Invertebrates Associated with *Paspalum repens* (Poaceae) at the Mouth of Caracu Stream (1991-1992), Affluent of the Paraná River, Porto Rico - PR - Brazil

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ABSTRACT

Temporal distributions of Paspalum repens at the mouth of the Caracu Stream on the left margin of the Paraná River were characterized and analyzed. Samples of Paspalum repens were taken monthly from March 1991 to February 1992. Fauna consisted of many taxa: Gastropoda, Oligochaeta, Copepoda, Ephemeroptera, Hemiptera, Trichoptera, Lepidoptera, Chironomidae, Coleoptera and Hydracarina. With the exception of May 1991, low density of organisms was registered during the sampling period. During May 1991, a sharp decline in the Paraná River water level was noted. This fact suggested that organisms dispersed in the submersed vegetation during the flooding of the Paraná River must have concentrated in the stream margin and increased the density of organisms at this site. In June 1991, during the lowering of water level a niche reduction occurred. In subsequent months, invertebrates decreased due to predation and competition of many groups.

Keywords: stream, fauna, *Paspalum repens*, Paraná River, Brazil

INTRODUCTION

The mouth of the Caracu Stream is very narrow and colonized by *Paspalum repen*s Berg. According to Lorenzi (1991), the species is extremely frequent in lake margins, drain channels and irrigated or flooded rice plantation. In lake margins *P. repens* is a root plant with roots extending themselves to great distances in the water.

Distribution of phytophilous fauna is determined by primary production potential. Plant community may affect the structure of stream fauna since aquatic macrophytes produce a range of microhabitats used by invertebrates as a refuge from predators and as a colonization and reproduction area (Dawkins & Donoglwe, 1992). Thus they form favorable habitats for the colonization of different animals (Strixino & Strixino, 1984). Although invertebrates do not directly consume aquatic macrophytes, root vegetation becomes the substrata for periphyton (Dawkins & Donoglwe, 1992). It also deposits high quantities of organic matter (Bechara & Andreani, 1989) which favors the succession of invertebrates in food availability (Dowing & Cyr, 1988).

There are only a few reports on fish populations and limnological variables in the Caracu Stream (Penczak *et al*., 1995; Pavanelli & Caramaschi, 1997 and Pavanelli *et al*., 1997). Therefore, this is the first research work on invertebrate fauna associated with *P. repens* in the state of Paraná, Brazil. The aim of this research was to characterize the invertebrates associated with *P. repens* and to analyse the monthly fluctuation of these organisms at the mouth of the Caracu Stream and their relationship to abiotic factors.

SAMPLING AREA

The Caracu Stream (22°45'S and 53°15'W) is a small tributary at the left margin of the Paraná River in the municipality of Porto Rico, PR, Brazil (Fig. 1). The stream is about 6.8 km in length, with sand and mud at the bottom. Sample site at the mouth of the Caracu Stream is directly affected by variations in the water level of the Paraná River.

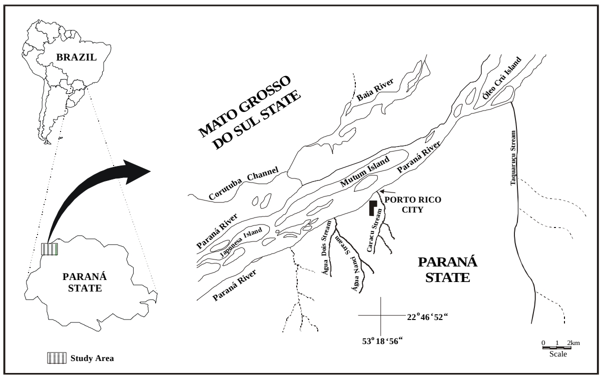


Figure 1 - Sampling area, → collecting sites (estuary of the Caracu Stream)

Pasture exists throughout the whole length of the stream banks and some dammed stretches are used for watering cattle. The area under analysis is affected by anthropic action namely, with species of plants and gramineous pasture, reaching up to the margins. However, native species adapted to this type of environment, are found in the bed and at the margin of the stream. *P. repens* grows abundantly at the mouth of the Caracu Stream (1991-1992) and is dependent on high and low water phases of the Paraná River.

