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Artigo Completo

COMPOSITION OF ZOOPLANKTON AT THE SMALL RIVERS PEDERNAL AND ANIL, SERRA DO DIVISOR NATIONAL PARK, ACRE, BRAZIL

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ABSTRACT

Regions with high biodiversity such as the small rivers at the High Juruá, Serra do Divisor National Park, state of Acre, are part of the existing tropical richness. However, the ecosystems in these regions, as in many others, have been changed by humans. This research aimed to study the zooplankton of two water systems: one at a pristine area (Pedernal; 7 º 30'23"S and 73º 42'05) and one at a deforested area (Anil; 7 ° 27'S and 73º37'). The limnological variables studied in both pelagic and littoral zones were: water temperature (°C); dissolved oxygen (mg.L-¹ e %); pH and turbidity (NTU), ascertained with the help of a multiparameter probe Troll, model 9500. Zooplankton was collected with a 50 micron mesh size net. Analysis of zooplankton samples were conducted using a micro camera attached to a DCE microscope which image was projected onto an Acer laptop loaded with a software to capture images and photos for species identification. The lowest value for turbidity (5 to 6 NTU) and the highest amounts of dissolved oxygen were found at Igarapé Pedernal, indicating that it is the best preserved area in our study. Forty-five species were found at Igarapé Pedernal and fifty-two at Igarapé Anil. 21 news records were recognized for the Acre State. The Jaccard index of 25% indicated a low similarity in zooplankton species composition between the small rivers. A seasonal pattern of zooplankton distribution was not found. The environment presents high frequency of rotifers, and the genera *Brachionus*, *Lecane* and *Trichocerca*, common in the tropics, were constant.

Keywords: *biodiversity; plankton; pristine area; limnologic variables.*

COMPOSIÇÃO DO ZOOPLÂNCTON DOS IGARAPÉS PEDERNAL E ANIL, PARQUE NACIONAL DA SERRA DO DIVISOR, ACRE, BRASIL

RESUMO

Regiões com rica biodiversidade como os igarapés do Alto Juruá fazem parte da riqueza existente nas regiões tropicais. Todavia, deve-se considerar também que estes ecossistemas, como outros, têm sofrido alterações e diversos prejuízos decorrentes das atividades antrópicas. Este estudo teve por objetivo estudar o zooplâncton de dois sistemas aquáticos: Igarapé abrangendo área não desmatada (Pedernal) localizado entre as coordenadas (7º30´23,7"S e 73º42'05,2"W) e igarapé abrangendo área desmatada (Anil) entre as coordenadas (7º27´014"S e 73º37'30,8"W). As variáveis limnológicas estudadas, tanto na região litorânea como limnética, foram temperatura (°C), oxigênio dissolvido (mg.L^{-1} e %), pH e turbidez (UNT). Estas foram determinadas com uma sonda multiparâmetros marca Troll, modelo 9500. As análises das amostras de zooplâncton foram realizadas utilizando micro câmera DCE acoplada em microscópio, cuja imagem era projetada no notebook marca Acer, com software instalado de captura de imagem e fotografias para identificação e registro de espécie. O Igarapé Pedernal apresentou o valor de turbidez mais baixo (5-6 UNT) e oxigênio dissolvido maior caracterizando-o neste estudo como o mais preservado. A comunidade zooplanctônica dos igarapés apresentou 45 espécies no igarapé Pedernal e 52 espécies no igarapé Anil. O índice de Jaccard de 25% revelou uma baixa similaridade na composição do zooplâncton entre os igarapés. 21 novos registros foram reconhecidos para o Acre. Os ambientes apresentaram frequências altas de rotíferos, assim como os gêneros *Brachionus*, *Lecane* e *Trichocerca*, comuns nos trópicos, foram constantes.

Palavras-chave: *biodiversidade; plâncton; área preservada; variáveis limnológicas.*

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INTRODUCTION

Most of the world's biodiversity is concentrated in tropical regions, and regions with high biodiversity such as the Upper Juruá small rivers are part of the existing tropical richness. The high diversity of this region, and of the entire state of Acre, where the Upper Juruá is located, may result from the interaction of many biotic and abiotic factors, for instance: origin and geological history of the region, past climatic changes, mechanisms that generate diversity throughout time, environmental heterogeneity, current climatic conditions (pluviosity, humidity, temperature, and seasonality) (1). However, the ecosystem in the region, like in others, has been changed to various extents by humans. These changes have resulted in biodiversity losses, particularly with respect to organisms such as zooplankton.

