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Desvelando la Belleza, los Misterios y los Desafíos del Mar

Maria do Socorro Saraiva Pinheiro
(organizadora)

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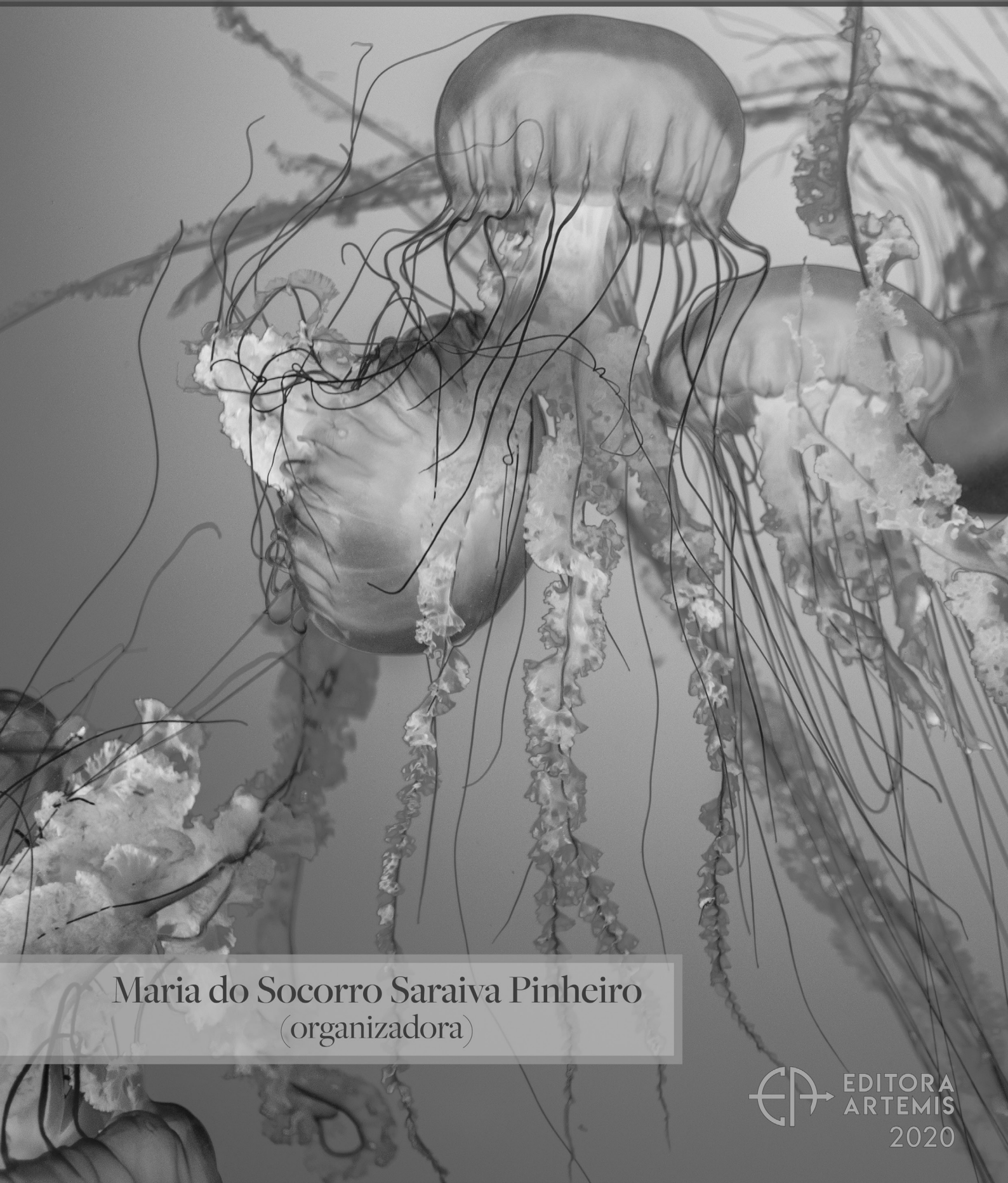

