

Composition of zooplankton of the small river Jesumira, located in a cleared in area at the Park National Serra do Divisor, State of Acre, Brazil

Composição do zooplankton do Igarapé Jesumira, localizado numa área desmatada no Parque Nacional da Serra do Divisor, Acre, Brasil

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Abstract

The Upper Juruá is rich in biodiversity, not only because it is located at an untouched region, but also because it is near the equator, it is part of wealth in the tropics. Ecosystems in the region, however, have been modified by humans, what has resulted in biodiversity loss. The zooplankton is very vulnerable to environmental perturbations. This work aimed to study zooplankton taxonomy, and to address some ecological issues. The Jesumira Igarapé is located at the Parque Nacional da Serra do Divisor, between coordinates 7 ° 28'10, 2 "S and 73 ° 33'54, 6" W. Quantitative sampling was conducted with a 55µm mesh size plankton net. Horizontal and vertical hauls were performed, totaling eight samplings in the littoral and pelagic zones, at low and high tides. 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 limnological variables obtained were as follows: temperature 24.17°C ± 2.19 (pelagic) and 24.01 °C ± 2.20 (littoral); pH 6.50 ± 0.37 (pelagic) and 6.42 ± 0.28 (littoral); dissolved oxygen 8.61 mg.L⁻¹ ± 0.65 e e 8,00±0,32 mg.L⁻¹; turbidity 39.50 UNT±7,14 (pelagic) and 27.86 TNU ±11,84 (littoral); transparency 0.26 m ±14.84 (pelagic) and 0.55±10.90 (littoral) and depth 0.31m ±0.21 (pelagic) and 0.73m ±0.11 (littoral). With respect to diversity, 30 species of rotifers, one species of Cladocera, immature stages of copepods, arthropod larvae (especially representatives of the abundant class Insecta) were listed. Another relevant result of this study was the finding of thirthy and two new records for the state of Acre.

Keywords: Plankton. Upper Juruá. Deforestation.

Resumo

A região do Alto Juruá é rica em biodiversidade, primeiro por fazer parte de regiões jamais intocadas e, segundo por encontrar-se próxima ao equador, fazendo 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. Os organismos zooplânctônicos respondem com elevada sensibilidade às perturbações ambientais. O presente trabalho teve por objetivo estudar a taxonomia do zooplâncton, e realizar algumas considerações ecológicas. O Igarapé Jesumira está localizado no Parque Nacional da Serra do Divisor, entre as coordenadas de 7°28'10,2"S e 73°33'54,6"W. A coleta foi realizada através de amostragens qualitativas, com arrastos horizontais e verticais com rede

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de plâncton com 55µm de abertura de malha, totalizando oito amostragens realizadas na região litorânea e pelágica, abrangendo as águas baixas e altas. As análises das amostras foram realizadas utilizando micro-câmara DCE acoplada em microscópio, cuja imagem era projetada no notebook marca Acer, com software instalado de captura de imagem, e fotografadas para identificação e registro da espécie. Em relação às características limnológicas, o Igarapé apresentou, temperatura $24,17^{\circ}\text{C} \pm 2,19$ (pelágica) and $24,01^{\circ}\text{C} \pm 2,20$ (litorânea); pH $6,50 \pm 0,37$ (pelágica) and $6,42 \pm 0,28$ (litorânea); oxigênio dissolvido $8,61 \text{ mg.L}^{-1} \pm 0,65$ e $8,00 \pm 0,32 \text{ mg.L}^{-1}$; turbidez $39,50 \text{ UNT} \pm 7,14$ (pelágica) e $27,86 \text{ UNT} \pm 11,84$ (litorânea); transparência $0,26 \text{ m} \pm 14,84$ (pelágica) e $0,55 \pm 10,90$ (litorânea) e profundidade $0,31 \text{ m} \pm 0,21$ (pelágica) e $0,73 \text{ m} \pm 0,11$ (litorânea). Quanto às espécies foram listadas 72 espécies de Rotifera, 01 espécie de Cladocera, formas jovem de Copepoda, larvas de Arthropoda, destacando-se abundância para representantes da classe insecta. Como grande relevância neste estudo foram observadas 32 (trinta e duas) novas ocorrências para o Estado do Acre.

