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Ichthyofauna in an ecological station in the Pantanal of Brazil: the hydrological cycle affecting species composition

H. Pains da Silva, A. P. D. Barbosa, L. N. L. Silva, E. S. Oliveira Jr, F. Corrêa, D. L. Z. Kantek, C. C. Muniz

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Abstract

Ichthyofauna in an ecological station in the Pantanal of Brazil: the hydrological cycle affecting species composition. This research aims to describe the ichthyological fauna in the area surrounding the Taiamã Ecological Station in the state of Mato Grosso, Brazil. Three expeditions were carried out, in September 2014, February 2015 and May/2015, in seasons ranging from the hydrological conditions of high waters (flood), low waters (drought), and decreasing waters (ebbing). During the research we sampled 3,664 individuals from six orders, 28 families and 78 species. Characiformes was the most abundant order (~81% of individuals), followed by Siluriformes (~13% of individuals), and Gymnotiformes (~4% of individuals). The most representative species were *Moenkhausia dichroura* (Kner, 1858), *Serrapinus calliurus* (Boulenger, 1900), *Odontostilbe pequira* (Steindachner, 1882) and *Pimelodella gracilis* (Valenciennes, 1840). The dry period showed the highest abundance (1,541 individuals), richness (61 species), diversity (H' = 2.69) and equitability (J' = 0.65). These results fill a gap concerning species composition in the Pantanal, mainly referring to data available on Conservation Unit, and its surroundings. Moreover, this research provides a database to update the checklist of fish species in a remote wetland, offering a tool for management and conservation.

Data published through GBIF (Doi: 10.15470/jjpuuu)

Key words: Diversity, Ichthyofauna, Wetland, Conservation Unit

Resumen

Ictiofauna en un espacio natural protegido del Pantanal de Brasil: afectación de la composición de especies por el ciclo hidrológico. Esta investigación tiene por objeto describir la fauna ictiológica del área situada en torno al Espacio Natural Protegido (*estação ecológica*) de Taiamã, en el estado de Mato Grosso (Brasil). Para desarrollar el estudio realizamos tres expediciones en los meses de septiembre de 2014 y febrero y mayo de 2015, cubriendo las estaciones hidrológicas de aguas altas (inundación), aguas bajas (sequía) y aguas decrecientes (retroceso). Durante la investigación recolectamos 3.664 ejemplares pertenecientes a seis órdenes, 28 familias y 78 especies. El orden más abundante fue Characiformes (~81% de los ejemplares), seguido por Siluriformes (~13% de los ejemplares) y Gymnotiformes (~4% de los ejemplares). Las especies más representadas fueron *Moenkhausia dichroura* (Kner, 1858), *Serrapinus calliurus* (Boulenger, 1900), *Odontostilbe pequira* (Steindachner, 1882)

y *Pimelodella gracilis* (Valenciennes, 1840). El periodo seco mostró la mayor abundancia (1.541 ejemplares), riqueza (61 especies), diversidad (*H'* = 2,69) y equidad (*J'* = 0,65). Estos resultados cubren un vacío en la composición de especies en el Pantanal, principalmente por lo que respecta a datos disponibles de las unidades de conservación y sus alrededores. Además, esta investigación proporciona una base de datos para incrementar la lista de control de especies de peces en un humedal remoto, así como una herramienta para la gestión y conservación de las mismas.

Datos publicados en GBIF (Doi: 10.15470/jjpuuu)

Palabras clave: Diversidad, Ictiofauna, Humedal, Unidad de conservación

Resum

Ictiofauna en un espai natural protegit del Pantanal del Brasil: afectació de la composició d'espècies pel cicle hidrològic. L'objectiu d'aquesta recerca és descriure la fauna ictiològica de l'àrea situada al voltant de l'Espai Natural Protegit (*estação ecológica*) de Taiamã, a l'estat de Mato Grosso (Brasil). Per portar a terme l'estudi vam fer tres expedicions els mesos de setembre de 2014 i febrer i maig de 2015, de manera que vam cobrir les estacions hidrològiques d'aigües altes (inundació), aigües baixes (sequera) i aigües decreixents (retrocés). Durant la recerca vam recol·lectar 3.664 exemplars pertanyents a sis ordres, 28 famílies i 78 espècies. L'ordre més abundant va ser Characiformes (~81 % dels exemplars), seguit de Siluriformes (~13 % dels exemplars) i Gymnotiformes (~4 % dels exemplars). Les espècies més representades van ser *Moenkhausia dichroura* (Kner, 1858), *Serrapinus calliurus* (Boulenger, 1900), *Odontostilbe pequira* (Steindachner, 1882) i *Pimelodella gracilis* (Valenciennes, 1840). El període sec va registrar l'abundància més gran d'espècies (1.541 exemplars), riquesa (61 espècies), diversitat (*H'* = 2,69) i equitat (*J'* = 0,65). Aquests resultats omplen un buit en la composició d'espècies al Pantanal, principalment pel que fa a dades disponibles de les unitats de conservació i els seus voltants. A més, aquesta recerca proporciona una base de dades per incrementar la llista de control d'espècies de peixos en un aiguamoll remot, com també un instrument per gestionar–les i conservar–les.

Dades publicades a GBIF (Doi: 10.15470/jjpuuu)

Paraules clau: Diversitat, Ictiofauna, Aiguamoll, Unitat de conservació

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Hugmar Pains da Silva, Citogenetics and Animal Genetics Laboratory, Bioscience Institute, Federal University of Mato Grosso–UFMT, Av. Fernando Corrêa da Costa 2367, Boa Esperança, Cuiabá, MT. 78060–900, Brasil.– Ana Paula Dalbem Barbosa, Larissa Nayara Lima Silva, Ernandes Sobreira Oliveira Junior, Claumir Cesar Muniz, Laboratory of Ichthyology of the Northern Pantanal, Research Centre in Limnology, Biodiversity, and Ethnobiology of the Pantanal, Graduate Program in Environmental Sciences, University of the State of Mato Grosso–UNEMAT, University Campus of Cáceres, 78200–000 Cáceres, MT, Brazil.– Fabiano Corrêa, Gratuate Program in Ecology and Conservation, University of the State of Mato Grosso–UNEMAT, University Campus of Nova Xavantina, 78200–000 Nova Xavantina, MT, Brazil.– Daniel Luis Zanella Kantek, Taiamã Ecological Station, Environmental Analyst, Chico Mendes for Biodiversity Conservation–ICMBio/MT, Cáceres, 78200–000 Cáceres, MT, Brazil.