MATERIALS AND METHODS

Samples were taken monthly from March 1991 to February 1992. A 0.25 m² rectangle with a 500-µm mesh coupled to a PVC glass was immersed under the grass bank. Samples of *P. repens* were cut and placed in plastic bags. Contents of the PVC glass were conditioned in a polyethylene flask and fixed in 4% formaldehyde with calcium carbonate. The plant was washed in three containers, two of which contained formaldehyde diluted in water and one contained just water. The water of the three containers and the fixed contents of the glass were filtered in a sieve with 500 µm mesh and fixed in neutral 4% formaldehyde.

Water samples were collected in a Van Dorn bottle for the following physical and chemical factors: pH, electrical conductivity and dissolved oxygen (Winkler's method, modified by Golterman *et al*., 1978). Water temperature was measured by simple thermometer.

Qualitative and quantitative analyses of biological material were undertaken in laboratory by stereoscopic and optic microscopes; organisms were identified to the lowest possible taxonomic level. The plants were dried at 80 ºC for dry weight.

In the temporal variation analysis, some families were grouped together at a higher taxonomic level owing to their low density. In the graphs, less dense and less frequent groups were listed as "others".

Constancy Index (C) of Dajoz's (1983) was calculated for each taxon associated with *P. repens* at the mouth of the Caracu Stream. The physical and chemical variables were standardized and analyzed by Principal Components Analysis (PCA). Fauna associated with *P. repens*, represented by 22 higher taxonomic groups, were log-transformed, log (x+1), and analyzed by Detrended Correspondence Analysis (DCA).

To test the influence of abiotic variables on the associated fauna, the first two axes of PCA and DCA were compared by the Procrustean Randomization test (Jackson, 1995). Statistic programs PCORD, version 2.0 (McCume & Mefford, 1995), Statistica, version 5.0 and Protest, version 2.0 (Jackson, 1995) were used.

RESULTS

Figure 2 shows monthly average of water levels of the Paraná River. The period between March to May 1991 and the months of January and February 1992 have been considered high water phase; the other months form the low water phase.

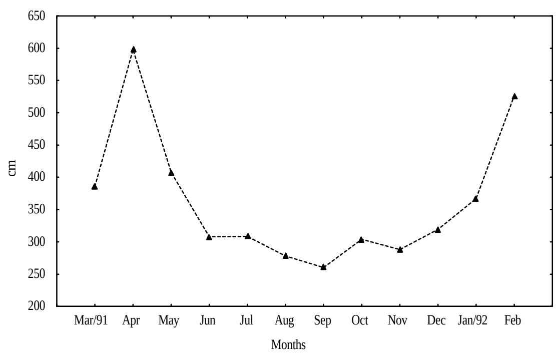


Figure 2 - Monthly average of water level of the Paraná River (source: DNAEE)

The concentration of dissolved oxygen was high during the whole period; pH values were slightly acidic to neutral and electrical conductivity had higher values during high water period. (Table 1).

Table 1. Physical and chemical variables of high and low water phases. Average values, deviation pattern (between parentheses) and variation range are given.

