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Ichthyofauna of shallow zones of the estuary of Timonha and Ubatuba Rivers, Northeastern Brazil

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ABSTRACT

The influence on seasonality on the ichthyofauna of shallow waters and estuaries of northeastern Brazil has been little studied. The present investigation evaluated the number of species, abundance and diversity as a function of alternation of dry and rainy periods along 12 months in three areas from the estuary of Timonha and Ubatuba Rivers, between the border of Ceará and Piauí States. Overall, 25 hand-trawling net were performed from August 2014 to September 2015, assessing the structure of fish assemblage with the 1387 total individuals captured, belonging to 49 species of Teleostei (38 genera and 24 families). Considering the number of species, the families Carangidae (7 species), Gerreidae (6), and Lutjanidae (4) contributed most. The community structure revealed a greater numerical participation of *Eucinostomos argenteus*, *Mugil curema*, *Atherinela brasiliensis*, *Trachinotus falcatus* and *Sphoeroides testudineus*, which accounted for 68.9% of the total number of individuals captured. Estuarine species dominated the community, followed by marine migrants and marine stragglers. The upper part of estuary, Porto dos Mosquitos, presented 38 species, Porto do Itam 32 species, and Porto da Lama 6 species. The diversity index was higher in the dry season when compared to the rainy period, which may indicate higher competition between species during rainfall regime. The results presented here show seasonal differences in the ichthyofaunal composition throughout the hydrological cycle, where mangrove and estuarine coastal areas are the key early life fish habitats, contributing to the diversity and conservation of fish populations in the region.

Keywords: Inventory; estuarine fishes; spatial distribution; mangrove; taxonomy.

Ictiofauna de zona rasa do estuário dos rios Timonha e Ubatuba, Nordeste do Brasil

RESUMO

A influência da sazonalidade sobre a ictiofauna das águas rasas e estuários do nordeste do Brasil tem sido pouco estudada. A presente investigação avaliou o número de espécies, abundância e diversidade como função da alternância dos períodos de chuva e estiagem ao longo de 12 meses em três áreas do estuário dos rios Timonha e Ubatuba, na divisa dos estados do Ceará e Piauí. No geral, 25 arrastos manuais foram realizados de agosto de 2014 a setembro de 2015, acessando a estrutura da assembleia de peixes com o total de 1387 indivíduos capturados, que pertencem a 49 espécies de Teleostei (38 gêneros e 24 famílias). Considerando o número de espécies, as famílias que mais contribuíram foram Carangidae (7 espécies), Gerreidae (6) e Lutjanidae (4). A estrutura da comunidade revelou uma maior participação numérica de *Eucinostomos argenteus*, *Mugil curema*, *Atherinela brasiliensis*, *Trachinotus falcatus* e *Sphoeroides testudineus* que responderam por 68,9% do total dos indivíduos capturados. Os estuarinos dominaram em número de espécies seguidos pelos migrantes marinhos e visitantes marinhos. A localidade mais a montante, Porto dos Mosquitos, apresentou 38 espécies, Porto do Itam 32 espécies, e Porto da Lama seis espécies. O índice de diversidade foi superior no período seco quando comparado com o período chuvoso, o que pode indicar maior competição entre espécies durante regime de chuvas. Os resultados apresentados aqui mostram diferenças sazonais na composição da ictiofauna durante os ciclos hidrológicos, onde áreas costeiras de manguezais e estuarinas são habitats-chave para o início da vida de peixes, contribuindo para a diversidade e conservação de populações de peixes na região.

Palavras-chave: inventário, peixes estuarinos, distribuição espacial, manguezais, taxonomia.

Introduction

Estuaries, mangroves and reefs are among the world's most productive and ecologically significant ecosystems (SHEAVES et al. 2015). Estuaries and bays play an important role as spawning, feeding, breeding and shelter areas for many species of fish, and this fact has been widely recorded in the literature through observations of composition and structure of fish assemblages involving their spatial and temporal patterns (ARAÚJO et al., 1998; BARLETTA et al., 2003; REIS-FILHO et al., 2010; PAIVA et al., 2009). In this context, the Timonha and Ubatuba Rivers incorporate regions considered natural nurseries for several species of marine animals, which includes endangered species, such as the West Indian manatee, *Trichechus manatus*, hawksbill turtle, *Eretmochelys imbricata*, olive turtle, *Lepidochelys olivacea*, sea turtle leather, *Dermochelys coriacea* and atlantic goliath grouper, *Epinephelus itajara* (SILVA et al., 2016; SOUZA et al, 2016).

The Environmental Protection Area of Parnaíba Delta, created under Decree number 49/96 on August 28th, 1996, is important for bio-ecological conservation, extending around the northern Maranhão and Ceará States. This estuary is in the eastern boundary of Northeastern Brazil region, belonging to the Tropical Southwestern Atlantic Province and to the Tropical Atlantic Realm, in terms of Marine Ecoregions of the World, MEOW, a global system for coastal and shelf areas (SPALDING et al., 2007). The freshwater sources of Timonha and Ubatuba Rivers are in the northern portion of the Plateau Ibiapaba, receiving waters of several other rivers and lagoons, and find the sea in the border of the States of Piauí and Ceará, in Barra do Timonha.

The Timonha-Ubatuba Estuarine System – TUES has a good capacity of renewal its waters and reaches hypersalinic condition (MORAIS et al., 2014; SILVA et al., 2016), however the knowledge related to the structure and biodiversity in this is scarce. LOEBMANN et al., (2010) reported the presence of three invasive species of crustaceans in Cajueiro da Praia beach, *Litopenaeus vannamei*, *Macrobrachium rosenbergii* and *Charybdis helleri*. Mai et al. (2012) present a list of 128 species of cartilaginous and bony fish caught in Curral trap by fishermen during the period of December 2008 to November 2009 in the mouth of this estuarine

system. Therefore, studies focused on the knowledge of the ichthyic diversity that inhabit the shallow area of the estuary are nonexistent. Inventory studies are the first step in the development of biological studies and management of an area, providing basic information on the composition and structure of the fauna investigated (SILVEIRA et al., 2010; MORRISON et al., 2008).

The goals of the present study are (1) to identify the species of reef fish that use the estuary of Timonha and Ubatuba Rivers as natural nursery and shelter areas, and (2) to describe the spatial distribution of the marine ichthyofauna along two seasons (dry and rainy). The results of the present study potentially identify seasonal changes in the fish fauna in relation to species number and composition in three localities of the estuary of Timonha and Ubatuba Rivers

Material and Methods

The present investigation was carried out in the Timonha-Ubatuba Estuarine System, abbreviated to TUES throughout the text, located between Piauí and Ceará States, on the semiarid coast of the Brazilian northeastern region, where the rivers are intermittent and they flow only during the rainy season (ROSA et al., 2003; MORAIS et al., 2014). The distance of the tidal influence is 25 km from the coast (MORAIS et al., 2014). The region at this estuarine system is classified as tropical, hot and humid according to Köppen climatic system (KOTTEK et al., 2006), with a dry season (ALVARES et al., 2013), where the rainy season is from January to June, the same period of Summer and Autumn on the Southern hemisphere (DIAS, 2005).

