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Composition and ecological diversity of the ichthyofauna from the Namorados Dam, semi arid region of Paraíba, Brazil

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Abstract – The aim of this study was to characterize the composition and ecological diversity of the ichthyofauna from the Namorados Dam, in the semi arid region of Paraíba, northeastern Brazil. Samples were collected between January 2006 and July 2007, in morning and afternoon shifts, using different fishing gear. Ecological diversity was calculated using diversity indexes of Shannon-Wiener (H'), richness (D') and evenness (J'), using the average abundance of the species. 176 individuals were collected throughout the analyzed period, being represented by 2 orders, 4 families of 5 species. With the exception of January 2006, the composition did not show specific changes, with equal predominance of the species *Cichlassoma orientale* and *Steindachnerina notonota*. Throughout the period of 2007, the prevalence was of the Order Perciformes, with dominance of the species *C. orientale*, which may have been caused by a population decline of *Oreochromis niloticus*. The lower diversity observed (H'=0,46) was due to the lower species richness (3) and the predominance of the species *C. orientale* in the same period. During the rainy seasons of 2006 and 2007 low diversity indexes were registered (H'=0,60 e H'=0,46) due to lower species richness (2 and 3), and dominance of *O. niloticus* and *C. orientale*. The dry season presented an average diversity of H'=0,90, which corresponds to a slight increase in species richness (5). We conclude that in this environment there is a weak annual variation in the fish assemblage, as well as in the species richness associated with seasonality of the region

Key Words: *Biodiversity; Fishes; Cariri of Paraíba.*

Composição e diversidade ecológica da ictiofauna do Açude Namorados, semi-árido Paraibano, Brasil

Resumo – Objetivou-se com este trabalho, caracterizar a composição e a diversidade ecológica da ictiofauna do Açude Namorados, no semiárido paraibano, Nordeste brasileiro. As coletas foram realizadas entre os meses de janeiro de 2006 e julho de 2007, nos turnos da manhã e tarde, utilizando-se diversas artes de pesca. Para a diversidade ecológica foram calculados os índices de diversidade de Shannon-Wiener (H'), riqueza específica (D') e equitabilidade (J'), utilizando-se a abundância média das espécies. Foram capturados 176 indivíduos em todo o período analisado, representados por 2 ordens, 4 famílias de 5 espécies. Com exceção do mês de janeiro de 2006, a composição não apresentou alterações específicas, com igual predominância das espécies *Cichlassoma orientale* e *Steindachnerina notonota*. Em todo o período de 2007, predominou a Ordem Perciformes, com dominância da espécie *C. orientale*, possivelmente, ocasionada pela redução populacional de *Oreochromis niloticus*. A menor diversidade observada (H'=0,46) foi dada pela menor riqueza de espécies (3) e a predominância da espécie *C. orientale* neste mesmo período. Durante os períodos de chuva de 2006 e de 2007 registraram-se baixos índices de diversidade (H'=0,60 e H'=0,46) levados por uma menor riqueza de espécies (2 e 3), e dominância de *O. niloticus* e *C. orientale*. Diferentemente do período de estiagem que apresentou uma diversidade média (H'=0,90), correspondida por um ligeiro aumento na riqueza de espécies (5). Concluiu-se que neste ambiente há pouca variação anual entre as assembleias de peixes, assim como pequena riqueza de espécies associada à sazonalidade da região.

Palavras-Chave: *Biodiversidade; Peixes; Cariri Paraibano.*

Composición y diversidad ecológica de la ictiofauna del Embalse Namorados, semi-árido de Paraíba, Brasil