The richness, diversity and the seasonal dynamics of zooplankton communities in response to hydrological cycles can be used to investigate the trophic evolution and stability of aquatic environments, and to devise plans for the conservation and preservation of aquatic ecosystems, including the use of water (2). Biomonitoring is the systematic evaluation of biological changes in the environment, often caused by anthropogenic activities (2). The use of such data to evaluate environmental degradation is advantageous when compared with alternatives such as chemical and physical water analyses, because the latter two offer only a snapshot of the existing water conditions (3). The impact of environmental degradation on organisms, by contrast, stretches over a longer period of time. Zooplankton is a good bioindicator (3) because its components have a short life-cycle, allowing for the fast detection of anthropic changes.

The main groups present in zooplankton are Protozoa, Rotifera, Cladocera and Copepoda, and immature Arthropods (3). Among the components of zooplankton, the Rotifera are good water quality bioindicators because they play an important role in the structure of ecosystems and respond quickly to changes in abiotic conditions. Therefore, rotifers can be used to ascertain the impact of pollution.

Aside from the qualities mentioned above, rotifers abound in species richness and population density. In continental waters, these organisms represent a component of food chains, occupying the niche of small filter-feeders. They are indicators of specific ecological conditions and are utilized in the determination of the trophic state of water bodies (3-4). In Brazil, they have been subjected to taxonomic and ecological studies (5-6).

In Amazon, the taxonomic and ecological aspects of zooplankton were studied by Koste e Robertson (7); Koste e Hardy (8); Koste et al. (9); Hardy et al. (10); Segers e Sarma (11), Segers et al. (12), Cicchino et al. (13), Waichmann et al. (14) and Alves et al. (15). In Acre, zooplankton was investigated, in the last years, by various authors: Keppeler (16-17), Keppeler and Hardy (18-19). The zooplankton of the Upper Juruá has only been investigated by Keppeler et al. (20-21). In view of this, our main goal was to list the zooplankton of the Serra do Divisor National Park, state of Acre, and to provide a limnological characterization of the area. Additionally, we compared the biodiversity of a pristine area with that of a deforested area.

MATERIAL AND METHODS

This study was performed in two small rivers located within the Serra do Divisor National Park (Figure 1), including two distinct areas: one pristine (Pedernal: 7 º 30'23, 7 "S and 73 º 42'05, 2"W) and one affected by deforestation (Anil: 7 ° 27'014 "S and 73 º 37'30, 8"W).

The limnological variables studied in both, pelagic and littoral zones were: temperature (°C), dissolved oxygen (mg.L^{-1} e %), pH and turbidity (NTU), ascertained with the help of a multiparameter probe Troll, model 9500. We conducted quantitative sampling performing horizontal and vertical hauls with a 50 micron mesh size plankton net, totaling 12 samplings at each stream. Hauls were conducted in coastal and pelagic regions, in high and low depths. The quantitative sampling was conducted by filtering 200 L in net plankton of 50 µm. In the laboratory, analysis of zooplankton samples were conducted using a micro camera attached to a DCE microscope whose image was projected onto an Acer laptop with software installed to capture images and photos for species identification. The organisms were identified to genera and species, using appropriate descriptions, reviews and keys, particularly Koste (22).