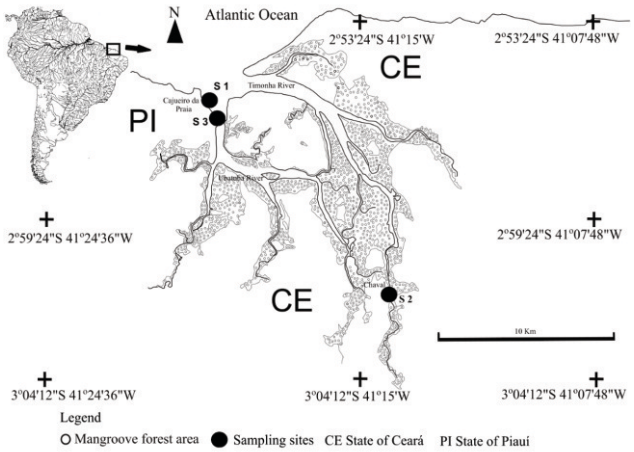

Figure 1. Sampling localities at Timonha-Ubatuba Estuarine System, assigned as S1, S2 and S3. State of Piauí (PI). State of Ceará (CE).

Fishes were collected diurnally in three sites of the estuary in a tentative biweekly periodicity during August 2014 and September 2015 (Table 1). The fishing gear used for sampling is a 20 m long net, 2 m high, with a stretched mesh size of 12 mm. It was hand-trawled perpendicularly to the margin of the estuary, at a depth between 1.7 and 0 meter for approximately one hour. All captured specimens (license SISBIO number. 43544-1 from Instituto Chico Mendes de Conservação da Biodiversidade - ICMBio) were euthanized by eugenol solution prior to fixation, being killed by overexposure according to protocol of Lucena et al. (2013). All samples were fixed in the field in 10% formalin, posteriorly preserved in 70% ethanol for permanent storage.

Table 1. Description of localities at Timonha-Ubatuba Estuarine System. Li – Locality information; Gc – Geographic coordinates; Ne – Number of Expeditions; State – S; Municipality - M

Site	Li	Gc	M	Ne	S
S1	Porto do Itam, non-vegetated area with sand bottom	2°55'51.00"S 41°19'29.07"W	Cajueiro da Praia	11	Piauí
S2	Porto dos Mosquitos, mangrove area with mud bottom	03°01'51"S 41°14'05"W	Chaval	13	Ceará
S3	Porto da Lama, non-vegetated area with sand bottom	2°56'25.10"S 41°19'21.09"W	Cajueiro da Praia	1	Piauí

Specimens were sorted, weighted to the nearest 0.1g, and identified to the lowest level in the laboratory. Species identification was based on dichotomic keys, original descriptions, identification manuals, and taxonomic reviews (ASTARLOA et al., 2018; ESPÍRITO-SANTO et al., 2005; FIGUEIREDO; MENEZES, 1978, 1980, 2000; LESSA; NÓBREGA, 2000; MENEZES; FIGUEIREDO 1980, 1985; CARPENTER 2002a, b, MARCENIUK 2005; MOURA; LINDEMAN 2007). The species list and terminology follow the taxonomic classification used by Menezes et al. (2003) updated by Nelson et al. (2016) and Eschmeyer et al. (2016) with genera and species listed alphabetically. Voucher specimens were deposited in UESPIPHB (Coleção Ictiológica UESPI *Campus* Parnaíba). The sample voucher is listed in the appendix as examined material, including the number of specimens and range of standard length in millimeters (mm).

The species were qualified according to the mode of occupation following a standardized categorization as in Elliott et al. (2007): 1) marine visitor, 2) marine migrants (estuarine-opportunistic and estuary-dependent), 3) estuarine species (resident and estuarine migrants), 4) anadromous, 5) semianadromas, 6) catadromas 7) semicatadromas, 8) amphidromas, 9) freshwater migrants and 10) fresh water wanders. Fish species were allocated following Passos et al. (2013) and Silva and Araujo (2000), according to functional groups classification. Species of teleosts living primarily associated with hard substrates on the continental shelf were also classified as reef fish species, following Floeter et al. (2003) and Herrero-Barrencua et al. (2019).

Statistical analysis followed general and specific ecological measurements as seen in Table 1. Diversity index used here varies between 0 and 1; the greater the value, the greater the sample diversity (KREBS, 2013). Constancy values were categorized as constant ($C > 50\%$), accessory ($25\% < C < 50\%$), and accidental ($C < 25\%$), following Dajoz (1983).

Table 2. Description of statistical measurements used in the investigation at Timonha-Ubatuba Estuarine System.

Abbreviation	Index	Formula	Description
n_{sp}	Abundance	-	n_{sp} = number of specimens from a given species
N	Total abundance	-	N = number of specimens at a given sample
RA_{sp}	Relative abundance	$RA_{sp} = n_{sp}/N * 100$	n_{sp} = abundance of a given species; N = total abundance at a given sample
R	Species richness	-	R = number of species at a given sample
D	Inverse Simpson's diversity index	$1 - D = \Sigma(RA_{sp}/100)^2$	RA_{sp} = relative abundance of a given species
C_{sp}	Species constancy index	$C_{sp} = s_{sp}/S * 100$	s_{sp} = number of samples in which a given species was present; S = total number of samples

Results

Taxonomic Distribution and Functional Groups

A total of 1390 specimens were sampled, weighing 12.55kg, and belonging to 49 species, 24 families and 11 orders (Table 3). Almost half of those species (49.0%) are of reef origin and are juveniles. The richest family in the whole study was Carangidae with 7 species, followed by Gerreidae with 6 species, Lutjanidae and Paralichthyidae with 4 species, Engraulidae, Haemulidae with 3 species, Clupeidae, Hemiramphidae, Ogcocephalidae, Tetraodontidae with 2 species and the remaining families had one species each.

A total of 38 species were captured in Porto dos Mosquitos (S2), followed by Porto do Itam (S1) with 32, and 7 in Porto da Lama (S3). The inner (S2) and outer estuary (S1 and S3) shared 24 species in common. The inner Porto dos Mosquitos had representatives of all fish orders within the complex of species collected in this investigation, while the species of Batrachoidiformes, Lophiiformes and Syngnathiformes were absent in the outer stations.

