia Fittkau, 1962	0.004	0.003		0.029						0	-	0
Coelotanypodini												
Clinotanypus Kieffer, 1913			0.007	0.010	0.013					0	-	0
Coelotanypus Kieffer, 1913	0.004									0	-	0
Procladiini												
Djalmabatista Fittkau, 1968		0.221	0.236	0.314	0.275	0.007	0.416	0.134	0.350	0	-	0
Procladius Skuse, 1889			0.007	0.005						0	-	0
Tanypodini												
Tanypus Meigen, 1803	0.051		0.007		0.013					0	-	0

**There were not samplings*

Shannon-Wiener diversity (H') index values indicated higher values during dry season, being the highest value obtained in June. Pielou evenness index (J) presented higher values in August and December, while the Simpson dominance index (D) showed high values in May and September (Table 2). Cluster analysis (Figure 3), based on the abundance of 29 genera collected, revealed the formation of three groups: (1) represented by P8 and P9, showed greater similarity (67.0%); (2) formed by P6 and P10, presented similarity of 54.8%; (3) formed by P3 and P4 showed lower affinity (53,5%). P7 located in dam ETA (DAE/Bauru) was the point most distinct in relation to others.

DISCUSSION

In this study, the variation in distribution of the Chironomidae fauna seem to be related, mainly to input of organic matter for within the environment, to silt process resulting from the erosive process caused by inexistence of riparian vegetation, and to human activities carried out along Batalha River. According to Graça *et al*. (2004), these factors can affect the presence and species density of aquatic communities.

As well as Rodrigues (1997), Fonseca-Gessner & Guereschi (2000) and Higuti & Takeda (2002), in this study was recording a decline of absolute abundance of Chironomidae assembly during rainy season, as resulting from, probably, of increase draught velocity and destabilization of the substrate. These factors can have been responsible by overall absence of chironomids in the month of January and March. On the other hand, according to Aburaya & Callil (2007), in the dry season the Chironomidae abundance increase due to a higher of diversification of the sediment. Such fact was confirmed in this study, since it was recorded a slight increase in the number of chironomids during dry period.

Table 2: Values of richness (S), absolute abundance (N) diversity (H'), equitability (J) and dominance (D) of Chironomidae larvae (Insecta, Diptera) recorded in Batalha River (SP, Brazil), from April 1996 to March 1997

	S	N	H'	J	D
Apr	16	236	0.727	0.604	0.290
May	13	375	0.503	0.452	0.461
Jun	18	144	0.874	0.696	0.191
Jul	17	207	0.823	0.669	0.222
Aug	13	80	0.872	0.783	0.162
Sep	10	273	0.421	0.421	0.475
Oct	11	89	0.748	0.718	0.244
Nov	11	201	0.595	0.571	0.379
Dec	8	20	0.709	0.786	0.221
Jan	0	0	0	0	0
Feb*	-	-	-	-	-
Mar	0	0	0	0	0
Total	29	1625			

**There were not samplings*

In the Batalha River, *Polypedilum* was the taxon most abundant, present almost every month during the study, this genus is composed of grazer-collectors (COFFMAN & FERRINGTON, 1996) and belongs to the group of psammophilic Chironomidae (Barton, 1984), usually associated with sandy bottoms. The silting process and formation of deposition zones can have contributed to the predominance of this genus.

Caladomyia and *Djalmabatista* also showed expressive abundances. The first is a genus composed of filters-collectors (COFFMAN & FERRINGTON, 1996), found in little deep environments, with substrate rich in organic matter (TRIVINHO-STRIXINO & STRIXINO, 1991). The second genus is considered predators-engulfers (COFFMAN & FERRINGTON, 1996), although this genus has been recorded often feeding up of dead leaves, wood fragments and detritus (HENRIQUES-OLIVEIRA *et al*., 2003). The predominance these genera can be attributed to in input of organic matter resulting from deforestation of riparian vegetation of stream.