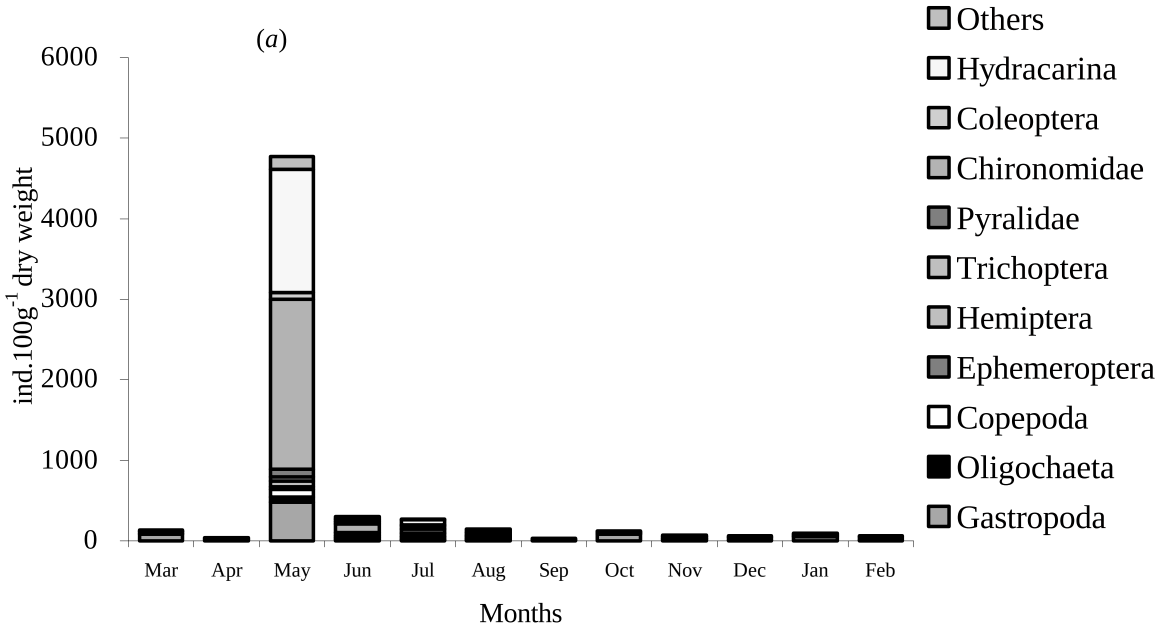
Variables	High water	Low water
Water temperature (^{o}C)	24.3 (2.4)	23.4 (4.2)
	21.5 – 27.0	19.0 – 29.5
pH	5.9 (0.3)	6.4 (0.6)
	5.6 – 6.2	5.2 – 6.8
Electrical Conductivity	56.1 (7.0)	54.5 (7.4)
(μS.cm^{-1})	48.6 – 67.0	46.0 – 64.7
Dissolved oxygen	9.0 (3.4)	7.8 (1.40
(mg.l^{-1})	5.7 – 14.7	6.0 – 10.1

Constancy Index (Table 2) showed group **constancy** (C > 50%) were Ancylidae, Planorbidae, Ampullariidae, Naididae, Baetidae, Tricorythidae, Hemiptera, Polycentropididae, Hydroptilidae, Pyralidae, Chironomidae, Tabanidae, Simuliidae, Elmidae, Noteridae, Araneae and Hydracarina; organisms considered **accessory** (25%<C≤50%) were Nematoda, Bivalvia, Hirudinea, Chydoridae, Harpacticoida, Entomobryidae, Caenidae, Coenagrionidae, Libellulidae, Ceratopogonidae, Culicidae, Dixidae, Empididae, Hidroptilidae, Dytiscidae and Chrysomelidae; other organisms (C ≤ 25%) were **accidental**.

Fauna associated with *P. repens* was represented by 43 taxa (Table 2), totaling 6129 ind. 100g^{-1} dry weight. Figures 3 ***a*** and ***b*** show monthly fluctuation and density of organisms associated with *P. repens*. Highest density was observed during May (4689 ind. 100g^{-1} of dry weight) and the lowest during April (42 ind. 100g^{-1} of dry weight) (Fig. 3 ***a***). Predominant groups were Chironomidae and Hydracarina with high densities in almost all the months. Highest density of organisms was verified in the high water phase; the most abundant organisms were Hydracarina, Chironomidae and Gastropoda with the absence of many groups. During the low water phase, lower density of individuals and a greater number of taxa were recorded (Fig 4).