Fifth percent of the fish species are of reef origin. Six guilds we-

re recognized; the estuarine and the marine migrants dominated the number of species (20.4% each), followed by marine stragglers (12.2%, 6 species). The other functional groups (*i.e.*, amphidromous, anadromous, estuarine migrants) accounted for 8,2% of the species. Nineteen species were not assigned to any functional group due to a complete lack of information about their habitat use patterns. The marine migrant group dominated in number of specimens (47.1%), followed by estuarine group (28.6%).

In general, the dry and rainy periods contributed with the same amount of species from all fish families (Figure 2). The families Balistidae, Gobiidae, Hemiramphidae, Megalopidae and Ogcocephalidae had more species during the rainy period, while Batrachoididae, Clupeidae, Engraulidae Gerreidae, Haemulidae, Paralichthyidae and Scaridae had more species during the dry period.

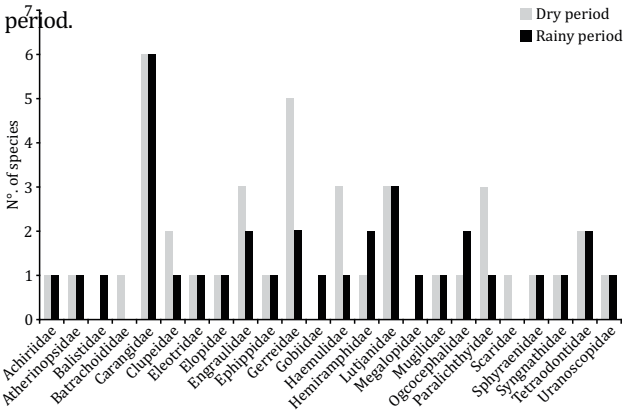

Figure 2. Differences of number of species from dry and rainy periods of the fish families collected on Timonha-Ubatuba Estuarine System.

Table 3. List of species captured at the Timonha-Ubatuba Estuarine System, with the corresponding classification according to their use of the estuary. N = Total number of individuals; N% = relative abundance. Number of specimens collected at sampling sites: S1 = Porto do Itam; S2 = Porto dos Mosquitos. S3 = Porto da Lama; FO = Frequency of occurrence (% of total samples); CI = Constancy index, classified as: Accidental (A), Accessory (AC), or Constant (C); R = species classified from reef origin; G = Guild, classified as: Amphidromous (AM), Anadromous (AN), Amphidromous (AM), Catadromous (CA), Estuarine Migrant (EM), Estuarine Species (ES), Marine Stragglers (MS), Marine Migrants (MM), Unknown Guild (UG).

Taxa	N	N%	S1	S2	S3	FO	CI	R	G
ELOPIFORMES									
Elopidae									
Elops saurus	5	0.4	2	3	0	16.0	A		AM
Megalopidae									
Megalops atlanticus	3	0.2	0	3	0	4.0	A		AM
CLUPEIFORMES									
Engraulidae									
Anchoviella brevirostris	12	0.9	7	0	5	12.0	A		ES
Lycengraulis batesii	7	0.5	4	3	0	12.0	A		ES
Lycengraulis grossidens	42	3.0	32	10	0	32.0	AC		AN
Clupeidae									
Harengula sp.	13	0.9	10	3	0	20.0	A		UG
Opisthonema oglinum	5	0.4	1	0	4	8.0	A		MS
BATRACHOIDIFORMES									
Batrachoididae									
Amphichthys cryptocentrus	2	0.1	0	2	0	4.0	A	X	UG
GOBIIFORMES									
Eleotridae									
Eleotris pisonis	42	3.0	4	38	0	44.0	AC		UG
Gobiidae									
Gobionellus oceanicus	1	0.1	0	1	0	4.0	A		ES
MUGILIFORMES									
Mugilidae									
Mugil curema	126	9.1	22	104	0	40.0	AC	X	MM
ATHERINIFORMES									
Atherinopsidae									
Atherinella brasiliensis	122	8.8	24	98	0	50.0	C		ES
BELONIFORMES									
Belonidae									
Strongilura marina	4	0.3	0	4	0	12.0	A		MM
Hyporhamphus roberti	3	0.2	2	1	0	8.0	A	X	MS
CARANGIFORMES									
Carangidae									
Carangoides crysos	4	0.3	3	1	0	8.0	A	X	MS
Caranx latus	3	0.2	0	3	0	12.0	A	X	MM
Oligoplites palometa	3	0.2	1	2	0	12.0	A		MM
Oligoplites saurus	2	0.1	2	0	0	4.0	A	X	MM
Selene vomer	3	0.2	3	0	0	12.0	A	X	MS
Trachinotus carolinus	18	1.3	18	0	0	24.0	A	X	UG
Trachinotus falcatus	104	7.5	104	0	0	28.0	AC	X	ES
ISTIOPHORIFORMES									
Sphyraenidae									
Sphyraena barracuda	9	0.6	1	8	0	28.0	AC	X	UG
PLEURONECTIFORMES									
Paralichthyidae									
Citharichthys spilopterus	6	0.4	4	1	1	12.0	A		MM
Paralichthys brasiliensis	2	0.1	1	1	0	8.0	A		MM
Paralichthys sp.	1	0.1	0	1	0	4.0			MM
Scyacium micrurum	2	0.1	1	1	0	8.0	A		UG
Achiriidae									
Achirus declivis	8	0.6	3	5	0	20.0	A		ES
SYNGNATHIFORMES									
Syngnathidae									
Hippocampus reidi	2	0.1	0	2	0	8.0	A	X	ES
TRACHINIFORMES									
Uranoscopidae									
Astroscopus y-graecum	2	0.1	0	2	0	8.0	A		UG
LABRIFORMES									
Scaridae									
Sparisoma rubripinne	1	0.1	0	0	1	4.0	A		UG
Gerreidae									
Diapterus auratus	3	0.2	0	3	0	4.0	A	X	EM
Diapterus olithostomus	1	0.1	1	0	0	4.0	A		UG
Diapterus rhombeus	4	0.3	4	0	0	8.0	A	X	ES
Eucinostomus argenteus	501	36.0	156	345	0	88.0	C	X	MM
Eugerres sp.	2	0.1	0	2	0	4.0	A		UG
Ulaema lefroy	34	2.4	2	32	0	8.0	A		ES
Haemulidae									
Genyatremus luteus	8	0.6	2	6	0	12.0	A		MS
Haemuluon plumieri	19	1.4	0	18	1	12.0	A	X	UG
Haemulopsis corvinaeformis	7	0.5	2	5	0	16.0	A		MM

Table 3 (continuation). List of species captured at the Timonha-Ubatuba Estuarine System, with the corresponding classification according to their use of the estuary. N = Total number of individuals; N% = relative abundance. Number of specimens collected at sampling sites: S1 = Porto do Itam; S2 = Porto dos Mosquitos. S3 = Porto da Lama; FO = Frequency of occurrence (% of total samples); CI = Constancy index, classified as: Accidental (A), Accessory (AC), or Constant (C); R = species classified from reef origin; G = Guild, classified as: Amphidromous (AM), Anadromous (AN), Amphidromous (AM), Catadromous (CA), Estuarine Migrant (EM), Estuarine Species (ES), Marine Stragglers (MS), Marine Migrants (MM), Unknown Guild (UG).