Resumen – El objetivo de este estudio fue caracterizar la composición y diversidad ecológica de la ictiofauna del Embalse Namorados, semi-árido de Paraíba, Nordeste de Brasil. Las muestras fueron realizadas entre los meses de enero de 2006 y julio de 2007, en la mañana y tarde turnos, utilizando diferentes artes de pesca. Para la diversidad ecológica se calcularon los índices de diversidad de Shannon-Wiener (H'), la riqueza específica (D') y equitatividad (J'), el uso de la abundancia media de las especies. Se capturaron 176 individuos en todo el período de estudio, representado por 2 órdenes, 4 familias de 5 especies. Con la excepción de enero de 2006, la composición no mostró cambios específicos, con la misma prevalencia de las especies *Cichlassoma orientale* y *Steindachnerina notonota*. A lo largo del período de 2007, predominaron Orden Perciformes, con predominio de la especie *C. orientale*, posiblemente causados por la reducción de la población de *Oreochromis niloticus*. El observado una menor diversidad (H'=0,46) fue dada por la riqueza de especies menores (3) y la prevalencia de la especie *C. orientale* el mismo período. Durante los períodos de lluvia, 2006 y 2007 se registraron bajos niveles de diversidad (H'=0,60 y H'=0,46), dirigido por una menor riqueza de especies (2 y 3), y el dominio de *O. niloticus* y *C. orientale*. La diferencia de la sequía, que tuvo una diversidad media (H'= 0,90), acompañado de un ligero aumento en la riqueza de especies (5). Se concluyó que en este entorno hay poca variación anual entre las asambleas de peces, cuanto ya suya riqueza de especies asociadas a la estacionalidad de la región.
Palabras Clave: *Biodiversidad; Peces; Cariri de Paraíba.*

Introduction

Water is a natural resource essential to human life, providing a leading role for life support in different ecosystems. Water is a World Heritage Site and various activities related to the development underlie the use of water resources. Brazil holds about 15% of the water available on the planet and is privileged in terms of water availability. However, what we see is an increased use of water for various human activities, caused by population growth (Marinho 2009).

According to Tundisi (1999), changes in the quantity, distribution and quality of water resources threaten human survival and other species on the planet.The economic and social development of countries is based on good water availability and the ability to conserve and protecte it.

The water bodies in various regions of the world have shown a significant reduction in the diversity of native fish, due mainly to habitat degradation, overfishing of stocks and introduction of exotic species, which together cause the disintegration of communities or even local extinction of native species. Despite the great diversity of fish, it is estimated that this group has lost about 20% of its global diversity (Fernando 1991, Latini 2001).

The Neotropical region has the greatest diversity of fish on our planet. It is ironical that Brazil is among the countries that received the largest amount of exotic species (25,3% of the world total). Brazil maintains the highest occurrence of such introductions in order to increase fish production, to enhance sport fishing, and as food supply for the local population (Agostinho 1996).

According Britski et al. (1984), internal waters of Brazil occupy a flooded area of approximately three million hectares. They estimate that these environments are inhabited by thousands of species of fish. However, the evaluation and understanding of this rich diversity is negatively affected by incomplete knowledge of their bioecology (Menezes 1996).

Among the micro-regions from the Brazilian Northeast, the arid or semi arid regions suffer major limitations of their water resources, due mostly to low rainfall indexes and high evaporation

rates of its waters (Marinho 2009). According to Lazzaro et al. (2003), this region is characterized by having heavy rainfall concentrated in a few days a year, distributed in time and space, and often be plagued by the drought phenomenon.

According to Medeiros (1999), these events play an important role in the organization and functionality of these ecosystems. They provide novel survival strategies for species, generating intra and inter-specific competition, changes in the structure of populations, as well as the availability of natural resources. This makes the fish true environmental indicators, contributing to the characterization of fish populations.

Aquatic ecosystems of the caatinga are represented by different groups of typical Neotropical fish, although they are far less diversified compared to other environments due to historical processes of allopatric speciation held by marine transgressions, semi arid climate expansions, reordering drainage networks and ecological processes. These processes together determined the adaptation of the species to climate change, to the hydrological regime of the region, and also to anthropogenic processes. These involve mainly the introduction of exotic species, which possibly led to changes in the original composition, causing local or generalized extinctions (Rosa et al. 2005). The complete lack of water in most aquatic semi arid environments can be, also, the reason for the low diversity of species in these regions.

According to Angermeier & Karr (1984) the knowledge of diversity, especially of the fish assemblages and their spatial and temporal variation patterns, is of great importance to assess the environmental quality, since fish occupy different positions in the food web., But it is also essential to identify environmental responses to the impacts caused by human activities, in addition to providing subsidies for the regulation of water resources use, enabling the development of alternatives to minimize the degradation of the rivers.

