

Updated and supplementary data on Brito et al. (2019): Freshwater fishes of the PN dos Lençóis Maranhenses and adjacent areas.

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Abstract

In the present work we provided the complete list of specimens examined by Brito et al. (2019), including the voucher numbers, and the river basin where the specimens were collected. In addition, we yielded new collections in the studied area, cataloging seven new records of freshwater fish species for the Parque Nacional dos Lençóis Maranhenses.

keywords: ichthyology, Maranhão, Maranhão-Piauí ecoregion, sand dunes, survey

Resumo

No presente trabalho nós apresentamos a lista completa de exemplares examinados por Brito et al. (2019), incluindo os números de voucher e as bacias hidrográficas aonde os exemplares foram coletados. Além disso, nós realizamos novas amostragens de coleta na área estudada, catalogando sete novos registros de espécies de peixes de água doce para o Parque Nacional dos Lençóis Maranhenses.

palavras-chave: ictiologia, Maranhão, ecorregião Maranhão-Piauí, dunas de areia, inventário

Remarks on this update

One year after the publication of *Freshwater fishes of the Parque Nacional dos Lençóis Maranhenses and adjacent areas* (Brito et al. 2019), the results of more recent collecting activities, presented in this work, confirm the presence of seven additional species which have been unknown from this area previously. Also, as a supplement, we are presenting the complete list of specimens examined by Brito et al. (2019), including the voucher numbers, the locality, and the river basin where the specimens were collected, as well as the new records from the studied area. In addition to the 21 localities shown in Brito et al. (2019), four new localities have been sampled (fig. 1, table 1). Photos are provided for the new localities (figs. 8-11) and for those localities for which no photos could be included in the original paper (figs. 2-7).

Material and Methods

'NEW' in the last column indicates a first record for this National Park. '<' indicates the voucher lot which was provided as a single example for the respective species in Brito et al. (2019).

The new records were collected with manual trail-net (2 m long × 1.8m high; mesh size of 2mm), cast nets (2 m height, mesh size of 15 mm), gillnets of various mesh sizes (15, 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 100 mm), and dip nets (mesh size of 5 and 10 mm). The ichthyological material obtained in the samples was euthanized in a buffered solution of ethyl-3-amino-benzoate-methanesulfonate (MS-222) at a concentration of 250 mg/l until completely ceasing opercular movements, according to animal welfare laws and guidelines (Leary et al. 2013, Close et al. 1996, 1997). Specimens selected for morphological analysis were fixed in formalin 10% and stored in this solution for 15 days. After that, the material was transferred to a 70% ethanol solution for preservation. Specimens for future molecular works were fixed directly in absolute ethanol. The specimens' identification was carried out at the Laboratório de Sistemática e Ecologia de Organismos Aquáticos and Laboratório de Ecologia e Sistemática de Peixes, both from the Universidade Federal do Maranhão, using specialized bibliography for each taxonomic group (e.g. Keith et al. 2000, Kullander & Ferreira 2006, Van Der Steen & Albert 2018) and consulting experts. The material was deposited in the Coleção Ictiológica do Centro de Ciências Agrárias e Ambientais of the Universidade Federal do Maranhão (CICCAA) and Coleção de Peixes da Universidade Federal do Maranhão (CPUFMA). The taxonomic classification, the names of species considered as valid, authors and years of species descriptions, and geographic distribution of the species were based on the compilations proposed by Fricke et al. (2020a, b), where the authors gather the most recent classifications for each group of fish.

table 1. Details of the four localities not included in Brito et al. (2019).

	locality	river basin	municipality	coordinates
22	Rio Negro	Preguiças	Santo Amaro	02°29'41"S 42°59'05"W
23	Rio Preguiças	Preguiças	Barrerinhos	02°42'11"S 42°47'07"W
24	Rio Alegre	Periá	Santo Amaro	02°30'19"S 43°15'09"W
25	no name	Periá	Santo Amaro	02°29'51"S 43°13'22"W

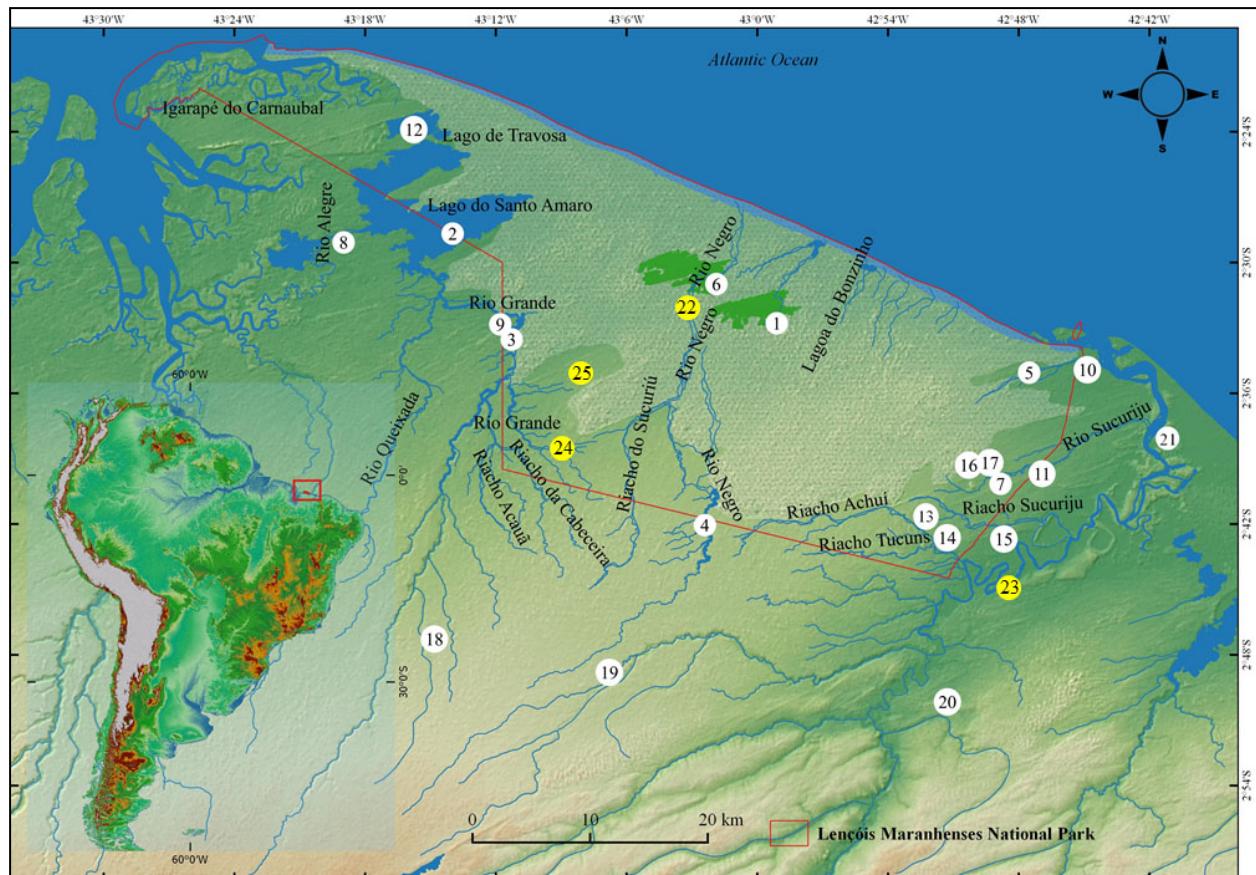


fig. 1. Map as from Brito et al. (2019), indicating the four new localities in yellow.



fig. 2. locality 2, Lago de Santo Amaro



fig. 3. locality 5, Ponta do Mangue



fig. 4. locality 7, Riacho Mata-Fome, Tucunzal



fig. 5. locality 11, Rio Sucuriju

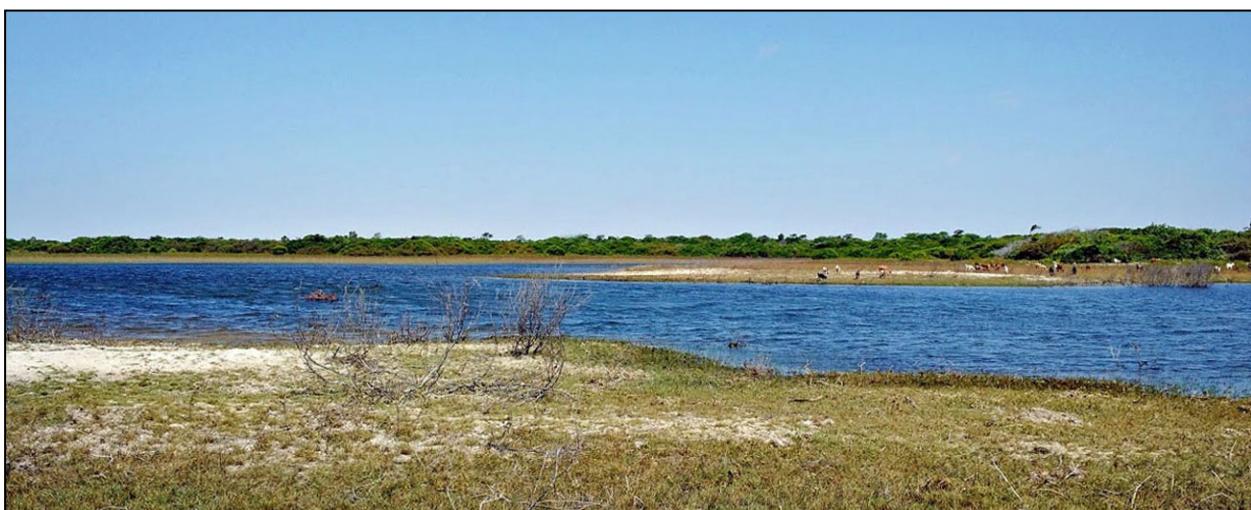


fig. 6. locality 12, Lago de Travosa

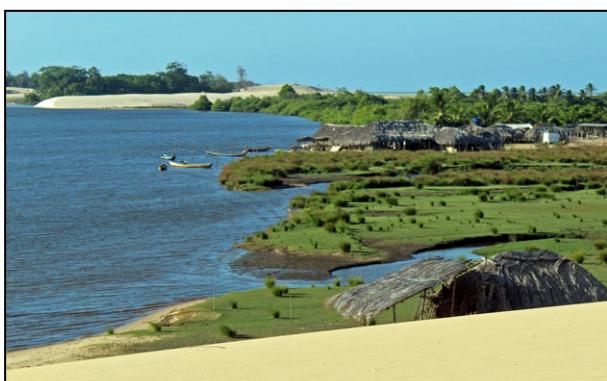


fig. 7. locality 21, Morro do Boi



fig. 8. locality 23, Rio Preguiças



fig. 9. locality 22, Rio Negro



fig. 10. locality 24, Rio Alegre



fig. 11. locality 25, place with no name

Results

The studied area currently comprises 56 fish species, that range from obligate freshwater to estuarine organisms, including the 49 species listed by Brito et al. (2019) and the seven new records reported herein, representing 12 orders (+2 vs. Brito et al. 2019) and 28 fish families (+3). Only two of these species are introduced ones (*Cichla kelberi* and *Oreochromis* sp.), what demonstrates that the original ichthyofauna composition of the park is still little modified, being relatively well preserved.

The orders comprising the highest percentage of species richness were: Characiformes (24 species, 43%), Cichliformes (7 species, 12%), Siluriformes (6 species, 11%), and Gymnotiformes (5 species, 9%), representing the sum of these orders approx. 75% of the total species richness.

The families with the highest number of species were Characidae (12 species, 21%), followed by Cichlidae (7 species, 13%), and Serrasalmidae (3 species, 5%).