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APRESENTAÇÃO

Em 2016, as Nações Unidas concluíram a primeira Avaliação Mundial dos Oceanos que apontou a urgência de gerenciar com sustentabilidade as atividades no oceano. Por esta razão, em 2017, foi proclamada a Década da Ciência Oceânica para o Desenvolvimento Sustentável, a ser implementada de 2021 a 2030, buscando cumprir os compromissos da Agenda 2030, com foco no Objetivo de Desenvolvimento Sustentável (ODS) 14 e correlatos. Neste sentido a obra **"Oceanografía: desvelando la belleza, los misterios y los desafíos del mar"** traz uma coletânea de trabalhos científicos que busca contribuir com uma base científica de apoio às ações de gerenciamento sustentável do Oceano executadas por diversos países. Entre os temas apresentados nesta obra estão: impactos ambientais em zonas costeiras, aquicultura, ecologia de ictiofauna, conservação de ecossistemas marinhos e zoonoses de organismos aquáticos.

Maria do Socorro Saraiva Pinheiro

SUMÁRIO

CAPÍTULO 5

STRUCTURE OF A FISH ASSEMBLAGE IN A MANGROVE IN RAPOSA, SÃO LUIS ISLAND, MARANHÃO, BRAZIL

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ABSTRACT: This study analyzes aspects of the fish community present in a mangrove on the island of São Luís, Maranhão, Brazil; encompassing species composition, frequency of occurrence and sexual proportion. Sampling was monthly for 16 months. 10824 specimens of fish were collected, representing 63 species belonging to 27 families. The Sciaenidae family was the most important with ten species; followed by Carangidae, with six species; Ariidae, Haemulidae and Gerreidae with four species. *Genyatremus luteus* was the most frequent species, corresponding to 95% of the samples. Second were *Micropogonias furnieri, Stellifer naso, Mugil curema and Colomesus psittacus*, each present in 88% of the samples. Sex was observed in 38 species, and in 18 species the hypothesis of equality (1:1) was accepted and rejected for 9 species.

KEYWORDS: Ichthyofauna; Sex ratio; Frequency of occurrence; Sciaenidae.

ESTRUCTURA DE UN CONJUNTO DE PECES EN UN MANGLAR EN RAPOSA, ISLA SÃO LUIS, MARANHÃO, BRASIL.

RESUMEN: En este estudio se abordaron aspectos de la comunidad de peces presentes en un manglar en la isla de São Luís, Maranhão, Brasil; que cubre la composición de especies, la frecuencia de ocurrencia y la población sexual. El muestreo fue mensual durante 16 meses. Se recolectaron 10824 ejemplares de peces, que representan 63 especies pertenecientes a 27 familias. La familia Sciaenidae fue la más importante con diez especies; seguido de Carangidae, con seis especies; Ariidae, Haemulidae y Gerreidae con cuatro especies. *Genyatremus luteus* fue la especie más frecuente, correspondiente al 95% de las muestras. En

segundo lugar se ubicaron las especies *Micropogonias furnieri, Stellifer naso, Mugil curema* y *Colomesus psittacus*, cada una presente en el 88% de las muestras. Se pudo observar el sexo en 38 especies, y en 18 especies se aceptó y rechazó la hipótesis de igualdad (1:1) para 9 especies.
PALABRAS CLAVE: Ictiofauna; Proporción sexual; Frecuencia de ocurrencia; Sciaenidae.

1 . INTRODUCTION

The mangrove system is characterized by the presence mainly of halophyte plant species, which occur in the transition zone between the marine and terrestrial environments, and tolerate high salinities (Hossain, 2001), including in salinity stress as observed by Santos (1989) in two areas located on São Luís Island, on the Anajatuba River and on Tubarão Bay in the State of Maranhão. Characterizing a type of estuary based on data from the available literature proves to be a complex task. The existing classifications are based on the variation in salinity, tidal amplitudes, or geomorphological characteristics. So it was considered for this study that the type of estuary present in the Raposa mangrove of the Baía de Maré type, proposed by Kjerfive and Magill (1989). In this classification, the authors address both salinity and geomorphological characteristics; these types of estuaries would have salinities ranging from oceanic to brackish and would have coastal features formed by some large-scale geological event.