It thus becomes necessary to characterize the diversity and composition of the ichthyofauna in Namorados Dam, located in the semi arid region of Paraíba (Brazil). This ecosystem is of great important for the economy and sustainability of the region.

Material and Methods

Place of study

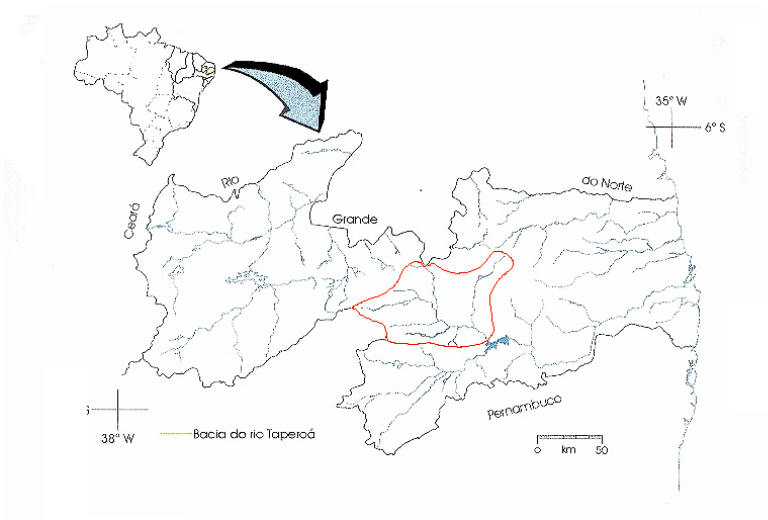
The study was conducted in the Namorados Dam, a part of the sub-basin of the Taperoá River in the State of Paraiba.

The sub-basin of the Taperoá River (Figure 1) is inserted into the large River Basin of the Paraíba River, which presents a maximum capacity of 42.447.106m^3 (AESA 2015).

The semi arid region of Paraíba has a climate of the BSh type, hot semi arid with summer rains (maximum annual rainfall of 400-450 m^3/year), and average air temperature of 25 °C (AESA 2015).

The dry season is variable, reaching a period of 8 to 9 months per year (April to December), with prolonged drought periods that lead to greater evaporation and considerably reducing the water volume (Nimer 1979), significantly interfering in the hydrology of the region.

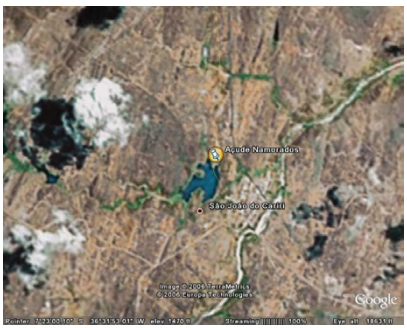
Figure 1 - Location of the sub-basin of the River Taperoá, semiarid of Paraíba



The Namorados Dam is located between the coordinates 7°23'64"S and 36°31'80"W, in the municipality of São João do Cariri and has a maximum capacity of water accumulation 2.118.980 m³ (AESA 2015, LMRS/PB 2015, Google Earth) (Figure 2).

Figure 2 - (A) Location of the Namorados Dam. (B) Parcial view of the Namorados Dam in the dry period. Source: Google Earth. Photo: Randolpho S. Araújo Marinho

A



B

Methodology

Samples were collected between the months of January 2006 and July 2007, in morning and afternoon shifts, using cast nets (mesh 15 and 30 mm) and gillnets (mesh 15, 20, 25, 35 and 40 mm) between adjacent knots.

Collection of samples were labeled on-site, placed in plastic bags, kept in a cooler with

ice packs and were transported to the Aquatic Ecological Laboratory, Systematic and Ecology Department, Center of Exact and Nature Sciences, at the Federal University of Paraíba (LABEA/DSE/CCEN/UFPB). In laboratory, after screening, the taxonomic identification of the collected species was donr, based on Britski et al. (1984), Ploeg (1991), Vari (1991), Nelson (1994), Nakatani et al. (2001).

Some representatives of each species were fixed in formalin 10%, preserved in alcohol 75%, and subsequently cataloged in the Ichthyological Collection of UFPB.