List of species, voucher numbers and collecting sites

The collecting sites are the same as listed by Brito et al. (2019), with the addition of the new sample sites presented in this paper.

order

ELOPIFORMES

family

Megalopidae

Megalops Lacepède, 1803

M. atlanticus Valenciennes, 1847

Preguiças ○ CICCAA 4875 (1), loc. 22, coll.: Guimarães & Brito, 06.Oct.2019

NEW

order **CLUPEIFORMES**family **Engraulidae*****Lycengraulis*** Guenther, 1868***L. batesii*** (Guenther 1868)

Periá

o CPUFMA 001178 (2), loc. 2, coll.: Piorski, 20.Dez.2000

<

order **CHARACIFORMES**family **Erythrinidae*****Hoplerythrinus*** Gill, 1896***H. unitaeniatus*** (Agassiz, 1829)

Periá

o CPUFMA 001155 (2), loc. 12, coll.: Piorski, 20.Jul.2000

Preguiças

o CPUFMA 001157 (2), loc. 6, coll.: Piorski, 18.Nov.2000

o CPUFMA 172196 (1), loc. 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017

Hoplias Gill, 1903***H. malabaricus*** (Bloch, 1794)

Periá

o CPUFMA 001151 (1), loc. 8, coll.: Piorski, 15.Jun.2000

Preguiças

o CPUFMA 001149 (4), loc. 6, coll.: Piorski, 18.Nov.2000

o CPUFMA 001150 (4), loc. 4, coll.: Piorski, 20.Jul.2000

o CPUFMA 001152 (1), loc. 6, coll.: Piorski, 20.Jul.2000

o CPUFMA 172190 (2), loc. 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017

family

Serrasalmidae***Metynnis*** Cope, 1878***M. lippincottianus*** (Cope, 1870)

Periá

o CPUFMA 001140 (2), loc. 2, coll.: Piorski, 20.Dec.2000

o CPUFMA 001141 (1), loc. 9, coll.: Piorski, 14.Nov.2000

o CPUFMA 001142 (3), loc. 2, coll.: Piorski, 20.Nov.2000

o CPUFMA 001144 (2), loc. 12, coll.: Piorski, 19.Nov.2000

o CPUFMA 001148 (3), loc. 8, coll.: Piorski, 15.Nov.2000

o CPUFMA 001176 (11), loc. 9, coll.: Piorski, 20.jul.2000

o CPUFMA 002816 (1), loc. 12, coll.: Piorski, 19.Nov.2000

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o CPUFMA 001138 (3), loc. 1, coll.: Piorski, 20.Jul.2000

o CPUFMA 001139 (5), loc. 4, coll.: Piorski, 20.Jul.2000

o CPUFMA 001143 (4), loc. 6, coll.: Piorski, 18.Nov.2000

o CPUFMA 001145 (4), loc. 4, coll.: Piorski, 20.Jul.2000

o CPUFMA 001146 (3), loc. 6, coll.: Piorski, 20Jul.2000

o CPUFMA 001147 (6), loc. 6, coll.: Piorski, 18.Nov.2000

o CPUFMA 172229 (1), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017

o CPUFMA 172811 (1), loc. 20, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017

Pygocentrus Mueller & Troschel, 1844***P. nattereri*** Kner, 1858

Preguiças

o CICCAA 4876 (1), loc. 23, coll.: Guimarães & Brito, 20.Feb.2020

NEW

Serrasalmus Lacepède, 1803***S. rhombeus*** (Linnaeus, 1766)

Periá

o CPUFMA 001158 (2), loc. 2, coll.: Piorski, 20.Nov.2000

<

o CPUFMA 001159 (1), loc. 8, coll.: Piorski, 15.Nov.2000

family **Anostomidae****Leporinus** Agassiz, 1829**L. aff. friderici**

- Periá ○ CPUFMA 001136 (1), loc. 02, coll.: Piorski, 20.Dec.2000
 ○ CPUFMA 001137 (1), loc. 08, coll.: Piorski, 15.Nov.2000 <

family **Curimatidae****Curimatopsis** Steindachner, 1876**C. aff. cryptica**

- Periá ○ CICCAA 172805 (16), loc. 19, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017
 ○ CICCAA 802 (2), loc. 17, coll.: Ferreira, Guimarães, Brito & Ottoni, 16.Jun.2017
 ○ CICCAA 834 (11), loc. 16, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017
 ○ CICCAA 842 (4), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017
 ○ CICCAA 843 (1), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017
 ○ CPUFMA 001292 (41), loc. 6, coll.: Piorski, 18.Nov.2000
 ○ CPUFMA 001923 (12), loc. 4, coll.: Piorski, 19.Jul.2000
 ○ CPUFMA 172802 (42), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 <
 ○ CPUFMA 172803 (6), loc. 19, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017
 ○ CPUFMA 172804 (12), loc. 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017
 ○ CPUFMA 172810 (7), loc. 20, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017

Steindachnerina Fowler, 1906**S. notonota** (Miranda Ribeiro, 1937)

- Periá ○ CPUFMA 001179 (3), loc. 8, coll.: Piorski, 20.Jul.2000
 ○ CPUFMA 001180 (7), loc. 8, coll.: Piorski, 15.Nov.2000 <

family **Lebiasinidae**

subfamily Pyrrhulininae

Nannostomus Guenther, 1872**N. beckfordi** Guenther, 1872

- Periá ○ CPUFMA172202 (10), loc. 18, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017
 ○ CICCAA 799 (11), loc. 17, coll.: Ferreira, Guimarães, Brito & Ottoni, 16.Jun.2017
 ○ CICCAA 824 (1), loc. 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017
 ○ CICCAA 825 (7), loc. 20, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017
 ○ CICCAA 830 (8), loc. 19, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017
 ○ CPUFMA 001238 (50), loc. 7, coll.: Piorski, N. M., 16.nov.2000
 ○ CPUFMA 001239 (9), loc. 6, coll.: Piorski, N. M., 18.nov.2000
 ○ CPUFMA 001244 (30), loc. 11, coll.: Piorski, N. M., 20.jul.2000
 ○ CPUFMA 001275 (2), loc. 7, coll.: Piorski, N. M., 16.nov.2000
 ○ CPUFMA 001290 (5), loc. 6, coll.: Piorski, N. M., 20.jul.2000
 ○ CPUFMA 001297 (2), loc. 6, coll.: Piorski, N. M., 18.nov.2000
 ○ CPUFMA 172197 (6), loc. 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017
 ○ CPUFMA 172198 (27), loc. 20, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017
 ○ CPUFMA 172199 (23), loc. 20, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017
 ○ CPUFMA 172200 (2), loc. 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017
 ○ CPUFMA 172201 (37), loc. 13, coll.: Ferreira, Guimarães, Brito

- & Ottoni, 15.Jun.2017
- CPUFMA 172203 (7), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017
- CPUFMA 172204 (18), loc. 19, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 <
- CPUFMA 2819 (11), loc. 4, coll.: Piorski, 20.Jul.2000

family

Iguanodectidae***Bryconops*** Kner, 1858***B. cf. affinis***

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| Periá | ○ CPUFMA 172776 (5), loc. 18, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 |
| Preguiças | ○ CPUFMA 172772 (7), loc. 19, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 |
| | ○ CPUFMA 172773 (23), loc. 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 < |

B. cf. melanurus

- | | |
|-----------|--|
| Preguiças | ○ CICCAA 1085 (5), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 |
| | ○ CPUFMA 172806 (15), loc. 20, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 < |

family

Acestrorhynchidae***Acestrorhynchus*** Eigenmann & Kennedy, 1903***A. falcatus*** (Bloch, 1794)

- | | |
|-----------|---|
| Periá | ○ CPUFMA 001130 (2), loc. 2, coll.: Piorski, 20.Nov.2000 |
| | ○ CPUFMA 001175 (1), loc. 9, coll.: Piorski, 14.Nov.2000 |
| Preguiças | ○ CPUFMA 172188 (1), loc. 19, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 |
| | ○ CPUFMA 172189 (3), loc. 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 < |

family

Characidae

subfamily

Stethaprioninae

tribus

Stethaprionini

Brachychalcinus Boulenger, 1892***B. parnaibae*** Reis, 1989

- | | |
|-------|---|
| Periá | ○ CPUFMA 001268 (1), loc. 08, coll.: Piorski, 15.Nov.2000 < |
|-------|---|

Hemigrammus Gill, 1858***H. sp. 1***

- | | |
|-----------|---|
| Preguiças | ○ CICCAA 2140 (4), loc. 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 < |
|-----------|---|

H. sp. 2

- | | |
|-----------|---|
| Preguiças | ○ CICCAA 2158 (6), loc. 20, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 < |
|-----------|---|

H. sp. 3

- | | |
|-------|--|
| Periá | ○ CICCAA 2119 (10), loc. 18, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 < |
|-------|--|

Hyphessobrycon Durbin, 1908***H. piorskii*** Guimarães, Brito, Feitosa, Carvalho-Costa & Ottoni, 2018

- | | |
|-----------|---|
| Periá | ○ CPUFMA 172812 (3), loc. 18, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 |
| Preguiças | ○ CICCAA 810 (45), loc. 16, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 |
| | ○ CICCAA 1382 (5), loc. 15, coll.: Ferreira, Guimarães, Brito & |

- Ottoni, 17.Jun.2017
 ○ CICCAA 2051 (8), loc. 16, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 <
 ○ CPUFMA 172808 (50), loc. 19, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017
 ○ CPUFMA 172809 (15), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017
 ○ CPUFMA 172813 (20), loc. 16, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017

Moenkhausia Eigenmann, 1903***M. cotinho*** Eigenmann, 1908

- Preguiças ○ CICCAA 2085 (4), loc. 17, coll.: Ferreira, Guimarães, Brito & Ottoni, 16.Jun.2017 <
 ○ CPUFMA 001196 (12), loc. 1, coll.: Piorski, 17.Nov.2000
 ○ CPUFMA 172771 (5), loc. 16, coll.: Ferreira, Guimarães, Brito & Ottoni, 16.Jun.2017
 ○ CPUFMA 172774 (1), loc. 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017

M. oligolepis (Guenther, 1864)

- Preguiças ○ CICCAA 2102 (4), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 <
 ○ CPUFMA 171775 (4), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017

M. sp.

- Preguiças ○ CPUFMA 172770 (14), loc. 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 <

Poptella Eigenmann, 1908***P. compressa*** (Guenther, 1864)

- Periá ○ CPUFMA 001194 (1), loc. 2, coll.: Piorski, 15.Nov.2000 <

Pristella Eigenmann, 1908***P. maxillaris*** (Ulrey, 1894)