The main objective of this study was to address structural characteristics of the associations of teleost fish in a mangrove, emphasizing the composition, frequency of occurrence and sexual proportion.

2 . MATERIAL AND METHODS

2.1 Study área

The study area is located in the northeastern part of the island of São Luís, municipality of Raposa (02° 25’ 22”S and 44° 05’ 21”W) (Meneghetti and Kux, 2014), comprising a set of tidal channels, flooded during high tide. It is characterized by low relief and a dominant mangrove flora. The main supply of river waters comes from the Paciência River basin, on the east side of the island of São Luís.

2.2 Sample design

The collection of fish for the accomplishment of this study was monthly between

August 1999 and November 2000. The fish were captured with igarapé net, also called “taping net”. They are fixed devices, arranged at the entrance to the stream, supported by mangrove poles, fixed during low tide; the harvest is carried out at the next low tide, totaling an effort of 12 hours.

The fish caught for this study were packaged in the field in polystyrene boxes with ice and transported to the laboratory, where identification was carried out based on Cervigón (1993), Fischer (1978), Cervigón et al. (1992), FIGUEIREDO and MENEZES (1980), MENEZES and FIGUEIREDO (1980), MENEZES and FIGUEIREDO (1985), FIGUEIREDO and MENEZES (2000).

For the study of the proportions of males and females and identification of the gonadal maturity stages of the species collected, some care was taken. The abdominal cavity of each fish, with the exception of pleuronectiforms, was exposed through an incision in the region of the genital pore towards the head, to observe sex and the identification of both sex was done through visual inspection of the gonads, comparing their aspects with the scales proposed by VAZZOLER (1996).

2.3 2.3 Data analysis

To verify the frequency of occurrence, samples of all species were grouped by month of collection and the study was based on the ratio between the total number of samples where a given species occurred and the total number of samples.

Therefore, to determine the frequency of occurrence of species caught in the Raposa mangrove, the following nomenclature was adopted: Constants - species (or families) present between 50 to 100% of the samples; Moderate - species (or families) present between 20 to 49% of the samples; Little constant - species (or families) present between 10 to 19% of the samples; Rare - species (or families) present in less than 10% of the samples.

For the study of the sexual proportion of the populations, the Chi-square test was applied in order to test whether there was a significant predominance of males or females for each species, taking as a null hypothesis the ratio 1:1 (ZAR, 1999).

3 . RESULTS

3.1 General characteristics of the composition of the fish association.

10,824 individuals were collected, comprising 63 species distributed in 27 families. Table 1 shows the list of fish collected in the mangrove of Raposa, accompanied by the names of orders and families follow the ordering proposed by NELSON (1994).

Table 1. List of teleost fish species that occur in the mangrove of Raposa, São Luís island.

Order Clupeiformes
Famíly Clupeidae
Odontognathus sp.

Famíly Engraulidae
Anchoa sp.
Cetengraulis edentulus (Cuvier, 1928)
Pterengraulis atherinoides (Linnaeus, 1766)

Order Elopiformes
Famíly *Elopidae*
Elops saurus Linnaeus, 1766

Order Anguilliformes
Famíly Muraenidae
Gymnothorax funebris Ranzani, 1839

Famíly Ophichthidae
Ophichthus parilis (Richardson, 1844)

Order Siluriformes
Famíly Ariidae
Sciades herzbergii (Bloch, 1794)
Arius sp.
Cathorops spixii (Agassiz, 1829)
Cathorops sp.
Famíly Auchenipteridae
Pseudauchenipterus nodosus (Bloch, 1794)

Famíly Batrachoidiformes
Famíly Batrachoididae
Batrachoides surinamensis (Bloch & Schneider, 1801)
Thalassophryne nattereri Steindachner, 1876.

