



# Anuran diversity on the Ilha do Caju, Parnaíba Delta River, Maranhão State, Northeastern Brazil

Diversidade de anuros na Ilha do Caju, Delta do Rio Parnaíba,  
Estado do Maranhão, nordeste do Brasil

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## Abstract

In this work we aim to increase knowledge about biodiversity in the Parnaíba Delta River through characterization of anuran fauna of Ilha do Caju, municipality of Araiões, Maranhão state. We recorded nine species belonging to three families: Leiuperidae, Leptodactylidae and Hylidae. In addition to biogeographical and historical factors, environmental conditions and irregular rainfall distribution, seem to contribute to the low species richness of amphibians in this island that have a predominance of species that build foam nests (Leiuperidae and Leptodactylidae). Ilha do Caju is considered as a natural laboratory that allows obtaining information for planning and evaluating the status of conservation and preservation of regional biodiversity, helping to support future studies in the Parnaíba Delta River region.

Key words: Amphibia, Anura, Biodiversity, Anuran fauna, Conservation.

## Resumo

O presente trabalho tem por objetivo aumentar o conhecimento sobre a biodiversidade registrada no Delta do Rio Parnaíba através da caracterização da anurofauna da Ilha do Caju, município de Araiões, Estado do Maranhão. Foram registradas nove espécies pertencentes a três famílias: Leiuperidae, Leptodactylidae e Hylidae. Além de fatores históricos e biogeográficos, condições ambientais e distribuição irregular de chuvas contribuem para a baixa riqueza de espécies de anfíbios na ilha que tem uma predominância de espécies que constroem ninhos de espuma (Leiuperidae e Leptodactylidae). A Ilha do Caju é considerada como um laboratório natural que permite a obtenção de informações para o planejamento e avaliação do estado de conservação e preservação da biodiversidade regional, contribuindo para estudos futuros na região do Delta do Rio Parnaíba.

Palavras-Chave: Amphibia, Anura, Biodiversidade, Anurofauna, Conservação.

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## Introduction

Studies on the composition of amphibian communities along the Brazilian coast are still scarce (LOEBMANN; MAI, 2008). This is especially true in the northeast of the country where only 10% of the studies conducted on the region are related to wildlife inventories (LEWINSOHN; PRADO, 2002). Despite the great biodiversity, influenced by biomes Cerrado and Caatinga besides Coastal Marine Zone, the low number of studies on the composition of anuran fauna (SILVA et al., 2007, LOEBMANN; MAI, 2008) creates a false impression of low representativity of amphibians in the region. The constant records of new occurrences (LEITE JR. et al., 2008a, 2008b; GUMARÃES et al., no prelo), demonstrating the lack of substantiated knowledge on regional biodiversity.

The Parnaíba River Delta is a complex of ecosystems and has a great environmental importance for Piauí and Maranhão states, exhibiting a large diversity of terrestrial and marine environment transitions. It is characterized by rivers, islands, several estuaries and bays and is considered as a breeding sanctuary for many migratory species such as birds, fish, and crustaceans (BRASIL, 2002).