- Periá ○ CICCAA 4880 (5), loc. 24, coll.: Guimarães & Brito, 22.Nov.2019 NEW

tribus

Gymnocharacini

Astyanax Baird & Girard, 1854***A. cf. lacustris***

- Periá ○ CPUFMA 001198 (2), loc. 9, coll.: Piorski, N. M., 14.Nov.2000
 ○ CPUFMA 001200 (3), loc. 3, coll.: Piorski, N. M., 15.Nov.2000
 ○ CPUFMA 001201 (10), loc. 2, coll.: Piorski, N. M., 20.Nov.2000
 ○ CPUFMA 001202 (4), loc. 8, coll.: Piorski, N. M., 15.Nov.2000
 ○ CPUFMA 001204 (1), loc. 2, coll.: Piorski, N. M., 20.Dec.2000
 ○ CPUFMA 001206 (1), loc. 12, coll.: Piorski, N. M., 20.Jul.2000
 ○ CPUFMA 001208 (2), loc. 12, coll.: Piorski, N. M., 19.Nov.2000
 ○ CPUFMA 001209 (4), loc. 2, coll.: Piorski, N. M., 20.Nov.2000
 ○ CPUFMA 001210 (2), loc. 2, coll.: Piorski, N. M., 20.Nov.2000
 ○ CPUFMA 001197 (3), loc. 11, coll.: Piorski, N. M., 20.Jul.2000
 ○ CPUFMA 001199 (3), loc. 4, coll.: Piorski, N. M., 20.Jul.2000
 ○ CPUFMA 001203 (1), loc. 4, coll.: Piorski, N. M., 20.Jul.2000
 ○ CPUFMA 001205 (1), loc. 6, coll.: Piorski, N. M., 20.Jul.2000
 ○ CPUFMA 001207 (2), loc. 10, coll.: Piorski, N. M., 20.Jul.2000
 ○ CPUFMA 172778 (5), loc. 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017
 ○ CPUFMA 172779 (1), loc. 20, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017
 ○ CPUFMA 172780 (4), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017
 ○ CPUFMA 172807 (24), loc. 16, coll.: Ferreira, Guimarães, Brito & Ottoni, 16.Jun.2017 <

subfamily Cheirodontinae

Serrapinnus Malabarba, 1998

S. sp.

Períá o CPUFMA 001293 (80), loc. 7, coll.: Piorski, 16.Nov.2000 <
Preguiças o CPUFMA 001273 (13), loc. 15, coll.: Ferreira, Guimarães, Brito
 & Ottoni, 15.Jun.2017

order **GYMNOTIFORMES**

family **Apteronomidae**

subfamily Apteronotinae

Apterodonotus Lacepède, 1800

A. albifrons (Linnaeus, 1766)

Preguiças o CPUFMA 001173 (1), loc. 20, coll.: Piorski, Jul.2000

1

family Sternopygidae

Eigenmannia Jordan & Evermann, 1896

E. virescens (Valenciennes, 1842)

Periá ○ CPUFMA 001169 (7), loc. 2, coll.: Piorski, 20.Nov.2000

- o CPUFMA 001170 (11), loc. 2, coll.: Piorski, 20.Nov.2000
 - o CPUFMA 001171 (4), loc. 9, coll.: Piorski, 14.Nov.2000
 - o CPUFMA 001172 (10), loc. 2, coll.: Piorski, 20.Nov.2000
 - o CICCAA 797 (2), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017
 - o CICCAA 833 (1), loc. 16, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017
 - o CPUFMA 001165 (4), loc. 4, coll.: Piorski, 20.Jul.2000
 - o CPUFMA 001193 (3), loc. 11, coll.: Piorski, 20.Jul.2000
 - o CPUFMA 172228 (4), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017
 - o CPUFMA 172815 (3), loc. 20, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017

Sternopygus Mueller & Troschel, 1846

S. macrurus (Bloch & Schneider, 1801)

Períá o CPUFMA 001166 (1), loc. 2, coll.: Piorski, 20.Nov.2000
 Preguiças o CPUFMA 001167 (13), loc. 4, coll.: Piorski, 20.Jul.2000
 o CPUFMA 001168 (1), loc. 11, coll.: Piorski, 20.Jul.2000

family **Gymnotidae**

Gymnotus Linnaeus, 1758

G. carapo Linnaeus, 1758

Peria o CPUFMA 001174 (1), loc. 9, coll.: Piorski, 14.Nov.2000

<

family **Hypopomidae**

Brachyhypopomus Mago-Leccia, 1994

B. sp.

Preguiças

- CICCAA 832 (1), loc. 19, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017
- CPUFMA 172225 [ex CPUFMA 172800] (1), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.jun.2017
- CPUFMA 172226 (1), loc. 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.jun.2017
- CPUFMA 172227 (4), loc. 19, coll.: Ferreira, Guimarães, Brito &

Ottoni, 17.jun.2017

order

SILURIFORMES

family

Callichthyidae

subfamily

Callichthyinae

Callichthys Scopoli, 1777***C. callichthys*** (Linnaeus, 1758)

Periá

- CICCAA 4879 (2), loc. 25, coll.: Guimarães & Brito,
22.Nov.2019

NEW

Megalechis Reis, 1997***M. thoracata*** (Valenciennes, 1840)

Preguiças

- CICCAA 1393 (1), loc. 15, coll.: Ferreira, Guimarães, Brito &
Ottoni, 15.Jun.2017
- CPUFMA 172194 (1), loc. 15, coll.: Ferreira, Guimarães, Brito & <
Ottoni, 15.Jun.2017

family

Loricariidae

subfamily

Loricariinae

tribus

Loricariini

Loricaria Linnaeus, 1758***L. cf. parnabybae***

Periá

- CPUFMA 001160 (1), loc. 9, coll.: Piorski, 14.Nov.2000
- CPUFMA 001161 (1), loc. 3, coll.: Piorski, 15.Nov.2000
- CPUFMA 001162 (1), loc. 2, coll.: Piorski, 20.Nov.2000
- CPUFMA 001164 (3), loc. 8, coll.: Piorski, 15.Nov.2000

<

subfamily

Hypostominae

tribus

Hypostomini

Hypostomus Lacepède, 1803***H. johnii*** (Steindachner, 1877)

Periá

- CPUFMA 002174 (3), loc. 8, coll.: Piorski, 15.Nov.2000

<

family

Auchenipteridae

subfamily

Auchenipterinae

tribus

Trachelyopterini

Trachelyopterus Valenciennes, 1840***T. galeatus*** (Linnaeus, 1766)

Periá

- CPUFMA 001131 (2), loc. 2, coll.: Piorski, 20.Nov.2000

<

Preguiças

- CPUFMA 001134 (1), loc. 9, coll.: Piorski, 14.Nov.2000

- CPUFMA 001135 (1), loc. 2, coll.: Piorski, 20.Nov.2000

- CICCAA 795 (1), loc. 20, coll.: Ferreira, Guimarães, Brito &

Ottoni, 17.Jun.2017

- CPUFMA 001132 (2), loc. 6, coll.: Piorski, 18.Nov.2000

- CPUFMA 001133 (1), loc. 6, coll.: Piorski, 18.Nov.2000

- CPUFMA 001177 (1), loc. 4, coll.: Piorski, 20.Jul.2000

- CPUFMA 172184 (2), loc. 15, coll.: Ferreira, Guimarães, Brito &

Ottoni, 15.Jun.2017

- CPUFMA 172187 (1), loc. 14, coll.: Ferreira, Guimarães, Brito &

Ottoni, 15.Jun.2017

family

Heptapteridae***Pimelodella*** Eigenmann & Eigenmann, 1888***P. parnabyae*** Fowler, 1941

Periá

- CICCAA 839, (1), loc. 18, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017
- CPUFMA 001242 [ex CPUFMA 00242] (1), loc. 8, coll.: Piorski, < 20.Jul.2000
- CPUFMA 001243 (1), loc. 8, coll.: Piorski, 15.Nov.2000
- CPUFMA 001245 (1), loc. 2, coll.: Piorski, 14.Nov.2000
- CPUFMA 001258 (2), loc. 2, coll.: Piorski, 17.Nov.2000
- CPUFMA 172781 (2), loc. 18, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017

order

GOBIIFORMES

family

Gobiidae

subfamily

Gobionellinae

Awaous Valenciennes, 1837***A. tajasica*** (Lichtenstein, 1822)

Preguiças

- CPUFMA 001183 (1), loc. 01, coll.: Piorski, 17.Nov.2000 <

order

SYNBRANCHIFORMES

family

Synbranchidae***Synbranchus*** Bloch, 1795***S. marmoratus*** Bloch, 1795

Preguiças

- CICCAA 796 (1), loc. 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017
- CPUFMA 001192 (1), loc. 06, coll.: Piorski, 18.Nov.2000 <

order

CARANGIFORMES

family

Centropomidae***Centropomus*** Lacepède, 1802***C. undecimalis*** (Bloch, 1792)

Preguiças

- CICCAA 4878 (1), loc. 16, coll.: Guimarães & Brito, 20.Feb.2020

NEW

family

Polynemidae***Polydactylus*** Lacepède, 1803***P. virginicus*** (Linnaeus, 1758)

Preguiças

- CPUFMA 001195 (1), loc. 10, coll.: Piorski, 17.Nov.2000 <

<

family

Achiridae***Achirus*** Lacepède, 1802***A. achirus*** (Linnaeus, 1758)

Periá

- CPUFMA 001186 (3), loc. 2, coll.: Piorski, 20.Nov.2000 <
- CPUFMA 001188 (1), loc. 10, coll.: Piorski, 17.Nov.2000

order	CICHLIFORMES		
family	Cichlidae		
subfamily	Pseudocrenilabrinae		
tribus	Oreochromini		
Oreochromis Guenther, 1889			
O. sp.			
Periá	<ul style="list-style-type: none"> ○ CPUFMA 001184 (1), loc. 9, coll.: Piorski, 20.Jul.2000 ○ CPUFMA 001185 (4), loc. 12, coll.: Piorski, 20.Jul.2000 ○ CPUFMA 001190 (6), loc. 12, coll.: Piorski, 20.Jul.2000 ○ CPUFMA 001191 (2), loc. 12, coll.: Piorski, 19.Nov.2000 ○ CPUFMA 001281 (2), loc. 2, coll.: Piorski, 20.Nov.2000 ○ CPUFMA 001187 (4), loc. 10, coll.: Piorski, 20.Jul.2000 ○ CPUFMA 001189 (1), loc. 10, coll.: Piorski, 17.Nov.2000 	<	
Preguiças			
remarks	introduced exotic species		

subfamily	Cichlinae
tribus	Cichlini

Cichla Bloch & Schneider, 1801

C. kelberi Kullander & Ferreira, 2006		NEW
Preguiças	○ CICCAA 4877 (1), loc. 23, coll.: Guimarães & Brito, 20.Feb.2020	
remarks	introduced species	

tribus	Geophagini
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Aristogramma Regan, 1913

A. piauiensis Kullander, 1980		
Periá	<ul style="list-style-type: none"> ○ CPUFMA 172176 (3), loc. 18, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 ○ CICCAA 837 (2), loc. 18, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 ○ CICCAA 441 (1), loc. 1, coll.: Piorski, 17.Nov.2000 ○ CICCAA 805 (9), loc. 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 ○ CICCAA 827 (5), loc. 20, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 ○ CICCAA 831 (1), loc. 19, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 ○ CICCAA 837 (2), loc. 18, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 ○ CICCAA 841 (4), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 ○ CPUFMA 001224 (11), loc. 1, coll.: Piorski, 20.Jul.2000 ○ CPUFMA 001225 (1), loc. 4, coll.: Piorski, 17.Nov.2000 ○ CPUFMA 001226 (4), loc. 6, coll.: Piorski, 20.Jul.2000 ○ CPUFMA 001227 (7), loc. 4, coll.: Piorski, 16.Nov.2000 ○ CPUFMA 001276 (7), loc. 6, coll.: Piorski, 16.Nov.2000 ○ CPUFMA 001287 (1), loc. 6, coll.: Piorski, 20.Jul.2000 ○ CPUFMA 172173 (14), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 ○ CPUFMA 172175 (20), loc. 20, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 ○ CPUFMA 172177 (13), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 ○ CPUFMA 172192 (19), loc. 20, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 ○ CPUFMA 172193 (15), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 ○ CPUFMA 172777 (20), loc. 20, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 	<
Preguiças		

Crenicichla Heckel, 1840***C. brasiliensis*** (Bloch, 1792)