Palavras-chave: Plâncton. Alto Juruá. Desmatamento

Introduction

Low latitudes are characterized by high diversity. According to Lewis (1996), regions near the equator are very efficient in nutrient cycling, particularly in the water columns that result from intra-seasonal variations.

In these environments the zooplankton fauna is more diverse and endemic with respect to the fauna of temperate areas. The Upper Juruá region, located in the Amazon basin, is spatially heterogeneous, and presents seasonal fluctuation in water levels.

These two characteristics favor the occupation of different lowland habitats, which become isolated and then connected again according to the season (LANSAC-TÔHA et al., 2004). Variations in water levels create pulses that correspond to floods and droughts. These pulses severely alter the structure and dynamics of aquatic communities. During the flood period, aquatic ecosystems receive large amounts of water. As a consequence, rivers and lakes expand and become deeper. Several of them become inter-communicated, forming a unified system. During the dry season, by contrast, when water levels are low, these water bodies recede and separate again, or stay connected through narrow channels.

Floodplains abound in Amazonian ecosystems, especially surrounding large rivers. Large rivers

comprise mosaics of ecosystems that globally work as a subsystem (NEIFF, 2003). Within the floodplains, ecotones (intermediate areas of tension between two communities), depending on the degrees of environmental exchanges (especially the hydrological regime), may form. Floodplains differ structurally and functionally (NEIFF, 2003) among each other, especially along streams.

Horizontally, ecosystems can be divided into two zones: pelagic and littoral. The first is in direct contact with the adjacent terrestrial system, being considered an ecotone. The littoral zone is an important interface between the terrestrial and aquatic ecosystems (TANIGUCHI et al., 2004), having great influence on the composition and dynamics of the aquatic biota, particularly because it harbors structurally complex and diverse habitats (NOGUEIRA; GEORGE, 2003). The littoral zone generally has great amounts of marginal vegetation (aquatic macrophytes), which results in high primary productivity. Furthermore, due to habitat and food availability, this zone offers a great variety of ecological niches (WETZEL; LIKENS, 1991) and food chains involving herbivory (the energy source being live vegetable biomass) and detritivory (supplied by dead matter). Detritivores, including numerous aquatic invertebrates, are the main players in the energy flux of the littoral zone. All trophic levels are present in the littoral zone: primary

producers, consumers, and decomposers. For this reason, it can be considered an autonomous unit within the aquatic ecosystem, characterized by the presence of macroalgae, bryophytes, pteridophytes and higher plants (aquatic macrophytes).

The pelagic zone, by contrast, does not suffer from the direct impact of the adjacent terrestrial ecosystem. In this zone, living organisms are more exposed to changes in water level regimens. The latter determine the longitudinal flux, and also the vertical stratification caused by the effects of radiation, by the wind moving and mixing the water (STRASKRABA; TUNDISI, 2000).

Contrasting with the well-studied zooplankton fauna of southwestern Amazon in the last years (KEPPELER; HARDY, 2002; KEPPELER 2003a, 2003b; KEPPELER; HARDY 2004a, b), the zooplankton of northeastern Acre is basically unknown. The main studies conducted in the Amazon basin have focused on ecosystems that are