Determination of the ecological diversity

To determine the ecological diversity the diversity indexes of Shannon-Wiener (H'), of species richness (D') and evenness (J') were calculated, using the average abundance of the species collected at the study site.

According to Pinto-Coelho (2000), the diversity index of Shannon-Wiener reflects two basic attributes: the number and the evenness of species, assuming that all individuals are sampled randomly, and that all species are represented in the sample.

To determine the richness, we used the Margalef index (D'), based on the relationship between the number of species identified and the total number of individuals collected (Pinto-Coelho 2000).

The indexes mentioned above were obtained through of the software GW-Basic v.3.23 (Ludwig & Reynolds 1988).

Results and Discussion

Composition of the ichthyofauna

The environment analyzed in this study showed different patterns of diversity of the ichthyofauna on the seasonality and on the periods.

A total of 176 individuals were collected in the Namorados Dam throughout of the studied period, resulting in the identification of 2 orders, 4 families of 5 species (Table 1).

With the exception of January/2006 (rainy season), the composition of the ichthyofauna of the Namorados Dam did not present specific changes.,The species *C. orientale* and *S. notonota* were equally prevalent in each analyzed month (Figure 3).

The dominance of *C. orientale* throughout the period of 2007 may be related to the population reduction of the species *O. niloticus*, caused by interspecific competition.

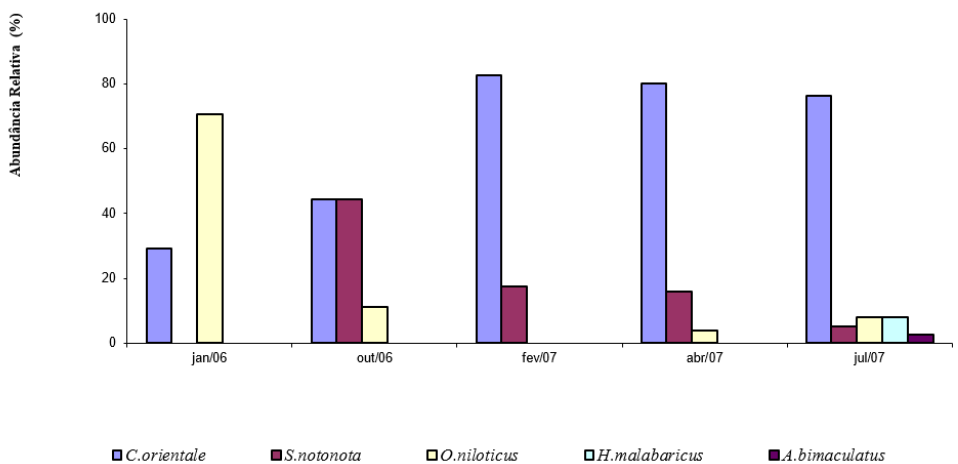
Table 1 - Taxonomic list of the ichthyofauna collected of the Namorados Dam in the period from January 2006 to July 2007.

ORDER	FAMILY	SPECIES	POPULAR NAME
Characiformes	Characidae	*Astyanax bimaculatus* (Linnaeus, 1758)	Piaba
	Curimatidae	*Steindachnerina notonota* (Miranda-Ribeiro, 1937)	Saguiru
	Erythrinidae	*Hoplias malabaricus* (Bloch, 1794)	Traira
Perciformes	Cichlidae	*Oreochromis niloticus* (Linnaeus, 1978)	Tilapia Nilótica
		Cichlassoma orientale (Swainson, 1839)	Cará

With the exception of January/2006 (rainy season), the composition of the ichthyofauna of the Namorados Dam did not present specific changes.,The species *C. orientale* and *S. notonota* were equally prevalent in each analyzed month (Figure 3).

The dominance of *C. orientale* throughout the period of 2007 may be related to the population reduction of the species *O. niloticus*, caused by interspecific competition.

Figure 3 - Relative abundance of the composition of the ichthyofauna from the Namorados Dam, São João do Cariri, semi-arid of Paraiba



The Neotropical ichthyofauna is rich in species of the orders Characiformes and Siluriformes, which generally include most species of existing fish assemblages in various ecosystems (Lowe-McConnell 1987).