Taxa	N	N%	S1	S2	S3	FO	CI	R	G
Lutjanidae									
Lutjanus jocu	41	2.9	2	39	0	40.0	AC	X	UG
Lutjanus synagris	40	2.9	4	35	1	44.0	AC	X	UG
Lutjanus cf. *bucanella*	3	0.2	0	3	0	4.0	A	X	UG
Lutjanus cyanopterus	1	0.1	0	1	0	4.0	A	X	UG
MORONIFORMES									
Ephippidae									
Chaetodipterus faber	5	0.4	5	0	0	12.0	A	X	MS
LOPHIIFORMES									
Lophiidae									
Ogcocephalus vespertilio	55	4.0	0	55	0	40.0	AC	X	UG
Ogcocephalus nasutus	1	0.1	0	1	0	4.0	A		UG
TETRAODONTIFORMES									
Balistidae									
Cantherhines macrocerus	1	0.1	1	0	0	4.0	A	X	UG
Tetraodontidae									
Chilomycterus antillarum	4	0.3	0	2	2	12.0	A	X	UG
Sphoeroides testudineus	103	7.4	34	69	0	76.0	C	X	ES

Abundance, biomass and ecological indexes

Regarding fish abundance in shallower areas of Timonha-Ubatuba Estuarine System, *Eucinostomus argenteus* dominated the catches with 36.0% of the total specimens captured, followed by *Mugil curema* with 9.1%, *Atherinella brasiliensis* with 8.8%, *Trachinotus falcatus* with 7.5%, and *Sphoeroides testudineus* with 7.4%. These five species represent 68.8% of total specimens' abundance. In terms of biomass, *Amphichthys cryptocentrus, Atherinela brasiliensis*, *Chilomycterus antillarum*, *Eucinostomus argenteus* and *Ogcocephalus vespertilio* summed 60.4% of total weighed specimens, although *A. cryptocentrus* and *C. antillarum* only represent 0.4% of collected specimens.

Three species were considered constants, contributing with specimens in more than 50% of the samples: *Atherinela brasiliensis*, *Eucinostomus argenteus* and *Sphoeroides testudineus*. Eight species were considered accessories, occurring between 50 and 25% of the samples: *Eleotris pisonis, Lutjanus jocu, Lutjanus synagris, Lycengraulis grossidens, Mugil curema, Ogcocephalus vespertilio, Sphyraena barracuda, Trachinotus falcatus*. The remaining 38 species were classified as accidentals, which include 13 species that were recorded in only one sample; seven of them with only one specimen captured.

The inner locality in the estuary, Porto dos Mosquitos, presented most of the captured specimens (913) and the localities of the outer zone, Porto do Itam and Porto da Lama, presented respectively 462 and 15. *Eucinostomus argenteus*, *Mugil curema* and *Atherinella brasiliensis* were the most abundant species collected in the inner area of the estuary, while *Eucinostomus argenteus*, *Trachinotus falcatus*, *Sphoeroides testudineus*, on this sequence, at the outer portion.

During the 14 months of sampling, most of the specimens (776) were collected on rainy season, while 614 on dry season (Table 4). *Cantherhines macrocerus*, *Gobionellus oceanicus*, *Hyporhamphus roberti*, *Lutjanus bucanella*, *Megalops atlanticus*, *Ogcocephalus nasutus*, *Oligoplites saurus*, *Scyacium micrurum*, and *Ulaema lefroy* were captured only on rainy season. *Amphichthys cryptocentrus*, *Anchoviella brevirostris*, *Citharichthys spilopterus*, *Diapterus auratus*, *Diapterus olisthostomus*, *Diapterus rhombeus*, *Eugerres* sp., *Genyatremus luteus*, *Haemuluon plumieri*, *Harengula* sp., *Lutjanus cyanopterus*, *Oligoplites palometa*, *Paralichthys brasiliensis*, *Paralichthys* sp., and *Sparisoma rubripinne*, were captured only on dry season.

The species' richness ranged between 4 (Porto do Itam) to 15 (Porto dos Mosquitos) (Table 4). These extremes on species' richness were recorded during the rainy season, although no evidence of seasonal correlation to this index is clearly observed. However, it is evident that the inner locality pursuits more species than the outer zone (Table 4).

The lower values on diversity index were also related to the rainy season, indicating less diversity in this period. Higher values are apparent especially on the dry season, even though it presented the lowest index' value related to one sampling event during spring (Table 4). Spatially, the inner locality is also more diverse and had the higher catches than the outer zone.

Table 4. Ecological statistics and classification of the sampling period. Locality: Porto dos Mosquitos = PM, Porto do Itam = PI, Porto da Lama = PL; Hydric balance = HB; Richness of species = *R*; Number of specimens = *N*; and inverse Simpson diversity index = (1 – *D*).

Sample	Locality	Season	Sample date	HB	R	N	(1 – D)
1	PM	Winter	15.VIII.2014	Dry	9	19	0.84
2	PI	Winter	22.VIII.2014	Dry	6	24	0.78
3	PM	Winter	12.IX.2014	Dry	12	72	0.77
4	PI	Spring	17.X.2014	Dry	10	38	0.74
5	PM	Spring	28.XI.2014	Dry	6	35	0.46
6	PL	Spring	05.XII.2014	Dry	7	15	0.78
7	PI	Spring	12.XII.2014	Dry	10	67	0.71
8	PM	Spring	19.XII.2014	Dry	9	81	0.73
9	PM	Summer	23.I.2015	Rain	5	49	0.63
10	PI	Summer	13.II.2015	Rain	6	97	0.58
11	PM	Summer	20.II.2015	Rain	9	79	0.67
12	PI	Summer	13.III.2015	Rain	10	66	0.61
13	PM	Summer	20.III.2015	Rain	10	75	0.80
14	PI	Fall	10.IV.2015	Rain	4	25	0.48
15	PM	Fall	24.IV.2015	Rain	15	136	0.62
16	PI	Fall	15.V.2015	Rain	5	12	0.68
17	PM	Fall	22.V.2015	Rain	11	136	0.80
18	PI	Fall	15.VI.2015	Rain	7	11	0.79
19	PM	Fall	19.VI.2015	Rain	12	90	0.61
20	PI	Winter	10.VII.2015	Dry	6	34	0.63
21	PM	Winter	24.VII.2015	Dry	8	58	0.78
22	PI	Winter	07.VIII.2015	Dry	10	74	0.62
23	PM	Winter	28.VIII.2015	Dry	13	52	0.88
24	PI	Spring	11.IX.2015	Dry	6	14	0.73
25	PM	Spring	25.IX.2015	Dry	12	31	0.89