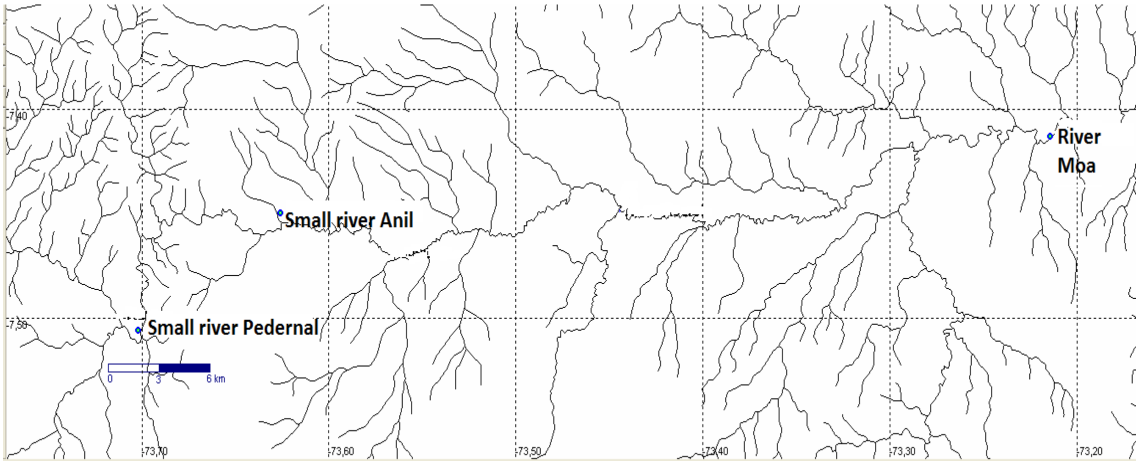

Figure 1. Location of small rivers Anil and Pedernal, located within the Serra do Divisor National Park - Acre, Brazil

Voucher specimens are deposited at the biological collection, Limnology laboratory, University Federal of Acre, Cruzeiro do Sul, Acre.

The frequency of occurrence (F) was calculated according to Cavalcanti and Larrazábal (23). The total number of samples in which each species was found with respect to the total number of samples was calculated using the following equation: F = p X 100/P, where: (p) number of samples containing the species and (P) total number of samples. As a function of F, the following categories were devised: very frequent (>70%); frequent (70-30%); not frequent (30-10%), sporadic (< 10%). The Jaccard similarity index (J) was used to compare between the two small rivers. It is one of the most commonly used indexes to make qualitative comparisons between communities (24). The Jaccard index is calculated using the formula [cj = c / (a + b) - c], where cj = similarity index, a = species found at site a, b = species found at site b and c = species found in both locations (and and b)] was used to test for similarity. This index rarely reaches values above 60%. Areas that have similarity values around 25% (25) are considered similar.

RESULTS AND DISCUSSION

The physical and chemical parameters obtained from the pristine and deforested areas are given on table 1. In general, the temperature between the two areas, and between pelagic and littoral zones, did not differ. The rich surrounding vegetation may have provided a buffer, avoiding variations in the environmental temperature.

Table 1. Physical and chemical variables of the small rivers Anil and Pedernal, Serra do Divisor National Park – Acre, Brazil.

ANIL (deforested area) **(7º27´014"S and 73º37'30,8")**		
	LITTORAL	**PELAGIC**
Temperature (ºC)	21.41±0.74(n=3)	21.42±0.71(n=3)
Dissolved oxygen (mg.L^{-1})	7.10±0.34(n=3)	7.09 ± 0.80 (n=3)
pH	5.16±0.04(n=3)	5,10±0,04(n=3)
Turbidity (UNT)	29±5.54(n=3)	28±16,96(n=3)
Transparency (m)	0.45±0.06 (n=3)	0.50±0.12 (n=3)
Depth (m)	0.73±0.23 (n=3)	1.01±0.30 (n=3)
PEDERNAL (pristine area) **(7º30´23,7"S and 73º42'05,2")**		
Temperature (ºC)	21.87±1.06(n=3)	22.01±1.06(n=3)
Dissolved oxygen (mg.L^{-1})	8.72±0.54(n=3)	9.06±0.54(n=3)
pH	6.35±0.04(n=3)	6.47±0.04(n=3)
Turbidity (UNT)	6±1.92 (n=3)	5±1.92(n=3)
Transparency (m)	0.35±7.07 (n=3)	0.60±14.14 (n=3)
Depth (m)	0.55±0.21 (n=3)	0.6±0.4 (n=3)

Small fluctuations in dissolved oxygen accompanied temperature fluctuations. The concentration of dissolved oxygen was higher in the pristine area than in the deforested area. It varied between 5.00 and 8.00, values consistent with a previous survey by Keppeler and Hardy (16,17) of the Amapá Lake (AC).

The pH was slightly more acidic at the deforested area. It varied between 5.10 and 6.42, values similar to those found at Upper Acre, particularly the Amapá Lake (17-19).

On the other hand, turbidity (4 – 28) was apparently more strongly influenced by the Môa River than by the pristine and deforested areas established at the small rivers. This was demonstrated when this parameter presented new values at the deforested area. Transparency, which is inversely correlated with turbidity, also presented values in the deforested region. No marked differences were found between the pelagic and littoral zones.

The turbidity was lower at small river Pedernal (5-6 UNT), and the dissolved oxygen was higher than at small river Anil, consistent with its classification as a more preserved area. The long-term effects of deforestation did not cause modifications in the water quality.