Most individuals collected in the Namorados Dam, mainly in the dry season, represented the order of the Characiformes, corroborating with the results found by Cardoso et al. (2012), in pools of an intermittent river of the semi arid of Paraiba, as well as by Hoffmann (2005) in the reservoir of the UHE Mackenzie Engineering School (Capivara), Paranapanema River, Upper Paraná River watershed. Similar results were also found by Teixeira (2005) in studies conducted in the River Paraíba do Sul.

The prevaialnce of Characidae and Curimatidae families among the Characiformes is due to a wide distribution of its species in freshwater. This family includes most fish species of interior waters in Brazil (Britski 1972). In addition, there is a great predominance of species of small size and/or able to complete the life cycle in lentic environments, as shown by Agostinho (1992), Araujo & Santos (2001), and Orsi et al. (2002).

The rainy season in the dam showed higher species richness, probably due to the large input of organic matter and sediments originating from the soil leaching by rain, thus providing greater food supply, and causing an increase in the diversity of habitats (Barbiere & Kronemberg 1994). Furthermore, the water level reach the marginal vegetation and make available shelters and habitats structurally more complex for the fishes.

Agostinho et al. (2007) reported that in Brazilian reservoirs, about 85% have a total richness of less than 40 fish species, and almost half are between 20 and 40, averaging around 30 species per reservoir. Few were those with more than 80 species..

Similar results were found by Luíz et al. (2003), who studied the ichthyofauna of a reservoir from Alagados region in Paraná State, where they registered a low number of species. *Astyanax scabripinnis paranae* was dominant, representing about 86% of the total captured individuals.

Ecological diversity of the ichthyofauna

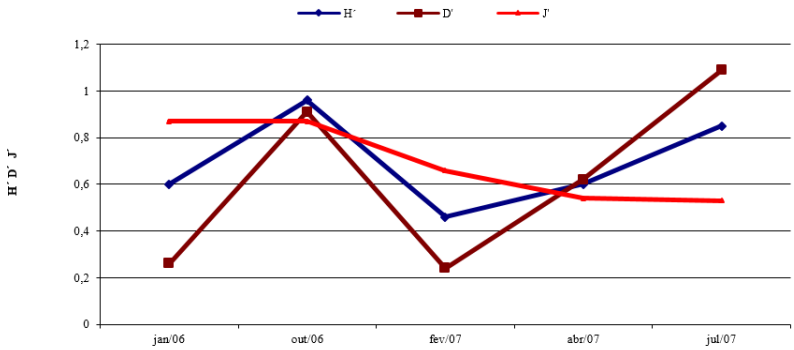
The ecological diversity in the Namorados Dam presented variations between the indexes and the seasonality of the region.

During rainy periods of 2006 (January) and 2007 (February) were registered low diversity indexes (H'=0,6 and H'=0,46, respectively) leading to a lower species richness (2 and 3) with dominance of *O. niloticus* and *C. orientale* in this period, with evenness index of J'=0,69.

During drought periods (October/2006 and July/2007) the diversity index (H'=0,96 and H'=0,85, respectively) was higher than in the rainy season, which corresponded to a slight increase in the species richness (5) in the period of July 2007, with evenness index of J'=0,7.

The diversity indices of Namorados Dam differed from those obtained by Marinho (2006) and Marinho et al. (2007) in this same environment, between 2005 and 2006.They found higher diversity indexes during the rainy season (H'=1,2), when 7 species were identified, while in the dry season 5 species were recorded, with a lower index (H'=0,6) during the same period.

Figure 4 - Diversity indexes of the ichthyofauna from Namorados Dam, São João do Cariri, Paraíba semi arid



Conclusion

We conclude that the Namorados Dam is represented by a small ichthyic richness, with 5 species represented. A variation in the composition throughout the study period was found, 2 (January 2006 and February 2007) to 5 species (July 2007) being recorded.

The 5 recorded species were simultaneously present only in July, 2007.

In the end of the rainy period the highest richness and diversity indexes were recorded.

Dominance in different periods by *Cichlassoma orientale* and *Steindachnerina notonota* was observed.

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