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RESEARCH ARTICLE

Chironomidae (Insecta, Diptera) associated with stones in a first-order Atlantic Forest stream

Chironomidae (Insecta, Diptera) asociados a piedras en un arroyo de primer orden de Mata Atlántica

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ABSTRACT

Stones are stable substrates in streams, usually sheltering high richness and abundance of invertebrates. To investigate the structure of the Chironomidae assemblages associated with stones in a first-order stream located in an Atlantic Forest reserve in two periods of the year, stones with diameters from 10 cm to 25 cm were collected along a stretch of 100 m in riffle areas, during three months in the dry season and three months in the rainy season. The structure of the community was analyzed for each period through calculation of observed richness, Shannon's diversity (H'), and Pielou's evenness. The ordination of the samples from the dry and rainy seasons was evaluated by detrended correspondence analysis (DCA) and the presence of indicator species in the seasons was tested by IndVal analysis. The similarity in the faunistic composition between the periods was checked by ANOSIM. The results showed that, in general, the water velocity and rainfall were the abiotic variables that most strongly explained the abundance of larvae in the two periods studied, but the increase in these two parameters did not produce any significant effect on the richness and abundance of the fauna, suggesting stability of the stones for the Chironomidae community. There was a significant change in the faunistic composition (ANOSIM) and some samples had a stronger relationship with one of the seasons analyzed (DCA). The IndVal analysis indicated the characteristic taxa of each period, suggesting different responses to rainfall regimes. Besides this, Orthocladiinae were more abundant during the rainy season, while Chironomini was more abundant in the dry season. This study demonstrated the importance of the stones present in the stream channel as habitats for Chironomidae fauna, mainly in periods of high rainfall and water flow.

Key words: aquatic insects, lotic systems, rainfall variation, substrates.

RESUMEN

Las piedras forman un sustrato estable en los arroyos, albergan usualmente alta riqueza y abundancia de invertebrados. Se evaluó la estructura de la fauna de Chironomidae asociada a las piedras de un arroyo de primer orden ubicado en una reserva de Mata Atlántica. Para ello se recolectaron 180 piedras de 10 cm a 25 cm de diámetro a lo largo de un trecho de 100 m en área de corredera, durante tres meses del periodo seco y tres meses del periodo lluvioso. La estructura de la comunidad fue analizada para cada periodo a través del cálculo de riqueza taxonómica observada, diversidad de Shannon (H') y la equidad de Pielou (E), al respecto. La ordenación de las muestras de las estaciones seca y lluviosa fue evaluada por análisis de correspondencias sin tendencia (DCA) y la presencia de especies indicadoras de los períodos se ensayó por análisis IndVal. La similitud en la composición de la fauna entre los períodos se comprobó mediante el análisis de ANOSIM. Los resultados muestran que en general la disminución del flujo y la precipitación fueron las variables abióticas que más explicaron la abundancia de larvas en los dos períodos de investigación, sin embargo, el aumento de la pluviosidad y velocidad del agua no producen un efecto significativo en la riqueza y abundancia de fauna, sugiriendo la estabilidad de las piedras para las larvas de Chironomidae. Cambios significativos en la composición faunística (ANOSIM) y algunas muestras tenían una mayor correlación con uno de los períodos analizados (DCA). El análisis IndVal indicó tasas características para cada período, lo que sugiere diferentes respuestas a los cambios hidrológicos (pluviosidad). Asimismo, Orthocladiinae fue más abundante en el período de lluvias mientras que Chironomini fue más abundante en el período seco. Este estudio demostró la importancia de las piedras como hábitat favorable para la fauna de Chironomidae, especialmente en periodos de aumento de la pluviosidad y del flujo de agua.

Palabras clave: aguas corrientes, insectos acuáticos, sustratos, variación pluviométrica.

