Variação espacial e temporal na estrutura trófica de assembleias de peixes em bancos de sedimentos de planícies aluviais

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Spatial and temporal variation in the trophic structure of fish assemblages in floodplain sediment banks

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Abstract

In tropical floodplains, rivers exhibit high spatio-temporal dynamics, which are key determinants of the organization and trophic structure of fish assemblages. We evaluated the spatial and temporal influences on the trophic structure of fish assemblages in the sediment banks of the Bananal floodplain, located in the Middle Araguaia River region. Diet preferences were identified through stomach content analysis of 564 individuals, representing 48 species across 22 families and six orders. Based on the Alimentary Index (IA_i), the assemblages were classified into eight trophic groups. Analyses of abundance and richness indicated that the trophic structure varied significantly across different environments and seasonal periods. Our results suggest that the composition and distribution of fish trophic groups in the sediment banks of the Bananal floodplain are structured by both spatial and temporal gradients. Taken together, space and time drive high variability in the trophic organization of the ichthyofauna in these environments.

Key words: sandbanks, diet, trophic groups, fish fauna, Bananal floodplain

Resumo

Em planícies inundáveis tropicais, os rios exibem alta dinâmica espaço-temporal, que é determinante fundamental da organização e estrutura trófica das assembleias de peixes. Avaliamos as influências espaciais e temporais na estrutura trófica das assembleias de peixes nos bancos de sedimentos da planície aluvial do Bananal, localizada na região do Médio Rio Araguaia. As preferências alimentares foram identificadas por meio da análise do conteúdo estomacal de 564 indivíduos, representando 48 espécies distribuídas em 22 famílias e seis ordens. Com base no Índice Alimentar (IAi), as assembleias foram classificadas em oito grupos tróficos. As análises de abundância e riqueza indicaram que a estrutura trófica variou significativamente entre diferentes ambientes e períodos sazonais. Nossos resultados sugerem que a composição e a distribuição dos grupos tróficos de peixes nos bancos de sedimentos da planície aluvial do Bananal são estruturadas por gradientes espaciais e temporais. Em conjunto, o espaço e o tempo impulsionam a alta variabilidade na organização trófica da ictiofauna nesses ambientes.

Palavras chaves: bancos de areia, dieta, grupos tróficos, ictiofauna, Planície do Bananal

Trophic structure of fish in the floodplain

Introduction

The characteristics of floodplain habitats vary spatio-temporally and are structured by hydrological cycle fluctuations (Winemiller 1996, Albrey Arrington and Winemiller 2006). Seasonal water level variations drive physicochemical shifts, altering the balance between primary production and respiration, while enhancing nutrient cycling (Junk et al. 1989, Junk and Wantzen 2004). During the flood period, an increase in autochthonous food resources and microhabitat availability occurs, which facilitates key ecological processes, such as reproduction and immigration within aquatic communities (Junk et al. 1989, Winemiller 1996). Conversely, the dry season leads to a reduction in available resources (*i.e.*, habitat and food), consequently intensifying interspecific interactions such as predation and competition (Winemiller and Jepsen 1998). The trophic structure of fish assemblages in floodplains is inherently complex (Angelini and Agostinho 2005, Layman et al. 2005, Jepsen and Winemiller 2007), as high species richness and resource diversity result in a broad spectrum of trophic groups (Winemiller 1991, Hahn et al. 2004). Furthermore, spatio-temporal habitat heterogeneity adds further layers of complexity to the trophic organization of these assemblages (Pouilly et al. 2004, Quirino et al. 2015).

Spatial environmental heterogeneity in floodplains supports high taxonomic diversity, as varied fish behaviors and morphologies enable species to occupy and exploit distinct habitats, these conditions are key determinants of the trophic structure of assemblages (Ward et al. 1999, Amoros and Bornette 2002). The intrinsic characteristics of each habitat drive patterns of selection, which, in turn, influence the complexity and trophic composition of fish communities (Fernandes et al. 2009, Brejão et al. 2013, Wolff et al. 2013). Consequently, distinct trophic group compositions may be observed across different geographical areas (Rodríguez and Lewis 1997, Allan 2004, Silva et al. 2007).

Another defining feature of floodplains is the hydrological cycle (*i.e.*, flood and drought phases), which plays a pivotal role in maintaining the diversity of lotic, lentic, and semi-aquatic habitats (Junk et al. 1989, Ward et al. 1999, Thomaz et al. 2007, Silva et al. 2014). Generally, the onset of rainfall promotes a substantial influx of allochthonous resources into water bodies. This phenomenon results from the transport of organic matter accumulated in adjacent areas during the dry season, as well as the leaching of soils by rising water levels (Luiz et al. 1998, Esteves and Aranha 1999). During the flood period, increased habitat connectivity and availability allow fish to disperse and exploit new environments. Conversely, during the dry season, fish distribution is often restricted to the main river channels or perennial lakes (Arrington et al. 2005, Arthington et al. 2005, Albrey Arrington and Winemiller 2006, Silva et al. 2007).