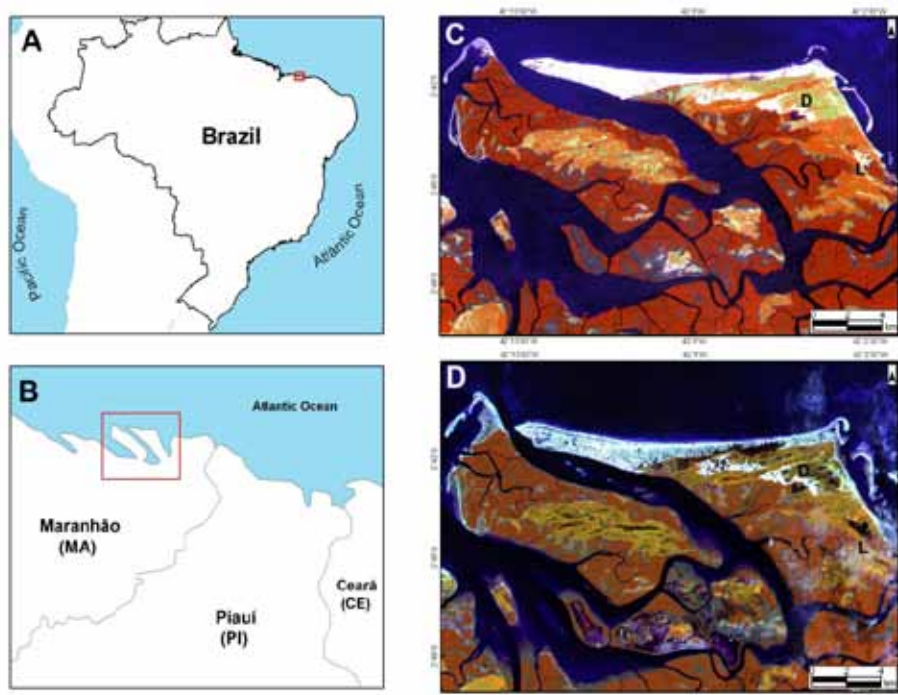
Studies on amphibians, especially on natural history and ecology, is an important tool to understand biodiversity and the conservation level of the studied environment, pointing its use in integrated analysis of data (WILLINK et al., 2000) for the plan-

ning and decision-making on conservation strategies (HEYER et al., 1994; HADDAD, 1998; DOAN; ARRIAGA, 2002; ROCHA et al., 2004).

In order to promote a better knowledge on the amphibian community of the Parnaíba Delta River it is necessary to elaborate an inventory of species that will offer unique and important information to be included in inventories of the regional fauna as a whole. This study aims to characterize the anuran fauna of Ilha do Caju, Parnaíba Delta River in the municipality of Araioses, Maranhão state, in an attempt to contribute with information on biodiversity and to provide the basis for the establishment of mechanisms to preserve the Parnaíba Delta River.

## Material and methods

Ilha do Caju is the third largest island in the Parnaíba Delta River, about 100 km<sup>2</sup>, and belongs to Araioses municipality, Maranhão state, northeast Brazil. It is located between coordinates 02°45'00"S, 42°05'00"W (Figure 1), about 50 km northwest from Parnaíba city, Piauí state. Most of the environment in Ilha do Caju is still well preserved. It consists of mosaic ecosystems of high environmental significance, typical of coastal areas, formed mainly by mangroves, dunes, estuaries, lagoons and flooded fields (Figure 2). It exhibits many dynamic geomorphologic features (LABOHIDRO, 1999), showing some degree of weakness due to its location and its high erosive potential (BRASIL, 1996). The climate is characterized by a small range in temperatures (between 25 and 27°C) and annual average rainfall up to over 1.200 mm, concentrated mainly from



**Figure 1.** Map of Ilha do Caju, Parnaíba Delta River. Map of Ilha do Caju, Parnaíba Delta River, Northeast Brazil. Landsat TM satellite image of a dry period (C) and rainy period (D). The marks on the images represent two main collecting areas with greater anuran biodiversity (D, Duna alta) and (L, Lagoa Grande) in Ilha do Caju (see Figure 2).

January to May (Figure 3).

Capture of animals occurred mainly between dusk and night (18-23 h), on swamps and flooded fields (temporary). The samples were monthly, lasting three days each, both in the dry and rainy periods of the 2007-2008 biennium. Two complementary survey methods were used: the method of visual encounter survey and the active survey on tracks over places animals use as refuge (HEYER et al., 1994), with an effort total of 36 hours/men.