INTRODUCTION

In preserved lotic environments, sandy substrates with the accumulation of leaves, branches and the presence of stones provide a heterogeneous range of habitats (Cranston 1995) that, when associated with different water flow speeds, favor the establishment of a great diversity and abundance of invertebrates. The substrates vary in size, surface texture, heterogeneity and availability of food particles, as well as providing different degrees of stability for the fauna (Reice 1980). Stones normally are stable habitats in periods of high rainfall because they are less susceptible to being carried downstream by the current (Hose et al. 2007) and because their uneven surfaces facilitate the movement and attachment of invertebrates when the water flow slows, offering greater stability and availability of micro-sites for colonization (Ayres-Peres et al. 2006). According to Wang et al. (2009) streambeds consisting of cobbles (6.4 - 25 cm diameters) and boulders (above 25 cm in diameter) are very stable and provide benthic macroinvertebrates diversified living spaces. In streams during flood periods, Robinson et al. (2004) found that stones in the streambeds lost fewer organisms than other types of habitats such as sandy sediments and plant debris.

Since increase in rainfall has been indicated as one of the main factors affecting fauna in tropical lotic systems (Bispo et al. 2004, Ribeiro & Uieda 2005), the presence of substrates that are more stable during periods of increased water flow is important for the stability of the benthic community in streams (Allan 1995).

Among the insects commonly associated with stones, Chironomidae (Diptera) larvae are often the predominant group. Egglishaw (1969), observing streams in Scotland, investigated the association of benthic fauna with different substrates in different seasons and found Chironomidae made up from 70 % to 90 % of the fauna associated with stone surfaces. Carvalho & Uieda (2004), studying the colonization of artificial rock substrates in a forest stream in the Itatinga Mountains in the state of São Paulo, Brazil, reported that Chironomidae larvae were the most abundant group. Hose et al. (2007) observed a greater density of Chironomidae in riffle areas along a stony, cobble-dominated stretch of an Australian river in a colonization experiment. Heino & Korsu (2008), studying the relationship between stone surface area and the associated benthic fauna in a temperate climate stream, observed that the Chironomidae were among the most abundant taxa.

Larvae of this family have great ecological importance because they take part in the processing of organic matter (Trivinho-Strixino & Strixino 1995) and are a source of food for many species of vertebrates (Rezende & Mazzoni 2003, Dutra & Callisto 2005) and invertebrates (Walker 1987), constituting a link between the lotic and land habitats.

Since stones are among the most stable substrates in lotic environments, our hypothesis is that the richness, abundance and composition of the Chironomidae fauna associated with this substrate do not change during the rainy season with the significant changes in precipitation and water velocity, even though these are the main factors that alter the benthic fauna in general in tropical streams. Therefore, the purpose of this study is to shed light on the structure of the Chironomidae fauna associated with stones in a stream in a preserved forest area in two periods of the year with different hydrological conditions.

METHODS

The study was conducted in Poço D'anta Municipal Biological Reserve (RBMPD), located in the municipality of Juiz de Fora, in the southeastern region of the state of Minas Gerais, Brazil (21°45' S, 43°20' W). This reserve contains a remaining fragment of the Atlantic Forest in a secondary succession stage, with an area of 277 ha (Sousa 2008), inserted in an urban area. The environment chosen for the study was a segment of approximately 100 m of a first-order stream, 21°44'36" to 21°44'31" S and 43°18'51" to 43°18'53" W, at an altitude of about 850 m.

To characterize the two collection periods (dry and rainy season), we obtained information on rainfall and air temperature for the period from June 2007 to June 2008 for Juiz de Fora (Fig. 1).