A common habitat within floodplains consists of marginal sediment banks formed by the deposition of eroded material (Arthington and Winemiller 2004). These habitats are characterized by high environmental homogeneity and limited internal structural complexity; for instance, they typically lack riparian root systems, leaf litter patches, or submerged woody debris (Hughes 1997). Furthermore, they exhibit low physical stability due to the seasonal dynamics of the flood pulse (Gordon et al. 2004, Pereira et al. 2007). Despite their simplified structure, these banks serve as essential areas for foraging, breeding, and refuge for numerous small-bodied fish species and juveniles at various developmental stages (Pereira et al. 2007, Roach and Winemiller 2011). Sandbanks are intrinsically linked to the natural flow regime (Arthington and Winemiller 2004). In the Araguaia River, the prevalence of these areas has become more pronounced due to geomorphological and sedimentary shifts resulting from high deforestation rates over recent decades (Aquino et al. 2009). The fish assemblages inhabiting these sites are vital for maintaining aquatic ecosystem dynamics (Pereira et al. 2007, Roach and Winemiller 2011); being primarily small-sized benthic species, they function as critical trophic links, serving as prey for larger predators and thereby sustaining a complex food web (Pereira et al. 2007).

Trophic ecology analyses provide critical insights into fish behavior across spatial and temporal gradients of food resource availability (Melo et al. 2007). Such studies allow for the characterization of fish assemblages at various scales and help elucidate the interrelationships among individuals across distinct communities (Pereira et al. 2007). In this context, the present study evaluated the spatial and seasonal effects on the trophic structure of fish assemblages associated with marginal sediment banks in the Middle Araguaia River, within the Bananal Floodplain. Specifically, we examined whether fish trophic organization: (i) differs among the three studied environments (Araguaia River, Crixás-Açu River, and Montaria Lake); (ii) varies between drought and flood periods; (iii) exhibits significant differences among trophic groups; and (iv) which group contributes most to the observed differences between environments and periods. We hypothesized that fish assemblages would exhibit distinct trophic structures across both spatial and temporal scales.

Material and methods

Study area

Samplings were conducted in marginal sediment banks associated with the main channel of the Araguaia River (13º 19' 51.4" *S*, 50° 37' 22.5" *W*), its tributary, the Crixás-Açu River (13°21' 07.6" *S*; 50° 36' 35.7" *W*), and Montaria Lake (13° 22' 37.9" *S*, 50° 40' 28.1" *W*), a meandering lake permanently connected to the Araguaia River. All sampling sites are located within the Bananal Floodplain, inside the Meanders of the Araguaia River Environmental Protection Area (Figure 1). The Bananal Floodplain is a major inundation area in the Middle Araguaia basin, characterized by lacustrine-marshy environments and extensive alluvial sedimentation zones (Prado de Morais et al. 2005, Latrubesse and Stevaux 2006, Aquino et al. 2008). Flood and drought events in this region vary primarily with the duration of the rainy season, which typically spans from late October to June or July. Although the dry season begins as early as March or April, sediment banks generally remain submerged until July. For this study, June was classified as the high-water (flood) period, as most sandbanks are still inundated during this stage of the receding limb. The Araguaia River drains the Cerrado biome and supports high aquatic biodiversity (Latrubesse and Stevaux 2006). The basin extends over 2,110 km, covering an area of approximately 379,836 km² across four states: Goiás, Mato Grosso, Pará, and Tocantins (Prado de Morais et al. 2005). The river reaches a discharge of 6,000 m^3s^{-1}at the Araguatins hydrological station (Aquino et al. 2008). Its middle course flows through the Bananal Floodplain, a vast seasonal alluvial plain encompassing nearly 106,000 km² (Valente and Latrubesse 2012). The Crixás-Açu River, a major right-bank tributary of the Araguaia, features a complex floodplain with a meandering pattern. Together with other tributaries, it forms the largest sedimentation area in the State of Goiás (Aquino et al. 2009). Its sediment banks are characterized by heterogeneous substrates, primarily sand-clay, sandy, and pebble sediments with variable depths. Montaria Lake, situated on the left bank of the Araguaia, is connected to the main channel via a 90-meter-wide inlet. The lake is bordered by seasonally flooded riparian vegetation (Prado de Morais et al. 2005), and its sediment banks consist of fine sand and sandy-clayey substrates, typically exhibiting greater depths.

Fish sampling

Fish samplings were conducted in two campaigns: September 2012 (dry season) and June 2013 (flood season), across three environments (Araguaia River, Crixás-Açu River, and Montaria Lake). Fish were collected using a "picaré" type seine net (10 m long, 2 m high, 5.0 mm mesh size) at four sediment banks per environment, totaling 12 sampling sites. At each bank, a 100 m² area was sampled during both daytime and nighttime (n=24 samples per campaign). Following capture, specimens were fixed in 10% formalin and subsequently transferred to 70% ethanol in the laboratory for preservation, identification, and measurement of standard length (cm). Sampling was performed in compliance with Brazilian environmental regulations (ICMBio permit nº 33663-1). All voucher specimens are deposited in the laboratory of ichthyology at the Universidade Estadual do Mato Grosso (UNEMAT) campus Nova Xavantina, Brazil.

Diet analysis

Dietary composition was determined through the analysis of stomach contents. We included only species with a total abundance of at least five individuals and with at least one individual containing identifiable food remains. Stomachs were dissected and examined using stereoscopic and optical microscopes. Food items were identified and quantified using the volumetric method (Hyslop, 1980). For small items, volume was estimated using a gridded dish with a standardized height of 1 mm, subsequently converted to milliliters ($1\ cm^3 = 1\ mL$) (Hellawell and Abel 1971). For larger items, volume was determined by water displacement in a graduated cylinder. Identified items were consolidated into broad food categories as follows: (i) Terrestrial invertebrates (Coleoptera, Diptera, Araneae, Zygoptera, and Lepidoptera); (ii) Aquatic invertebrates (Diptera, Ephemeroptera, Plecoptera, Trichoptera, Megaloptera, Coleoptera, Acarina, and Decapoda); (iii) Fish; (iv) Periphyton (filamentous and diatom algae, plus associated microorganisms); (v) Mollusks (Bivalvia); (vi) Scales and fins; (vii) Plant material (leaves, fruits, flowers, woody debris, and roots); (viii) Plankton (zooplankton, such as Cladocera and Copepoda, and planktonic algae); (ix) Detritus (unidentified organic matter and microorganisms associated with the substrate); (x) Blood; and (xi) Others (rare items, such as amphibians, or unidentified material).