Table 2 - Constancy Index (C) of organisms associated with *P. repens* at the mouth of the Caracu Stream.

Taxa	%
Nematoda	25.00
Gastropoda	
Ancylidae	66.67
Planorbidae	58.33
Ampullariidae	58.33
Bivalvia	33.33
Oligochaeta	
Naididae	66.67
Tubificidae	8.33
Lumbriculidae	8.33
Hirudinea	50.00
Cladocera	
Chydoridae	41.67
Ostracoda	8.33
Copepoda	
Harpacticoida	25.00
Cyclopidae	16.67
Decapoda	8.33
Collembola	
Entomobryidae (adult)	25.00
Ephemeroptera	
Baetidae (nymph)	83.33
Tricorythidae (nymph)	50.00
Caenidae (nymph)	25.00
Odonata	
Coenagrionidae (naiads)	41.67
Libellulidae (naiads)	25.00
Hemiptera (nymph)	91.67
Trichoptera	
Polycentropidae (larva)	83.33
Hydroptilidae (larva)	58.33
Leptoceridae (larva)	16.67
Lepidoptera	
Pyralidae (larva)	83.33
Diptera	
Ceratopogonidae (larva)	33.33
Chironomidae (larva)	100
Culicidae (larva)	25.00
Dixidae (larva)	8.33
Tabanidae (larva)	58.33
Simuliidae (larva)	66.67
Empididae (larva)	33.33
Ephydridae (larva)	8.33
Syrphidae (larva)	8.33
Coleoptera	
Hydrophilidae (larva)	41.67
Dytiscidae (larva)	41.67
Elmidae (larva)	58.33
Chrysomelidae (larva)	33.33
Lampyridae (larva)	8.33
Noteridae (larva)	66.67
Gyrinidae (larva)	8.33
Araneae	75.00
Hydracarina	75.00



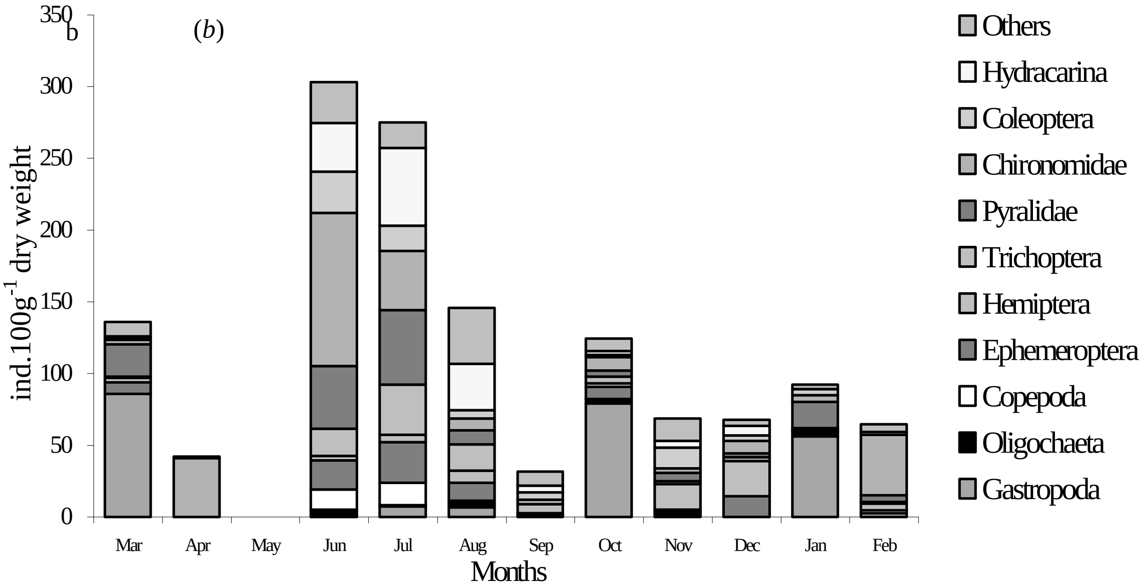


Figure 3 - Density (ind. $100g^{-1}$ dry weight) of organisms during sampling period; (*a*) all months; (*b*) excluding May 1991