Pitfall traps with drift fence were also used as an additional method in an attempt sampled litter amphibians and arranged in two sections on the island. For this study, we used 60 liter buckets

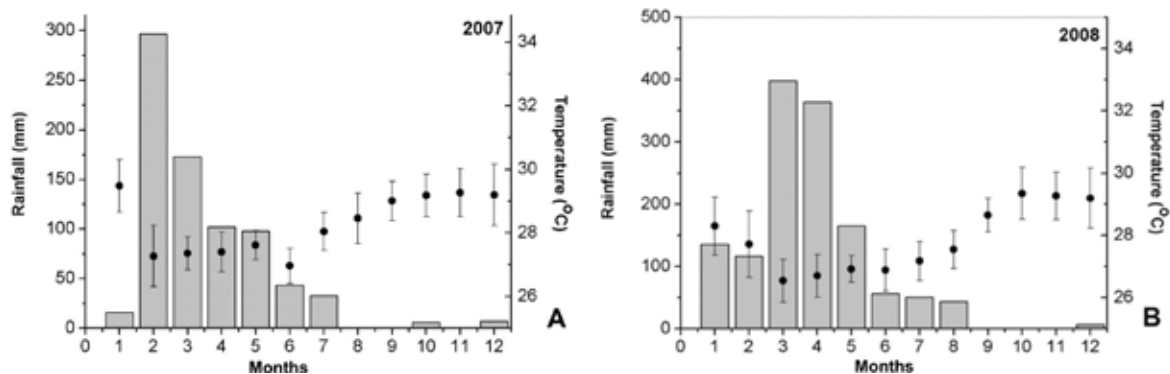
(0.52 m diameter and 0.42 m deep), buried into the ground with a drift fence of black plastic 0.7 m wide canvas fixed to the ground. Traps were marked and coordinates were taken by GPS: Pitfall Trap 1 (P1) - 2°44'59.91"S, 42°2'16.93"W and pitfall trap 2 (P2) - 2°45'4.71"S, 42°2'7.32"W. P1 and P2 have an radial format ("Y"), with four buckets 2 m away from each other and then 2 additional meters from each end of the bucket. The buckets remained open for a week and were checked once a day, always in the morning, to avoid death of animals by desiccation. Due to the low number of individuals collected through this method, the data were used in a qualitative way.



**Figure 2.** Photographs of two collecting sites. Photographs of two collecting sites at Ilha do Caju showing examples of the phytosociology of the region. (A) Duna Alta and (B) Lagoa Grande at the margins of Baía do Caju.

Some animals were collected, photographed and released at the same location where they were captured. Voucher specimens were deposited at the Coleção Herpetológica Delta Parnaíba, CHDP (Cam-

pus Ministro Reis Velloso, Universidade Federal do Piauí), Brazil. Collecting permits was emitted by Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis, IBAMA (SISBIO/17687-1).



**Figure 3.** Temperature and rainfall graph. Mean and standard deviation (SD) of temperature (point line). Rainfall (histogram) (period 2007 and 2008). Source: Meteorological station of the Embrapa Meio-Norte, Parnaíba, Piauí, Brazil.

## Results and discussion

Nine species belonging to three families were recorded in this study: Hylidae, Leptodactylidae, and Leiuperidae (Table 1; Figure 4).

The Leiuperidae family exhibited the greatest richness encompassing four species followed by Leptodactylidae with three species Hylidae family had the lowest representation with only two species.

**Table 1.** Check list of anurans at Ilha do Caju, Maranhão state, Brazil. Breeding Sites: SW, swamps; TP, temporary pond; PP, permanent pond; P, puddles, D, dunes.

Family/Species	Tomb datas	Habitat	Breeding Sites
<b>Hylidae</b>			
<i>Scinax x-signatus</i> (Spix, 1824)	CHDP 0113	Arboreal	SW, PP, TP
<i>Scinax fuscovarius</i> (A. Lutz, 1925)	CHDP 0456	Arboreal	SW, PP, TP, P
<b>Leptodactylidae</b>			
<i>Leptodactylus fuscus</i> (Schneider, 1799)	CHDP 0454	Terrestrial	TP, SW
<i>Leptodactylus vastus</i> (A. Lutz, 1930)	CHDP 0455	Terrestrial	TP, PP
<i>Leptodactylus macrosternum</i> (Miranda-Ribeiro, 1926)	CHDP 0008	Terrestrial	TP, PP
<b>Leiuperidae</b>			
<i>Physalaemus albifrons</i> (Spix, 1824)	CHDP 0109	Terrestrial	TP, D
<i>Physalaemus cuvieri</i> (Fitzinger, 1826)	CHDP 0001	Terrestrial	TP, PP
<i>Pleurodema diplolister</i> (Peters, 1870)	CHDP 0010	Terrestrial	D, TP
<i>Pseudopaludicola</i> sp. (gr. <i>mystacalis</i> ) (Cope, 1887)	CHDP 0243	Terrestrial	TP