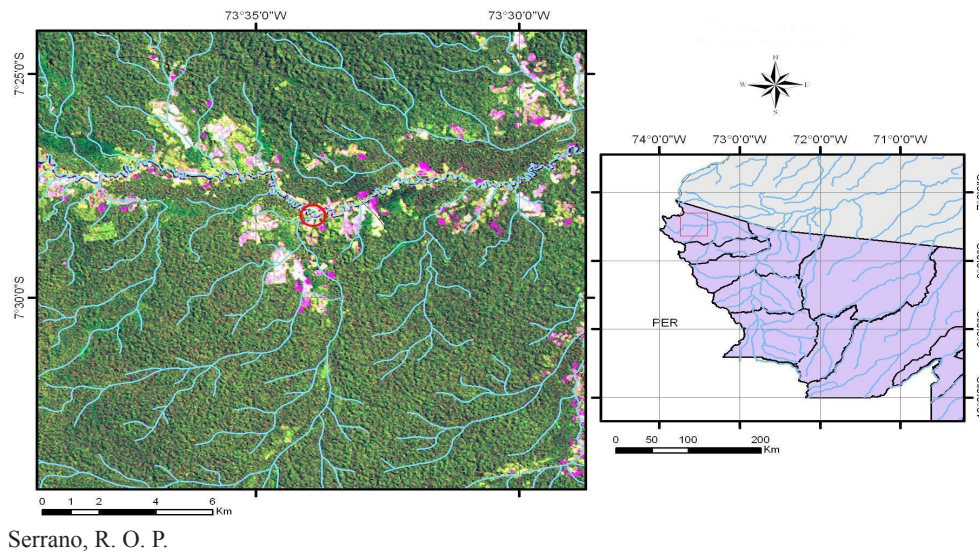
similar to the ecosystems found at the Paraná basin floodplains: Lansac-Tôha et al. (2004), Bonecker et al. (2005), Joko et al. (2008), Bonecker et al. (2009), Lansac-Tôha et al. (2009) e Simões et al. (2009).

Material and Methods

This work aimed to study the horizontal distribution of rotifers in the pelagic and littoral zones of an small river (igarapé), using qualitative data. We hypothesized that the zooplankton communities would differ between the two zones and aimed to provide a limnological characterization of the area. In order to accomplish these goals, we (a) identified the species present at small river Jesumira; (b) compared the zooplankton fauna of the pelagic with that of the littoral zone.

This study was performed at small river Jesumira ($7^{\circ}28'10,2''S$ and $73^{\circ}33'54,6''W$; Figure 1).

Figure 1 - Location of small river Jesumira . The circle and square indicate the location.



Source: Keppeler et al. (2010).

The climate at Alto Juruá is hot and humid, with two seasons: dry and wet. The dry season is also called “summer”, lasting from May to October. The wet season, also known as “winter” (ACRE, 2000), is characterized by constant rain showers, and lasts from October to the end of April.

The Alto Juruá region is located in southwestern Amazon (Figure 1). It is characterized by high biodiversity, harboring several Indian reservations and conservation units. The main river, Juruá, is an affluent of the right margin of the Amazon River, stretching over 3.350 km. High tides occur between February and April, and low tides are present between July and September.

The lower basin of the Juruá presents a dendritic configuration. The rivers in this area are sinuous due to sudden changes in the flow of water. The Juruá communicates directly with the Moa River, and both communicate with small rivers one of which, Jesumira, is the subject of this study.

The region is located on a sub-basin formed in the Cenozoic Era (between 65 million and 12,000 years ago). This sub-basin consists of the Solimões formation, a thick package of sedimentary rocks of fluvio-lacustrine origin. The sources of these sediments, which occupy the entire south-central portion of the Amazon, are the rocks of the Andes mountain range (ROIG; MARTINI, 2002).

There are two main geomorphologic units (or reliefs) in the Upper Juruá, which correspond roughly to the geological units Solimões formation and recent alluvial sediments (ROIG; MARTINI, 2002).

We measured the following variables in late September: temperature, pH, dissolved oxygen and turbidity with a multiparameter probe limnological TROLL brand, model 9500. Transparency was measured with Secchi disk Disk Sechii and depth. All samples were performed in the littoral and pelagic zones.

Two sampling campaigns were conducted, one

in the dry season (late September) and another in the rainy season (mid-April). Each sampling campaign consisted of three collecting trips, yielding a total of six collecting trips. The samples were collected with plankton net, mesh opening of 50µm, in three replicates. 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. In the laboratory, the material was examined under a light microscope and binocular camera. For taxonomic identifications, a specialized bibliography was utilized (ELMOOR-LOUREIRO, 1997, KOSTE, 1978; and others). Voucher specimens are deposited at the biological collection of the sinbio (sistema de informação da biodiversidade), in Cruzeiro do Sul, Acre.