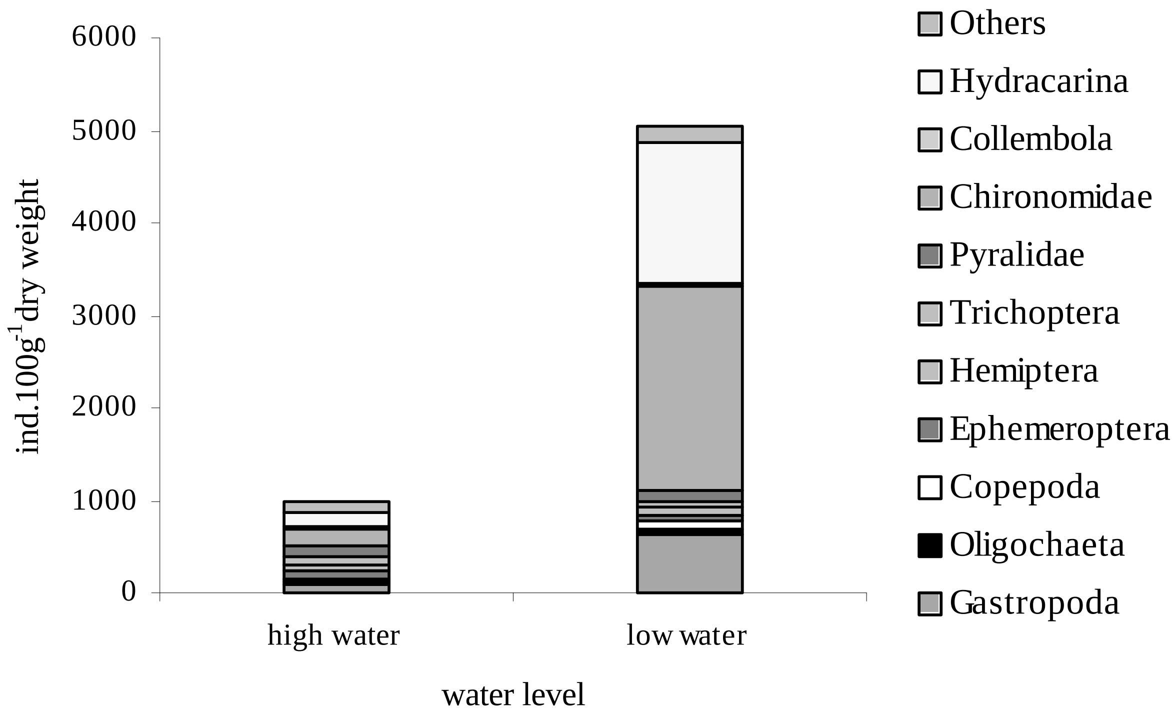


Figure 4 - Total density (ind. $100g^{-1}$ dry weight) of organisms in low and high water levels.

The first two axes of PCA from abiotic variables could explain 71% of total data variance. The first axis (39%) was correlated with water temperature (r= 0,77), electrical conductivity (r= 0,75) and dissolved oxygen (r= -0,61). The second axis (32%) showed correlation with pH (r= - 0,89) and dissolved oxygen (r= 0,55). PCA suggested the demarcation between high and low water phases. The high water phase was characterized by greater concentration of dissolved oxygen and more acid water. In axis 1 the separation of months with high temperature (September, December and February) and greater electrical conductivity may also be noted (Fig. 5).