Data analysis

Fish species were classified into trophic groups based on the predominance of food categories, determined by the Alimentary Index (IA_i) (Kawakami and Vazzoler 1980), calculated as follows: $IA_i = F_i \times V_i / \sum^{L}_{i=1} F_i \times V_i \times 100$ where F_i is the frequency of occurrence (%) and V_i is the relative volume (%) of a given food item *i*.

Species with an IA_i below 60% for all food categories were classified as omnivores. Conversely, species with an $IA_i \geq 60\%$ for a specific category were assigned to the corresponding trophic group: Detritivore, Invertivore (including both allochthonous and autochthonous prey), Lepidophagous, Periphytophagous, Piscivore, Planktivore, or Hematophagous.

To evaluate patterns in the trophic organization of the ichthyofauna in relation to spatial (Araguaia River, Crixás-Açu River, and Montaria Lake) and seasonal (drought and flood) variations, we employed Non-Metric Multidimensional Scaling (NMDS; Pinha et al. 2024). This analysis was based on abundance and richness matrices of the trophic groups using Bray-Curtis distance measures. The effects of spatial and seasonal factors on the fish assemblages were tested using a two-way Analysis of Similarity (ANOSIM; CLARKE 1993, Silva et al. 2022). Additionally, Similarity Percentage Analysis (SIMPER) was used to assess average dissimilarity between groups and identify which trophic categories contributed most to the observed spatial and temporal differences (CLARKE 1993). All analyses were performed in R (R Team 2018) using the vegan package (Oksanen et al. 2022), with a significance level of $\alpha = 0.05$.

Results

A total of 5,587 fish were collected (Araguaia River: 1,631; Crixás-Açu River: 1,715; Montaria Lake: 2,241), comprising 106 species and nine orders. Dietary analysis was performed on 564 individuals from 48 species, belonging to 22 families and six orders (Characiformes, Clupeiformes, Gymnotiformes, Perciformes, Siluriformes, and Tetraodontiformes). These included 140 individuals (27 species) from the Araguaia River, 138 individuals (39 species) from the Crixás-Açu River, and 138 individuals (40 species) from Montaria Lake. Fish were classified into eight trophic groups (Table S1, Figure 2). Invertivores were the most abundant group in the rivers, whereas detritivores and planktivores predominated in the lake (Table 1).

The Alimentary Index (IA_i) revealed that 87.5% of the species exhibited a preference for a specific food resource ($IA_i \geq 60\%$) while only six species were classified as omnivores ($IA_i < 60\%$). Site-specific analyses showed that specialized feeding was prevalent in 88.8% of species in the Araguaia, 84.6% in the Crixás-Açu, and 85% in Montaria Lake. Omnivory was restricted to a few taxa: *Colomesus asellus*, *Geophagus neambi*, and *Tetragonopterus* gr. *chalceus* in the Araguaia River; these three plus *Retroculus lapidifer*, *Tetragonopterus* sp. 2, and *Triportheus trifurcatus* in the Crixás-Açu; and *G. neambi*, *Poptella compressa*, *T. chalceus*, *Tetragonopterus* sp. 2, and *T. trifurcatus* in Montaria Lake.

Trophic structure varied in composition, richness, and abundance across sites and periods. Piscivores, represented by *Pygocentrus nattereri* and *Hoplias malabaricus*, were absent in the Araguaia and occurred at low abundance in the Crixás-Açu and Montaria Lake. Planktivores (*e.g.*, *Metynnis* sp. and *Moenkhausia dichroura*) were present in all environments but were most abundant in the Araguaia and the lake. Lepidophagous species (*e.g.*, *Serrasalmus rhombeus* and *Roeboides* sp.) were absent in the Araguaia but reached higher abundance in the lake. Periphytophagous fish (*e.g.*, *Leporinus friderici*, *Aphanotorulus emarginatus*, and *Apareiodon* sp.) were recorded across all sites, albeit in low numbers in the rivers. Finally, hematophagous species (*e.g.*, *Stegophilus* sp. and *Vandellia* sp.) were exclusive to the Araguaia and Crixás-Açu rivers at low abundances.

Invertivores displayed the highest species richness across all environments (Figure 3) and dominated in abundance in both lotic and lentic systems. Detritivores were most abundant and diverse in Montaria Lake (535 individuals, seven species) and the Crixás-Açu River (114 individuals, six species), but were virtually absent in the Araguaia. Seasonally, detritivore abundance shifted from 441 individuals in the dry season to 211 in the flood season. Invertivore abundance also fluctuated, with 1,671 individuals recorded during the drought and 1,854 during the flood.

Trophic group richness remained relatively stable between seasons (46 species in drought vs. 42 in flood). NMDS ordination indicated clear differentiation in trophic structure between sites based on abundance and richness (Figure 4). Samples from the lentic environment (Montaria Lake) formed a distinct cluster, while lotic samples, particularly from the Araguaia River, formed a separate, tighter grouping. These spatial and temporal patterns were confirmed by ANOSIM, which identified significant differences in trophic structure between environments (Table 3). SIMPER analysis identified the primary contributors to these dissimilarities (Table 4). Seasonally, planktivores, invertivores, and hematophagous groups drove differences in abundance. Spatially, the dissimilarity between the Araguaia and Crixás-Açu rivers was primarily driven by detritivores, omnivores, and planktivores. Between the Araguaia and Montaria Lake, detritivores, lepidophagous, and omnivores were the main contributors. For the Crixás-Açu and Montaria Lake, differences were largely due to planktivores, detritivores, lepidophagous, and piscivores. Regarding species richness, SIMPER highlighted hematophagous, omnivores, and planktivores as the key groups contributing to seasonal dissimilarity.