Results and Discussion

In table 1, the values relative to the parameters of the physical and chemical variables are shown. The water temperature in all small rivers was, on average, 24.17°C in the littoral region and 24.01°C in the pelagic region. The rich surrounding vegetation may have provided a buffer, avoiding variations in the environmental temperature. Dissolved oxygen was 8.61 mg.L⁻¹ in the littoral region and 8.00 mg.L⁻¹ in the pelagic region. The pH in the small river was acidic, on average 6.50 in the littoral zone and 6.42 in the pelagic. The pH was slightly more acidic at the deforested area. These values were also similar to those found at Alto Acre, particularly at the Amapá Lake (KEPPELER; HARDY 2004a, 2004b). Small fluctuations in dissolved oxygen accompanied temperature fluctuations. These values were similar to those obtained in a previous survey at the Amapá Lake (AC) and Pirapora (AM), carried out by Philips, Havens e Lopes (2008). Water turbidity varied from 0.26 to 0.55 UNT, on

average, in the littoral and pelagic regions. Water transparency was low during the entire study, with values between 0.31 and 0.73 m, on average, for the littoral and pelagic regions.

Table 1 - Physical and Chemical variables at small river Jesumira, Park National Serra do Divisor

	Littoral	Pelagic
Temperature (°C)	24.17±2.19±(n=3)	24.01±2.20(n=3)
Dissolved oxygen (mg.L ⁻¹)	8.61±0.65(n=3)	8.00±0.32(n=3)
pH	6.50±0.37(n=3)	6.42±0.28(n=3)
Turbidity (UNT)	0.26±14.84 (n=3)	0.55±10.90 (n=3)
Transparency (m)	0.31±0.21(n=3)	0.73±0.11(n=3)

Source: Authors.

The qualitative analyses of the pelagic and littoral environments revealed the presence of 73 taxa. 25 new records for the state of Acre were encountered in the small river (Table 2).

The greatest richness was found in rotifers, followed by cladocerans. Copepods were not

identified because most of them were copepodites. macrophytes, a common group in the littoral region, were not found. A list of observed taxa is given on table 2. Previous studies have found greater richness of rotifers in zooplankton of tropical freshwater environments.

Table 2 - Zooplankton of small river Jesumira, Park National Serra do Divisor, Alto Juruá, AC.

	FO (%)	NR
Rotifera		
Gastropodidae		
<i>Ascomorpha saltans</i> Bartsch, 1870	9	X
<i>Ascomorpha</i> spp	27	
Brachionidae		
<i>Brachionus</i> sp.	27	
<i>Brachionus budapestinensis</i> <i>budapestinensis</i> Daday, 1885	9	X
Colurellidae		
<i>Colurella uncinata</i> (MÜLLER, 1773)	9	X
<i>Colurella uncinata bicuspidata</i> (EHRENBERG, 1832).	18	X

<i>Colurella sp</i>	9	
Euchlanidae		
<i>Dipleuchlanis propatula</i> fa. <i>acrodactyla</i> (GOSSE, 1886)	18	
<i>Euchlanis sp.</i>	9	
Filiniidae		
<i>Filinia terminalis</i> (PLATE, 1886)	9	
Keratellidae		
<i>Keratella lenzi lenzi</i> (HAUER, 1953):	36	
Lecanidae		
<i>Lecane bulla</i> (GOSSE, 1851)	27	X
<i>Lecane bulla goniata</i> (HARRING e MYERS, 1926).	18	X
<i>Lecane closterocerca</i> (SCHMARDA, 1859)	9	X
<i>Lecane flexilis</i> (GOSSE, 1886)	9	X
<i>Lecane hamata hamata</i> (STOKES, 1896).	18	X
<i>Lecane kluchor</i> Tarnogradski, 1930	27	X
<i>Lecane luna</i> (MÜLLER, 1776)	18	
<i>Lecane lunaris lunaris</i> (EHRENBERG, 1832)	18	
<i>Lecane monostyla</i> (DADAY, 1897)	18	
<i>Lecane</i> cf. <i>murrayi</i>	9	X
<i>Lecane physalis</i> Wulfert, 1939	9	X
<i>Lecane pyriformis</i> (DADAY, 1905)	9	X
<i>Lecane proiecta</i> Hauer 1956	18	
<i>Lecane quadridentata</i> (EHRENBERG, 1832)	9	
<i>Lecane rhacois</i> Harring e Myers, 1926	9	X
<i>Lecane stichaea</i> cf. <i>amazonica</i> Koste, 1978	9	X
<i>Lecane stichaea stichaea</i> Harring, 1913	9	
<i>Lecane spp</i>	45	
<i>Lecane unguinata</i>	9	X
<i>Lepadella bejamini braziliensis</i> Koste, 1972	9	X
<i>Lepadella</i> cf. <i>branchicola</i> Hauer, 1926	18	X