Ilha do Caju exhibited a lower richness than other parts of the Paraíba Delta River. In a study on coastal sand dunes species at Ilha Grande do Piauí, with approximately 240 km<sup>2</sup>, Silva et al. (2007) recorded 14 species, and Loebmann and Mai (2008) recorded 21 species of amphibians in the coastal region of Piauí state. Recently, Andrade et al. (unpublished data) recorded 21 species anuran in a survey realized in two of the largest islands in the Parnaíba Delta (20 species in the Ilha Grande de Santa Isabel and 11 on Ilha das Canárias).

Besides to historical factors (islands formation)

and biogeographic (dispersion sources proximity and island size), the low species richness may be due to the fact that Ilha do Caju is a fluvial-marine island, without a fresh water source independent of rainfall. Temporary ponds, the only sources of fresh water, are formed as a result of damming rain water (LABOHIDRO, 1999), which occurs mainly from January to May (Figure 1). During this period the lakes reach the maximum accumulation of water (Figure 2C), possibly influencing the reproductive activity of amphibians, and providing ideal conditions for species reproduction (DUELLMAN; TRUEB, 1994).

Figure 3 (A and B) shows the relationship between rainfall and temperature indices. From September to November the rainfall rates do not reach significant rain values, when compared with others months of the year (December to August), and temperature reaches high values, drastically reducing the water surface (Figure 1C). In tropical regions with well defined seasons, the occurrence and reproduction of most amphibian species are mainly restricted to the rainy season (ROSSA-FERES; JIM, 1994; BERTOLUCI; RODRIGUES, 2002; PRADO et al., 2005), especially for those entirely dependent on humid environments for reproduction. In regions that are more humid and lack defined seasons, such as in Atlantic rainforest, 11 to 16% of the species reproduce throughout the year (BERTOLUCI; RODRIGUES, 2002), while in areas with severe dry seasons, such as the Brazilian Caatinga, continuous breeding species is not known (ARZABE, 1999). This occurs because rain in tropical climates is the main abiotic factor controlling reproduction of amphibian populations (POMBAL JR., 1997).

Although Ilha do Caju is located in an equatorial region, the low predominance of species of the family Hylidae does not confirm the pattern observed by Duellman (1978) and Heyer et al. (1990) in Neotropical region, and more specifically, in various biomes of Brazil where there is predominance of the Hylidae and Leptodactylidae: Araucaria Forest (CONTE; ROSSA-FERES, 2006), Atlantic Forest (ABRUNHO-SA et al., 2006; SANTANA et al., 2008), semi-deciduous forest (SANTOS; ROSSA-FERES; CASATTI, 2007; ZINA et al., 2007), Cerrado (BRASILEIRO et al., 2008), Caatinga (VIEIRA; ARZABE; SANTANA, 2007) and urban Amazonian areas (KNISPEN; BARROS, 2009). This is possibly due to the fact that Ilha do Caju is a river-sea island, subject to various historical and ecological processes (ETEROVICK; SAZIMA, 2000; MCCARTHY; LINDENMAYER, 2000), and environmental conditions limiting such as precipitation and hydroperiod (BEJA; ALCAZAR, 2003).