Order Beloniformes
Famíly Belonidae
Strongylura marina (Walbaum, 1792)

Order Atheriniformes
Famíly Atherinopsidae
Atherinella brasiliense (Quoy & Gaimard, 1825)

Order Cyprinodontiformes
Famíly Anablepidae
Anableps anableps (Linnaeus, 1758)

Order Perciformes
Famíly Centropomidae
Centropomus parallelus Poey, 1860
Centropomus undecimalis (Block, 1792)

Famíly Serranidae
Epinephelus itajara (Lichtenstein, 1822).
Rypticus randalli Courtenay, 1967

Famíly Carangidae
Caranx latus Agassiz, 1831
Caranx sp.
Oligoplites palometa (Cuvier, 1832)
Oligoplites saurus (Bloch & Schneider, 1801)
Selene vomer (Linnaeus, 1758)
Trachinotus carolinus (Linnaeus, 1766)

Famíly Lutjanidae
Lutjanus buccanella (Cuvier, 1828)
Lutjanus jocu (Bloch & Schneider, 1801)
Lutjanus synagris (Linnaeus, 1758)

Famíly Lobotidae
Lobotes surinamensis (Bloch, 1790)

Famíly Gerreidae
Diapterus auratus Ranzani, 1842
Diapterus rhombeus (Cuvier, 1829)
Eucinostomus argenteus Baird & Girard, 1855
Eugerres sp.

Famíly Haemulidae
Conodon nobilis (Linnaeus, 1758)
Genyatremus luteus (Bloch, 1790)
Orthopristis ruber (Cuvier, 1830)
Pomadasys corvinaeformis (Steindachner, 1868).

Famíly Sciaenidae
Cynoscion acoupa (Lacepède, 1801)
Cynoscion leiarchus (Cuvier, 1830)
Cynoscion sp.
Isopisthus parvipinnis (Cuvier, 1830)
Macrodon ancylodon (Bloch & Schneider, 1801)
Micropogonias furnieri (Desmarest, 1823)
Bairdiella ronchus (Cuvier, 1830)
Stellifer naso (Jordan, 1889)
Stellifer sp.
Nebris microps Cuvier 1830

Famíly Ephippidae
Chaetodipterus faber (Broussonet, 1782)

Famíly Mugilidae
Mugil curema Valenciennes, 1836
Mugil gaimardianus Desmarest, 1831
Mugil incilis Hancock, 1830

Famíly Polynemidae
Polydactylus oligodon (Günther, 1860)

Famíly Trichiuridae
Trichiurus lepturus Linnaeus, 1758

Order Pleuronectiformes
Famíly Paralichthyidae
Paralichthys sp.
Citharichthys sp.

Famíly Achiridae
Achirus sp.
Trinectes sp.

Famíly Cynoglossidae
Symphurus diomedeanus (Goode&Bean,1885)

Order Tetraodontiformes
Famíly Tetraodontidae
Colomesus psittacus (Bloch & Schneider, 1801).
Lagocephalus sp.
Sphoeroides testudineus (Linnaeus, 1758).

Considering the number of species, the family Sciaenidae was the most important with ten species; followed by Carangidae, with six species; Ariidae, Haemulidae and Gerreidae with four species; Engraulidae, Lutijanidae, Mugilidae and Tetraodontidae, with three species; Batrachoididae, Centropomidae, Serranidae, Paralichthyidae and Achiridae with two species; the remaining thirteen families contributed one species each.

3.2 Frequency of occurrence.

Genyatremus luteus was the most frequent species, corresponding to 95% of the samples. In second place were the species *Micropogonias furnieri*, *Stellifer naso, Mugil curema* and *Colomesus psittacus*, each one present in 88% of the samples.

Of the sixty-three species collected in the mangrove of Raposa, nineteen were considered “constant”, including those mentioned above; fourteen, “moderate”; nineteen, “little constant” and eleven, “rare” (Table 2).

Table 2. Frequency of occurrence of species caught in Mangue da Raposa.