Periá

- CICCAA 50 (5), loc. 12, coll.: Piorski, 20.Jul.2000
- CICCAA 836 (1), loc. 18, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017
- CPUFMA 001237 (3), loc. 2, coll.: Piorski, 20.Nov.2000
- CPUFMA 001260 (10), loc. 12, coll.: Piorski, 20.Jul.2000
- CPUFMA 001278 (6), loc. 12, coll.: Piorski, 20.Jul.2000
- CPUFMA 001285 (1), loc. 12, coll.: Piorski, 19.Nov.2000
- CPUFMA 002817 (1), loc. 12, coll.: Piorski, 19.Nov.2000
- CICCAA 49 (10), loc. 1, coll.: Piorski, 17.Nov.2000
- CICCAA 804 (3), loc. 17, coll.: Ferreira, Guimarães, Brito & Ottoni, 16.Jun.2017
- CICCAA 806 (1), loc. 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017
- CICCAA 809 (2), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017
- CICCAA 826 (5), loc. 20, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017
- CICCAA 829 (2), loc. 19, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017
- CICCAA 844 (2), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017
- CPUFMA 001259 (2), loc. 4, coll.: Piorski, 20.Mar.2000
- CPUFMA 001277 (10), loc. 1, coll.: Piorski, 17.Nov.2000
- CPUFMA 001279 (1), loc. 7, coll.: Piorski, 20.Jul.2000
- CPUFMA 001280 (1), loc. 4, coll.: Piorski, 20.Jul.2000
- CPUFMA 001286 (5), loc. 4, coll.: Piorski, 20.Jl.2000
- CPUFMA 001288 (1), loc. 1, coll.: Piorski, 20.Jul.2000
- CPUFMA 172179 (8), loc. 20, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017
- CPUFMA 172180 (2), loc. 19, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017
- CPUFMA 172181 (3), loc. 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017
- CPUFMA 172182 (2), loc. 16, coll.: Ferreira, Guimarães, Brito & Ottoni, 16.Jun.2017
- CPUFMA 172183 (5), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017

<

Satanoperca Guenther, 1862***S. jurupari*** (Heckel, 1840)

Periá

- CICCAA 54 (4), loc. 2, coll.: Piorski, 20.Nov.2000
- CPUFMA 001222 (3), loc. 12, coll.: Piorski, 19.Nov.2000
- CPUFMA 001234 (7), loc. 12, coll.: Piorski, 20.Jul.2000
- CPUFMA 001235 (4), loc. 2, coll.: Piorski, 20.Nov.2000
- CPUFMA 001251 (19), loc. 8, coll.: Piorski, 20.Jul.2000
- CPUFMA 001254 (16), loc. 9, coll.: Piorski, 20.Jul.2000
- CPUFMA 001257 (3), loc. 12, coll.: Piorski, 20.Jul.2000
- CPUFMA 002818 (1), loc. 8, coll.: Piorski, 20.Jul.2000
- CICCAA 53 (1), loc. 1, coll.: Piorski, 20.Jul.2000
- CICCAA 821 (3), loc. 1, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017
- CPUFMA 001223 (1), loc. 4, coll.: Piorski, 20.Jul.2000
- CPUFMA 001228 (2), loc. 1, coll.: Piorski, 17.Nov.2000
- CPUFMA 001241 (2), loc. 4, coll.: Piorski, 20.Jul.2000
- CPUFMA 001253 (1), loc. 1, coll.: Piorski, 20.Jul.2000
- CPUFMA 172195 (1), loc. 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017

<

tribus

Cichlasomatini

Aequidens Eigenmann & Bray, 1894***A. tetramerus*** (Heckel, 1840)

Periá

- CICCAA 835 (1), loc. 18, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017
- CICCAA 822 (1), loc. 20, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017
- CPUFMA 001230 (2), loc. 6, coll.: Piorski, 18.Nov.2000
- CPUFMA 001231 (1), loc. 4, coll.: Piorski, 20.Jul.2000
- CPUFMA 172171 (1), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017

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Cichlasoma Swainson, 1839**C. cf. zarskei**

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|-----------|--|
| Periá | <ul style="list-style-type: none"> ○ CICCAA 51 (2), loc. 8, coll.: Piorski, 18.Nov.2000 ○ CICCAA 52 (13), loc. 2, coll.: Piorski, 20.Nov.2000 ○ CICCAA 803 (1), loc. 18, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 ○ CICCAA 840 (1), loc. 18, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 ○ CPUFMA 1125 (37), loc. 12, coll.: Piorski, 20.Jul.2000 ○ CPUFMA 1127 (27), loc. 12, coll.: Piorski, 19.Nov.2000 ○ CPUFMA 1219 (3), loc. 12, coll.: Piorski, 20.Jul.2000 ○ CPUFMA 1232 (1), loc. 9, coll.: Piorski, 14.Nov.2000 ○ CPUFMA 1233 (3), loc. 2, coll.: Piorski, 20.Nov.2000 ○ CPUFMA 1246 (2), loc. 2, coll.: Piorski, 20.Jul.2000 ○ CPUFMA 1252 (13), loc. 8, coll.: Piorski, 20.Jul.2000 ○ CPUFMA 1255 (42), loc. 12, coll.: Piorski, 20.Jul.2000 ○ CPUFMA 1908 (3), loc. 12, coll.: Piorski, 20.Jul.2000 ○ CPUFMA 1909 (2), loc. 09, coll.: Piorski, 20.Jul.2000 ○ CICCAA 47 (20), loc. 1, coll.: Piorski, 17.Nov.2000 ○ CICCAA 119 (3), loc. 21, coll.: Guimarães & Ottoni, 16.Abr.2016 ○ CICCAA 794 (17), loc. 17, coll.: Ferreira, Guimarães, Brito & Ottoni, 16.Jun.2017 ○ CICCAA 823 (5), loc. 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 ○ CICCAA 828 (1), loc. 20, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 ○ CICCAA 845 (3), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 ○ CPUFMA 1126 (35), loc. 6, coll.: Piorski, 18.Nov.2000 ○ CPUFMA 1128 (12), loc. 6, coll.: Piorski, 18.Nov.2000 ○ CPUFMA 1217 (6), loc. 4, coll.: Piorski, 20.Jul.2000 ○ CPUFMA 1220 (1), loc. 5, coll.: Piorski, 17.Nov.2000 ○ CPUFMA 1221 (1), loc. 7, coll.: Piorski, 16.Nov.2000 ○ CPUFMA 1236 (3), loc. 4, coll.: Piorski, 20.Jul.2000 ○ CPUFMA 1240 (14), loc. 10, coll.: Piorski, 20.Jul.2000 ○ CPUFMA 1247 (20), loc. 1, coll.: Piorski, 17.Nov.2000 ○ CPUFMA 1256 (5), loc. 6, coll.: Piorski, 20.Jul.2000 ○ CPUFMA 1261 (70), loc. 6, coll.: Piorski, 18.Nov.2000 ○ CPUFMA 1907 (4), loc. 6, coll.: Piorski, 20.Jul.2000 ○ CPUFMA 172172 (1), loc. 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 ○ CPUFMA 172178 (1), loc. 20, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 ○ CPUFMA 172191 (4), loc. 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 < |
| Preguiças | |

order

CYPRINODONTIFORMES

family

Rivulidae

subfamily

Rivuliniae

tribus

Melanorivulini**Anablepsoides** Huber, 1992**A. vieirai** Nielsen, 2016

- | | |
|-----------|--|
| Periá | <ul style="list-style-type: none"> ○ CICCAA 814 (3), loc. 18, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 ○ CICCAA 838 (2), loc. 18, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 |
| Preguiças | <ul style="list-style-type: none"> ○ CICCAA 798 (2), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 ○ CICCAA 813 (3), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 ○ CICCAA 814 (3), loc. 18, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 ○ CICCAA 819 (5), loc. 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 ○ CICCAA 838 (2), loc. 18, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 |

- CPUFMA 172821 [ex CPUFMA 172801] (2), loc.15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.jun.2017 <

Melanorivulus Costa, 2006

M. cf. parnabensis

- | | |
|-----------|--|
| Preguiças | <ul style="list-style-type: none"> ○ CICCAA 800 (3), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 ○ CICCAA 812 (3), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 ○ CICCAA 817 (7), loc. 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 ○ CPUFMA 172782 (1), loc. 19, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 < |
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family

Poeciliidae

subfamily

Poeciliinae

tribus

Poeciliini

Poecilia Bloch & Schneider, 1801

P. sarrafae Bragança & Costa, 2011

- | | |
|-----------|--|
| Periá | <ul style="list-style-type: none"> ○ CICCAA 815 (2), loc. 18, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 |
| Preguiças | <ul style="list-style-type: none"> ○ CICCAA 801, (06), loc. Site 17, coll.: Ferreira, Guimarães, Brito & Ottoni, 16.Jun.2017 ○ CICCAA 808, (12), loc. Site 20, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 ○ CICCAA 811, (10), loc. Site 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 ○ CICCAA 815, (02), loc. Site 18, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 ○ CICCAA 816, (27), loc. Site 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 ○ CICCAA 818, (08), loc. Site 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 ○ CPUFMA 001216 (65), loc. 9, coll.: Piorski, 14.Nov.2000 ○ CPUFMA 172784, (34), loc. Site 20, coll.: Ferreira, Guimarães, Brito & Ottoni, 17.Jun.2017 < ○ CPUFMA 172785, (11), loc. Site 16, coll.: Ferreira, Guimarães, Brito & Ottoni, 16.Jun.2017 ○ CPUFMA 172814, (10), loc. Site 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 ○ CPUFMA 172820, (15), loc. Site 14, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 ○ CPUFMA 172822, (02), loc. Site 15, coll.: Ferreira, Guimarães, Brito & Ottoni, 15.Jun.2017 |

P. vivipara Bloch & Schneider, 1801

- | | |
|-----------|--|
| Periá | <ul style="list-style-type: none"> ○ CPUFMA 001212 (15), loc. 12, coll.: Piorski, 20.Jul.2000 ○ CPUFMA 001214 (24), loc. 12, coll.: Piorski, 19.Nov.2000 ○ CPUFMA 001215 (4), loc. 2, coll.: Piorski, 20.Nov.2000 ○ CPUFMA 001291 (4), loc. 12, coll.: Piorski, 19.Nov.2000 ○ CPUFMA 001211 (16), loc. 10, coll.: Piorski, 17.Nov.2000 < |
| Preguiças | <ul style="list-style-type: none"> ○ CPUFMA 001211 (16), loc. 10, coll.: Piorski, 17.Nov.2000 |

family

Anablepidae

subfamily

Anablepinae

Anableps Scopoli, 1777

A. anableps (Linnaeus, 1758)

- | | |
|-----------|---|
| Preguiças | <ul style="list-style-type: none"> ○ CICCAA 178 (1), loc. 21, coll.: Guimarães & Ottoni, 16.Mar.2016 NEW |
|-----------|---|

order **MUGILIFORMES**

family **Mugilidae**

Mugil Linnaeus, 1758

M. curema Valenciennes, 1836

Preguiças	○ CPUFMA 001181 (4), loc. 10, coll.: Piorski, 17.Nov.2000	<
	○ CPUFMA 001182 (2), loc. 10, coll.: Piorski, 17.Nov.2000	

order **"PERCIFORMES"** (sedis mutabilis)

family **Gerreidae**

Eucinostomus Baird & Girard, 1855

E. cf. argenteus

Preguiças	○ CPUFMA 001218 (1), loc. 10, coll.: Piorski, 17.Nov.2000	<
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available as pdf-file at www.pecescriollos.de since 13.Jul.2020

Freshwater fishes of the Parque Nacional dos Lençóis Maranhenses and adjacent areas

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Abstract: We present here an embracing freshwater fish inventory of the Parque Nacional dos Lençóis Maranhenses and adjacent areas, reporting 49 fish species, 33 of which were identified accurately at the species level, representing ten orders and 25 fish families that range from obligate freshwater to estuarine organisms. This number of species is much larger than two previous studies for the park, each reporting just 12 and 33 fishes occurring on freshwater environments. Among the 49 freshwater species recorded in this study, 14 are new records for the Parque Nacional dos Lençóis Maranhenses, and just one corresponds to an introduced species. Some of the 14 new records in the Parque Nacional dos Lençóis Maranhenses, cited above, as well as some of the 16 species which we are not able to identify accurately at the species level, could include undescribed species, but more study is necessary before sorting out which species are truly undescribed, and which are already described ones. The orders reported by this survey which comprise the highest percentage of species richness, excluding introduced species, were: Characiformes, Cichliformes and Siluriformes, in the same ranking position, and Gymnotiformes, as expected for Neotropical freshwater surveys. The families with the highest number of species, excluding non-native species, were: Characidae, followed by Cichlidae, and Loricariidae. Out of the 33 species herein identified accurately at the species level, five of them are species typically found in brackish water environments, and when occurring on freshwater environments, are restricted mainly to estuaries, or, occasionally, the lower portions of the rivers. Thus, we will not address them in our biogeographical comments. From the remaining 28 species, eight did not occur in the Amazon River basin, six of them being endemic to the Maranhão-Piauí ecoregion. The remaining species herein reported also have their distribution recorded for the Amazon River basin, which shows the great influence of the Amazon basin. In the last two decades efforts to inventory the freshwater fish fauna and to taxonomically solve some groups occurring on the Maranhão state have been made. However the knowledge regarding the composition of the Maranhão freshwater fishes is still insufficient and underestimated, with several groups still lacking adequate taxonomic and systematic resolution, and with many gaps of knowledge, something that is not appropriate for our current picture of “biodiversity crisis”. As well as, the other Brazilian protected areas, the PNLM fails to preserve its freshwater environment properly, since it includes only fragments of the major river systems of the area, not including and conserving the hole river drainages, mainly excluding their headwaters. Thus, its water bodies are exposed to typical human impacts.