Discussion

Among the 128 species listed by Mai et al. (2012), 16.4% were also pointed out in the present study: *Anchoviella brevirostris*, *Opisthonema oglinum*, *Ogcocephalus vespertilio*, *Mugil curema*, *Atherinella brasiliensis*, *Strongylura marina*, *Caranx crysos*, *Caranx latus*, *Chloroscombrus chrysurus*, *Oligoplites palometa*, *Oligoplites saurus*, *Selene vomer*, *Trachinotus carolinus*, *Trachinotus falcatus*, *Diapterus auratus*, *Diapterus rhombeus*, *Eucinostomus argenteus*, *Genyatremus luteus, Haemulopsis corvinaeformis*, *Chaetodipterus faber* and *Sphoeroides testudineus*.

Elops saurus, Megalops atlanticus, Lycengraulis batesii, Harengula sp., *Amphichthys cryptocentrus, Eleotris pisoni, Gobionellus oceanicus, Hyporhamphus roberti, Sphyraena barracuda, Citharichthys spilopterus, Paralichthys* sp., *Scyacium micrurum, Achirus declivis,*

Hippocampus reidi, Astroscopus y-graecum, Sparisoma rubripinne, Diapterus olithostomus, Eugerres sp, *Ulaema lefroy, Haemuluon plumier, Lutjanus jocu, Lutjanus synagris, Lutjanus* cf *bucanella, Lutjanus cyanopterus, Ogcocephalus nasutus, Cantherhines macrocerus* and *Chilomycterus antillarum* range from western north Atlantic, Caribean to Brazil (MENEZES et al., 2003) but are by the first time recorded at TUES through this study.

Research projects focused on fish composition and artisanal fisheries of Timonha-Ubatuba Estuarine System – TUES indicates the presence of 153 species on its area (MELO et al., 2015; 2016). The recent information availability is related to the current increasing of detailed studies on estuarine fish (BLABER; BARLETTA, 2016). The previous data deficiency is linked to logistical difficulties (*e.g.* use of inappropriate fishing gear, access and dislocation in the muddy substrate, and its complex environmental structure), lack of experienced taxonomists, financing sources and research infrastructure (BLABER; BARLETTA, 2016).

It is difficult the comparison of richness among different ichthyofaunas due to the heterogeneity of habitats, the physical-chemical differences of the environment, and the differences on fish catching methodology. It is even important to highlight the existence of extreme, large-scale events that affect flora and fauna, such as El Niño/La Niña episodes. These phenomena are associated to the extremes higher/lower precipitation in the Northeast Brazil, and the situation presented in the previous years than the sampling of the current investigation indicates an extreme drought period (MARENGO et al., 2018). It might interfere the ecological and biological composition in estuarine systems not only locally, but elsewhere. Considering that the previous decades had well-above seasonal mean precipitation in Northeast Brazil (MARENGO et al., 2018), our results presented herein are more associated to drought condition than the wet one.

Despite the possible sources of differences, TUES presented a comparable number of species to the other estuaries on northeastern Brazil (ANDRADE-TUBINO et al., 2008). Guimarães-Rosa et al. (2019) collected 89 marine species on Parnaíba Delta; Soares Filho (1996) checked 75 species to estuary of Jaguaribe River; Vasconcelos-Filho; Oliveira (1999) checked 114 species to Santa Cruz River; Teixeira; Falcão (1992) checked 86 species to Mandaú and Manguaba Rivers; Lopes et al. (1999) checked 45 species to Baía de Todos os Santos; Paiva et al. (2008; 2009) observed 78 species in Formoso River; Reis-Filho et al. (2010) captured 124 species in Paraguaçu River. Of those species listened by Guimarães-Costa et al. (2019) collecting in 12 localities of Delta do Parnaíba, the closest estuary to TUES, 14% of them were also checked in the present study.

The comparison among different fish assemblages in the same estuary reveals interesting aspects of how ichthyofauna occupy these ecosystems. The inner locality in the estuary, Porto dos Mosquitos, presented the largest number of specimens and the localities of the outer zone, Porto do Itam and Porto da Lama, presented the smallest numbers. Araújo et al. (1998) also recorded less specimens on the outer estuary in Sepetiba Bay. Curva do Pontal Beach in Mamanguape River, estuarine region in northeastern Brazil with predominantly muddy sediment, calm waters and seagrass meadows, showed a higher abundance, biomass and richness than at reflective and intermediary beaches (OLIVEIRA; PESSANHA, 2014).

The situation highlighted above at Curva do Pontal Beach is in consonance to what is observed in Porto dos Mosquitos at TUES. The greater richness may also be associated to the mangrove area where it is inserted, which allows harboring a larger number of species, including juveniles of the families Haemulidae, Lutjanidae and Mugilidae. Haemulidae has a certain degree of habitat requirements as hiding places to avoid predation, and related to food availability (SALES et al., 2016; CHAVES et al., 2013).

In the northeastern Brazil, marine fishes occupy inner portions of estuaries. The inner portion of TUES is composed by muddy bottom, being exactly the spatial position where *Gobionellus oceanicus* was collected. The presence of Gobiidae species in such type of environment are known (MÉRIGOT et al., 2017; FERREIRA et al., 2019), what corroborates to the present investigation. Further, it is even observed that this Gobiidae species was only collected during the rainy months, suggesting the deposition of fine sediments during the rainy period attracts the species to that estuarine area, possibly related to food availability and/or reproductive rhythm. Further diet and gonadosomatic investigations are necessary to confirm the habitat use of *G. oceanicus* at the Timonha-Ubatuba Estuarine System, contributing to the ecology of this species.

There is also a significant contribution of other marine species in the estuary, most notably in mangrove swamps, where fishes use this environment during certain stage of their life cycle, usually as juveniles (BARLETTAA et al., 2003, OLIVEIRA NETO et al., 2008). Here, we detected the presence of juveniles of *Mugil curema*, *Carangoides crysos*, *Caranx latus*, *Lutjanus jocu*, *Lutjanus synagrys*, *Lutjanus cyanopterus*, *Lutjanus* cf. *bucanella*, *Haemulon plumieri*, *Citharichtys spilopterus*, *Scyacium micrurum*, *Eucinostous argenteus*, *Diapterus auratus*, *Ulaema lefroy*, *Eugerres* sp., *Sphryraena barracuda*, *Strongilura marina*, *Hyporhamphus roberti* on the banks of Porto dos Mosquitos.