Applied to the density of associated fauna, DCA verified that in the low water phases there was a distribution pattern different from the high water one. In low water the smallest number of taxa was recorded, albeit with high density. In high water lowest density and a greater number of taxa were registered (Fig. 6).

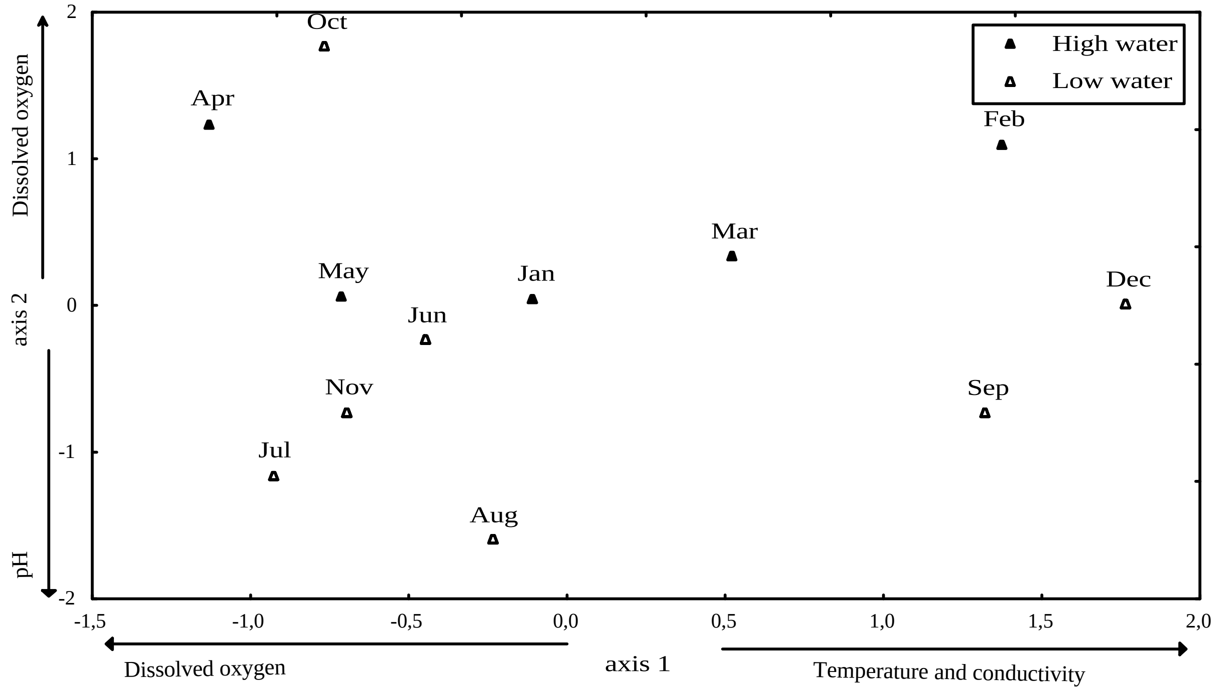


Figure 5 - Ordenation of scores of the first two PCA axes for abiotic variables.