The anuran fauna of Caju Island consists of species considered typical of open formations in South America and species of wide geographical distribution (FROST, 2010). The species *Scinax x-signatus* (Spix, 1824) and *S. fuscovarius* (A. Lutz, 1925) were found sporadically on shrubs near the temporary lakes in the interior of the island, where environmental conditions are less adverse. These sites show an extended hydroperiod and do not suffer any marine influence, showing zero salinity. In lakes that border the island there is influence of the tide, and salinity ranges from 3.6 to 14%, according to data of Laboratório de Hidrologia (Hydrology Laboratory) of Universidade Federal do Maranhão (LABOHIDRO, 1999).

The anuran fauna of Caju Island consists of species considered typical of open formations in South America and species of wide geographical distribution (FROST, 2010). The species *Scinax x-signatus* (Spix, 1824) and *S. fuscovarius* (A. Lutz, 1925) were found sporadically on shrubs near the temporary lakes in the interior of the island, where environmental conditions are less adverse. These sites show an extended hydroperiod and do not suffer any marine influence, showing zero salinity. In lakes that border the island there is influence of the tide, and salinity ranges from 3.6 to 14%, according to data of Laboratório de Hidrologia (Hydrology Laboratory) of Universidade Federal do Maranhão (LABOHIDRO, 1999).



**Figure 4.** Anuran species list of Ilha do Caju. Anuran species recorded at Ilha do Caju in Maranhão state, between 2007 and 2008. *Leptodactylus vastus* - A; *L. macrosternum* - B; *L. fuscus* - C; *Pseudopaludicola* gr. *mystacalis* - D; *Physalaemus cuvieri* - E; *P. albifrons* - F; *Pleurodema diplolister* - G; *Scinax fuscovarius* - H; *S. x-signatus* - I.



Except for *Pleurodema diplolister* (Peters, 1870), which was found often calling in dry environments close to the water or buried in the sand, species of the Leiuperidae family were commonly recorded in the marginal vegetation or calling with the body partially submerged in water, as observed for some species of the genus *Physalaemus* (BARRETO; ANDRADE, 1995; WOGEL, ABRUNHOSA, POMBAL, 2002).

Leiuperidae and Leptodactylidae species deposited their eggs in foam nests on the water surface (except the *Pseudopaludicola* genus that deposits its eggs directly into lentic environment), in underground burrows or in depressions made by males, protecting them from desiccation (DUELLMAN; TRUEB, 1994; PRADO; UETANABARO; HADDAD., 2005), this is a common strategy in species that inhabit dry environments with open vegetation types and availability of water restricted to short periods of the year (CARDOSO; ARZABE, 1993; DUELLMAN, 1995; ARZABE, 1999).

Resistance to desiccation is a predominant factor for the success of species in such environments, particularly when the distribution of rainfall is erratic during the reproductive season. Species of Hylidae are more susceptible to changes in the volume of water because eggs are deposited in a gelatinous mass submerged or on the water surface (DUELLMAN; TRUEB, 1994; ARZABE, CARVALHO; COSTA, 1998).

Despite the low richness of anurans, Ilha do Caju is a natural laboratory, where their geological condition allows the generation of biogeographic and ecological hypothesis for to explain the composition of fauna. This offers numerous opportunities for comparative studies with other areas of Deltaic region, and allows obtaining useful information for the planning and evaluation of the conservation level of the regional biodiversity and sustainable use of natural resources.

These studies on species composition will contribute for a greater understanding of the conservation status of anuran communities, which is declining on a global scale. The causes for the decline of amphibians are well-understood, and appear to affect other groups of organisms. Among the causes are: habitat modification and fragmentation, introduced predators or competitors species, pollution, pesticide use or over-harvesting (BAKER; RICHARDSON,

2006; EISENBEIS, 2006). Therefore, mitigating measures in the region need to be taken, especially in a small area on the island used as a pasture instead of ecotourism and scientific research area.

Thus the data presented herein have consistently contributed to the knowledge of the amphibian fauna of the region, providing information on their ecological characteristics. This will enable a better understanding of this group of animals and this information will support future studies involving these species of amphibians, both at the Parnaíba Delta River as well as in other locations.

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