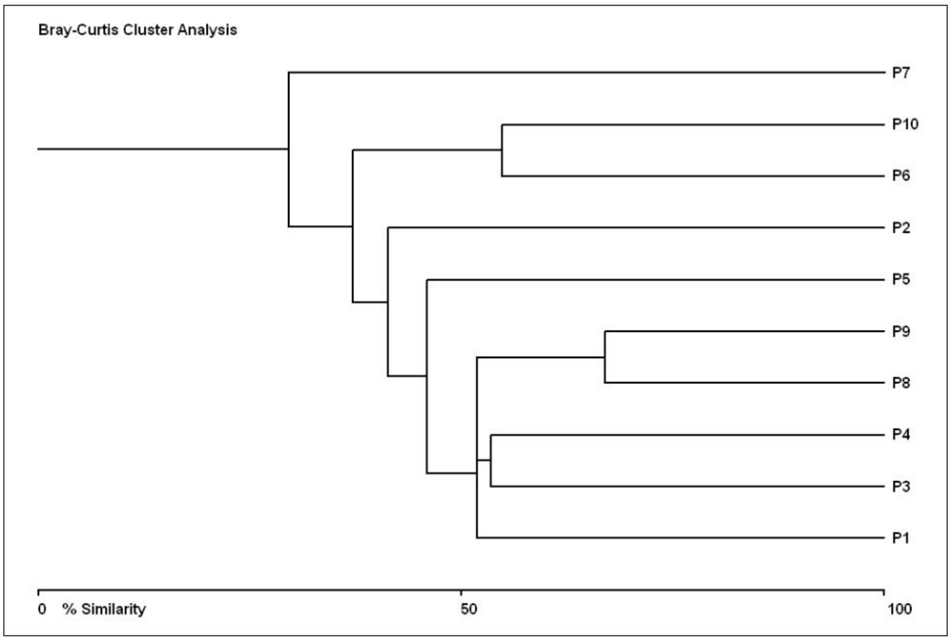
Despite *Chironomus* to have presented high abundance, the majority these organisms was collected at Point 8 (80,4%), which receive discharges of domestic sewage, which causes the increase of organic matter and reduces the levels of dissolved oxygen, and makes the environment more appropriate to development of *Chironomus*, given that this genus presents high tolerance to eutrophization conditions, showing significant increase in abundance, as reply to organic enrichment caused for anthropogenic actions (MARQUES *et al*., 1999; CALLISTO *et al*., 2005).

The Shannon-Wiener diversity index (H') showed little variation throughout the year, being most elevated in the dry season, probably due to higher environmental stability characteristic this period (RODRIGUES, 1997). The pattern showed by Pielou evenness index values (J) with the highest values in August and December can be attributed to a distribution more homogenous of the organisms within the taxa collected in these month. The predominance of *Polypedilum* and *Chironomus* in May and September respectively can explain the elevated values obtained, for the Simpson dominance index (D), elevated in these months.

Cluster analysis showed the arrangement of three groups: P8 and P9, P6 and P10 in P3 and P4, respectively. In formation of the first group, it is possible to assume that the greater similarity is related to human activities that these sites are submitted: discharges of sewage into P8 and tourist activities in P9. Whereas the second group was determined possibly by the presence of sandy substrate, condition which may have contributed to abundance of chironomids in both sites. The formation of a third group may be linked to the fact of chironomids have found similar environmental conditions at these sites, since the livestock activities carried out the margins of these points possibly determined the distribution of the organisms. Based on the cluster analysis, was possible also to infer that the fauna collected in P7 probably differs from the other points due its location in impounded area, which confers distinct characteristics to the environment.

An overall analysis of the results indicates that the structure and composition of the Chironomidae fauna from Batalha River presented variation during the year, with the months of January and March showing total absence of organisms. The taxa that best characterized, the Chironomidae fauna of the aquatic system (for their greater participation) were *Caladomyia*, *Chironomus*, *Djalmabatista* and *Polypedilum*, genera associated to sandy substrate and/or rich in organic mater. The predominance these chironomids can be an indicative of a worsening of deforestation of riparian vegetation of stream, given that this action is directly related to the silting process, caused for anthropogenic activities, which leads to formation of deposition areas and to massive input of organic matter for system, these conditions can favor the establishment these organisms. The results reaffirm the importance of the Chironomidae family as bioindicators in environmental investigations.

Figure 3: Classification of samplings points along Batalha River (SP, Brazil), using UPGMA analysis and Bray-Curtis distance



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