Corresponding author: Fabiano Corrêa. E–mail: correafecologia@yahoo.com.br

ORCID ID: H. Pains da Silva: 0000-0003-3540-2889; A. P. D. Barbosa: 0000-0002-6282-4799; L. N. L. Silva: 0000-0003-3140-6188; E. S. Oliveira, Jr: 0000-0002-6953-6917; F. Corrêa: 0000-0003-1909-5137; D. L. Z. Kantek: 0000-0001-9558-1503; C. C. Muniz: 0000-0002-2082-2234

Introduction

The Pantanal is an extensive plain composed of a series of periodically flooded landscape units (Pozer and Nogueira, 2004), and covering a range of approximately 140,000 km² in the Midwest of Brazil (Da Silva et al., 2001; Lourenço et al., 2008). Within this area, 11,555 ha belong to the Taiamã Ecological Station (TES), delimited by the Paraguay River and containing a variety of aquatic environments. Southwest of the TES is a flood region named Campo. This region is a Conservation Unit and one of the most flooded areas of the Pantanal (Pereira et al., 2012; Ikeda–Castrillon et al., 2011). Fishery activity is now prohibited here (Resolução CEPESCA 02/2018) due to the region´s importance for ichthyofauna as an area for breeding, growth and feeding, and consequent high relevance for the conservation and maintenance of species. It is therefore important to determine the ichthyofauna present in the Conservation Unit in order to create a database of species that have a high probability of occurrence in the Northern Pantanal.

Each week, hundreds of tourists explore the abundance of high commercial value fish in the regions near the Conservation Unit from the boat hotels and professional fishermen. Exploration of these resources has a strong impact on fisheries in the region, emphasizing the importance of determining the local biodiversity and aspects related to conservation. Besides the fish of high commercial value, such as *Piaractus mesopotamicus* (Holmberg, 1887), other smaller, less known species are also found in high abundance, such as *Astyanax lacustris* (Lütken, 1875). This species is commonly found below the macrophyte beds as a result of the production of detritus and shelter availability (Schiesari et al., 2003), and it is the base of the food chain of many species. The importance of maintaining the base of the food chain reflects the maintenance of larger species (Layman et al., 2015), consequently affecting the ecological process of an environment (Sanders et al., 2014). However, to understand the food chain and the ecological processes, studies comprising checklists are needed to provide information about the species composition and create a robust database that will aid management and conservation of aquatic ecosystems (Corrêa et al., 2015).

Studies addressing lists of fish species in the Pantanal are scarce. We highlight the work of Súarez and Petrere–Júnior (2007), Pains–Silva et al. (2010), Fernandes et al. (2015) in a system of bays connected to the Paraguay River (MT); Teresa et al. (2016) in the drainage system of the Miranda and Aquidauana rivers (MS); Súarez et al. (2013) in Porto Murtinho (MS); and Severo–Neto et al. (2015) in Medal Bay (MS). However, only one work has been conducted in protected areas, that is, the study by Polaz et al. (2014) who conducted research in the Pantanal National Park (MT). This current research describes the fish species in the Taiamã Ecological Station, in the Pantanal of Cáceres, Mato Grosso, Brazil. Furthermore, it provides an accretion of data that fills a gap about the ichthyofauna composition in the northern Pantanal, mainly referring to seasonal hydric variation.

Material and methods

Study area

The Taiamã Ecological Station (TES) is located in the Pantanal of Mato Grosso (between 57º 24' W and 45º 40' W; and 16º 48' S and 16º 58' S; fig. 1), 165 km from the municipality of Cáceres. The TES covers an area of 11,550 ha, comprising the islands of Taiamã and Sararé, and limited by a bifurcation of the Paraguay River (Ikeda–Castrillon et al., 2011). The annual average temperature is 26 ºC, with highest temperatures in the rainy season (October to December) according to Neves et al. (2011).

The flood pulse directly influences the area, promoting marked changes in the availability of aquatic habitats. The Pantanal is made up of several phyto physiognomies, such as wet

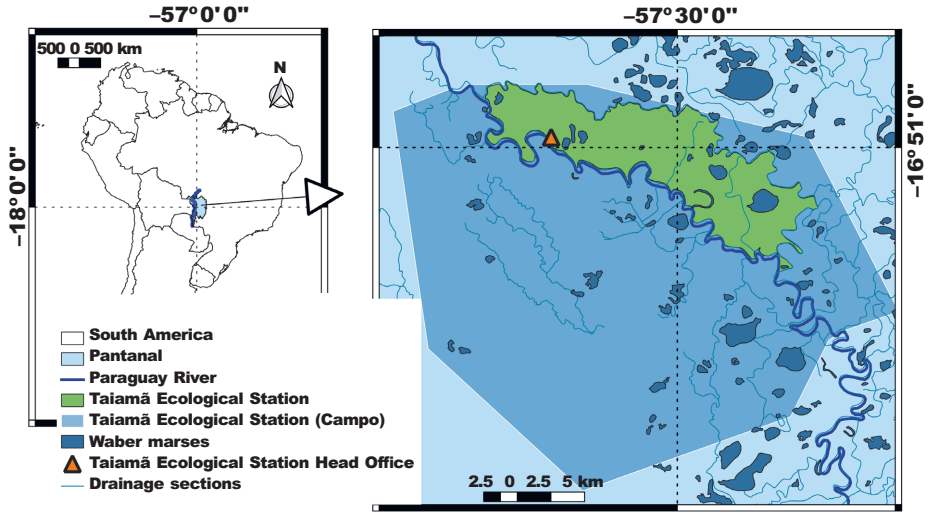

Fig. 1. Location of sample units at the Taiamã Ecological Station, Mato Grosso, Brazil.