A total of 45 species were found in the zooplankton community of Pedernal and 52 species in Anil (Table 2). In Pedernal, Lecanidae (18 species) and Lepadellidae (7 species) were the most common families. At small river Anil, also the diversity concentrated in the following families: Lecanidae (18 species) and Lepadellidae (7 species). This assemblage, including Lecanidae and Lepadellidae are common in the tropics (27). 21 new records were recognized for the state of Acre. It was found in both small rivers, particularly in Rotifera (Table 2), also found in the lakes of the Central Amazon (28-30).

In general, species were in low frequency 12%, (Table II), and their distribution among seasons did not reveal a clear pattern between the rainy and the dry seasons. Even the few frequent species were uniformly distributed among seasons, in contrast with results in other studies conducted at the Lakes Amapá and Pirapora (16-17-18-19). This discrepancy may be explained by the fact that our sampling was less intense.

In this study, the Jaccard index of 25% indicated a low similarity in zooplankton species composition between the small rivers. A pattern of zooplankton distribution consistent with deforestation was not found. Much to the contrary, a great diversity of species, including rotifers, was found in both small rivers. Rotifers are typically well-represented in eutrophic systems (30). Many rotifers are considered opportunists in different environments. The small rivers studied are subject to cyclical changes that occur in lowland areas. The stress generated by these changes may cause strategist species to reproduce rapidly. Birky and Gilbert (31) suggested that the reproductive system of rotifers has many advantages, which may facilitate the colonization of many areas by these opportunistic, free-living animals.

Esteves and Sendacz (32) established a correlation between the composition of zooplankton and the trophic state of reservoirs in São Paulo. According to their data, the representation of rotifers and nauplii is stronger in environments that are more eutrophic. *Brachionus*, *Lecane* and *Trichocerca*, well-represented in the small river evaluated, and also have been recorded in eutrophic environments. But studies about phosphorus in situ are still needed to better substantiate confirm this.

Table 2. Zooplankton of small rivers Pedernal and Anil, Serra do Divisor National Park, Alto Juruá, AC. An= Anil; Ped = Pedernal; X = Species Occurrence; FO = Ocurrence frequence: very frequent (>70%); frequent (70-30%); not frequent (30-10%), sporadic (< 10%). NR = New records for the state of Acre. .

ROTIFERA	An	Ped	An(FO)	Ped(FO)	NR
Brachionidae					
Brachionus urceolaris Muller, 1773	X		12		X
Paranuraeopsis sp.	X		24		
Platyias quadricornis brevispinus Daday, 1905	X			36	
Platyias quadricornis quadricornis Ehrenberg, 1832		X		24	
Plationus patulus patulus Muller, 1786	X		12		

Continuation of Table 2. Zooplankton of small rivers Pedernal and Anil, Serra do Divisor National Park, Alto Juruá, AC. An= Anil; Ped = Pedernal; X = Species Occurrence; FO = Ocurrence frequence: very frequent (>70%); frequent (70-30%); not frequent (30-10%), sporadic (< 10%). NR = New records for the state of Acre