Discussion

Our findings demonstrate that the trophic structure (richness and abundance) of fish assemblages in the sandbanks of the Bananal Floodplain shifts across spatial and temporal scales. We identified eight trophic groups across the three studied environments (Araguaia River, Crixás-Açu River, and Montaria Lake). The spatial variation in trophic organization likely stems from environmental variability and food resource availability; while fish species may disperse throughout the floodplain, they are ultimately selected by environmental filters

(Poff 1997). In tropical floodplains, seasonal variation is driven by the flood pulse, which reconfigures habitat structure and resource supply (Junk et al. 1989). These temporal shifts provoke significant alterations in the organization and trophic structure of fish assemblages (Tejerina-Garro et al. 1998, Li and Gelwick 2005). Given that taxonomic composition varies over space and time, it follows that the functional (trophic) roles of these species also fluctuate according to seasonal habitat changes. Furthermore, tropical ichthyofauna often exhibits high dietary flexibility, consuming the most abundant resources available in a given period or location (Abelha et al. 2001, Pereira et al. 2007).

Despite this potential flexibility, our study shows that many species in the Bananal Floodplain exhibit a preference for specific food types, particularly invertivores. Specialized species tend to occupy environments where foraging conditions are optimal, whereas generalist species forage across diverse habitats, utilizing resources of both autochthonous and allochthonous origins (Willis et al. 2005). Dietary variation in these assemblages may result from morphological adaptations for prey capture or a stable supply of specific resources (Winemiller et al. 2008). For instance, lentic environments, such as Montaria Lake, promote the deposition of organic matter, favoring detritivorous species (*e.g.*, *Prochilodus nigricans*, *Curimatella dorsalis*, and *C. immaculata*) and supporting a high diversity of fish at lower trophic levels (Winemiller et al. 2008).

Conversely, some sandbank species exhibited generalist feeding habits, a common trait among tropical fishes (Lowe-McConnell 1987, Abelha et al. 2001, Wolff et al. 2013), that exploit the most abundant local resources. Similar to the findings of (Pereira et al. 2007) in the Tocantins River, we observed a high abundance of invertivores, suggesting a substantial supply of invertebrates in these shallow marginal habitats.

Overall, the trophic structure varied significantly along spatial and seasonal gradients, with the most pronounced differences occurring between lentic (lake) and lotic (rivers) environments. These variations are driven by habitat changes that stabilize or restructure fish communities (Gido et al. 1997). Spatial distribution is closely linked to structural complexity and abiotic factors such as depth, temperature, and turbidity (Lowe-McConnell 1987, Oliveira and Goulart 2000). The sandbanks in the Crixás-Açu River and Montaria Lake—characterized by slower currents, greater stability, and proximity to riparian vegetation—supported higher richness and abundance of trophic groups compared to the Araguaia River. These stable environments accumulate more organic matter and provide a wider array of microhabitats, facilitating species coexistence through resource partitioning (Jepsen 1997, Esteves and Aranha 1999, Pianka 2006).

In conclusion, the trophic structure of fish assemblages in the Bananal Floodplain is dynamic, responding to spatial and seasonal variability in habitat structure. This variation dictates the distribution, abundance, and richness of trophic groups. While many species show a degree of dietary specialization, with aquatic invertebrates serving as the primary resource, the overall high diversity of trophic groups suggests a complex and robust trophic network. The variety of available food resources in these sandbanks facilitates the exploitation of the habitat by a diverse array of species with distinct functional roles.

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DATA NOT AVAILABLE

The data that support the findings of this study are not publicly available.

CONFLICT OF INTEREST

The authors report no conflicts of interest.

Animal Ethics Committee

At the time this project was developed, issues related to the use of fish in research were evaluated and approved by the funding agency.