During the three months of the dry season (July, August and September 2007) and the three months of the rainy period (January, February and March 2008), we recollected stones from the streambed along a riffle segment approximately 100 m in length and average width of mean ± DE = 1.55 m ± 0.21. Each month we obtained three samples of 10 bare stones each with diameters between 10 cm to 25 cm (cobbles) and irregular surfaces that were submersed but not buried in the sand, for a total of 90 stones per season. The stones were removed manually, placed in a 0.21-mm mesh net and washed with water from the stream itself for retention of the fauna specimens. Then the stones were analyzed visually to check for the presence

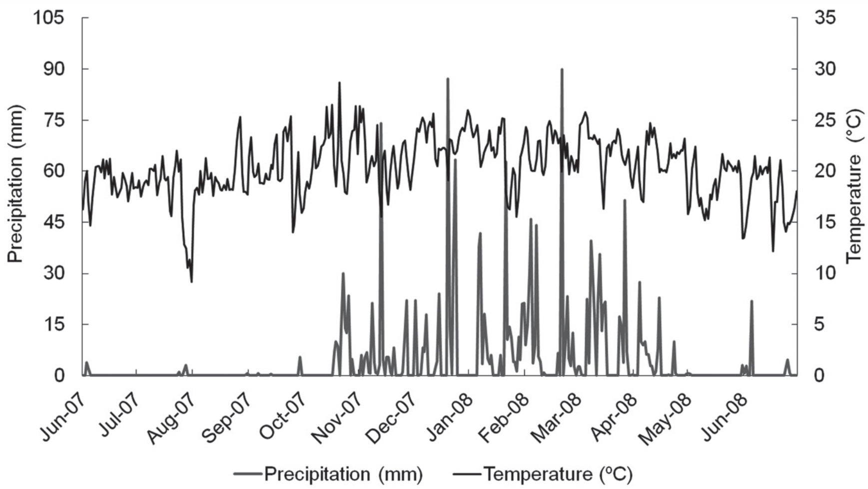

Fig. 1: Monthly precipitation and average air temperature from June 2007 to June 2008 in Juiz de Fora, Brazil. The bars indicate precipitation and the line indicates temperature.

Precipitación mensual y temperatura media del aire entre junio de 2007 junio de 2008 en Juiz de Fora, Brasil. Las barras indican la precipitación y la línea indica la temperatura.

of organisms possibly still adhered to them after washing. The material retained in the net was fixed in 4 % formaldehyde and sorted under a stereoscopic microscope. The Chironomidae larvae were preserved in 70° GL alcohol and identified down to the lowest taxonomic level possible, according to Wiederholm (1983), Epler (1992) and Trivinho-Strixino & Strixino (1995).

During collection, the water surface speed was measured (three measurements per collection) by the float method (Martinelli & Krusche 2007). To check for significant variation in the monthly averages of water speed, electrical conductivity, rainfall, water temperature and air temperature between the dry and rainy periods, the Mann-Whitney test or Student's test was used ($\alpha < 0.05$). The dissolved oxygen and pH were measured only twice at each season. To check which abiotic variables (rainfall, water and air temperature, water speed and conductivity) were most correlated with the larval abundance data in the two seasons, the Bioenv method was used, calculated from Spearman's correlation coefficient in the R program (R Foundation for Statistical Computing 2011).

The structure of the Chironomidae assemblages was analyzed for each month by calculating the Shannon diversity index (H'), the observed richness and Pielou's evenness index (E). The Shapiro-Wilk test was used to verify the normality of the data ($\alpha > 0.05$) and the Mann-Whitney test ($\alpha < 0.05$) to verify significant differences in the total abundance. Student's t-test was used to check for differences in the total abundance of the sub-families.

Detrended correspondence analysis (DCA) was employed to investigate the ordination of the samples from the dry and rainy seasons. This analysis groups samples by similarity of species composition (Melo & Hepp 2008) so that those nearer each other on the graph are more similar. The PC-ORD version 5.10 programs (McCune & Mefford 2006) was used for this analysis and the graphs were generated by the STATISTICA version 7 program (StatSoft Inc. 2004). To test the variation in the faunistic composition between periods, ANOSIM was used, calculated in the R program (R Foundation for Statistical Computing 2011).

Possible indicator taxa for each season were checked by indicator species analysis (IndVal), as proposed by Dufrêne & Legendre (1997), using the PC-Ord version 5.10 program (McCune & Mefford 2006).