Fig. 1. Localización de las unidades de muestreo en el Espacio Natural Protegido de Taiamã, Mato Grosso (Brasil).

fields, and permanent and temporary bays (Carvalho, 1986; Junk and Da Silva, 2000). The uniform geographical relief denotes a lentic water flow, with periodic flooding due to the flood pulse, which regulates the ecological process in this region (Fernandes et al., 2010). The annual droughts and floods lead to variations in the abundance of certain species (Da Silva et al., 2001; Junk et al., 2014).

Sampling methods

We conducted three field excursions, in September 2014, February 2015, and May 2015. These three periods comprise the seasonal hydric periods of low waters (drought), decreasing waters (ebbing), and high waters (flooding). The study was approved by the Instituto Chico Mendes para a conservação da Biodiversidade–SISBIO num 46263–1). Fish samples were collected at three different points surrounding the TES. Fish capture were captured using a square metallic structure (1 m width x 2 m length x 1 m depth) with a 3 mm nylon net that was passed underneath the macrophyte beds three times. Netting of several mesh sizes and a dragging net (5 mm internode, 25 m length and 4 m high) were also passed once in the limnetic region of the water body. After the samples were collected, the fish were anesthetized with Eugenol (Keene et al., 1998; Fernandes et al., 2017) and fixed in formalin (concentration of 10 %) until identification. Fish were identified following Britski et al. (2007) and manuscripts of species description. Specimens were then conserved in 70 % alcohol (and deposited in the Laboratory of Ichthyology of the Northern Pantanal (LIPAN), linked to the Research Centre in Limnology, Biodiversity and Ethnobiology of the Pantanal (CELBE/UNEMAT). Abundance, richness (taxa S), diversity (Shaanon's index, *H'*) and equitability (Pielou index, *J'*) were calculated for each season with PAST 3.0 free software (Hammer et al., 2001).

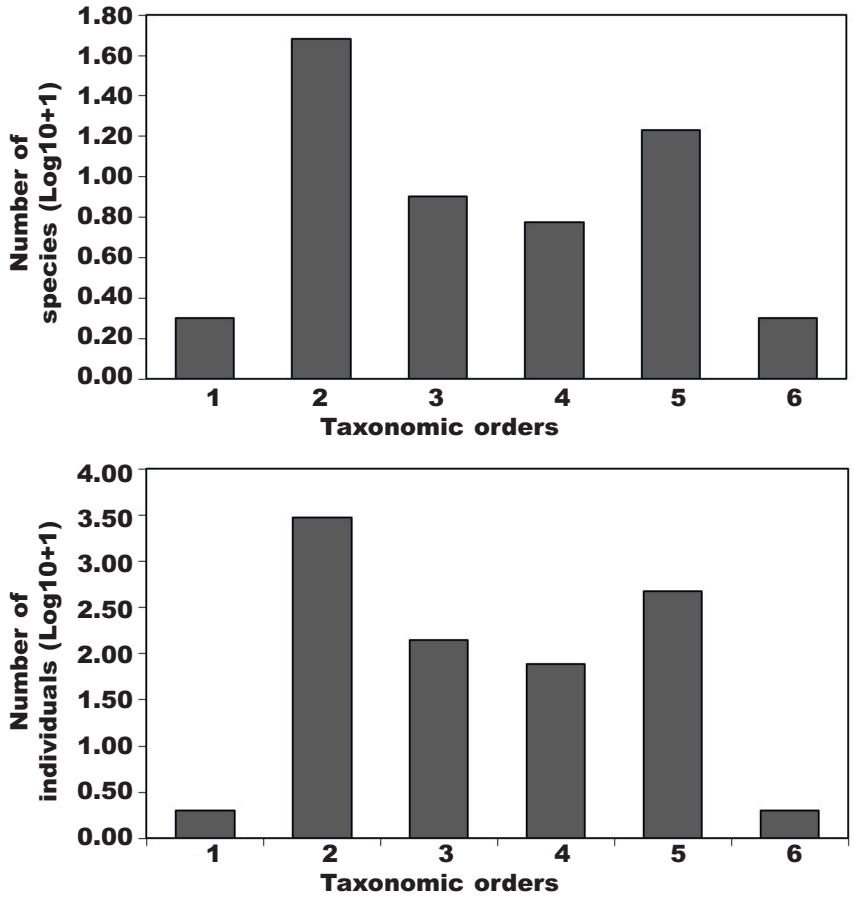

Fig. 2. Number of species (A) and number of individuals (B) collected at the Taiamã Ecological Station, Mato Grosso, Brazil. Taxonomic orders: 1, Beloniformes; 2, Characiformes; 3, Gymnotiformes; 4, Cichliformes; 5, Siluriformes; 6, Synbranchiformes.

Fig. 2. Número de especies (A) y número de individuos (B) recolectados en el Espacio Natural Protegido de Taiamã, Mato Grosso (Brasil). Para las abreviaturas de los órdenes taxonómicos, véase arriba.

Results

A total of 3,664 individuals belonging to six orders, 28 families and 78 species were sampled. The order Characiformes was the most abundant (2,970 individuals, ~81 % of the total), followed by Siluriformes (477 individual, ~ 13 % of the total), Gymnotiformes (138 individuals, ~4 % of the total), Cichliformes, Beloniformes and Synbranchiformes (table 1, data published through GBIF: Doi:10.15470/jjpuuu, fig. 2). From the 29 families, Characidae was the most representative both in number of species and individuals (17 and 2,667, respectively), followed by Serrasalmidae, Cichlidae, Heptapteridae, Loricariidae and Pimelodidae (fig. 3). The most

Table 1. Taxonomic list of the species de fishes, collected in the Taiamã Ecological Station, Mato Grosso, Brazil.

Tabla 1. Lista taxonómica de las especies de peces recolectadas en el Espacio Natural Protegido de Taiamã, Mato Grosso (Brasil),.