Species	Constants	Moderatr	Little Constant	Rare
Odontognathus sp.				*
Anchoa sp.		*		
C. edentulus		*		
P. atherinoides			*	
E. saurus		*		
G. funebris		*		
O. parilis				*
S. herzbergii	*			
Arius sp.	*			
C. spixii		*		
Cathorops sp	*			
P. nodosus		*		
B. surinamensis	*			
T. nattereri				*
S. marina		*		
A. brasiliense				*
A. anableps		*		
C. parallelus	*			
C. undecimalis		*		
E. itajara		*		
R. randalli	*			
C. latus			*	
Caranx sp				*
O. palometa			*	
O. saurus	*			
S. vomer		*		
T. carolinus			*	
L. buccanella				*
L. jocu			*	
L. synagris		*		
L. surinamensis			*	
D. auratus			*	
D. rhombeus			*	
E. argenteus	*			
Eugerres sp.				*
C. nobilis			*	

G. luteus	*				
O. ruber					*
P. corvinaeformis			*		
C. acoupa	*				
C. leiarchus	*				
Cynoscion sp				*	
I. parvipinnis					*
M. ancylodon				*	
M. furnieri	*				
B. ronchus				*	
S. naso	*				
Stellifer sp.				*	
N. microps					*
C. faber			*		
M. curema	*				
M. gaimardianus	*				
M. incilis			*		
P. oligodon				*	
T. lepturus	*				
Paralichthys sp.				*	
Citharichthys sp.				*	
Achirus sp.				*	
Trinectes sp.	*				
S. diomedeanus				*	
C. psittacus	*				
Lagocephalus sp.				*	
S. testudineus	*				

The families Ariidae, Haemulidae and Sciaenidae were the most frequent families, each with representatives in 100% of the samples obtained.

Of the twenty-seven families collected in the mangrove of Raposa, fourteen were considered “constant”, including those mentioned above; five, “moderate”; five, “little constant” and three “rare”, as shown in Table 3.

Table 3. Frequency of occurrence of families captured in Mangue da Raposa.

Family	Constants	Moderate	Little Constant	Rare
Clupeidae				*
Engraulidae	*			
Elopidae			*	
Muraenidae		*		
Ophichthidae				*
Ariidae	*			
Auchenipteridae		*		
Batrachoididae	*			
Belonidae		*		
Atherinopsidae				*
Anablepidae		*		
Centropomidae	*			

Serranidae	*			
Carangidae	*			
Lutjanidae	*			
Lobotidae				*
Gerreidae	*			
Haemulidae	*			
Sciaenidae	*			
Ephippidae			*	
Mugilidae	*			
Polynemidae				*
Trichiuridae	*			
Paralichthyidae				*
Achiridae	*			
Cynoglossidae				*
Tetraodontidae	*			

3.3 Sexual proportion.

A total of 1914 specimens of 38 species could be classified according to sex, for safety reasons this classification was only adopted when the gonads were effectively visualized.

The hypothesis of equality in the proportions of males and females tested by the Chi-square test at the significance level of 0.05 was accepted for 18 species and rejected for 9 species, as shown in Table 4.

Table 4. Number of males and females per species and the χ^2 result

Species	Males	Females	χ^2
Anchoa sp.		12	
E. saurus		3	
G. funebris	5	2	1,28
S. herzbergii	6	7	0,08
Arius sp.	29	23	0,70
C. spixii		1	
Cathorops sp.	49	69	3,4
P. nodosus	17	12	0,86
B. surinamensis	6	22	9,14*
T. nattereri	1		
S. marina	2	7	2,78
A. anableps	17	34	5,66*
C. parallelus		2	
R. randalli	14	51	21,06*
L. jocu		1	
L. synagris	13	15	0,14
E. argenteus	3	10	1,66
C. nobilis	1	5	2,66
G. luteus	8	23	7,26*
P. corvinaeformis	6	7	0,08

C.acoupa	3	12	5,4*
C. leiarchus	7	12	1,32
I. parvipinnis		1	
M. furnieri	54	44	1,02
B. ronchus	1	2	0,34
S. naso	31	50	4,46*
Stellifer sp.	26	29	0,16
M. curema	240	246	0,08
M. gaimardianus	58	72	1,50
M. incilis	7	12	1,32
P. oligodon		2	
T. lepturus	20	47	10,88*
Paralichthys sp.	1		
Achirus sp.		7	
Trinectes sp.	2	29	23,53*
S. diomedeanus		1	
C. psittacus	114	119	0,10
S. testudineus	69	112	10,22*

The species *Anchoa* sp, *Elops saurus, Cathorops spixii, Centropomus parallelus, Lutjanus jocu, Isopisthus parvipinnis, Polydactylus oligodon, Achirus* sp., *Symphurus diomedeanus*, only female individuals were observed, while the species *Thalassophryne nattereri* and *Paralichthys* sp. only males were observed; for this reason the hypothesis has not been tested.