RESULTS

The stream is shallow (5.63 ± 1.43 cm), containing clear and well oxygenated water (10.03 ± 0.42mg L^{-1}), with low conductivity (17.75 ± 2.06 µS cm^{-1}), slightly acidic pH (6.38 ± 0.41) and low temperature (17.75 ± 2.06 °C). There is dense vegetation along the banks, providing ample entrance of leaves and other plant matter in the stream. The bed is narrow (1.88 ± 0.61 m), with predominance of particles of coarse and medium sand and average organic matter content of 30 %, and contains many rocks of different sizes (Rosa et al. 2011a).

The average water velocity during the rainy season (0.39 ± 0.40 m s^{-1}) was significantly greater by the Mann -Whitney test (U = 3.02; n = 9; P < 0.01) than in the dry season (0.07 ± 0.10 m/s). Significant variations between seasons was also obtained for the mean monthly rainfall (U = -2.55; n = 10; P = 0.01) and air temperature by Student's test (t = - 5.30; df = 8; P < 0.01).

TABLE 1

Mean abundance and standard deviation (sd) of the Chironomidae fauna collected in stone substrate of a first-order stream in Poço D'Anta Municipal Biological Reserve, Juiz de Fora, Minas Gerais, in two seasons of the year (dry and rainy).

Promedio de la abundancia y la desviación estándar (dp) de la fauna de Chironomidae recogidos en el sustrato de piedra de un arroyo de primer orden de la Reserva Biológica Municipal Poço D'Anta, Juiz de Fora, Minas Gerais, en dos estaciones del año (seca y lluviosa).

	Dry						Rainy					
Orthocladiinae	Jun.	(sd)	Jul.	(sd)	Aug.	(sd)	Jan.	(sd)	Feb.	(sd)	Mar.	(sd)
Corynoneura (Winnertz)	2.00	± 1.73	5.00	± 4.58	8.33	± 7.50	4.00	± 2.27	3.67	± 1.52	2.33	± 2.51
Cricotopus (van der Vulp)	0.67	± 0.57	-	-	-	-	2.00	± 0.89	3.33	± 5.77	0.33	± 0.57
Lopescladius (Oliveira)	1.00	± 1.73	0.67	± 1.15	5.33	± 7.07	4.00	± 2.40	4.33	± 6.65	10.67	± 15.94
Nanocladius (Kieffer)	0.67	± 0.57	1.67	± 1.52	1.67	± 1.15	0.67	± 0.58	1.67	± 0.57	-	-
Onconeura (Saether)	1.33	± 1.52	-	-	3.33	± 5.77	18.67	± 7.94	25.70	± 2.08	17.33	± 19.65
Parametriocnemus (Gerghebuer)	1.00	± 1.00	3.00	± 3.60	2.33	± 2.08	1.00	± 1.00	1.67	± 2.08	0.33	± 0.57
Thienemaniella (Kieefer)	0.33	± 0.57	-	-	-	-	-	-	-	-	-	-
Orthocladiinae type 1	0.33	± 0.57	-	-	-	-	-	-	-	-	-	-
Orthocladiinae type 2	-	-	-	-	-	-	0.33	± 0.12	-	-	-	-
Orthocladiinae type 3	-	-	-	-	-	-	0.33	± 0.12	-	-	-	-
Orthocladiinae type 4	-	-	-	-	-	-	0.33	± 0.12	-	-	-	-
Orthocladiinae type 5	-	-	-	-	-	-	-	-	-	-	0.33	± 0.57
Orthocladiinae type 6	-	-	-	-	-	-	-	-	-	-	0.33	± 0.57
Tanypodinae												
Ablabesmya (Johannsen)	-	-	-	-	-	-	-	-	0.33	± 0.57	1.33	± 1.52
Djalmabatista (Fittkau)	0.67	± 1.15	-	-	-	-	0.67	± 1.15	0.67	± 1.154	-	-
Labrundinia (Fittkau)	-	-	1.00	± 1.73		-	0.33	± 0.58	0.33	± 0.57	0.33	± 0.57
Larsia (Fittkau)	1.00	± 1.00	0.33	± 0.57	0.33	± 1.15	-	-	0.33	± 0.57	-	-
Monopelopia (Fittkau)	-	-	0.33	± 0.57		-	0.67	± 1.15	-	-	-	-
Nilotanypus (Kieffer)	0.33	± 0.57	-	-	2.00	± 2.64	-	-	-	-	0.33	± 0.57
Thienemannimyia (Fittkau)	3.00	± 2.64	6.00	± 7.93	2.00	± 1.00	-	-	0.67	± 1.15	-	-