Taxa	Flood (%)	Dry (%)	Ebb (%)	Frequency %	Voucher No
Order Beloniformes					
Family Belonidae					
Potamorhaphis eigenmanni Ribeiro, 1915		1 (0.06)		1 (0.03)	
Order Characiformes					
Family Acestrorhynchidae					
Acestrorhynchus pantaneiro Menezes, 1992	3 (0.22)	5 (0.32)		8 (0.22)	CPUFMT 5972
Family Anostomidae					
Abramites hypselonotus (Günther, 1868)		1 (0.06)		1 (0.03)	
Leporinus friderici (Bloch, 1794)	3 (0.22)		26 (3.50)	29 (0.79)	CPUFMT 5915
Leporinus striatus Kner, 1858	6 (0.43)			6 (0.16)	
Schizodon borellii (Boulenger, 1900)	3 (0.22)	1 (0.06)		4 (0.11)	CPUFMT 5959
Family Bryconidae					
Salminus brasiliensis (Cuvier, 1816)	1 (0.07)			1 (0.03)	
Family Characidae					
Aphyocharax anisitsi Eigenmann & Kennedy, 1903		74 (4.8)		74 (2.02)	CPUFMT 5940
Aphyocharax dentatus Eigenmann & Kennedy, 1903	5 (0.36)	7 (0.45)	3 (0.40)	15 (0.41)	
Astyanax alleni (Eigenmann & McAtee, 1907)		2 (0.13)		2 (0.05)	CPUFMT 5904
Astyanax lacustris (Lütken, 1875)	4 (0.29)	7 (0.45)	1 (0.13)	12 (0.33)	
Bryconamericus exodon Eigenmann, 1907	14 (1.01)		33 (4.45)	47 (1.28)	CPUFMT 5929
Piabarchus stramineus (Eigenmann, 1908)	18 (1.30)			18 (0.49)	
Hemigrammus ulreyi (Boulenger, 1895)	9 (0.65)	58 (3.76)		67 (1.83)	CPUFMT 5924
Hyphessobrycon eques (Steindachner, 1882)		88 (5.71)	36 (4.85)	124 (3.38)	CPUFMT 5901
Jupiaba acanthogaster (Eigenmann, 1911)	1 (0.07)	1 (0.06)		2 (0.05)	
Poptella paraguayensis (Eigenmann, 1907)	3 (0.22)	1 (0.06)		4 (0.11)	CPUFMT 5908
Moenkhausia dichroura (Kner, 1858)	783 (56.70)	487 (31.6)	357 (48.11)	1627 (44.41)	CPUFMT 5934
Moenkhausia oligolepis (Günther, 1864)		10 (0.65)	10 (1.35)	20 (0.55)	CPUFMT 5941
Odontostilbe pequira (Steindachner, 1882)	139 (10.07)	77 (4.99)	81 (10.92)	297 (8.11)	CPUFMT 5976
Roeboides descalvadensis Fowler, 1932	7 (0.51)	23 (1.49)	1 (0.13)	31 (0.85)	
Serrapinnus calliurus (Boulenger, 1900)	53 (3.84)	225 (14.6)	41 (5.53)	319 (8.71)	CPUFMT 5937
Serrapinnus kriegi (Schindler, 1937)	1 (0.07)			1 (0.03)	CPUFMT 5975
Tetragonopterus argenteus (Cuvier, 1816)	4 (0.29)	3 (0.19)		7 (0.19)	CPUFMT 5967
Family Crenuchidae					
Characidium zebra Eigenmann, 1909	3 (0.22)	20 (1.3)	11 (1.48)	34 (0.93)	
Family Curimatidae					
Curimatella dorsalis (Eigenmann & Eigenmann, 1889)		2 (0.13)		2 (0.05)	CPUFMT 5927
Curimatopsis myersi Vari, 1982	1 (0.07)	14 (0.91)	8 (1.08)	23 (0.63)	
Potamorhina squamoralevis (Braga & Azpelicueta, 1983)		4 (0.26)		4 (0.11)	CPUFMT 5971
Steindachnerina conspersa (Holmberg, 1891)	3 (0.22)		3 (0.40)	6 (0.16)	CPUFMT 5963
Steindachnerina brevipinna (Eigenmann & Eigenmann, 1889)		8 (0.52)		8 (0.22)	CPUFMT 5921
Family Erythrinidae					
Hoplias malabaricus (Bloch, 1794)		1 (0.06)	1 (0.13)	2 (0.05)	CPUFMT 5970
Family Gasteropelecidae					
Gasteropelecus cf. *sternicla* (Linnaeus, 1758)		1 (0.06)		1 (0.03)	
Thoracocharax stellatus (Kner, 1858)		1 (0.06)		1 (0.03)	
Family Hemiodontidae					
Hemiodus semitaeniatus Kner, 1958	1 (0.07)			1 (0.03)	CPUFMT 5954
Hemiodus orthonops (Eigenmann & Kennedy, 1903)	5 (0.36)			5 (0.14)	CPUFMT 5903
Family Iguanodectidae					
Bryconops melanurus (Bloch, 1794)	2 (0.14)			2 (0.05)	CPUFMT 5942
Piabucus melanostoma Holmberg, 1891		1 (0.06)		1 (0.03)	CPUFMT 5912
Family Lebiasinidae					
Pyrrhulina australis Eigenmann & Kennedy, 1903	5 (0.36)	2 (0.13)	32 (4.31)	39 (1.06)	CPUFMT 5922
Pyrrhulina sp.			2 (0.27)	2 (0.05)	
Family Parodontidae					
Apareiodon affinis (Steindachener, 1879)		20 (1.3)	1 (0.13)	21 (0.57)	CPUFMT 5933