4 . DISCUSSION

The Sciaenidae family had the largest number of species in the mangrove system, followed by the Carangidae family. These results corroborate those found by MARTINS-JURAS (1989) in estuarine areas on the island of São Luís.

ROJAS et al. (1994) observed that the Ariidae family in mangrove areas in Costa Rica was the most abundant in number of individuals, and the largest number of species; STONER (1986) the Gerreidae family, in Laguna de Joyuda, Puerto Rico; SEDBERRY and CARTER (1993) family Haemulidae, Belize, Central America.

CHAVES and CORRÊA (1998) in the bay of Guaratuba, Paraná, observed three families with greater representation: Ariidae, Gerreidae and Sciaenidae; VENDEL et al. (2002) in the Baguaçu gamboa found that the families with the highest representation of species were: Engraulidae, Gerreidae, Gobiidae and Tetraodontidae, in addition to Clupeidae, Mugilidae and Sciaenidae; VENDEL et al. (2003) in a tidal plain of Paranaguá bay, concluded that the families with the greatest specific wealth were: Engraulidae, Gerreidae, Mugilidae and Tetraodontidae; SPACH et al. (2003) in the tidal channels, the greatest specific richness observed was from the families Carangidae and Gerreidae; SPACH et al. (2004) on sea plains in Pontal do Sul, observed that the

families with the greatest specific wealth were Carangidae and Sciaenidae; VENDEL and CHAVES (2006) observed two families with greater representation Gerreidae and Gobiidae on the coast of Santa Catarina.

The species that were most constant in the mangrove of Raposa were: *Genyatremus luteus*, in 93.8% of the samples*; Colomesus psittacus, Stellifer naso* and *Micropogonias furnieri* in 87.5% of the samples, each one, and *Trínectes* sp., in 75% of the samples.

Genyatremus luteus was also one of the most frequent species in other studies carried out in the Maranhão estuaries (MARTINS-JURAS et al. 1987; MARTINS-JURAS, 1989; BATISTA and REGO, 1996; CASTRO, 1997; 2001; PINHEIRO Jr. et al. 2005).

The presence of typically freshwater species was not observed, even occasionally during the capture period in the Raposa mangrove. But the fact that freshwater fish did not occur in this study is also not necessarily due to the presence of mangroves. According to LACERDA (1984), mangrove trees are not necessarily restricted to the high salinity environment; on the contrary, its development appears better in areas of low salinity, and its occurrence in the coastal environment seems to be linked to competition with other terrestrial plants.

CHAVES and CORRÊA (1998) did not observe the presence of freshwater fish in mangrove areas of Guaratuba bay, they considered that the high salinity perhaps explained the absence of fish associated with freshwater. However, CHAVES and VENDEL (2001) exploring a larger area and different habitats from CHAVES and CORRÊA (1998), plus the addition of other types of devices, on occasion captured a dulcícola species, *Rhamdia quelen*.

According to VAZZOLER (1996) the sex ratio in fish varies over the life cycle depending on the successive events that act differently on individuals of each sex, and mortality and growth are the main factors that can determine differences in the proportion sexual.

In this study *B. surinamensis, A. anableps, R. randalli, G. luteus, C. acoupa, S. naso, T. lepturus, Trinectes* sp. and *S. testudineus*, the sex ratio differed significantly from the sex ratio 1:1. But as the mangrove/estuary environment is usually more occupied by juvenile or pre-adult phases, the sex ratio should not manifest significant differences between males and females (LOWE-MCCONNELL, 1999).

The sex ratio for *Sphoeroides testudineus* in Gamboa do Baguaçu varied significantly during the year and the ratio of two males to one female coincided with the spawning period (ROCHA et al., 2002). While for *Sphoeroides greeleyi* in this same system, the number of females was higher than the number of males for most of the year, however during the months of January to March it was the same, and this corresponded to the end of the reproductive period after spawning.