TABLE 1. Continuation

	Dry						Rainy					
Orthocladiinae	Jun.	(sd)	Jul.	(sd)	Aug.	(sd)	Jan.	(sd)	Feb.	(sd)	Mar.	(sd)
Tanypodinae tipo 1	0.33	± 0.57	-	-	-	-	3.00	± 2.00	-	-	-	-
Chironomini												
Chironomus salinarus (Kieffer)	-	-	-	-	-	-	0.33	± 0.57	-	-	-	-
Nilothauma (Kieffer)	0.33	± 0.33	0.67	± 0.57	0.44	-	1.67	± 2.08	0.67	± 1.15	1.33	-
Paratendipes (Kieffer)	16.33	± 16.3	9.33	± 15.30	14.00	-	4.67	± 5.50	2.67	± 2.51	2.33	± 1.15
Polypedilum (Kieffer)	0.33	± 0.33			-		-	-	0.33	± 0.57	-	
Pseudochironomini	0.67	± 0.66	5.33	± 6.11	2.22	± 0.33	-	-	-	-	-	-
Chironomini type 1	0.33	± 0.33			-		-	-	-	-	-	-
Chironomini type 2	0.33	± 0.33	-	-	-	-	-	-	-	-	-	-
Chironomini type 3	-	-	-	-	-	-	-	-	-	-	-	-
Chironomini type 4	-	-	-	-	-		-	-	-	-	0.67	-
Tanytarsini												
Caladomyia (Säwedal)	-	-			-		-	-	-	-	-	-
Genus B (Trivinho-Strixino & Strixino)	-	-	-	-	-		-	-	-	-	-	-
Genus C (Trivinho-Strixino & Strixino)	-	-	-	-	-		-	-	-	-	-	-
Rheotanytarsus (Thienemann &Bause)	34.00	± 34	11.67	± 13.20	34.00	± 23.33	25.33	± 29.36	13.00	± 14	7.67	± 5.68
Tanytarsus (van der Vulp)	1.00	± 1.00	3.33	± 5.77	1.78	± 3-00	-	-	-	-	-	-
Tanytarsini type 1	0.33	± 0.33			-	-	-	-	-	-	-	-
Tanytarsini type 2	-	-	-	-	-	-	0.33	± 0.57	-	-	-	-
Tanytarsini type 3	-	-	-	-	-	-	-	-	0.33	± 0.57	-	-

The water conductivity and temperature values did not significantly vary between the seasons ($P > 0.05$). The Bioenv analysis showed that the set of variables that was most correlated with the abundance was water velocity, rainfall, water conductivity and water temperature (r of Spearman = 64 %), of which water velocity and rainfall explained 60 % of the variation.

We collected 1.079 larvae, distributed in 38 taxa (Table 1), belonging to the sub-families Chironominae (52.91 %), Orthocladiinae (39.48 %) and Tanypodinae (7.59 %). Of the 180 stones collected, 10 did not have any Chironomidae specimens. The Orthocladiinae larvae predominated numerically in the rainy season by Student's test ($t = -2.07$; $P = 0.04$; $df = 54$), while the Chironomini tribe predominated in the dry season ($t = 2.50$; $P = 0.01$; $df = 28$) (Fig. 2). Among the Chironominae, Tanytarsini larvae accounted for 66.19 % of the fauna.