Family Prochilodontidae					
Prochilodus lineatus (Valenciennes, 1836)	1 (0.07)	1 (0.06)		2 (0.05)	
Family Serrasalmidae					
Metynnis maculatus (Kner, 1858)			8 (1.08)	8 (0.22)	
Myloplus levis (Eigenmann & McAtee, 1907)	1 (0.07)	1 (0.06)		2 (0.05)	CPUFMT 5966
Mylossoma duriventre (Cuvier, 1818)	5 (0.36)	1 (0.06)		6 (0.16)	CPUFMT 5920
Pygocentrus nattereri Kner, 1858	28 (2.03)	10 (0.65)	9 (1.21)	47 (1.28)	CPUFMT 5968
Serrasalmus maculatus Kner, 1858	10 (0.72)	7 (0.45)	2 (0.27)	19 (0.52)	CPUFMT 5969
Serrasalmus marginatus Valenciennes, 1837	3 (0.22)		1 (0.13)	4 (0.11)	CPUFMT 5931
Family Triportheidae					
Triportheus pantanensis Malabarba, 2004	1 (0.07)	13 (0.84)		14 (0.38)	CPUFMT 5926
Order Gymnotiformes					
Family Apteronotidae					
Apteronotus caudimaculosus de Santana, 2003		2 (0.13)		2 (0.05)	CPUFMT 5932
Family Gymnotidae					
Gymnotus inaequilabiatus (Valenciennes, 1839)	2 (0.14)			2 (0.05)	CPUFMT 5950
Family Hypopomidae					
Brachyhypopomus bombilla Loureiro & Silva, 2006	6 (0.43)	20 (1.3)		26 (0.71)	CPUFMT 5946
Family Rhamphichthyidae					
Gymnorhamphichthys britskii Carvalho et al., 2011		1 (0.06)		1 (0.03)	
Family Sternopygidae					
Eigenmannia virescens (Valenciennes, 1836)		31 (2.01)	8 (1.08)	39 (1.06)	CPUFMT 5951
Eigenmannia desantanai Peixoto et al., 2015	12 (0.87)	45 (2.92)	7 (0.94)	64 (1.75)	CPUFMT 5956
Sternopygus macrurus (Bloch & Schneider, 1801)		4 (0.26)		4 (0.11)	
Order Cichliformes					
Family Cichlidae					
Aequidens plagiozonatus Kullander, 1984		3 (0.19)	1 (0.13)	4 (0.11)	
Apistogramma commbrae (Regan, 1906)	3 (0.22)	6 (0.39)	6 (0.81)	15 (0.41)	CPUFMT 5947
Crenicichla lepidota Heckel, 1840	10 (0.72)	24 (1.56)	20 (2.7)	54 (1.47)	CPUFMT 5952
Laetacara dorsigera (Heckel, 1840)		2 (0.13)		2 (0.05)	
Mesonauta festivus (Heckel, 1840)	1 (0.07)	1 (0.06)		2 (0.05)	CPUFMT 5943
Order Siluriformes					
Family Callichthidae					
Hypoptopoma inexspectatum (Holmberg, 1893)	4 (0.29)	11 (0.71)		15 (0.41)	CPUFMT 5939
Family Doradidae					
Ossancora eigenmanni (Boulenger, 1895)		1 (0.06)		1 (0.03)	
Oxydoras kneri Bleeker, 1862	8 (0.58)	2 (0.13)	1 (0.13)	11 (0.3)	CPUFMT 5973
Trachydoras paraguayensis (Eigenmann & Ward, 1907)		1 (0.06)		1 (0.03)	CPUFMT 5916
Family Heptapteridae					
Imparfinis stictonotus (Fowler, 1940)	2 (0.14)	49 (3.18)	1 (0.13)	52 (1.42)	CPUFMT 5938
Pimelodella cf. *mucosa* Eigenmann & Ward, 1907		1 (0.06)		1 (0.03)	CPUFMT 5960
Pimelodella gracilis (Valenciennes, 1840)	175 (12.67)	90 (5.84)	10 (1.35)	275 (7.51)	
Family Loricariidae					
Hypostomus sp.	11 (0.80)	38 (2.47)	5 (0.67)	54 (1.47)	CPUFMT 5906
Pterygoplichthys ambrosettii (Holmberg, 1893)	2 (0.14)	1 (0.06)	7 (0.94)	10 (0.27)	
Loricaria simillima Regan, 1904		1 (0.06)		1 (0.03)	CPUFMT 5962
Loricariichthys platymetopon Isbrücker & Nijssen, 1979		2 (0.13)		2 (0.05)	
Rineloricaria parva (Boulenger, 1895)	3 (0.22)	19 (1.23)	5 (0.67)	27 (0.74)	CPUFMT 5925
Family Pimelodidae					
Hemisorubim platyrhynchos (Valenciennes, 1840)		1 (0.06)		1 (0.03)	
Iheringichthys labrosus (Lütken, 1874)	14 (1.01)		3 (0.40)	17 (0.46)	CPUFMT 5974
Megalonema platanum (Günther, 1880)		3 (0.19)		3 (0.08)	CPUFMT 5910
Pimelodus pantaneiro Souza–Filho & Shibatta 2007	1 (0.07)	4 (0.26)		5 (0.14)	CPUFMT 5935
Pinirampus pirinampu (Spix & Agassiz, 1829)	1 (0.07)			1(0.03)	
Order Synbranchiformes					
Family Synbranchidae					
Synbranchus marmoratus Bloch, 1795			1 (0.13)	1 (0.03)	