5 . FINAL CONSIDERATIONS

Among the species present in the mangrove of Raposa, none can be considered endemic, as in the Golfão Maranhense.

The Sciaenidae family has a wide geographical distribution and many species on the five continents, so the fact that it was the most representative family, ten species, corroborates its interspecific heterogeneity.

Although the mangrove is a conspicuous environment, but provides places for protection against predation and feeding, the frequency of occurrence of certain species in the mangrove in this study is likely to be correlated with the tolerance of these species to the variation of some limiting environmental variables, such as salinity.

Several factors interfere differently in the sex ratio, among them mortality and growth that determines difference in the sex ratio, because in most cases there is a differential growth between males and females, then there should be further study at the level of length classes.

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REFERENCES

BATISTA, V.S.; REGO, F.N. Análise de associações de peixes, em igarapés do estuário do rio Tibiri, Maranhão. **Rev Bra Biol**, v. 56, n. 1, p. 163-176,1996.

CASTRO, A.C.L. Características ecológicas da ictiofauna da ilha de São Luís. **Bol Lab Hidrobiol**, v. 10, p. 1-18, 1997.

CASTRO, A.C.L. Diversidade da assembleia de peixes em igarapés do estuário do Rio Paciência (MA-Brasil). **Atlântica**, v. 23, p. 39-46, 2001.

CERVIGÓN, F. **Los peces marinos de Venezuela**. Fundación C. Los Roques, Caracas, Venezuela. v. 2, p. 1-497, 1993.

CERVIGÓN, F.; CIPRIANIR, R.; FISCHER, W.; GARIBALDI, L.; HENDRICK, M.; LEMUS, A.J.; MÁRQUEEZ, R.; POUTIERS, J.M.; ROBAINA, G.; RODRIGUEZ, B. Fichas **FAO de identificación de especies para /os fines de la pesca**. Guia de campo de las espécies comerciales marinas y de águas salobras de la costa septentríonal de Sur América. Rome, FAO. 1992.

CHAVES P.T.C.; CORRÊA, M.F.M. Composição ictiofaunística da área de manguezal da Baía de Guaratuba, Paraná, Brasil. **Rev Bra Zool**, v 15, n. 1, p. 195-202, 1998.

CHAVES P.T.C.; VENDEL A.L. Nota complementar sobre a composição ictiofaunística da Baía de Guaratuba, Paraná, Brasil. **Rev Bra Zool**, 18(supl.1), p. 349-352, 2001.

FISCHER, W. (ed). **FAO species Identification sheets for fishery purposes**. Western Central Atlantic (Fishing Área 31*).* Rome, FAO. p. 1-7.1978.

FIGUEIREDO, J.L.; MENEZES, N.A. **Manual de peixes marinhos do sudeste do Brasil**. III. Teleostei (2). São Paulo, Museu de Zoologia da Universidade de São Paulo. 1980.

FIGUEIREDO, J.L.; MENEZES N.A. **Manual de peixes marinhos do sudeste do Brasil**. VI. Teleostei (5). São Paulo, Museu de Zoologia da Universidade de São Paulo. 2000.

HOSSAIN S. Biological aspects of the coastal and marine enviroment of Bagladesh. **Ocean & Coastal Management**, v. 44, p. 261-282, 2001.

KJERFVE, B.; MAGILL, K.E. Geographic and hydrodynamic characteristic of shallow coastal lagoons. **Marine Geology**, 1989; 88:87-199.

LACERDA, L.D. Manguezais florestas de beira-mar. **Ciência Hoje**, v. 3, n. 13, p. 64-70, 1984.

LOWE-MCCONNELL, R.H. **Estudos ecológicos de comunidades de peixes tropicais***.* São Paulo, EDUSP. 1999.

MENEGHETTI, G.T.; KUX, H.J.H. 2014. Mapeamento da cobertura da terra do município de Raposa (Ma) utilizando imagens WorldView-II, o aplicativo InterIMAGE e mineração de dados. **Revista Brasileira de Cartografia**, v. 66, n. 2, p. 365-377, 2014.