Among the taxa identified, Pseudochironomini (24 individuals) and *Tanytarsus* (22 individuals) were only present in the dry season and *Ablabesmya* (7 individuals) was only present in the wet season. There were significant differences in the abundance of *Onconeura* ($t = -2.67$; $P = 0.01$; $df = 16$) and *Paratendipes* ($t = 1.94$; $P = 0.04$; $df = 16$) between the two seasons. The Mann-Whitney test did not detect significant differences in Shannon's diversity ($U = 0.75$; $n = 9$; $P = 0.45$), richness ($U = 1.01$; $n = 9$; $P = 0.30$) and total abundance of individuals ($U = 0.30$; $n = 9$; $P = 0.75$) between the two collection periods (Table 2).

TABLE 2

Taxonomic richness (S), mean abundance (A), Shannon's diversity index (H') and Pielou's evenness index (E) and respective standard deviations (±), of the Chironomidae fauna collected in stone substrate of a first-order stream in Poço D'Anta Municipal Biological Reserve, Juiz de Fora, Minas Gerais, in two seasons of the year (dry and rainy).

Riqueza taxonómica (S), abundancia media (A), el índice de diversidad Shannon (H') y el índice de Pielou de equitatividad (E), y las respectivas desviaciones estándar (±), de la fauna de Chironomidae recogido en el sustrato de piedra de un arroyo de primer orden en la Reserva Biológica Municipal Poço D'Anta, Juiz de Fora, Minas Gerais

	S	A	H'	E
Dry	28	69.75 ± 47.98	1.73 ± 0.44	0.72 ± 0.17
Rainy	25	57.89 ± 50.80	1.65 ± 0.22	0.75 ± 0.11

The first two axes of the DCA explained 68 % of the variance of the data. Axis I was related to the majority of the samples in the dry season and the *Onconeura* and *Nilotanypus* genera were negatively related to this axis. In contrast, axis II was more closely related to the samples in the rainy season and was positively related to the *Ablabesmya* genus. In general, the analysis showed separation of the samples obtained in the two seasons (Fig. 3). This was confirmed by the ANOSIM, which

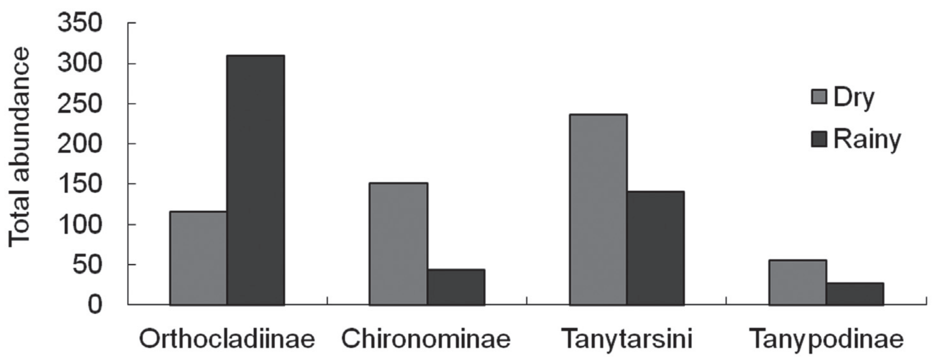

Fig. 2: Total abundance of Chironomidae in the stone substrate of a first-order stream in Poço D'Anta Municipal Biological Reserve, Juiz de Fora, Minas Gerais, in two seasons of the year (dry and rainy).

La abundancia total de Chironomidae en el sustrato de piedra de un arroyo de primer orden en la Reserva Biológica Municipal Poço D'Anta, Juiz de Fora, Minas Gerais, en dos estaciones del año (seca y lluviosa).