Ecological indexes	Flood (%)	Dry (%)	Ebb (%)	Total
Total of individuals				3,664
Total of individuals distinguished by seasons	1,381	1,541	742	
Total of orders				6
Total of orders distinguished by seasons	3	4	5	
Total of families				28
Total of families distinguished by seasons	22	25	17	
Total of species				78
Total of species distinguished by seasons	48	61	34	
Diversity Index of Shannon (*H'*) general				3.30
Diversity Index of Shannon (*H'*) by seasons	1.80	2.69	2.14	
Equitability Index of Pielou (*J'*) general				0.66
Equitability Index of Pielou (*J'*) by seasons	0.46	0.65	0.61	

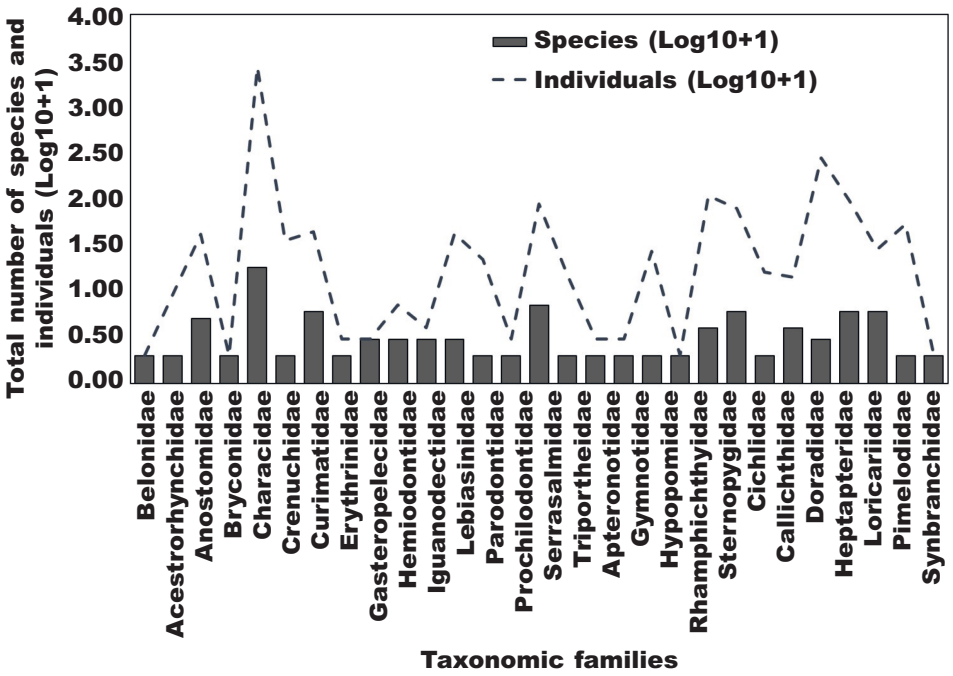

Fig. 3. Number of individuals of each species by family collected at the Taiamã Ecological Station, Mato Grosso, Brazil.

Fig. 3. Número de ejemplares de cada especie, por familia, recolectados en el Espacio Natural Protegido de Taiamã, Mato Grosso (Brasil).

abundant species were: *Moenkhausia dichroura* (Kner, 1858) presenting 44.41 %, *Serrapinnus calliurus* (Boulenger, 1900) 8.71 %, *Odontostilbe pequira* (Steindachner, 1882) 8.11 % and the catfish *Pimelodella gracilis* (Valenciennes, 1840) in 7.51 % of the total (table 1, fig. 4).

During the three study periods, the dry season was the most representative in richness and abundance of fish (61 and 1541, respectively), while the ebbing season was lowest (34 and 742, respectively). In general, diversity and equitability in the wetlands of the Taiamã Ecological Station were high (H' = 3.30; J' = 0.66), with the dry season showing the highest value (H' = 2.69; J' = 0.65), and flooding showing the lowest values (see table 1).

Discussion

The Characiformes Order has the greatest distribution in the Neotropical region and represents about 30 % of freshwater species in lentic and lotic waters (Reis et al., 2016). This order is found in a variety of environments. The high percentage of species belonging to this order in this study in the Pantanal is due to the provision of shelter and substrate underneath macrophyte beds (Lopes et al., 2015). Aquatic macrophyte beds have high structural complexity and are of great importance to ichthyofauna as they provide shelter from predation, food (aquatic invertebrates) and suitable sites for reproduction and growth

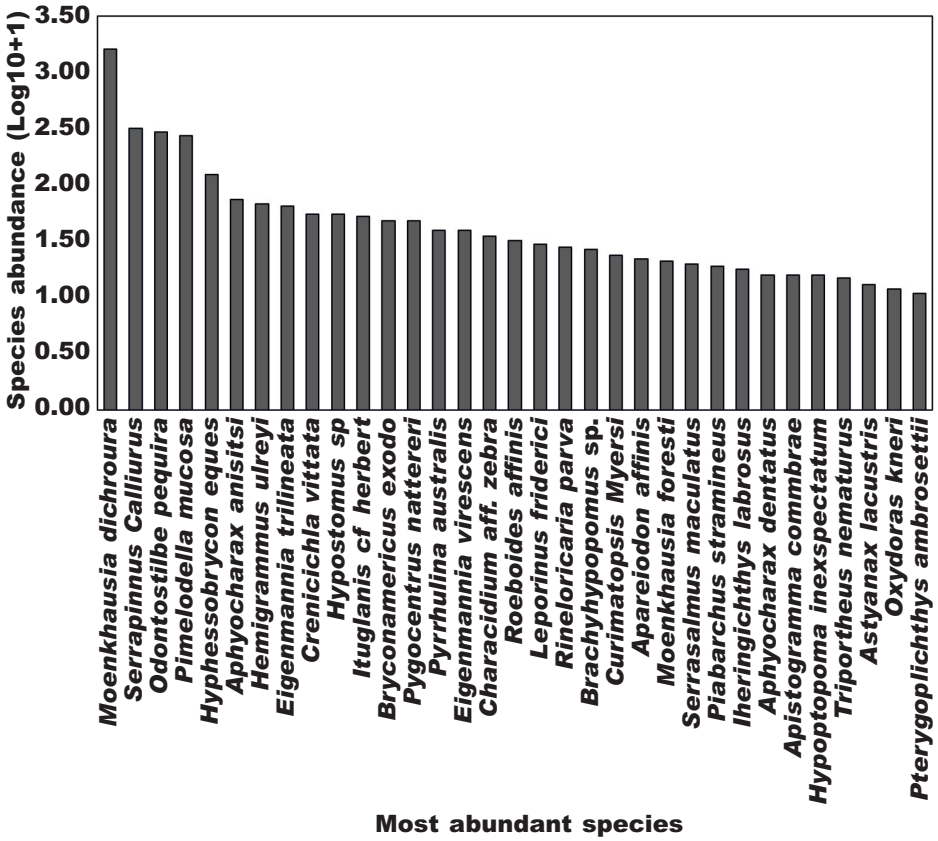

Fig. 4. Abundance of individuals of the main species collected at the Taiamã Ecological Station, Mato Grosso, Brazil.