Gastropodidae					
Ascomorpha sp.		X		12	
Ascomorpha ecaudis Perty, 1850	X	X	12	12	X
Ascomorpha ovalis Bergendal, 1892		X		12	
Beauchampiellidae					
Beauchampiella eudactylota eudactylota Gosse, 1886	X	X	12	12	X
Euchlanidae					
Euchlanis spp.		X		12	
Chephalodellidae					
Cephalodella spp.	X	X	12	12	
Cephalodella gibba Ehrenberg, 1830	X		36		
Colurellidae					
Colurella anodonta Carlin, 1939		X		12	X
Colurella sp.	X		24		
Colurella obtusa clausa Hauer, 1936	X		12		X
Colurella uncinata Muller, 1773	X		12		
Dipleuchlanis propatula macrodactyla Gosse, 1886	X		12		
Filinidae					
Filinia sp.		X		12	
Filinia novaezealandiae Shiel and Sanoamuang 1993	X	X	24	12	
Floscularia sp.		X		12	
Keratellidae					
Keratella lenzi lenzi Hauer (1953)	X	X		12	
Keratella tropica tropica Apstei (1907)	X		12		
Lecanidae					
Lecane spp.	X	X	12	24	
Lecane acus Harring, 1913		X		12	X
Lecane arcuata . cf. Bryce, 1891		X			X
Lecane benjamini brasiliensis Koste, 1972	X		12		X
Lecane bulla Gosse, 1851	X		12		
Lecane bulla goniata Harring and Myers, 1896	X		12		
Lecane closterocerca Schmarda, 1859	X		12		
Lecane closterocerca amazonica Koste, 1978	X	X	12	12	X
Lecane decipiens Murray, 1913	X		24		
Lecane doryssa cf. Harring, 1914	X		12		
Lecane elegans Harring, 1914	X		12		
Lecane flexilis Hudson and Gosse, 1886	X		12		
Lecane lauterborni, Hauer, 1924	X		12		
Lecane luna Muller, 1776	X		12		
Lecane lunaris lunaris Ehrenberg, 1832	X	X	36	36	
Lecane imbricata Carlin, 1939		X		36	X
Lecane lunaris constricta Murray, 1930		X		12	
Lecane lunaris crenata Harring, *1930*		X		24	
Lecane lunaris perplexa Alstrom, 1938		X		12	
Lecane ludwigi Eckstein, 1883		X		36	
Lecane monostyla Daday, 1897	X		36	36	
Lecane cf. *murrayi* Hauer, 1965	X		12	12	
Lecane pyriformis Daday, 1897	X	X	24	72	

Continuation of Table 2. Zooplankton of small rivers Pedernal and Anil, Serra do Divisor National Park, Alto Juruá, AC. An= Anil; Ped = Pedernal; X = Species Occurrence; FO = Ocurrence frequence: very frequent (>70%); frequent (70-30%); not frequent (30-10%), sporadic (< 10%). NR = New records for the state of Acre

ROTIFERA	An	Ped	An(FO)	Ped(FO)	NR
Lecane . pauliane cf. Berzins, 1960		X		12	
Lecane lauterborni cf. Hauer, 1924		X		12	X
Lecane cf. *furcata* Murray, 1913		X		12	X
Lecane papuana Murray, 1913	X		24	24	
Lecane quadridentata Ehrenberg, 1830		X		12	
Lecane stichaea cf. *verecunda* Harring andMyers, 1926		X		12	X
Lepadeliidae					
Lepadella benjamini benjamini Harring, 1916	X		12	12	X
Lepadella sp.	X	X	60	48	
Lepadella ovalis Muller, 1786	X	X	36	12	
Lepadella patella Muller, 1773	X	X	36	12	
Lepadella patella similis Remane, 1929	X	X	60	48	
Lepadella cf. *princisi* Berzins, 1943	X	X	24	12	X
Lepadella quadricarinata Stenroo, 1898		X		24	
Lepadella triptera triptera Ehrenberg, 1930	X		12		X
Mytilina sp.		X		12	
Proalidae					
Proales sp.	X	X	12	36	
Synchaetidae					
Polyarthra bicerca Wulfert, 1956	X		12		X
Polyarthra sp.	X				
Testudinellidae					
Testudinella mucronata hauerensis Gillard, 1967	X		12		
Testudinella patina Herman, 1783	X		12		
Testudinella patina intermedia Anderson, 1889		X		12	
Testudinella tridentata Smirnov, 1931	X	X	48	36	
Trichocercidae					
Trichocerca spp.	X	X	48	24	
Trichocerca montana cf. Hauer, 1956	X	X	12	12	
Trichocerca myersi Hauer, 1931	X		12		
Trichocerca similis Wierzejski, 1893	X	X	36	12	
Trichocerca tenuior Gosse, 1886	X	X	12	12	
Trichotria tertractis Ehrenberg, 1830	X		12		X
Wierzejskiellidae					
Wierzejskiella sabulosa Wiszniewski, 1932		X		12	X
CLADOCERA					
Chydoridae					
Alona cambouei Guerne and Richard, 1893	X		36		X
Lepidoziaceae					
Kurzia latissima Kurz, 1874		X		12	X
Machrothricidae					
Macrothrix sp.		X		12	
COPEPODA					
Copepodito				84	
MEROPLANKTONIC ORGANISMS					
Chaoboridae					
Chaoborus spp.	X	X	48	36	

CONCLUSION

Rotifera was the group with the highest number of identified species. There were 21 new recognized records for the Acre. There is little similarity in composition of zooplankton species between the two small rivers, in accordance with the Jaccard index (25%).

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