TUES is the place where anthropogenic activities take place as part of its actual structure, such as: shrimp farms, salt production, animal husbandry and other farming practices It is also moderately exploited by small scale fisheries (MAI et al. 2012; SALLES et al. 2015) and tourism (SILVA et al. 2016). All that practices put pressure on the mangroves at the area (NASCIMENTO; SASSI, 2001; NASCIMENTO; SASSI, 2007). Among the species collected, *Megalops atlanticus, Mugil curema, Paralichtys brasiliensis, Chaetodipterus faber*, *Lutjanus jocu*, *Lutjanus synagris*, *Lutjanus* cf. *bucanella*, *Lutjanus cyanopterus*, *Lutjanus cyanopterus*, *Carangoides crysos, Caranx latus, Oligoplites palometa, Oligoplites saurus, Selene vomer*, *Trachinotus carolinus, Trachinotus falcatus*, *Diapterus auratus*, *Diapterus olithostomus*, *Diapterus rhombeus*, *Eucinostomus argenteus, Eugerres* sp, *Ulaema lefroy*, most part reef species, have greater commercial value or are important fishery resource to artisanal fishery. The predatory fishing and destruction of mangrove areas may lead to an unsustainable situation, compromising fish populations that depend on mangrove areas to feed, reproduce and search for shelter, as the particular case of Lutjanidae and Haemulidae species (BUKERPILE; HAY, 2008). This ecosystem was even the scenario of a social environmental project named "Pesca solidária", whose goal was elaboration of a Fishing Agreement (ICMBIO, 2015) to avoid overexploitation of estuarine fishery resources and to recognize the socio-economic importance of artisanal fishing through the participation in decisions to the sustainability of their activities (BARLETTA; LIMA, 2019).

Some species showed similar pattern of abundance in other estuaries of northeastern Brazil. *Eucinostomus argenteus* is very common along the Brazilian coast, found over sand or shell bottoms, and its juveniles occur in lagoons and mangroves (FIGUEIREDO; MENEZES, 1980, CARPENTER 2002, MENEZES et al., 2003, PAIVA et al., 2009, REIS-FILHO et al., 2010, SALES et al., 2016). Among the fishes captured on our collections, *Atherinella brasiliensis*, *C. spilopterus*, *Diapterus rhombeus* and *L. jocu* are commonly found in estuaries at Northeastern Brazil (ANDRADE-TUBINO et al., 2008). *Atherinella brasiliensis* dominated the estuarine beach at Mamanguape River (OLIVEIRA; PESSANHA, 2014).

Carangoides chrysos was recorded as rare species in the surf zone of Jaguaribe beach, State of Pernambuco, northeastern Brazil (SANTANA et al., 2013), and corroborates with the present investigation. The large number of rare and low abundant species in this study is consistent with the pattern of diversity in a tropical environment (PAULY; LONGHURST, 2007). This theory can be applied in tropical estuaries, where the mixing environment would also be responsible for the abundance and distribution of fish species (VIEIRA; MUSIC 1993).

Regarding the conservation status, *Megalops atlanticus* and *Hippocampus reidi* are classified as 'vulnerable' (MMA, 2014),

Lutjanus synagris and *L. jocu* as 'near threatened', and *Mugil curema*, *Haemulon plumieri* and *Sphoeroides testudineus* are listed as 'data deficient' (ICMBio 2016). The remaining species are currently classified as 'least concern' or were not evaluated.

Mai and Rosa (2009) evaluated the populational estructure of *H. reidi* on Camurupim/Cardoso estuary, about 9 Km west to TUES, and strongly suggest a implementation of a conservation unity area, encompassing both estuaries, to protect the marine horse and other flag species.

Conclusion

Eucinostomus argenteus, *Mugil curema* and *Atherinella brasiliensis* were the most abundant species. Porto dos Mosquitos showed greater richness than other localities.

Lower diversity in rainy season may be explained by migratory habits of some species, especially considering the r-strategist species, which usually explore empty ecological niches during this hydric season (i.e. *Mugil curema*, *Trachinotus falcatus*).

Uniformly distributed specimens (higher diversity index) on dry season may be an indicative of less competition between species. Estuarine fish may compete for space and food, and during the rainy months the catches were higher, indicating increased density. Details of competition among fish species on Timonha-Ubatuba Estuarine System may be elucidated by future research investigations.

Hyppocampus reidi is a flag species by the first time recorded to the inner part of estuary which justify the TUES as an important area for monitoring and conservation.