Fig. 4. Abundancia de ejemplares de las principales especies recolectadas en el Espacio Natural Protegido de Taiamã, Mato Grosso (Brasil).

(Winemiller, 1989, 2005). In a study in the Pantanal of Poconé, Milani et al. (2010) highlighted the importance of aquatic macrophytes in the composition of fish species, where the family Characidae was the largest representative with a richness of 26 species underneath beds of *Eichhornia azurea*.

The high abundance of *M. dichroura*, *S. calliurus, O. pequira* and *P. gracilis* denotes a relation of coexistence, with little or no overlap of ecological niche. This may be because these species use different food resources, or it could be because the macrophyte bed provides a great variety of resources, such as periphytic algae, crustacean, invertebrates and organic detritus (Fulan and Henry, 2007; Santos et al., 2009; Câmara et al., 2012). Besides the fast reproduction of *M. dichroura* its abundance (1,627 individuals) was probably related to the fact that it has particular physiological adaptations such as modified gill rakers that allow water filtration and food capture (Da Silva and Hanh, 2009). These mechanisms can be influenced by the water regime of low and high waters. Many species spawn during the flood period and search for environments that provide shelter, which many find underneath the aquatic macrophyte beds (Súarez et al., 2004).

The abundance of small Characidae underneath the macrophyte bed shows that a high percentage of species from this family live here. Less abundant species are considered occasional visitors (Suárez et al., 2013) that mainly select this habitat during climatic events, such as alterations in the hydrological regime. The great quantity of fish belonging to the order Characiformes and the family Characide in areas near the Taiamã Ecological Station is considered to be due to their adaptation to the numerous lakes that originated from a sedimentation process (Ikeda–Castrillon et al., 2011). Our findings support previous research on fish assemblage beneath the aquatic macrophyte bed in a non–protected area, with 107 species sampled over a two–year period (Pacheco and Da Silva, 2009; Pains–Silva et al., 2010, 2014).

Our results emphasize the need to protect these wetlands around Conservation Units and highlight the importance of these regions for small species that are the base of the food chain of fish species of commercial interest in the region of the Pantanal of Cáceres.

References

Britski, H. A., Silimon, K. Z. S., Lopes, B. S., 2007. *Peixes do Pantanal: manual de identificação*. Embrapa Informação Tecnológica, Brasília DF.

Câmara, C. F., Castilho–Noll, M. S. M., Arcifa, M. S., 2012. Predation on microcrustaceans in evidence: the role of chaoboridae larvae and fish in two shallow and small Neotropical reservoirs. *Nauplius*, 1: 1–14.

Carvalho, N. O., 1986. Hidrologia da Bacia do Alto Paraguai. In: *Simpósio Sobre Recursos Naturais e Sócio–Econômicos do Pantanal*, *Corumbá*: 265. EMBRAPA–DDT, Brasília.

Corrêa, F., Oliveira, E. F., Tuchtenhagen, T., Pouey, J., Piedras, S., 2015. Ichthyofauna of the hydrographic basin of the Chasqueiro Stream (Mirim Lagoon system, southern Brazil): generating subsidies for conservation and management. *Biota Neotropica*, 4: 1–13.

Da Silva, M. R., Hahn, N. S., 2009. Influência da dieta sobre a abundância de *Moenkhausia dichroura* (Characiformes, Characidae) no reservatório de Manso, Estado de Mato Grosso. *Iheringia, Série Zoologia*, 3: 324–328.

Da Silva, C. J., Wantzen, M., Cunha, C. N., Machado, F. A., 2001. Biodiversity in the Pantanal Wetland, Brazil. In: *Biodiversity in wetlands: assessment, function and conservation*: 187–215 (J. J. Wolfgang, B. Gopal, J. A. Davis, Orgs.). Backhuys Publishers, Leiden.

Fernandes, I. M., Bastos, Y. F., Barreto, D. S., Lourenço, L. S., Penha, J. M., 2017. The efficacy of clove oil as an anaesthetic and in euthanasia procedure for small–sized tropical fishes. *Brazilian Journal of Biology*, 3: 444–450.

Fernandes, I. M., Penha, J., Zuanon, J., 2015. Size–dependent response of tropical wetland fish communities to changes in vegetation cover and habitat connectivity. *Landscape Ecology*, 30: 1421–1434.

Fernandes, I. M., Signor, C. A., Penha J., 2010. *Biodiversidade no Pantanal de Poconé*. Centro de Pesquisa do Pantanal, Cuiabá.

Fulan, J. A., Henry, R., 2007. Distribuição temporal de imaturos de Odonata (Insecta) associados a *Eichhornia azurea* (Kunth) na Lagoa do Camargo, Rio Paranapanema, São Paulo. *Revista Brasileira de Entomologia*, 2: 224–227.

Hammer, O., Harper, D. A. T., Ryan, P. D., 2001. PAST: Paleontological Statistics Software Package for Education and Data Analysis. *Paleontologia Eletronica*, 1: 1–9.

Ikeda–Castrillon, S. K., Da Silva, C. J., Fernandez, J. R. C., Ikeda, A. K., 2011. Avaliação da diversidade arbórea das ilhas do rio Paraguai na região de Cáceres, Pantanal Matogrossense, Brasil. *Acta Botanica Brasilica,* 3: 672–684.

Junk, W. J., Da Silva, C. J., 2000. O conceito do pulso de inundação e suas implicações para o Pantanal de Mato Grosso. In: *Anais do II Simpósio sobre Recursos Naturais e Sócio–economicos do Pantanal. Manejo e Conservação:* 17–28 (M. Dantas, J. B. Catto, E. K. D. Resende, Eds.). EMBRAPA, Corumbá/Brasil.