Keywords: Biodiversity, ichthyology, Periá River basin, Preguiças River basin.

Peixes de água doce do Parque Nacional dos Lençóis Maranhenses e áreas adjacentes

Resumo: Nós apresentamos aqui um inventário de peixes de água doce do Parque Nacional dos Lençóis Maranhenses e áreas adjacentes, relatando 49 espécies de peixes, 33 dos quais foram identificados com precisão à nível de espécie, representando dez ordens e 25 famílias de peixes que variam de água doce à organismos estuarinos. Esse número de espécies é muito maior do que dois estudos anteriores para o parque, cada um registrando apenas 12 e 33 espécies de peixes ocorrendo em ambientes de água doce. Entre as 49 espécies de água doce registradas neste estudo, 14 são novos registros para o Parque Nacional dos Lençóis Maranhenses, e apenas um corresponde a uma espécie introduzida. Alguns dos 14 novos registros no Parque Nacional dos Lençóis Maranhenses, citados acima, bem como algumas das 16 espécies que não foram possíveis de serem identificadas com precisão no nível de espécie, podem incluir espécies não descritas. Entretanto, são necessários mais estudos antes de se ter certeza de quais espécies são verdadeiramente não descritas, e quais já são descritas. As ordens relatadas por esta pesquisa que compõem a maior porcentagem de riqueza de espécies, excluindo espécies introduzidas, foram: Characiformes, Cichliformes e Siluriformes na mesma posição do ranking, e Gymnotiformes, como esperado para levantamentos de água doce Neotropical. As famílias com maior número de espécies, excluindo espécies não nativas, foram: Characidae, seguida por Cichlidae e Loricariidae. Das 33 espécies aqui identificadas com precisão no nível de espécie, cinco delas são espécies tipicamente encontradas em ambientes de água salobra, e quando ocorrem em ambientes de água doce, são restritas principalmente a estuários, ou ocasionalmente, as porções mais baixas dos rios. Assim, não os abordaremos em nossos comentários biogeográficos. Das 28 espécies restantes, oito não ocorrem na bacia do rio Amazonas, sendo seis endêmicas da ecorregião Maranhão-Piauí. As espécies restantes aqui relatadas também têm sua distribuição registrada para a bacia do rio Amazonas, o que mostra sua grande influência. Nas últimas duas décadas foram feitos esforços para inventariar a fauna de peixes de água doce e resolver taxonomicamente alguns grupos que ocorrem no estado do Maranhão. No entanto, o conhecimento sobre a composição dos peixes de água doce do Maranhão ainda é insuficiente e subestimado, com vários grupos ainda sem resolução taxonômica e sistemática adequada, e com muitas lacunas de conhecimento, algo que não é apropriado para nosso quadro atual da “crise da biodiversidade”. Assim como as demais áreas de proteção brasileiras, o PNLM falha em preservar seus ambientes de água doce de forma apropriada, já que ele inclui apenas fragmentos dos maiores sistemas fluviais da área, não incluindo e conservando as drenagens inteiramente, principalmente excluindo suas cabeceiras. Sendo assim, seus corpos de águas estão expostos a típicos impactos humanos.

Palavras-chave: Biodiversidade, ictiologia, Rio Periá, Rio Preguiças.

Introduction

South America presents a rich ichthyofauna, with an estimative of more than 9,100 valid species occurring in freshwater and marine environments of coastal areas (about 25% of all world fish species). Only for freshwater, there are about 5,100 described species; about a third of all freshwater fish species in the world (Reis et al. 2016). The published Check List of Freshwater Fish from South and Central America (CLOSSFCA) (Reis et al. 2003) listed about 4,500 valid species for the Neotropical region, also estimating that there was still at least 1,550 undescribed species. However, new estimates point that freshwater ichthyofauna diversity from the Neotropics may be even higher, with up to 8,000 or 9,000 species (Reis et al. 2016), a similar estimative proposed by Schaefer (1998). Since the publication of CLOSSFCA, an average of 104 new species have been described every year in South America, totaling 1,142 new species. In other words, about 28% of the ichthyofauna known in South America has been described in the last 11 years, according to Reis et al. (2016).

Brazil concentrates the largest hydrographic networks of the Neotropics, which present high aquatic biodiversity, comprehending about 20% of all freshwater fish species in the world (Buckup et al. 2007). Under the conservationist lens, Brazil can be considered a nursery for aquatic biodiversity, especially when it comes to freshwater fish. In addition, Brazil comprises about 55% of freshwater fish species of the Neotropics (Reis et al. 2003, Buckup et al. 2007).

Estimates predict that between 2,600 and 3,100 valid species belonging to the families that exclusively inhabit freshwater environments occur within the national territory, comparatively a much higher diversity than Brazil's marine ichthyofauna (Buckup et al. 2007, Fishbase 2019). Most of this diversity corresponds to small and medium size species, which are distributed mainly in small streams (Lowe-McConnel 1999).

Despite these attributes, the country has been suffering from severe environmental impacts caused by exploratory human activities, the degeneration and alteration of the natural habitats being the most harmful aspects in terms of conservation and consequently leading to the decline of biodiversity. Natural environments, both in Brazil and in the world, have been suffering a swift destruction, especially derived from anthropic actions, with a consequent loss and extinction of species and populations, many of them unknown to science (Wilson 1985, 1999, Brooks et al. 2002, Brook et al. 2006, Laurence 2007, Costa et al. 2012). These environmental impacts and habitats loss are not restricting to terrestrial ecosystems, but also occur in freshwater environments, caused by several human activities, such as construction of dams; hydropower expansion; aquaculture, introduction non-native species; agriculture; mining; among others (Agostinho et al. 2008, Azevedo-Santos et al. 2018, Lima Junior et al. 2018). This quick biodiversity loss and natural habitats degeneration create scarcity in data and complete information regarding fauna and flora.

This panorama becomes even more critic due to low investment in projects related to taxonomy, especially non-applied taxonomy (basic) and the training of taxonomists; lack of professionals and capable taxonomists; lack of funding for the maintenance and expansion of the collections of natural history museums and scientific collections; and the insufficient number of taxonomic studies associated to areas of great biodiversity. Such problematic can be translated as “the crisis of biodiversity” (Wheeler 2008). Information about the biological diversity and the identification and description of new species and other taxa is the starting point for all basic or applied studies related to the life sciences. The ability to name and identify them is crucial for any study that uses living organisms, such as ecological, conservation, ethology, evolutionary and other kinds of studies (Savage 1995, Wheeler 2008). The improvement of the knowledge related to systematics, taxonomy, ecology and distribution of our fauna and flora is of fundamental relevance in the current context of Brazilian and world development, mainly for the conservation of species (Wilson 1985, Brooks et al. 2002, Brook et al. 2006, Lewinsohn 2006, Laurence 2007, Wheeler 2008, Costa et al. 2012). Estimates indicate that about 90% of the living species in our planet are still unknown to science. Thus, we know nothing about morphology, ecology, behavior, and geographic distribution of most of our biodiversity (Wheeler 2008). The destruction of habitats at accelerated rates makes identification of new species, the conduction of regional inventories and the taxonomic resolution of species and species groups, before they are extinct, as priority actions. Just this way, appropriate actions and decisions concerning to conservation of species and environments can be made (Wilson 1985, Brooks et al. 2002, Brook et al. 2006, Lewinsohn 2006, Laurence 2007, Wheeler 2008, Nogueira et al. 2010, Costa et al. 2012, 2014, 2018, Thomson et al. 2018).

Most of the protected areas established in Brazil during the past three decades were constituted in order to conserve terrestrial fauna and flora, and many of these areas protect important water bodies (Agostinho et al. 2005). However, there is a huge possibility that the design and the coverage area of these protection units, because they are based on terrestrial biodiversity, are mismatched in the protection and conservation of aquatic ecosystems (Barletta et al. 2010, Herbert et al. 2010, Azevedo-Santos et al. 2018). This mismatch is probably related mainly to the fact that these areas only include stretches of the rivers, streams and hydrographic basins, thus, not including the essential regions that would guarantee a functional and protected freshwater biodiversity and fragmenting the conservation of the water bodies (Rodríguez-Olarte et al. 2011, Azevedo-Santos et al. 2018). Despite this gap, the inclusion of data on freshwater fish fauna, or even aquatic biota in the definition of protected areas has gathered greater attention (Rodríguez-Olarte et al. 2011); however, there still is the need for conducting inventories on ichthyofauna, since these aquatic environments present a significant risk of degradation (Barletta 2010, Azevedo-Santos et al. 2018).

Thus, the objective of our study is to present the list of freshwater fish of the Parque Nacional dos Lençóis Maranhenses (PNLM), an area of environmental protection managed by the federal government, characterized by the presence of dunes, lagoons and small watercourses. Although it is an area of integral protection, the environments contained in the PNLM have been under intense pressure, especially those related to tourism, which is increasing in the region. Most of the areas targeted by tourism are freshwater environments, making them the main attraction (Miranda et al. 2012).

In the past two decades, efforts have been made to inventory the freshwater fish fauna and to solve taxonomically some groups occurring on the Maranhão State. However, the knowledge regarding the composition of the Maranhão freshwater fishes is still insufficient and underestimated, with several groups still lacking adequate taxonomic and systematic resolution, and with many gaps of knowledge (Piorski 2010, Guimarães et al. 2018a). In a context of “freshwater biodiversity crisis” (sensu Harrison et al. 2018), this is not appropriate.

Material and Methods

1. Study area

The PNLM is a protected area located at the eastern coastal region of Maranhão, within the territorial limits of Primeira Cruz, Santo Amaro do Maranhão and Barreirinhas municipalities, with a coastline extending for 270 km and a total area of 155,000 hectares. This area is constituted by dunes interspersed by perennial and temporary lagoons, rivers, streams and lakes. It includes two main coastal river basins: Preguiças and Periá. The dunes present in the park, which are the reason for the denomination of Lençóis Maranhenses, are constituted of eolic and marine deposits of the Quaternary period, configuring an extensive area of free and fixed dunes (ICMBio 2003). Besides the dunes, the park also comprises a mosaic of ecosystems such as mangroves, riparian forest and restinga, the latter being predominant in the region (ICMBio 2003).