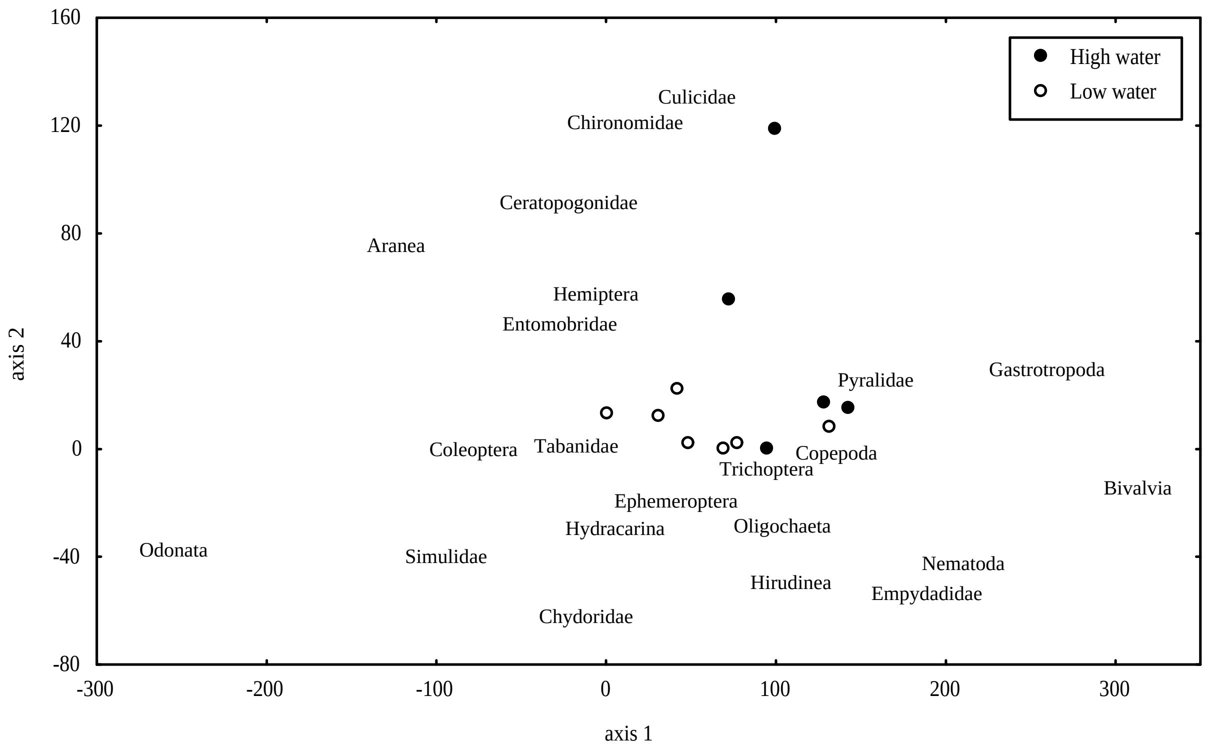


Figure 6 - Ordenation of scores of the first two DCA axes for density of fauna associated with *P. repens*.

In Procluster analysis with the first two axes of PCA and DCA, the observed m^2 (0,5367) contrasted to the expected m^2 showed a rejection probability of nil hypothesis equivalent to 0,023. Relationship among abiotic and biotic variables may have probably been the result of chance. This fact suggested a significant influence of environmental variables on invertebrates associated with *P. repens* (fig. 7).

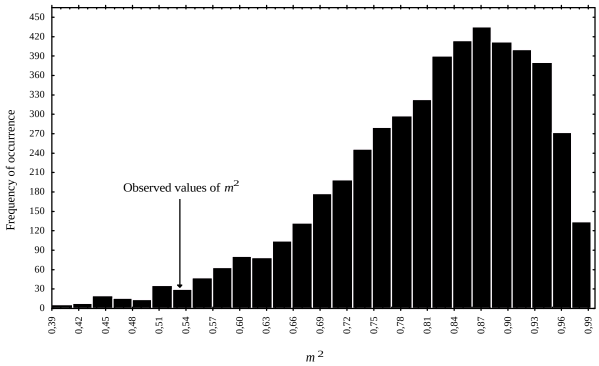


Figure 7 - Distribution of m^2 statistic based on 4999 randomized matrices of correspondence analysis results rotated to the geographic matrix.

DISCUSSION

The highest water level of the Paraná River was registered in April 1991. The whole margin of the Caracu stream was flooded and extensively covered by *P. repens*. Consequently the fauna niche expanded. Probably many organisms spread out and density declined. The fact that only Chironomidae were present was related to their short life cycle or even because the Paraná River strong current of the collection site carried many organisms away. Since they are r-strategists (Fuller & Cowell, 1985), Chironomidae quickly recolonize the environment. According to Bode (1990), Chironomidae occurred in many types of habitats.