Junk, W. J., Piedade, M. T. F., Lourival, R., Wittmann, F., Kandus, P., Lacerda, L. D., Bozelli, R. L., Esteves, F. A., Nunes Da Cunha, C., Maltchik, L., Schöngart, J., Schaeffer–Novelli, Y., Agostinho, A. A., 2014. Brazilian wetlands: their definition, delineation, and classification for research, sustainable management, and protection. *Aquatic Conservation* (Print), 24: 5–22.

Keene, J. L., Noakes, D. L., Moccia, R. D., Soto, C. G., 1998. The efficacy of clove oil as an anaesthetic for rainbow trout, *Oncorhynchus mykiss* (Walbaum). *Aquaculture Research*, 2: 89–101.

Layman, C. A., Giery, S. T., Buhler, S., Rossi, R., Penland, T., Henson, M. N., Bogdanoff, A. K., Cove, M. V., Irizarry, A. D., Schalk, C. M., Archer, S. K., 2015. A primer on the history of food web ecology: Fundamental contributions of fourteen researchers. *Food Webs*, 4: 14–24.

Lopes, T. M., Cunha, E. R., Silva, J. C. B., Behrend, R. D., Gomes, L. C., 2015. Dense macrophytes influence the horizontal distribution of fish in floodplain lakes. *Environmental Biology of Fishes*, 7: 1741–1755.

Lourenço, L. S., Mateus, L. A., Machado, N. G., 2008. Sincronia na reprodução de *Moenkhausia sanctaefilomenae* (Steindachner) (Characiformes: Characidae) na planície de inundação do rio Cuiabá, Pantanal Mato–grossense, Brasil. *Revista Brasileira de Zoologia*, 1: 20–27.

Milani, V., Machado, F. D. A., Silva, V. C. F., 2010. Assembleias de peixes associados às macrófitas aquáticas em ambientes alagáveis do Pantanal de Poconé, MT, Brasil. *Biota Neotropica*, 2: 261–270.

Neves, S. M. A. S., Nunes, M. C. M., Neves, R. J., 2011. Caracterização das condições climáticas de Cáceres/MT Brasil, no período de 1971 a 2009: subsídios às atividades agropecuárias e turísticas municipais. *Boletim Goiano de Geografia*, 2: 55–68.

Pacheco, É. B., Da Silva, C. J., 2009. Fish associated with aquatic macrophytes in the Chacororé–Sinhá Mariana Lake system and Mutum River, Pantanal of Mato Grosso, Brazil. *Brazilian Journal of Biology,* 1: 101–108.

Pains–Silva, H., Petry, A. C., Da Silva, C. J., 2010. Fish communities of the Pantanal wetland in Brazil: evaluating the effects of the upper Paraguay river flood pulse on baía Caiçara fish fauna. *Aquatic Ecology*, 1: 275–288.

Pains–Silva, H., Souza, F., Corrêa, F., 2014. Ichthyofauna of the Bento Gomes River in the Pantanal Matogrossense, Brazil. *Pan–American Journal of Aquatic Sciences*, 1: 48–53.

Pereira, G., Chávez, E. S., Silva, M., 2012. O estudo das unidades de paisagem do bioma Pantanal. *Ambiente & Água*, 1: 89–103.

Polaz, C. N. M., Melo, B. F., Britzke, R., Resende, E. K., Machado, F. A., Lima, J. A. F., Petrere, J. R. M., 2014. Fishes from the Parque Nacional do Pantanal Matogrossense, upper Paraguay River basin, Brazil. *Check List*, 1: 122–130.

Pozer, C. G., Nogueira, F., 2004. Flooded native pastures of the northern region of the Pantanal of Mato Grosso: biomass and primary productivity variations. *Brazilian Journal of Biology*, 4: 859–866.

Reis, R. E., Albert, J. S., Dario, F. D. I., Mincarone, M. M., Petry, P., Rocha, L. A., 2016. Fish biodiversity and conservation in South America. *Journal of Fish Biology*, 1: 12–47.

Sanders, D., Jones, C. G., Thebault, E. Bouma, T. J., van der Heide, T., Van Belzen, J., Barot, S., 2014. Integrating ecosystem engineering and food webs. *Oikos*, 5: 513–524.

Santos, C. L., Dos Santos, I. A., Da Silva, C. J., 2009. Ecologia trófica de peixes ocorrentes em bancos de macrófitas aquáticas na baia Caiçara, Pantanal Mato–Grossense. *Revista Brasileira de Biociências*, 4: 473–476.

Schiesari, L., Zuanon, J., Azevedo–Ramos, C., Garcia, M., Gordo, M., Messias, M., Vieira, E. M., 2003. Macrophyte rafts as dispersal vectors for fishes and amphibians in the Lower Solimões River, Central Amazon. J*ournal of Tropical Ecology*, 3: 333–336.

Severo–Neto, F., Tencatt, L. F. C., Costa–Pereira, R., Tavares, L. E. R., 2015. Peixes da Baía da Medalha, Pantanal Sul, Brasil: Uma revisão de 20 anos. *Biota Neotropica*, 2: 1–9.

Suárez, Y. R., Ferreira, F. S., Tondato, K. K., 2013. Assemblage of fish species associated with aquatic macrophytes in Porto Murtinho Pantanal, Mato Grosso do Sul, Brazil. *Biota Neotropica*, 2: 182–189.

Súarez, Y. R., Petrere–Júnior, M., 2007. Environmental factors predicting fish community structure in two neotropical rivers in Brazil. *Neotropical Ichthyology*, 1: 61–68.

Súarez, Y. R., Petrere–Júnior, M., Catella, A. C., 2004. Factors regulating diversity and abundance of fish communities in Pantanal lagoons, Brazil. *Fisheries Management Ecology,* 11: 45–50.

Teresa, F. B., Romero, R. M., Langeani, F., 2016. Pisces, Aquidauana and Miranda drainages, upper Paraguay River basin, Mato Grosso do Sul, Brazil. *Check List*, 4: 596–601.

Winemiller, K. O., 1989. Patterns of variation in life history among South American fishes in seasonal environments. *Oecologia*, 2: 225–241.

– 2005. Life history strategies, population regulation, and implications for fisheries management. *Canadian Journal of Fisheries and Aquatic Sciences*, 4: 872–885.