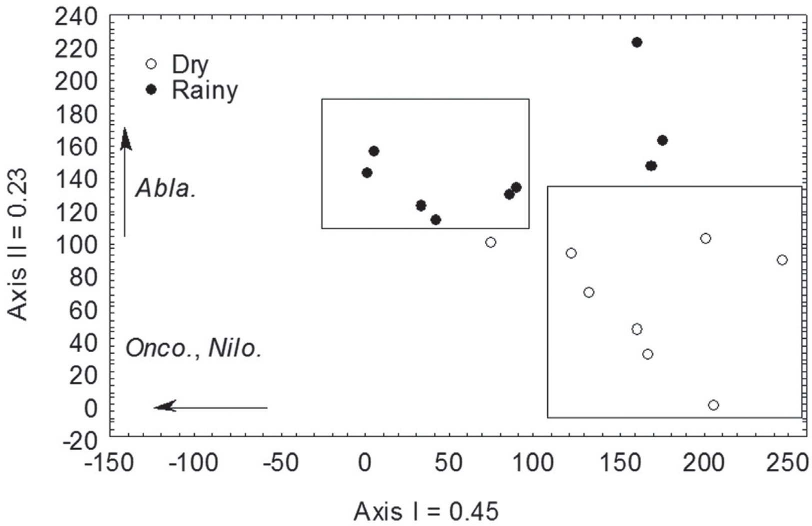

Fig. 3: Detrended correspondence analysis (DCA) of the Chironomidae fauna collected in stone substrate of a first-order stream in Poço D'Anta Municipal Biological Reserve, Juiz de Fora, Minas Gerais, in two seasons of the year (dry and rainy).

Análisis de correspondencia sin tendencia (DCA) de la fauna de Chironomidae recogida en sustrato de piedra de un arroyo de primer orden en la Reserva Biológica Municipal Poço D'Anta, Juiz de Fora, Minas Gerais.

showed a significant difference in the faunistic composition between the two seasons (ANOSIM $R = 0.3$; $P < 0.01$). The IndVal analysis indicated that the *Paratendipes, Thienemannimya,* Pseudochironomini and *Tanytarsus* taxa were related to the dry season while the *Onconeura* taxon was related to the rainy season (Table 3).

DISCUSSION

In tropical streams, changes in the habitat because of movement of substrates during periods of higher rainfall and water flow often cause variation in the structure of the benthic entomofauna (Ribeiro & Uieda 2005, Aburaya & Callil 2007). In this study, increased rainfall and water velocity did not have a significant effect on the richness and abundance of the Chironomidae assemblage, but there was a change in the faunal composition, demonstrated by the separation of the samples from the dry and rainy periods in the DCA, a result that was confirmed in the ANOSIM. Unlike these findings, Rosa et al. (2011b, 2013) reported, for the same stream and study period, a strong positive relation of water flow and rainfall with the abundance of Chironomidae and other macroinvertebrates associated with bryophytes adhered to stones. This demonstrates that the benthic fauna present on different substrates have distinct responses to variations in rainfall and water flow in the stream studied.

The results of this study also differ from others obtained in low-order streams in tropical forest regions, in which increased rainfall has been observed to cause a significant reduction in the abundance and richness of taxa due to the susceptibility of substrates and fauna to being dragged by the current. For example, Silva et al (2009) reported a decline in the abundance of Chironomidae larvae in the rainy season on sandy substrates and Amorim et al. (2004) observed a sharp reduction in the number of larvae in the rainy season, mainly in sandy streambeds. According to Lenat et al. (1981), the benthic community present in rocky areas is more stable, and is mainly controlled by biological interactions between organisms such as predation and competition, among others, in contrast to other substrates, where the parameters are physically controlled and thus more susceptible to environmental variations.

That change in faunistic composition probably occurred because of the substitution

TABLE 3

Result of the indicator species analysis (IndVal) of the the Chironomidae fauna collected in stone substrate of a first-order stream in Poço D'Anta Municipal Biological Reserve, Juiz de Fora, Minas Gerais, in the dry (D) and rainy (R) seasons. Indicator species ($P \leq 0.05$)

Resultado del análisis de especies indicadoras (IndVal) de la fauna de los Chironomidae recogidos en sustrato de piedra de un arroyo de primer orden en la Reserva Biológica Municipal Poço D'Anta, Juiz de Fora, Minas Gerais. Especies indicadoras ($P \leq 0.05$)