Figures Legends

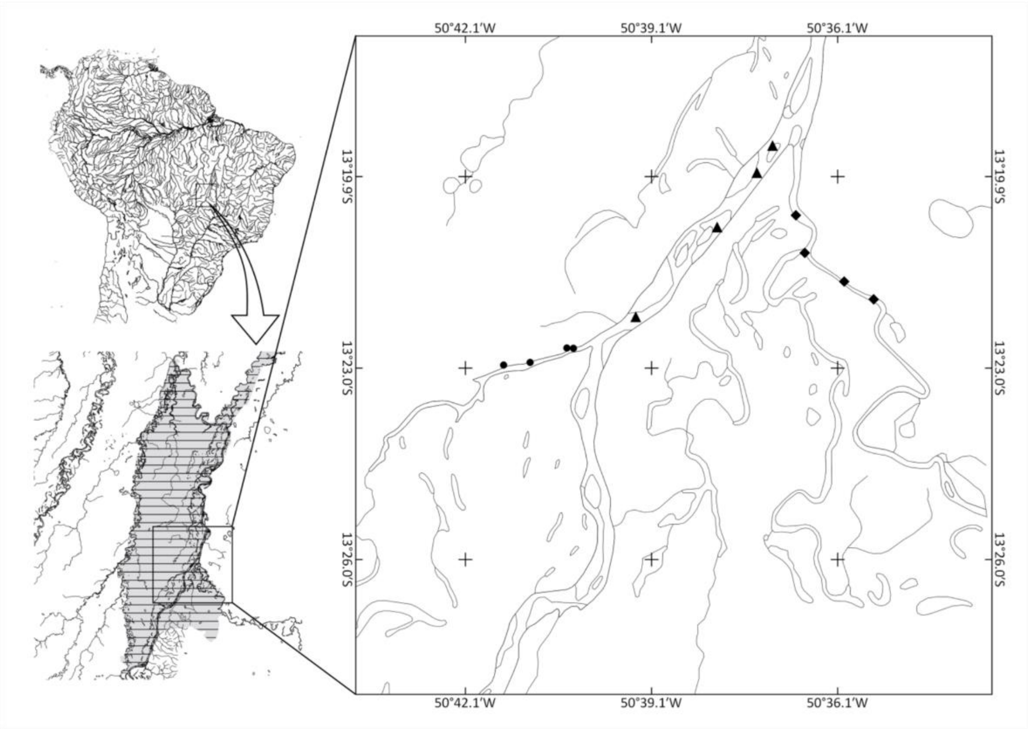

Figure 1. Study area in the middle Araguaia River, Bananal Floodplain. Black triangles indicate the sampled sites in the Araguaia River; black squares, sites in the Crixás-Açu River; and black circles, sites in the Montaria Lake, in the EPA Meanders of the Araguaia river.

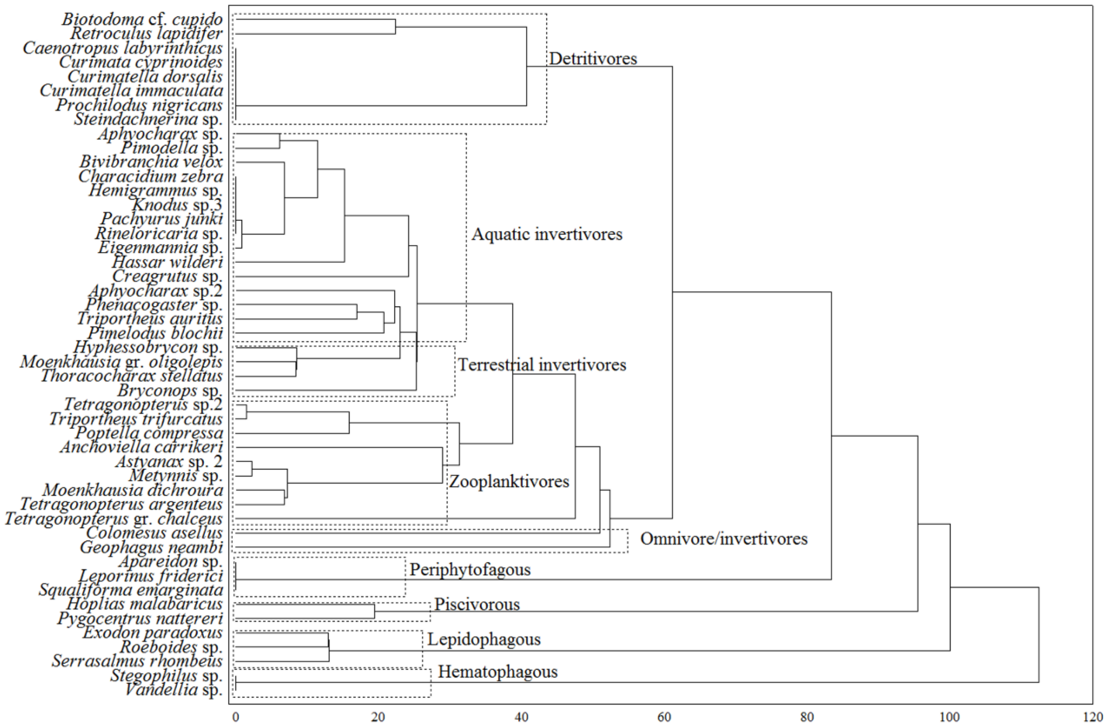

Figure 2. Grouping in trophic groups of species found in Montaria lake, Crixás-açu and Araguaia rivers based on the diet similarity, from the values of the Alimentary Index.