<i>Lepadella imbricata</i> Haring, 1914	27	X
<i>Lepadella monodactyla monodactyla</i> Berzins, 1960	9	X
<i>Lepadella ovalis</i> (MÜLLER, 1786)	36	
<i>Lepadella patella patella</i> (MÜLLER, 1786)	18	
<i>Lepadella patella similis</i> Lucks 1912	27	
<i>Lepadella</i> sp1	18	
<i>Manfredium</i> sp	9	
<i>Mitilina</i> cf. <i>macrocera</i> Jennings, 1894	9	X
<i>Notholca caudata</i> Carlin, 1943	27	X
<i>Notholca</i> sp.	9	
<i>Notholca japonica</i> Marukawa, 1928	9	X
<i>Paranuraeopsis</i> sp.	9	
<i>Paranuraeopsis</i> quadriantennata Koste, 1974	0	X
<i>Platyas quadricornis</i> (EHRENBERG, 1832)	18	
<i>Platyonus patulus</i> var. <i>patulus</i> (DADAY, 1905)	9	
<i>Ploesoma</i> sp.	9	
<i>Polyarthra</i> sp.	9	
<i>Proales</i> sp.	9	
<i>Testudinella emarginula</i> Stenroos 1898	9	X
<i>Testudinella mucronata</i> (GOSSE, 1886)	9	X
<i>Testudinella patina</i> (HERMANN, 1783)	9	
<i>Testudinella</i> spp.	18	
<i>Testudinella tridentata amazonica</i> Thomasson, 1971	9	X
<i>Trichocerca capucina</i> (Wierzejski e Zacharias, 1893)	9	X
<i>Trichocerca cilindrica chattoni</i> Beauchamp, 1907	9	X
<i>Trichocerca fusiformis</i> Carlin, 1939	9	X
<i>Trichocerca myersi</i> (HAUER, 1931)	18	X
<i>Trichocerca</i> spp.	54	
<i>Trichocerca similis</i> (WIERZEJSKI, 1893)	36	
<i>Trichocerca tenuidens</i> (HAUER, 1931)	9	X

Cladocera	
<i>Bosmina</i> sp.	18
Copepoda	
<i>Copepodito</i>	18
Larvae of insects	18
<i>Chaoborus</i>	27
Náuplio	45

X = Species occurrence; FO = Frequency of occurrence; NR = New records for the state of Acre

Source: Authors.

A few cosmopolitan species, for instance *Keratella lenzi*, were also found. Members of the family Brachionidae, typical of low latitudes, were less common than members of Lecanidae. Even though this family is believed to be associated with aquatic macrophytes, we have not found, in our study, any indication of this association.

Differences in zooplankton composition observed throughout this study reinforce previous knowledge that the region receives water from different sources, from both Acre and Amazonas, from River Juruá and River Môa. The species found in our data agreed more with those found in the Amazon region (ROBERTSON; HARDY 1984) than with species typical to the state of Acre, but the genera did not differ from those found by Keppeler (2003a, 2003b) and Keppeler e Hardy (2004a, 2004b).

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