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Appendix

Voucher material. Quantities of specimens are indicated in parentheses. *Elops saurus*: UESPIPHB 532 (1 ex) 136,66 mm; UESPIPHB 647 (3) 70,79-71,5 mm; UESPIPHB 651 (1) 181,88 mm; UESPIPHB 707 (1) 149,69 mm. *Megalops atlanticus* UESPIPHB 523 (3). *Anchoviella brevirostris*: UESPIPHB 489 (5) 53,32-53,94 mm; UESPIPHB 506 (6) 75,68-80,32 mm; UESPIPHB 574 (1) 83,47 mm. *Licengraulis batesii*: UESPIPHB 53 (2) 86,02-111,05 mm; UESPIPHB 616 (4) 92,42-111,33 mm; UESPIPHB 722 (1) 94,54 mm; *Lycengraulis grossidens*: UESPIPHB 498 (1) 110,99 mm; UESPIPHB 515 (5) 100,9-124,57 mm; UESPIPHB 544 (3) 88,72-118,55 mm; UESPIPHB 675 (10) 88,9-118,68 mm; UESPIPHB 507 (1) 134,56 mm; UESPIPHB 569 (2) 95,49-108,92 mm; UESPIPHB 630 (1) 104,78 mm; UESPIPHB 530 (2) UESPIPHB 669 (19) 87,39-157,01 mm; UESPIPHB 683 (5) 96,96-122,0 mm. *Harengula* sp.: UESPIPHB 516 (2) 73,59-75,92 mm; UESPIPHB 542 (7) 56,9-69,83 mm; UESPIPHB 585 (1) 65,37 mm. UESPIPHB 686 (2) 73,33-73,68 mm; UESPIPHB 704 (1) 80,29 mm; UESPIPHB 721 (2) 75,27-81,09 mm; *Opistonema oglinum*: UESPIPHB 485 (4) 54,24-63,11 mm; UESPIPHB 638 (1) 60,48 mm. *Amphichthys cryptocentus*: UESPIPHB 723 (2). *Eleotris pinonis*: UESPIPHB 564 (4) 65,81-92,54 mm; UESPIPHB 589 (3) 107,1-135,66; UESPIPHB 603 (2), 71,12-77,08 mm; UESPIPHB 619 (2), 73,85-79,15 mm; UESPIPHB 527 (2) 68,96-71,05 mm; UESPIPHB 659 (4) 69,82-79,82 mm; UESPIPHB 679 (4) 60,91-80,83 mm; UESPIPHB 715 (6) 72,66-94,92 mm; UESPIPHB 701 (8) 42,52-96,47 mm; *Gobionellus oceanicus*: UESPIPHB 650 (1) 123,22 mm. *Mugil curema*: UESPIPHB 501 (1) 99,9 mm; UESPIPHB 512 (2) 83,58-108,02 mm; USPIPHB 520 (20) 36,46-65,45 mm; UESPIPHB 602 (40) 19,59-88,82 mm; UESPIPHB 622 (9) 18,65-160,54 mm; UESPIPHB 631 (17) 18,36-29,73 mm; UESPIPHB 643 (25) UESPIPHB 520 (20) UESPIPHB 643 (25) 40,33-128,04 mm; UESPIPHB 653 (2) 73,68-80,28 mm; UESPIPHB 664 (2) 66,82-89,58 mm; UESPIPHB 689 (2) 85,26-104,63 mm; UESPIPHB 700 (8) 21,67-53,69 mm. *Atherinella brasiliensis*: UESPIPHB 510 (9) 83,56-99,07 mm; UESPIPHB 523 (10) 43,65-102,49; UESPIPHB 561 (2) 81,12-92,39 mm; UESPIPHB 570 (1) 103,3 mm; UESPIPHB 578 (25) 92,05-110,75 mm; UESPIPHB 505 (10) 86,16-103,34 mm; UESPIPHB 588 (13) 42,43-97,83; UESPIPHB 599 (25) 35,07-99,60 mm. UESPIPHB 614 (3) 88,0-98,17 mm; UESPIPHB 604 (4) 88,06-97,27 mm; UESPIPHB 623 (5) 35,18-95,26 mm; UESPIPHB 632 (1) 99,12 mm; UESPIPHB 523 (10); UESPIPHB 668 (1) 35,65 mm; UESPIPHB 680 (10) 63,59-101,01 mm; UESPIPHB 690 (9) UESPIPHB 695 (3) 22,83-95,85 mm; *Hyporhamphus roberti*: UESPIPHB 494 (2) 154,99-156,38 mm; UESPIPHB 595 (1) 104,69 mm; UESPIHB 498 (1); UESPIPHB 718 (1) 73,38 mm. *Strongilura marina*: UESPIPHB 566 (2) 12,0 13,5 mm; UESPIPHB 579 (1) 257,31 mm; UESPIPHB 608 (1) 55,78 mm. *Carangoides crysos*: UESPIPHB 663, 1 ex, 36,38 mm; UESPIPHB 710, 3 ex, 42,64-48,07 mm; *Caranx latus*: UESPIPHB 525 (1); UESPIPHB 547 (1) 84,58 mm; UESPIPHB 549 (3) 61,69-78,93 mm. UESPIPHB 581 (1) 67,69 mm. *Trachinotus carolinus*: UESPIPHB 513 (4) 74,83-80,84 mm; UESPIPHB 525 (1) 41,78 mm; UESPIPHB 584 (1) 71,84 mm; UESPIPHB 618 (3) 18,57-48,20 mm; UESPIPHB 639 (6) 19,02-52,04 mm; UESPIPHB 655 (1) 35,72 mm; UESPIPHB 672 (3) 29,98-62,41 mm; UESPIPHB 684 (4) 73,46-77,53 mm. *Trachinotus falcatus*: UESPIPHB 514 (4) 49,5-58,1 mm; UESPIPHB 539 (1) 56 mm; UESPIPHB 503 (5) 56,9-78,56 mm; UESPIPHB 493 (47) ex, 70,79-15,09 mm; UESPIPHB 609 (40) 20,43-58,69 mm; UESPIPHB 633 (6) 20,35-54,15 mm; UESPIPHB 635 (1) 32,32 mm; UESPIPHB 685 (4) 49,53-59,75 mm. *Oligoplites palometa*: UESPIPHB 517 (1) 106,0 mm; UESPIPHB 524 (3) 37,58-43,49 mm; UESPIPHB 676 (1) 102,55 mm; UESPIPHB 688 (1) 105,61 mm; UESPIPHB 699 (1) 83,07 mm. *Oligoplites saurus* UESPIPHB 371 (1) ex; UESPIPHB 496(2) 50,25-76,68 mm; UESPIPHB 646 (2) 126,98-158,68 mm. *Selene vomer*: UESPIPHB 656 (1) 41,55 mm; UESPIPHB 673 (1) 60,91 mm; UESPIPHB 706 (1) 35,37 mm. *Sphyraena barracuda*: UESPIPHB 528 (1) 133,54 mm; UESPIPHB 583 (1) 188,76; UESPIPHB 591 (1) 74,23 mm; UESPIPHB 607 (1) 227,13 mm; UESPIPHB 617 (1) 28,0 mm; UESPIPHB 642 (2) 26,25-58,76 mm; UESPIPHB 666 (2) 132,49-133,29 mm. *Citharichthys spilopterus*: UESPIPHB 557 (1) 98,6 mm; UESPIPHB 568 (4) 67,68-105,7 mm; UESPIPHB 486 (1) 78,74 mm. *Paralichthys brasiliensis*: UESPIPHB 575 (1) 90,55 mm; UESPIPHB 558 (1) 102,97 mm. *Paralichthys sp*: UESPIPHB 705 (1) 55,59 mm; *Scyacium micrurum*: UESPIPHB 652 (1) 61,63 mm; UESPIPHB 658 (1) 42,87 mm. *Achirus declivis*: UESPIPHB 529 (1).; UESPIPHB 590 (2) 63,18 mm; UESPIPHB 629 (1) 26,89 mm.; UESPIPHB 654 (2).; UESPIPHB 661 (1) 34,48 mm; UESPIPHB 671 (2) 37,81-47,37 mm; UESPIPHB 703 (2) 28,57-35,93 mm. *Hyppocampus reidi*: UESPIPHB 529 (1) 40,54 mm.; UESPIPHB 718 (1) 73,38 mm. *Astroscopus ygraecum*: UESPIPHB 627 (1) 75,75 mm; UESPIPHB 719 (2) 95,54-103,91 mm. UESPIPHB 720 (1) 140,47 mm. *Sparisoma rubripinne*: UESPIPHB 490 (1) 109,80 mm. *Diapterus auratus*: UESPIPHB 418 (1); UESPIPHB 681 (3); *Diapterus rhombeus*: UESPIPHB 409 (1); UESPIPHB 572 (1) 69,10 mm; UESPIPHB 674 (2) 57,1-67,57 mm; UESPIPHB 681 (3) 60,59-69,83 mm; UESPIPHB 708 (2) 75,21-75,59 mm. *Eucinostomus argenteus*: UESPIPHB 495 (41) 58,78-83,18 mm; UESPIPHB 500 (33) 59,71-73,27 mm; UESPIPHB 508 (44) 49,84-74,09 mm; UESPIPHB 518 (80) 64,65-23,12 mm; UESPIPHB 540 (7) 50,71-57,49 mm; UESPIPHB 553 (4)52,44-66,44 mm; UESPIPHB 554 (1) 71,43 mm; UESPIPHB 556 (28) 46,41-72,15 mm; UESPIPHB 576 (8) 54,42-75,08 mm; UESPIPHB 580 (6) 60,67-70,81 mm; UESPIPHB 500 (33) UESPIPHB 586 (37) 37,5-74,69 mm; UESPIPHB 596 (15) 65,03-84,06 mm; UESPIPHB 606 (20) 54,66-67,98 mm; UESPIPHB 611 (8) 55,96-67,45 mm; UESPIPHB 620 (24) 63,16-20,65 mm; UESPIPHB 636 (2) 48,46-60,68 mm; UESPIPHB 648 (43) 29,02-72,68 mm; UESPIPHB 667 (54) 30,37-71,41 mm; UESPIPHB 670 (7) 50,58-69,86 mm; UESPIPHB 678 (21) 21,76-75,29 mm; UESPIPHB 691 (44) 63,95-75,35 mm; UESPIPHB 698 (9) 29,82-66,32 mm; UESPIPHB 709 (5) 46,40-60,27 mm; UESPIPHB 712 (4) 57,31-62,22 mm. *Eugerres* sp: UESPIPHB 702 (2) 47,67-49,35 mm. *Ulaema lefroy*: UESPIPHB 637 (2) 44,77-50,26 mm; UESPIPHB 649 (32) 39,07-57(10) mm.