	Season	IV	P
Corynoneura	D	56.6	0.18
Cricotopus	R	39.2	0.31
Lopescladius	R	55.0	0.25
Nanocladius	D	57.6	0.13
Onconeura	R	81.9	0.02
Parametriocnemus	D	52.8	0.26
Ablabesmya	R	44.4	0.08
Djalmabatista	R	12.7	1.00
Labrundinia	R	8.30	1.00
Larsia	D	46.9	0.11
Nilotanypus	D	33.30	0.24
Thienemannimya	D	67.50	0.05
Nilotauma	R	42.50	0.23
Paratendipes	D	82.20	0.01
Polypedillum	D	17.30	0.58
Pseudochironomini	D	87.50	> 0.01
Genus C	D	12.50	0.47
Rheotanytarsus	D	62.80	0.40
Tanytarsus	D	62.50	> 0.01

of some taxa, reflecting the resilience of the Chironomidae assemblage to changes in hydrological aspects, likely resulting from different adaptive strategies of the taxa during heavy rainfall.

Pseudochironomini, *Tanytarsus* and *Paratendipes* are generally more suited to slower-flowing water (Wiederholm 1983) or are commonly found in pool areas (Sanseverino & Nessimian 1998, Sanseverino et al. 1998, Henriques-Oliveira et al. 1999), explaining the association of these genera with the dry season.

The insect larvae that are found drifting due to the effect of increased water flow may be favored by the capacity to re-colonize new habitats, finding opportunities for shelter in some substrates to protect them from being carried further downstream (Robinson et al. 2004). This can explain the greater abundance of Orthocladiinae in the rainy season and the greater association of *Onconeura* with this period. These Chironomidae are abundant in the drift of streams during periods of faster water flow and are considered to be rapid colonizers (Hose et al. 2007), making them well adapted to live in habitats where the water flow is faster (Trivinho-Strixino & Strixino 2005). Hose et al. (2007) reported that nearly 70 % of the Chironomidae that colonized the surface of stones that had been disturbed by increased flow within a period of 24 hours were composed of Orthocladiinae. Sanseverino & Nessimian (2001) found Orthocladiinae preferentially inhabiting stones exposed to the current in Atlantic Forest streams.

The subfamily Tanypodinae was the least represented in the samples, possibly because its species are more typical of pool areas and unconsolidated substrates (Wiederholm 1983). The *Thienemanniya* genus, which accounted for 58.66 % of these fauna, was indicative of the dry period. This genus can be found both in lotic and lenthic environments and its larvae can inhabit areas where the flow is faster (Cheng & Wang 2009). Culp et al. (1983), in a field experiment conducted in a low-order stream, also observed larvae of this genus inhabiting the surface of stones.

The occupation of a certain habitat can be closely related to the feeding behavior of Chironomidae larvae (Fidelis et al. 2008). This can be observed in many larvae of the Tanytarsini tribe (Sanseverino & Nessimian 2007[1]), represented in this study by eight taxa, of which *Rheotanytarsus* was predominant (91.75 %). These larvae build tubes to colonize hard and clean surfaces to which they can attach themselves and filter the food carried by the current (Kikuchi & Uieda 2005).

1 SANSEVERINO AM & JL NESSIMIAN (2007) A fauna de Tanytarsini (Insecta: Diptera) em áreas de terra firme na Amazônia Central. VIII Congresso de Ecologia do Brasil: 1-2.

Although increased rainfall is a determining factor of the variation of the benthic fauna structure in tropical streams (Diniz-Filho et al. 1998, Oliveira & Froehlich 1997b, Bispo et al. 2004, Abílio et al. 2007, Aburaya & Callil 2007), the results of this study indicate that overall stones provide a stable substrate for Chironomidae fauna, making them important components of the lotic ecosystem. Researchers studying the conservation and management of natural areas should consider the heterogeneity of lotic systems, reflected by the variety of substrates, including stones (10 to 25 cm in diameter), which constitute a habitat suitable for benthic organisms, as demonstrated in this study for Chironomidae larvae.

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