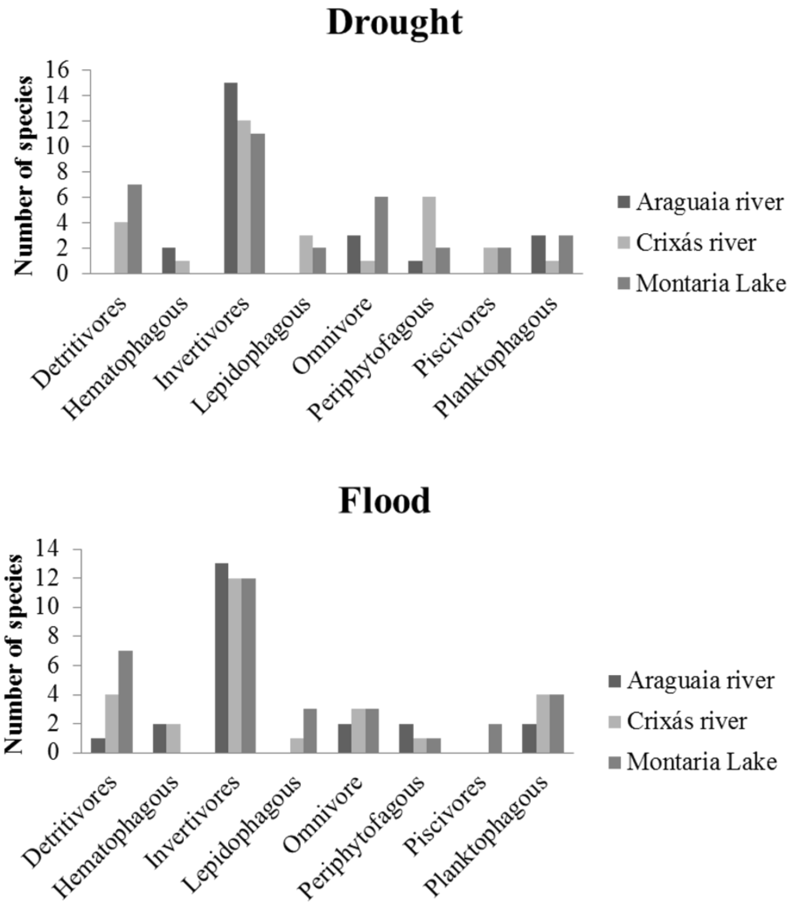

Figure 3. Total number of species (S) in the drought and flood periods per trophic group in Araguaia and Crixás-Açu rivers and Montaria lake.

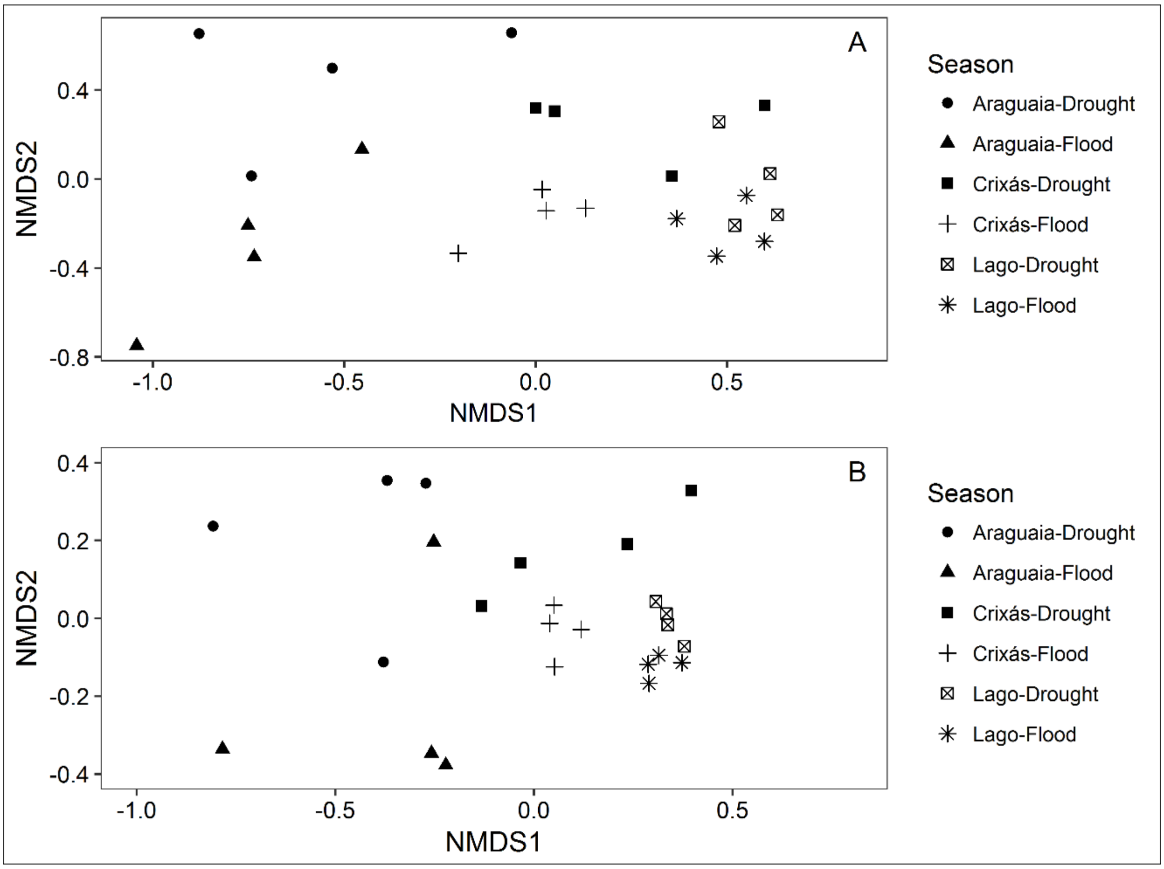

Figure 4. Ordination by Non-metric Multidimensional Scaling (NMDS) based on abundance (A) and richness (B) of trophic groups registered in sediment banks during the drought and flood periods. *Stress* 2D = 0.099 for abundance, *stress* 2D = 0.091 for richness after 1000 permutations.

Tables

Table 1. Abundance in number of individuals (N) and species richness (S) of trophic groups by environment and for total samples from the sediment banks in the Bananal Floodplain.

Trophic group	**Araguaia**		**Crixás**		**Lake**	
	N	S	N	S	N	S
Detritivore	3	1	114	6	535	7
Hematophagous	22	2	29	2	-	-
Invertivore	1358	16	1145	15	621	15
Lepidophagous	-	-	52	3	164	3
Omnivore	19	3	202	6	232	6
Periphytophagous	4	2	39	1	41	2
Piscivore	-	-	4	2	33	2
Planktivore	134	3	63	4	409	5
Total	**1540**	**27**	**1648**	**36**	**2035**	**40**

Table 2. Abundance of trophic groups in number of individuals in the dry and flood periods by environment and for total samples from the sediment banks in the Bananal Floodplain.