2. Sampling design

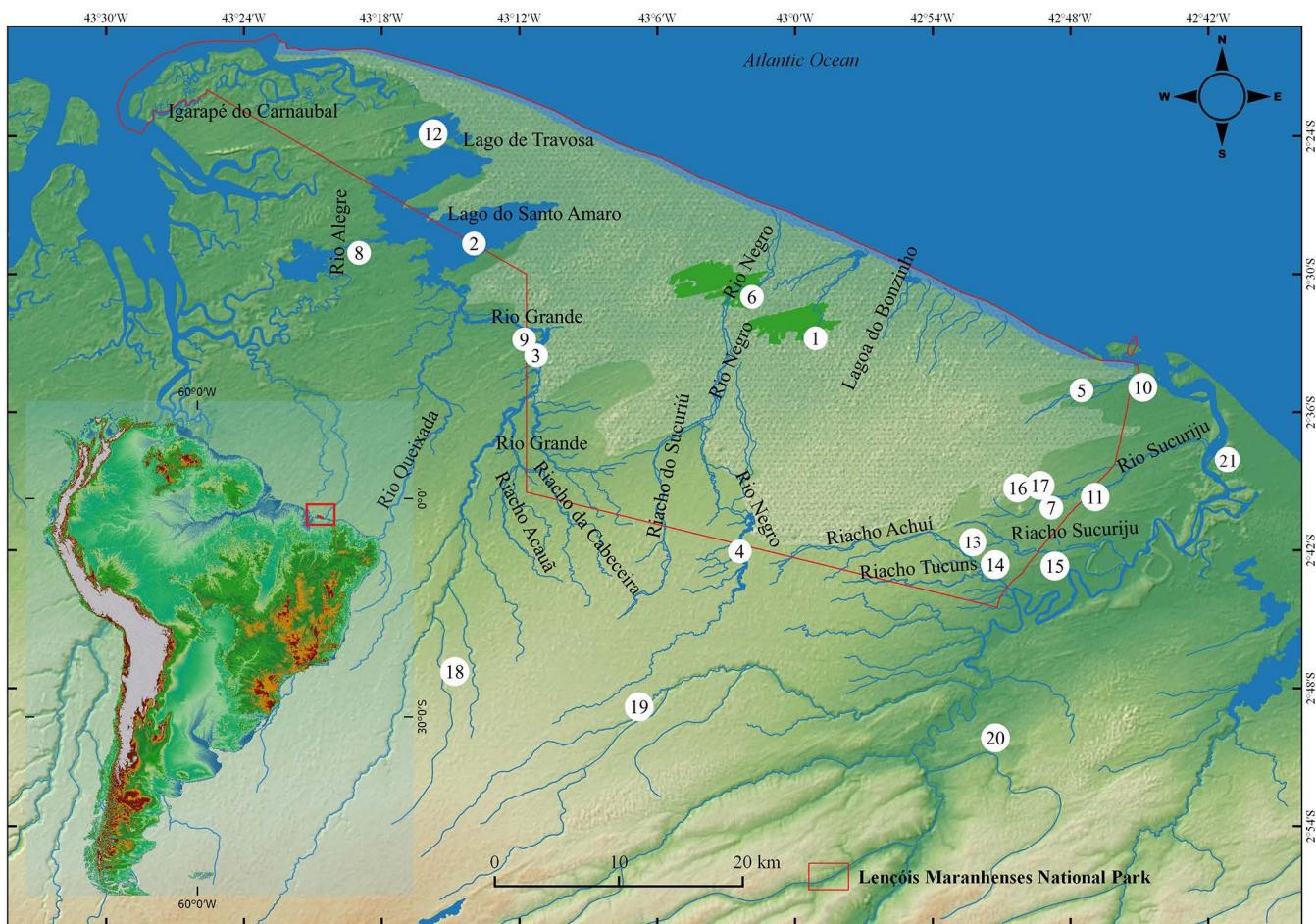
Collection of samples was conducted at 21 collecting sites distributed within and outside the boundaries of PNLM, comprising rivers, streams, lagoons and lakes (Table 1, Figures 1, 2), along the basins of rivers Preguiças and Periá. Sampling was conducted in three expeditions: the first ones taking place in 2000 in the mouths of July and December, and in 2017 in the month of July.

3. Collection and identification of specimens

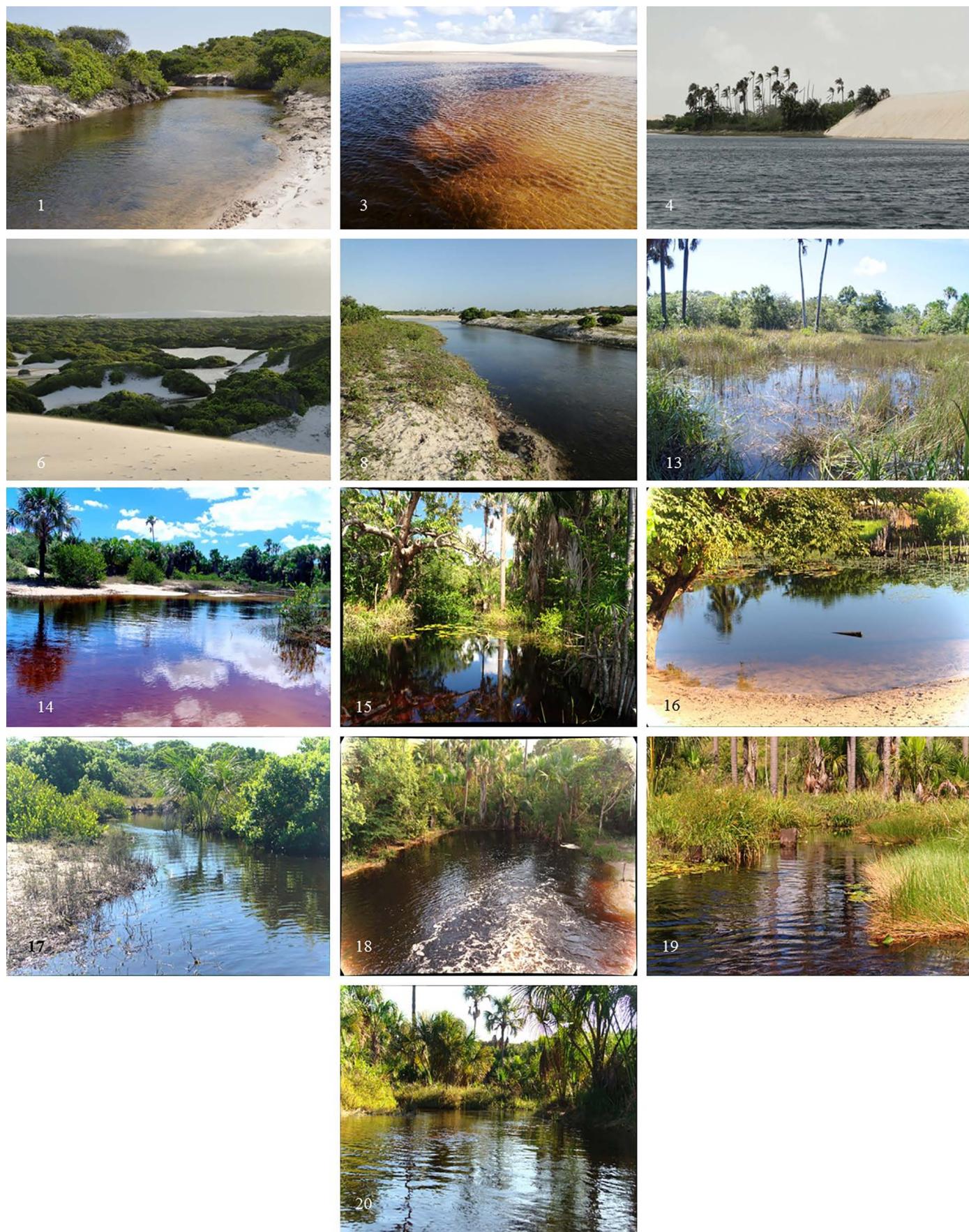
Fishes were collected with two seines (20 m long, 2.5 m high, mesh size 10 mm; and 4 m long, 2 m height, mesh size 5 mm), cast nets (2 m height, mesh size 15 mm), gillnets of various mesh sizes (15, 25, 35, 45 and 55 mm), and dip nets (mesh size 5 and 10 mm). The ichthyological material obtained in the samples was fixed in the field using 10% formalin solution neutralized with sodium tetraborate. Some specimens were photographed alive in order to obtain records of their natural coloration. Sorting and identification of specimens were carried out at the Laboratório de Sistemática e Ecologia de Organismos Aquáticos of the Universidade Federal do Maranhão and at the Laboratório de Ecologia e Sistemática de Peixes, from the same institution, using specialized bibliography for each taxonomic group and consulting experts. The ichthyological material was deposited in the Coleção de Peixes da Universidade Federal do Maranhão (CPUFMA) and Coleção Ictiológica do Centro de Ciências Agrárias e Ambientais of the Universidade Federal do Maranhão (CICCAA). The taxonomic classification follows Nelson et al. (2016); and the name, authors, year of publication, validity, distribution and updated data of each species were checked in Fricke et al. (2019).

Table 1. Collecting sites within the Parque Nacional dos Lençóis Maranhenses and adjacent areas.

Site	Locality	River basin	Municipality	Coordinates
1	Baixa Grande	Rio Preguiças	Barreirinhas	2° 32.3'S 42° 59.10'W
2	Lago de Santo Amaro	Rio Periá	Santo Amaro	2° 28.20'S 43° 13.98'W
3	Lago da Betânia	Rio Periá	Santo Amaro	2° 33.05'S 43° 11.02'W
4	Lagoa da Esperança	Rio Preguiças	Barreirinhas	2° 41.58'S 43° 2.35'W
5	Ponta do Mangue	Rio Preguiças	Barreirinhas	2° 34.53'S 42° 47.51'W
6	Queimada dos Britos	Rio Preguiças	Barreirinhas	2° 30.51'S 43° 1.87'W
7	Riacho Mata-Fome, Tucunzal	Rio Preguiças	Barreirinhas	2° 39.68'S 42° 48.83'W
8	Rio Alegre em Boa Vista	Rio Periá	Primeira Cruz	2° 28.60'S 43° 18.98'W
9	Rio Grande, na Ponta do Espigão	Rio Periá	Santo Amaro	2° 32.36'S 43° 11.79'W
10	Rio Santo Inácio, em Atins	Rio Preguiças	Barreirinhas	2° 34.44'S 42° 44.84'W
11	Rio Sucuriju	Rio Preguiças	Barreirinhas	2° 39.21'S 42° 46.92'W
12	Lago de Travosa	Rio Periá	Santo Amaro	2° 23.42'S 43° 15.76'W
13	Lagoa no Riacho Tucuns	Rio Preguiças	Barreirinhas	2° 43.2'S 42° 51.19'W
14	Riacho Achuí - Tucuns	Rio Preguiças	Barreirinhas	2° 43.24'S 42° 51.83'W
15	Riacho Sucuriju, Povoado Cedro	Rio Preguiças	Barreirinhas	2° 42.07'S 42° 49.23'W
16	Rio Sucuriju, em Tucunzal	Rio Preguiças	Barreirinhas	2° 39.91'S 42° 49.74'W
17	Riacho em Tucunzal	Rio Preguiças	Barreirinhas	2° 39.79'S 42° 49.87'W
18	Rio das Pedras	Rio Periá	Santo Amaro	2° 47.89'S 43° 15.37'W
19	Rio Juçaral	Rio Preguiças	Barreirinhas	2° 49.42'S 43° 07.34'W
20	Riacho Passagem do canto	Rio Preguiças	Barreirinhas	2° 50.77'S 42° 51.82'W
21	Morro do Boi	Rio Preguiças	Barreirinhas	2° 37.19'S 42° 41.02'W

**Figure 1.** Collecting sites in the Parque Nacional Lençóis Maranhenses, northeastern Brazil, and adjacent areas.

Fishes of the Lençóis Maranhenses

**Figure 2.** Some collecting sites at PNLM.

Results

The fish survey of the freshwater rivers (including some river estuaries) of Parque Nacional dos Lençóis Maranhenses reported 49 species, representing 10 orders and 25 fish families that range from obligate freshwater to estuarine organisms. Thirty-three of these species were identified accurately at the species level (Table 2). The Orders comprising the highest percentage of species richness, excluding non-native species, were: Characiformes (46%), Siluriformes (11%), Cichliformes (11%), and Gymnotiformes (10%) (Figure 3), representing 78% of the total species richness. Cyprinodontiformes (*Anablepsoides* Huber, 1992, *Melanorivulus*

Costa 2006 and *Poecilia* Bloch & Schneider 1801), Perciformes (*Eucinostomus* Baird & Girard 1855 and *Polydactylus* Lacepède 1803), Clupeiformes (*Lycengraulis* Günther 1868), Gobiiformes (*Awaous* Steindachner 1861), Mugiliformes (*Mugil* Linnaeus 1758), Synbranchiformes (*Synbranchus* Bloch 1795), Pleuronectiformes (*Achirus* Lacepède 1802) complete the list with four, two, one species each respectively (Table 2, Figure 3). The families with the highest number of species, excluding non-native species, were: Characidae, with 11 species, representing 22% of the species, followed by Cichlidae, with five species (10%), and Loricariidae with three (6%) (Figure 4).