Haemulon plumieri: UESPIPHB 488 (1) 71,18 mm; UESPIPHB 550 (1) 55,7 mm; UESPIPHB 563 (17) 48,36-76,38 mm. *Haemulopsis corvinaeformis*: UESPIPHB 502 (1) ex, 74,4 mm; UESPIPHB 551 (2) 75,49-78,09 mm; UESPIPHB 612 (1) 70,4 mm.; UESPIPHB 716 (3) 66,5-57,69 mm. *Genyatremus luteus*: UESPIPHB 541 (2) 43,96-58,06 mm; UESPIPHB 549 (3); UESPIPHB 560 (3) 54,27-61,04 mm. *Lutjanus bucanella*: UESPIPHB 645 (3) 57,91-71,21 mm. *Lutjanus cyanopterus*: UESPIPHB 552 (1) 79,2 mm. *Lutjanus jocu*: UESPIPHB 521 (1) 60,46 mm; UESPIPHB 548 (5) UESPIPHB 559 (1); UESPIPHB 548 (5) 69,93-162,75 mm; UESPIPHB 573 (2) 96,98-108,41 mm; UESPIPHB 559 (1) 57,5 mm; UESPI 592 (1) 59,94 mm; UESPIPHB 644 (5) 40,31-79,94 mm; UESPIPHB 657 (6) 55,69-80,89 mm; UESPIPHB 677 (8) 77,92-45,26 mm; UESPIPHB 696 (8) 49,75-77,17 mm; UESPIPHB 713 (4) 55,59-70,97 mm; *Lutjanus synagris*: UESPIPHB 526 (1) 63,28; UESPIPHB 543 (4) 46,95 mm; UESPIPHB 546 (1) 72,16 mm; UESPIPHB 567 (8) 52,19-68,27 mm; UESPIPHB 487 (1) 61,6 mm; UESPIPHB 526 (1) UESPIPHB 593 (6) 41,42-73,43 mm; UESPIPHB 605 (3) 36,69-78,73 mm. UESPIPHB 624 (5) 32,22-70,24 mm; UESPIPHB 662 (2) 59,12-66,02 mm; UESPIPHB 714 (4) 57,25-69,35 mm; UESPIPHB 697 (5) 57, 73-68,62 mm, *Chaetodipterus faber*: UESPIPHB 509 (2) 44,6-49,64 mm; UESPIPHB 571 (1) 47,72 mm; UESPIPHB 610 (2) 34,38-37,76 mm; UESPIPHB 687 (2) 45,01-47,44 mm, *Ogcocephalus vespertilio*: UESPIPHB 519 (1) 128,3 mm; *Ogcocephalus verpertilio*: UESPIPHB 565 (2) 95,44-118,37 mm; UESPIPHB 594 (13) 81,58-145,61 mm; UESPIPHB 598 (2) 157,67-166,99 mm; UESPIPHB 600 (3) 139,28-161,53; UESPIPHB 626 (17) 107,91-152,02 mm; UESPIPHB 641 (8) 83,68-19,65 mm; UESPIPHB 660 (5) 98,19-144,75 mm; UESPIPHB 693 (2) 94,35-109,16 mm; UESPIPHB 719 (2). *Ogcocephalus nasutus*: UESPIPHB 625 (1) 128,76 mm. *Cantherhines macrocerus* UESPIPHB 615 (1) 74,97 mm. *Chilomycterus antillarum*: UESPIPHB 491 (2) 194,66-235,65; UESPIPHB 531 (1) 21,60 mm UESPIPHB 628 (1) 17,34 mm. *Sphoeroides testudineus*: UESPIPHB 504 (8) 44,20-169,27 mm; UESPIPHB 511 (1) 78,54 mm; UESPIPHB 522 (11) 46,47-21,02 mm; UESPIPHB 554 (1) UESPIPHB 587 (5) 41,03-87,02 mm;UESPIPHB 562 (3) 55,16-67,79 mm; UESPIPHB 577 (17) 21,60-205,32; UESPIPHB 582 (1) 59,76 mm; UESPIPHB 597 (6) 40,05-57,73 mm; UESPIPHB 492 (4) 24,19-28,98 mm; UESPIPHB 601 (5) 46,58-58,03 mm; UESPIPHB 613 (3) 32,68-35,33 mm; UESPIPHB 621 (10) 19,5-59,85 mm; UESPIPHB 640 (12) 26,25-58,76 mm; UESPIPHB 665 (11) 34,05-61,05 mm; UESPIPHB 682 (1) 62,17 mm. UESPIPHB 692 (1) 79,4 mm; UESPIPHB 694 (2) 26,53-36,04 mm; UESPIPHB 711 (1) 41,75 mm; UESPIPHB 717 (1) 49,66 mm.

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