Trophic group	**Araguaia**		**Crixás**		**Lake**	
	Drought	Flood	Drought	Flood	Drought	Flood
Detritivore	-	3	80	34	361	174
Hematophagous	2	20	2	27	-	-
Invertivore	877	483	572	573	222	399
Lepidophagous	-	-	5	47	61	103
Omnivore	12	7	132	70	163	69
Periphytophagous	2	2	10	29	40	1
Piscivore	-	-	4	-	18	15
Planktophagous	113	21	2	61	331	78
Total	**1006**	**536**	**807**	**841**	**1196**	**839**

Table 3. Results of Factorial Analysis of Similarity (ANOSIM) and pairing of trophic groups for abundance and richness of environments based on 1000 permutations at a level of significance of 5%.

Comparison between groups	**R²**	***P* < 0,05**
Abundance		
R Global Season	*0.424*	*0.003*
R Global Site	*0.773*	*0.001*
Araguaia x Crixás	*0.766*	*0.001*
Araguaia x Lake	*0.891*	*0.001*
Crixás x Lake	*0.891*	*0.001*
Richness		
R Global Season	*0.333*	*0.003*
R Global Site	*0.639*	*0.001*
Araguaia x Crixás	*0.516*	*0.007*
Araguaia x Lake	*0.885*	*0.001*
Crixás x Lake	*0.76*	*0.001*

Table 4. Similarity Percentage Analysis (SIMPER) for the factors site and period based on the matrix of abundance and richness of species sampled in the Bananal Floodplain. DM(%) Percentage of average dissimilarity; IA – Invertivores; DT – Detritivores; ON – Omnivores; PL – Planktivores; LP – Lepidophagous; PX – Piscivores; HM – Hematophagous; Cumu. – cumulative percentage.

Paired comparisons	**DM (%)**	**Contribution of trophic groups (%)***							
		IA	DT	ON	PL	LP	PX	HM	Cumu.
Abundance									
Araguaia x Crixás	46.0	-	21.1	20.9	14.4	-	-	-	57.5
Araguaia x Lake	55.8	-	23.9	15.2	-	18.4	-	-	57.5
Crixás x Lake	27.5	-	15.3	-	19.8	13.9	13.5	-	62.5
Period (drought x flood)	28.8	15.8	-	-	23.1	-	-	14.7	53.6
Richness									
Araguaia x Crixás	35.9	-	20.1	16.1	14.9	-	-	-	51.2
Araguaia x Lake	44.8	-	22.7	13.9	-	17.4	-	-	54.0
Crixás x Lake	22.4	-	16.3	-	-	14.9	18.9	-	50.1
Period (drought x flood)	23.1	-	-	18.7	18.6	-	-	18.9	56.2

Supplementary material

Tabela S1. General classification of fish species into trophic groups (TG) based on the values of the Alimentary index (≥60 in bold) for food categories for all the samples. DT – Detritus; IT – Terrestrial invertebrates; IA – Aquatic invertebrates; PX – Fish; PE – Periphyton; MO – Mollusks; ES – Scales and fins; AF – Filamentous algae; MV – Plant material; OU – Others; SG – Blood; PL – Plankton; N – Number of stomachs with content.

Species	**DT**	**IT**	**IA**	**PX**	**PE**	**MO**	**ES**	**AF**	**MV**	**OU**	**SG**	**PL**	**TG**
Biotodoma cf. *cupido* (Heckel 1840)	71.2		28.8										Detritivore
Caenotropus labyrinthicus (Kner 1858)	100.0												Detritivore
Curimata cyprinoides (Linnaeus 1766)	100.0												Detritivore
Curimatella dorsalis (Eigenmann & Eigenmann 1889*)*	100.0												Detritivore
Curimatella immaculata (Fernández-Yépez 1948)	100.0												Detritivore
Prochilodus nigricans Spix & Agassiz 1829	100.0												Detritivore
Steindachnerina sp.	100.0												Detritivore
Stegophilus sp.											100.0		Hematophagous
Vandellia sp.											100.0		Hematophagous

Aphyocharax sp.	9.3	90.7									Invertivore
Aphyocharax sp.2	22.8	56.7					2.2			18.3	Invertivore
Bivibranchia velox (Eigenmann & Myers 1927)		94.9							5.1		Invertivore
Bryconops sp.	83.4	16.4					0.2				Invertivore
Characidium zebra Eigenmann. 1909		100.0									Invertivore
Creagrutus sp.	3.9	72.5					1.8	5.3	0.4	16.2	Invertivore
Eigenmannia sp.	0.1	99.4						0.5			Invertivore
Hassar wilderi Kindle 1895		87.2			12.8						Invertivore
Hemigrammus sp.		100.0									Invertivore
Hyphessobrycon sp.	65.6	34.4									Invertivore
Knodus sp.3		100.0									Invertivore
Moenkhausia gr. *oligolepis* (Günther 1864)	51.7	41.6		1.9					1.9	2.9	Invertivore
Pachyurus junki Soares & Casatti 2000		100.0									Invertivore
Phenacogaster sp.	28.2	71.8									Invertivore
Pimelodus blochii Valenciennes 1840	21.3	56.5	11.2		3.9	6.4		0.2	0.4		Invertivore
Pimodella sp.	6.4	88.7				5.0					Invertivore
Rineloricaria sp.		100.0									Invertivore
Thoracocharax stellatus (Kner 1858)	58.7	37.8								3.5	Invertivore