Table 2. List of species collected at the PNLM. New records marked with*.

Classe ACTINOPETRYGII	
Ordem CLUPEIFORMES	
Família Engraulidae	
<i>Lycengraulis batesii</i> (Günther, 1868)	CPUFMA001178
Ordem CHARACIFORMES	
Família Acestrorhynchidae	
<i>Acestrorhynchus falcatus</i> (Bloch, 1794)	CPUFMA172189
Família Anostomidae	
<i>Leporinus</i> aff. <i>friderici</i>	CPUFMA001137
Família Characidae	
<i>Astyanax</i> cf. <i>lacustris</i>	CPUFMA172807
<i>Brachychalcinus parnaibae</i> Reis, 1989*	CPUFMA001268
<i>Hypessobrycon piorskii</i> Guimarães, Brito, Feitosa, Carvalho-Costa & Ottoni 2018	CICCAA02051
<i>Hemigrammus</i> sp1.*	CICCAA02140
<i>Hemigrammus</i> sp.2*	CICCAA02158
<i>Hemigrammus</i> sp.3*	CICCAA02119
<i>Moenkhausia cotinho</i> Eigenmann, 1908	CICCAA02085
<i>Moenkhausia oligolepis</i> (Günter, 1864) *	CICCAA02102
<i>Moenkhausia</i> sp.	CPUFMA172770
<i>Poptella compressa</i> (Günther 1864) *	CPUFMA001194
<i>Serrapinus</i> sp. *	CPUFMA001293
Família Curimatidae	
<i>Steindachnerina notonota</i> (Miranda Ribeiro, 1937)	CPUFMA001180
<i>Curimatopsis</i> aff. <i>cryptica</i>	CPUFMA172802
Família Erythrinidae	
<i>Hoplias malabaricus</i> (Bloch, 1794)	CPUFMA172190
<i>Hoplerythrinus unitaeniatus</i> (Agassiz, 1829)	CPUFMA172196
Família Iguanodectidae	
<i>Bryconops</i> cf. <i>affinis</i> *	CPUFMA172773
<i>Bryconops</i> cf. <i>melanurus</i> *	CPUFMA172806
Família Lebiasinidae	
<i>Nannostomus beckfordi</i> Günther, 1872	CPUFMA172204
Família Serrasalmidae	
<i>Serrasalmus rhombeus</i> (Linnaeus, 1766)	CPUFMA001158
<i>Metynniss lippincottianus</i> (Cope, 1870)	CPUFMA001176

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Ordem CICHLIFORMES	
Família Cichlidae	
<i>Aistogramma piauiensis</i> Kullander, 1980	CPUFMA172193
<i>Aequidens tetramerus</i> (Heckel, 1840)	CPUFMA001230
<i>Cichlasoma</i> cf. <i>zarskei</i>	CPUFMA172191
<i>Crenicichla brasiliensis</i> (Bloch 1792)	CPUFMA001288
<i>Oreochromis</i> sp.	CPUFMA001191
<i>Satanopercajurupari</i> (Heckel, 1840)	CPUFMA001251
Ordem CYPRINODONTIFORMES	
Família Poeciliidae	
<i>Poecilia vivipara</i> Bloch & Schneider, 1801	CPUFMA001214
<i>Poecilia sarrafae</i> Bragança & Costa, 2011*	CPUFMA001216
Família Rivulidae	
<i>Melanorivulus</i> cf. <i>parnaibensis</i> *	CPUFMA172782
<i>Anablepsoides vietrai</i> Nielsen 2016*	CPUFMA172801
Ordem GYMNOTIFORMES	
Família Apteronotidae	
<i>Apteronotus albifrons</i> (Linnaeus, 1766)	CPUFMA001173
Família Gymnotidae	
<i>Gymnotus carapo</i> Linnaeus, 1758	CPUFMA001174
Família Hypopomidae	
<i>Brachyhypopomus</i> sp.*	CPUFMA172800
Família Sternopygidae	
<i>Eigenmannia virescens</i> (Valenciennes, 1836)	CPUFMA001165
<i>Sternopygus macrurus</i> (Bloch & Schneider, 1801)	CPUFMA001166
Ordem MUGILIFORMES	
Família Mugilidae	
<i>Mugil curema</i> Valenciennes, 1836	CPUFMA001181
Ordem PERCIFORMES	
Família Gerreidae	
<i>Eucinostomus</i> cf. <i>argenteus</i>	CPUFMA001218
Família Polynemidae	
<i>Polydactylus virginicus</i> (Linnaeus, 1758)	CPUFMA001195
Família GOBIIFORMES	
Ordem GOBIIDAE	
<i>Awaous tajasica</i> (Lichtenstein, 1822)	CPUFMA001183
Ordem PLEURONECTIFORMES	
Família Achiridae	
<i>Achirus achirus</i> (Linnaeus, 1758)	CPUFMA001186
Ordem SILURIFORMES	
Família Auchenipteridae	
<i>Trachelyopterus galeatus</i> (Linnaeus, 1766)	CPUFMA001131
Família Callichthyidae	
<i>Megalechis thoracata</i> (Valenciennes, 1840)*	CPUFMA172194
Família Heptapteridae	
<i>Pimelodella parnabyae</i> Fowler, 1941	CPUFMA00242
Família Loricariidae	
<i>Loricaria</i> cf. <i>parnabyae</i>	CPUFMA001160
<i>Hypostomus johnii</i> (Steindachner, 1877)	CPUFMA002174
Ordem SYNBRANCHIFORMES	
Família Synbranchidae	
<i>Synbranchus marmoratus</i> Bloch, 1795	CPUFMA001192

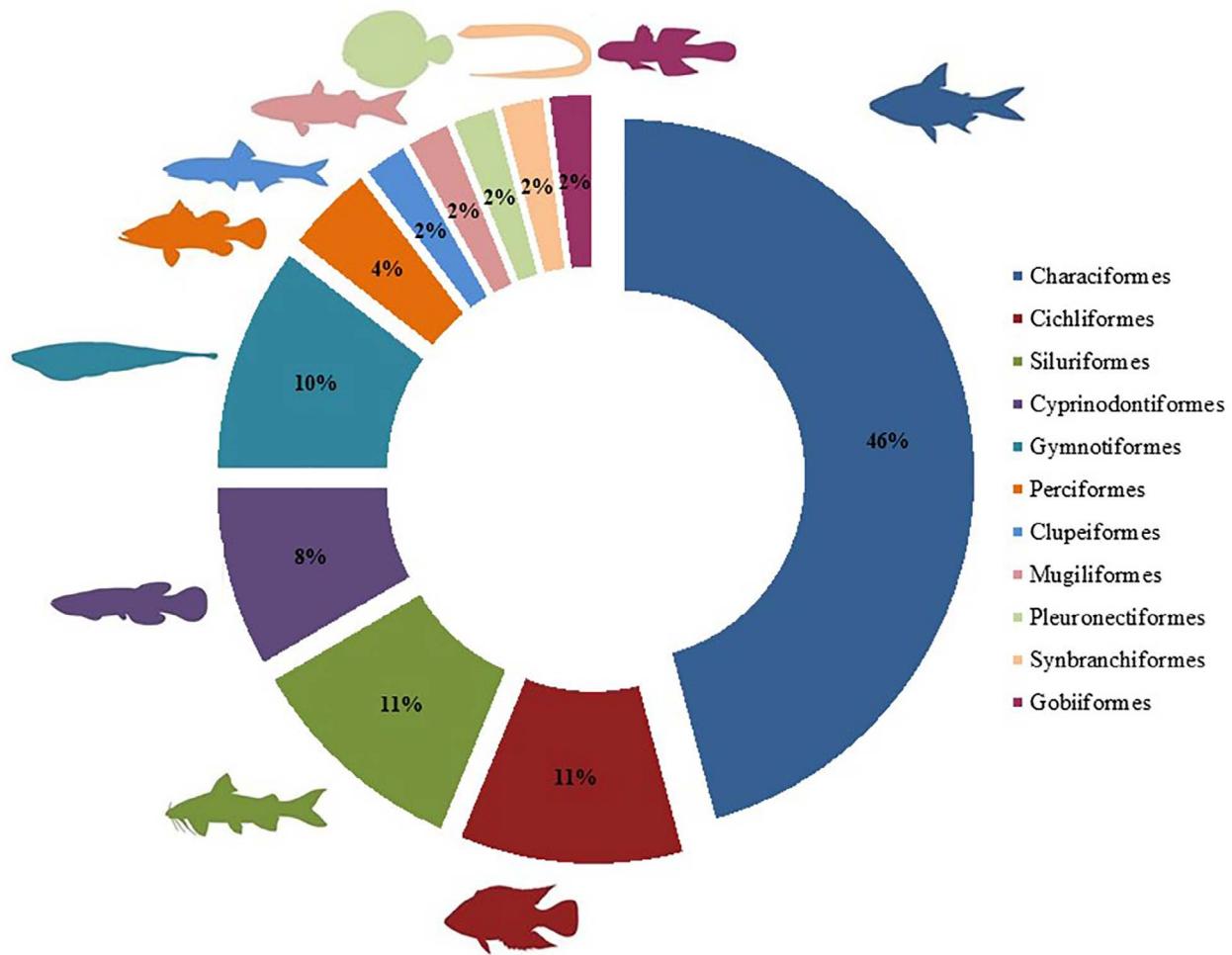


Figure 3. Ranking of richness by Orders observed in the PNLM, excluding non-native species.