High densities of Hydracarina could be related to abundance of Chironomidae, which might be their host. Diptera and especially Chironomidae were considered host insects for many aquatic acarid larvae (Winkel *et al.* 1989; Edwards & Dimok Jr. 1995) which parasited other water insects such as Hemiptera, adult aquatic Coleoptera, Odonata, Trichoptera and Plecoptera (Smith & Oliver, 1976).

The three Gastropoda families (Ancylidae, Planorbidae and Ampullariidae) were constant. Gastropoda are herbivorous, detritivorous or algae grazers. Ancylidae are periphyton grazers. Planorbidae are detritivorous species or bacteria filters. Some Prosobranchia (Ampullariidae) are herbivorous and feed on periphyton or on phytoplankton (Brown, 1991).

As a general rule, *P. repens* was a favorable substratum for Gastropoda and Oligochaeta due to the fact that periphyton algae were abundant in vegetation (Dvorák & Best, 1982) and plant decomposition favored increase in detritus and microorganisms. The highest density of Gastropoda and Naididae occurred in the high water phase. An increase in allochthone material occurred owing to water invasion of margins which favored detritivorous animals such as Planorbidae and some species of Naididae (Dioni, 1967). Naididae was the Oligochaeta family frequently found in water plant roots (Bechara & Andreani, 1989; Dioni, 1967; Poi de Neiff, 1983, 1986).

During May, with the Paraná River at low water level, the shrinking of the immersed vegetation gradually decreased the space in which invertebrates lived. Thus, an increase in densities and in number of taxa was registered.

With the reestablishment of the environment (June), predation and competition for space probably caused a decline in invertebrate density. According to Gregory (1981), plants and animals were, to a certain extent, determined by catastrophic events. The greatest mechanism for the start of the succession process in the lotic ecosystem consisted of water level elevation and its many recurrences during the year.

Results from multivariate analyses showed the influence of water level and this has been evidenced by seasonal fluctuation of abiotic variables, chiefly dissolved oxygen, pH and electrical conductivity. Temperature variation of ± 10 ^oC was not a restricting factor for invertebrates. This was due to the fact that variation reflected the seasons of the year and many organisms (principally insects) had a life cycle adapted to this factor.

We, therefore, concluded that the fauna associated with *P. repens* at the mouth of the Caracu Stream was affected by the water level of the Paraná River. The principal factor in the temporal variation of density of invertebrates associated with *P. repens* at the mouth of the Caracu Stream seemed to be the moment of retraction and expansion of the niche influenced by the water level and by the life cycle of each species.

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RESUMO

Este trabalho teve como objetivo caracterizar a fauna de invertebrados associada a *P. repens* da foz do riacho Caracu, verificar a distribuição temporal dos organismos, relacionando-o com fatores abióticos. O riacho Caracu situa-se na margem esquerda do rio Paraná, e as amostragens foram realizadas de março/91 a fevereiro/92. A fauna apresentou-se muito diversificada com vários táxons, sendo os mais abundantes: Gastropoda, Oligochaeta, Copepoda, Ephemeroptera, Hemiptera, Trichoptera, Lepidoptera, Chironomidae, Coleoptera, e Hydracarina. Durante o período de amostragem, verificou-se baixa densidade de organismos, exceto o mês de maio/91. Este mês caracterizou-se pelo acentuado declínio do nível fluviométrico do rio Paraná, sugerindo-se neste trabalho, que os organismos, antes espalhados na vegetação submersa com a inundação, provavelmente, concentraram-se na margem do riacho, aumentando a densidade. No mês seguinte, o nível da água estabilizou-se e, conseqüentemente, com o nicho reduzido, aumento da predação e competição, pode ter levado a diminuição da população de invertebrados nos meses subseqüentes.

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