MARTINS-JURAS, L.A.G. **Ictiofauna estuarina da Ilha do Maranhão***.* Tese (Doutorado) - Instituto Oceanográfico, Universidade de São Paulo, São Paulo. 184p. 1989.

MARTINS-JURAS, L.A.G; JURAS, A.A; MENEZES N.A. Relação preliminar dos peixes da ilha de São Luís. **Rev Bra Zool**, v. 4, n. 2, p. 105-113, 1987.

MENEZES, N.A; FIGUEIREDO, J.L. **Manual de peixes marinhos do sudeste do Brasil**. IV. Teleostei (3). São Paulo, Museu de Zoologia da Universidade de São Paulo, 1980.

MENEZES, N.A; FIGUEIREDO, J.L. *Manual de peixes marinhos do sudeste do Brasil*. V. Teleostei (4). São Paulo, Museu de Zoologia da Universidade de São Paulo, 1985.

NELSON, J.S. **Fishers of the World***.* 3.ed. Jonh Wiley & Sons, Inc. New York. 1994.

PINHEIRO Jr, J.R; CASTRO, A.C.L; GOMES, L.N. Estrutura da comunidade de peixes do estuário do Rio Anil, Ilha de São Luís, Maranhão. **Arq. Cien. Mar**, v. 38, p. 29-37, 2005.

ROCHA, C; FAVARO, L.F; SPACH, H.L. Biologia reprodutiva de *Sphoeroides testudineus* (Linnaeus) (Pisces, Osteichthyes, Tetraodontidae) da gamboa do Baguaçu, Paraná, Brasil. **Rev Bra Zool**, v. 19, n. 1, p. 57-63, 2002.

ROJAS, J.R; PIZARRO, M.J.F; CASTRO, M.V. Diversidad y abundancia íctica em três áreas de manglar em el Golfo de Nicoya, Costa Rica. **Rev Biol Trop**, v.42, p. 3, p. 663-672, 1994.

SANTOS, M.C.F.V. **Structural patterns of hiperhalinity stressed mangrove forests in the state of Maranhão Northern Brazil***.* Doctoral thesis - Colorado School of Mines Golden, Colorado. 164p,1989.

SEDBERRY, G; CARTER, J. The fish community of a Shallow Tropical Lagoon in Belize, Central America. **Estuaries**. v. 16, n. 2, p. 98-215, 1993.

SPACH, H.L; SANTOS, C; GODEFROID, R.S. Padrões temporais na assembléia de peixes na gamboa do Sucuriú, Baía de Paranaguá, Brasil. **Rev Bra Zool**. v. 20, n. 4, p. 591-600, 2003.

SPACH, H.L; GODEFROID, R.S; SANTOS, C; SCHWARZ, J.R.R; QUEIROZ, G.M.L. Temporal variation in fish assemblage composition on a tidal flat. **Braz Jour Oceanog**. v. 52, n. 1, p. 47-58, 2004.

STONER, A.W. Community structure of the demersal fish species of Laguna Joyuda, Puerto Rico. **Estuaries**. v. 9, n. 2, p. 42-152,1986.

VAZZOLER, A.E.A.M. **Biologia da Reprodução de peixes teleósteos**: teoria e prática. Maringá, EDUEM. 1996.

VENDEL, A.L; CHAVES, P.T.C. Use of an estuarine environment (Barra do Sal lagoon, Brazil) a nursery by fish. **Rev Bra Zool**. v. 23, n. 4, p. 1117-1122, 2006.

VENDEL, A.L; LOPES, S.G; SANTOS, C; SPACH, H.L. Fish assemblages in a tidal flat. **Braz Arch Biol Tech**. v. 46, n. 2, p. 233-242, 2003.

VENDEL, A.L; SPACH, H.L; LOPES, S.G; SANTOS, C. Structure and dynamics of fish assemblages in a tidal creek environment. **Braz Arch Biol Tech**. v. 45, n. 3, p. 365-373, 2002.

ZAR, J.H. **Biotatistical analysis** .4ed. New Jersey, Prentice-Hall, Inc. 1999.

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