Triportheus auritus (Valenciennes 1850)		36.2	57.6						4.8			1.3	Invertivore
Exodon paradoxus Müller & Troschel 1844				9.2			90.8						Lepidophagous
Roeboides sp.							100.0						Lepidophagous
Serrasalmus rhombeus (Linnaeus 1766)							88.7		2.8	8.6			Lepidophagous
Colomesus asellus (Müller & Troschel 1849)			38.9		32.2	29.0							Omnivore
Geophagus neambi Lucinda, Lucena & Assis 2010			30.0		15.0				30.0	25.0			Omnivore
Retroculus lapidifer (Castelnau 1855)	54.4		43.4				2.2						Omnivore
Tetragonopterus gr. *chalceus* Spix & Agassiz 1829		1.3	14.6				3.6		36.8			43.7	Omnivore
Tetragonopterus sp.2		1.1	49.3				0.2					49.3	Omnivore
Triportheus trifurcatus (Castelnau 1855)			50.0									50.0	Omnivore
Apareidon sp.					100.0								Periphytophagous
Leporinus friderici (Bloch 1794)					100.0								Periphytophagous
Aphanotorulus emarginatus (Valenciennes 1840)					100.0								Periphytophagous

Hoplias malabaricus (Bloch 1794)			100.0				Piscivore
Pygocentrus nattereri Kner 1858			84.4	5.5	10.1		Piscivore
Anchoviella carrikeri Fowler 1940	16.2	13.6				70.2	Planktivore
Astyanax sp. 2		1.6				98.4	Planktivore
Metynnis sp.						100.0	Planktivore
Moenkhausia dichroura (Kner 1858)	5.4	0.8				93.8	Planktivore
Poptella compressa (Günther 1864)		38.8				61.2	Planktivore
Tetragonopterus argenteus Cuvier 1816	0.6	3.6			3.6	92.3	Planktivore

Table S2. Comparação par-a-par da abundância e riqueza de grupos tróficos de peixes de bancos de areia marginais do Rio Araguaia, Rio Crixás- Açu e Lago Montaria, Planície do Bananal.

	Site *vs* Site	***F***	***R²***	**P**	***P* adjusted**
Abundance	Araguaia *vs* Crixás	9.296	0.399	0.002	0.004
	Araguaia *vs* Lago	22.237	0.614	0.002	0.004
	Crixás *vs* Lago	6.830	0.328	0.001	0.003
Richness	Araguaia *vs* Crixás	7.342	0.344	0.002	0.003
	Araguaia *vs* Lago	22.142	0.613	0.001	0.003
	Crixás *vs* Lago	8.174	0.369	0.001	0.003

Table S3. Comparação par-a-par da abundância e riqueza de grupos tróficos de peixes entre dois períodos hidrológicos (dry and ebb) de bancos de areia marginais do Rio Araguaia, Rio Crixás- Açu e Lago Montaria, Planície do Bananal. Prefixo dos locais: ARA – Rio Araguaia; CRI – Rio Crixás-Açu; MON – Lago Montaria.

	Dry *vs* EBB	***F***	***R²***	***P***	**p.adjusted**
Abundance	ARA-EBB *vs* CRI-EBB	8.476	0.586	0.033	0.345
	ARA-EBB *vs* MON-EBB	14.863	0.712	0.031	0.345
	ARA-EBB *vs* ARA-DRY	2.882	0.324	0.108	0.345
	ARA-EBB *vs* CRI-DRY	8.712	0.592	0.023	0.345
	ARA-EBB *vs* MON-DRY	16.727	0.736	0.035	0.345
	CRI-EBB *vs* MON-EBB	8.089	0.574	0.043	0.345
	CRI-EBB *vs* ARA-DRY	9.401	0.610	0.023	0.345
	CRI-EBB *vs* CRI-DRY	7.936	0.569	0.026	0.345
	CRI-EBB *vs* MON-DRY	9.056	0.601	0.037	0.345
	MON-EBB *vs* ARA-DRY	13.513	0.693	0.038	0.345
	MON-EBB vs CRI-DRY	9.512	0.613	0.025	0.345
	MON-EBB *vs* MON-DRY	2.417	0.287	0.108	0.345
	ARA-DRY *vs* CRI-DRY	8.330	0.581	0.026	0.345
	ARA-DRY *vs* MON-DRY	16.205	0.730	0.024	0.345

	CRI-DRY *vs* MON-DRY	8.259	0.579	0.030	0.345
Richness	ARA-EBB *vs* CRI-EBB	6.590	0.523	0.022	0.33
	ARA-EBB *vs* MON-EBB	17.129	0.741	0.035	0.364
	ARA-EBB *vs* ARA-DRY	3.169	0.346	0.068	0.364
	ARA-EBB *vs* CRI-DRY	6.412	0.517	0.029	0.364
	ARA-EBB *vs* MON-DRY	18.868	0.759	0.032	0.364
	CRI-EBB *vs* MON-EBB	14.804	0.712	0.026	0.364
	CRI-EBB *vs* ARA-DRY	8.110	0.575	0.035	0.364
	CRI-EBB *vs* CRI-DRY	3.194	0.347	0.034	0.364
	CRI-EBB *vs* MON-DRY	15.151	0.716	0.036	0.364
	MON-EBB *vs* ARA-DRY	13.261	0.688	0.027	0.364
	MON-EBB vs CRI-DRY	5.178	0.463	0.031	0.364
	MON-EBB *vs* MON-DRY	3.031	0.336	0.049	0.364
	ARA-DRY *vs* CRI-DRY	5.287	0.468	0.03	0.364
	ARA-DRY *vs* MON-DRY	14.581	0.708	0.034	0.364
	CRI-DRY *vs* MON-DRY	3.918	0.395	0.03	0.364

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