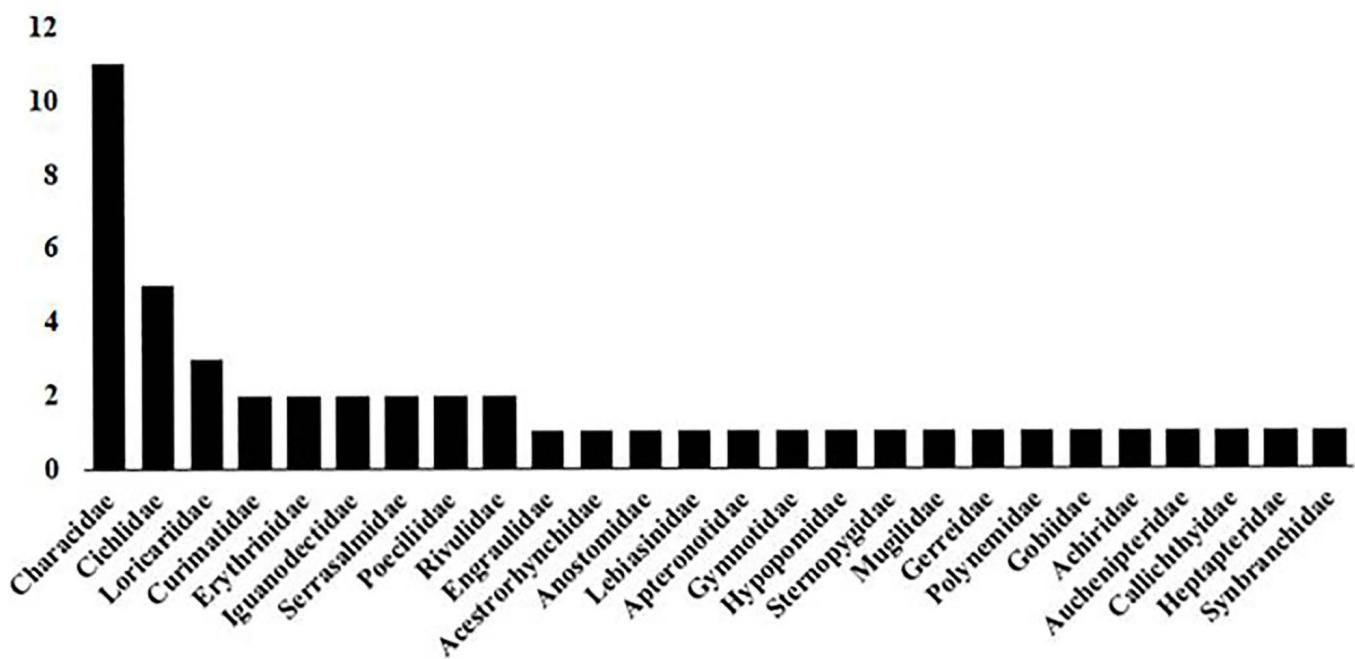


Figure 4. Ranking of richness by families observed in the PNLM, excluding non-native species.

Discussion

One of the few ichthyofauna studies conducted at the PNLM was the paper published by Garavello et al. (1998) which provided a preliminary list of fishes occurring on the sand dune lagoons of the park. They listed 13 species, one of them possessing a marine habit [*Arius spixii* (Agassiz, 1829)], and 12 freshwater species. In this preliminary list of fishes, Characiformes was the most diverse order; and despite the small number of species recorded by Garavello et al. (1998), the pattern of species richness did not differ from other freshwater fish inventories [e.g. Barros et al. 2011 (Itapecuru river basin), Claro-Garcia & Shibatta 2013 (upper Tocantins river basin), Ramos et al. 2014 (Parnaíba river basin), Melo et al. 2016 (Parnaíba river basin)]. The fish survey provided by our work reported 49 species occurring on freshwater habitats at the PNLM (including some river estuaries), representing ten orders and 25 fish families, that range from obligate freshwater to estuarine organisms (Table 2, Figure 1). This is more than three times the number of freshwater species (12) reported by Garavello et al. (1998) and furthermore added 16 species to the list provided by Piorski et al. (2017), including 14 new records for PNLM (Table 2). From the 12 freshwater species listed by Garavello et al. (1998), all the species, four of them except, were reported by our survey: *Curimata* sp., *Collossoma* sp., *Crenicichla* aff. *lugubris*, and *Aequidens pallidus* (Heckel 1840). Therefore, we opted to not consider them in our survey, since we collected other congeners or close related genera to these four species registered by Garavello et al. (1998), and a hypothesis of misidentification of these species by them is not rejected. In addition, neither *A. pallidus* nor *C. lugubris* have official distribution records for the studied area, nor for nearby regions, and their type localities are very far from PNLM (see Kullander 2003, Fricke et al. 2019), what makes the records of these two species for this protected area unlikely.

Among the 49 freshwater species recorded in this study, 14 are new records for the PNLM. From these 49 species, just one corresponds to an introduced one (*Oreochromis* sp.). The occurrence of this non-native species highlights the importance of long-term monitoring the populations of this species, attempting to control the populations, reducing the possible impacts over the natural freshwater community. Protected areas with non-native species are more challenge. Among the 14 new records in the PNLM, cited above, as well as some of the 16 species which we were unable to identify accurately at the species level, could include undescribed species, but more study is necessary before sorting out which species are truly undescribed and which are already described ones. The orders reported by this survey comprising the highest percentage of species richness were Characiformes (46%), Siluriformes (11%), Cichliformes (11%), and Gymnotiformes (10%), excluding non-native species (Figure 2), as expected for Neotropical freshwater surveys (e.g. Langeani et al. 2007, Lucinda et al. 2007, Sarmento-Soares et al. 2007, Vari et al. 2009, Casatti et al. 2013, Ramos et al. 2014, Polaz et al. 2014, Fagundes et al. 2015, Melo et al. 2016, Cetra et al. 2016).

When comparing the present survey with inventories from other river drainages from the Maranhão State, we can conclude that the freshwater fish fauna of the state is probably still underestimated, as argued by Piorski (2010) and Guimarães et al. (2018a). In hydrographic terms, the PNLM boundaries include the Preguiças and Periá river basins. These two coastal river basins are very small when compared to the major coastal river basins of the Maranhão-Piauí ecoregion, such as Parnaíba, Mearim, Turiaçu, Itapecuru and Gurupi river basins.

However, in terms of recorded biodiversity, we have a substantial number of species from these two basins. The 49 species herein recorded represent three times the number of freshwater species (13) reported by Matavelli et al. (2015) for the Munim, Parnaíba and other smaller coastal river basins, as well as more than twice the number of species (20) reported by Ribeiro et al. (2014) for the Munim river basin. It has just 11 species less than the number of species (60) reported by Soares (2013) for the Mearim river basin; just 20 species less than the number of species (69) reported by Barros et al. (2011), and 15 species less than the survey (64) performed by Nascimento et al. (2016), respectively, for the Itapecuru river basin, one of the major coastal river basins of this ecoregion; and just 16 species less than the inventory (65) published by Melo et al. (2016) for the Parnaíba river basin, the major coastal river basin of the Maranhão-Piauí ecoregion and one of the main river basins of Brazil. The two surveys including more species recorded from coastal river basins of the Maranhão state were the works published by Ramos et al. (2014) for the Parnaíba river basin, and the survey provided by Castro & Dourado (2011) for the Mearim, Pindaré, Pericumã and upper Turiaçu river drainages, including 146 and 109 species, respectively. The first one was an exhaustive inventory of one of the main and largest river basin of Brazil (Parnaíba), and the second one included three distinguished river drainages: Mearim and Pindaré from the Mearim river system, the second major river system of the Maranhão-Piauí ecoregion, and Turiaçu, one of the main river basins of this ecoregion. Even so, our survey recorded about a half to one third of the number of species than these two surveys cited above, what demonstrates the effort put in the inventory here presented.

From the 33 species herein identified accurately at the species level, five of them, *Achirus achirus* (Linnaeus 1758), *Awaous tajasica* (Lichtenstein 1822), *Mugil curema* Valenciennes 1836, *Poecilia vivipara* Bloch & Schneider 1801 and *Polydactylus virginicus* (Linnaeus 1758), are species typically found in brackish water environments, and when occurring on freshwater environments, are restricted mainly to estuaries, or, occasionally, the lower portions of the rivers. Thus, we will not address them in our biogeographical comments. From the remaining 28 species, eight did not occur in the Amazon River basin (*Anablepsoides vieirai* Nielsen 2016, *Aistogramma piauiensis* Kullander 1980, *Crenicichla brasiliensis* (Bloch 1792), *Hypessobrycon piorskii* Guimarães, Brito, Feitosa, Carvalho-Costa & Ottoni 2018, *Hypostomus johnii* (Steindachner 1877), *Poecilia sarrfae* Bragança & Costa 2011, *Pimelodella parnabyae* Fowler 1941 and *Steindachnerina notonota* (Miranda Ribeiro 1937); six of them (*A. vieirai*, *A. piauiensis*, *H. piorskii*, *H. johnii*, *P. sarrfae* and *P. parnabyae*) being endemic to the Maranhão-Piauí ecoregion (see Fricke et al. 2019). All the remaining species herein reported have their distribution recorded for the Amazon River basin (see Fricke et al. 2019), which shows the great influence of the Amazon basin.

According to Rosa et al. (2003), the fish fauna on Maranhão-Piauí ecoregion was historically pointed out as poorly endemic. Otherwise, the low level of endemism recorded during the past decades would be related to less sampling effort on the whole region (Piorski 2010, Ramos et al. 2014, Guimarães et al. 2018a). Several species in the Maranhão-Piauí rivers are known to occur along the Amazon basin (including coastal rivers in Suriname and the Guianas), a distribution pattern suggested by Barros et al. (2011),

who observed a predominance of Amazonian species in the Itapecuru basin, as well as corroborated for some putative species by Guimarães et al. (2016, 2017a, b). In addition, this influence of the Amazon River basin in the ecoregion was advocated by Hubert & Renno (2006) and Dagosta & de Pinna (2017), in their biogeographic analyses. However, these same authors also advocated the possibility of the coastal river basin of the Maranhão state constituting one or more areas of endemism. However, both papers suggest that data related to the freshwater ichthyofauna from this region are too scarce to have a more conclusive hypothesis. Guimarães et al. (2018a) provided a list of several species that are endemic to the river drainages of the Maranhão state or occur just on neighboring areas. This fortifies the hypothesis that the coastal river basins of the Maranhão state could constitute one or more areas of endemism. In addition, a new species (*H. piorskii*) was recently described by Guimarães et al. (2018b) with its distribution known to be restricted to the Munim and Preguiças River basins (including the freshwater bodies of the PNLM). As pointed out above, some of the species which we were not able to identify accurately at the species level could be undescribed ones, and more studies and research need to be done, preferably including molecular data, since many of them are member of species complexes (some of them including cryptic species) or groups still poorly resolved taxonomically. In terms of conservation, the PNLM has a key role in the conservation of the six species, cited above, endemic to the Maranhão-Piauí ecoregion, since it is the most internationally appreciated and subsidized protected area of the ecoregion, which contributes to the preservation of these species, especially the endemic species of the region.

The PNLM presents a unique scenic beauty, appreciated internationally. However, knowledge about existing biodiversity does not follow the same standards. Information on the biota diversity in the limits of its area dates back to the beginning of the 2000s when studies were carried out to prepare the management plan of the protected area (ICMBio 2003). According to these studies, the fauna diversity is relatively low compared to other regions. In general, the fauna consists of 17 groups of mammals, 112 bird species, including migratory species (ICMBio 2003) and 42 species of reptiles (Miranda et al. 2012). As well as the other Brazilian protected areas, the PNLM fails to preserve its freshwater environment properly, since it includes only fragments of the major river systems of the area, not including and conserving the hole river drainages, mainly excluding their headwaters (see Figure 2). Thus, its water bodies are exposed to typical human impacts, as discussed by Azevedo-Santos et al. (2018).

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Author Contributions

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Erick Cristofore Guimarães: Contribution for data collection, to taxonomic identification of fishes, contributed to manuscript preparation, critical revision and adding intellectual

Beldo Rywllon Abreu Ferreira: Contribution for data collection, to taxonomic identification of fishes and contributed to manuscript preparation

Felipe Polivanov Ottoni: Contribution for data collection, to taxonomic identification of fishes, contributed to manuscript preparation, critical revision and adding intellectual

Nivaldo Magalhães Piorski: Contribution to data collection

Conflicts of Interest

The authors declare that they have no conflict of interest related to the publication of this manuscript.

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