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DISTRIBUTION OF ESTUARINE FISH FAUNA ALONG COAST OF BRAZIL.

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RESUMO

O presente estudo teve como objetivos: listar a ictiofauna estuarina que ocorre no Brasil, a partir de dados compilados de artigos publicados em periódicos e em livros; rever a nomenclatura taxonômica válida das espécies; além de analisar ecologicamente as similaridades entre os segmentos ictiofaunísticos. Foram compilados os dados de 52 artigos científicos e livros, que tratam sobre assembleias de peixes estuarinos ou listas com abundância por espécie. Os trabalhos registraram 451 espécies válidas, sendo 225 associadas aos ambientes recifais, e 64 exclusivamente dulciaquícolas. Quatro espécies: *Lutjanus apodus*, *L. griseus*, *Scartella nuchifilis* e *Scomberomorus maculatus* não ocorrem na costa brasileira. Dentre as 104 famílias registradas, Sciaenidae foi predominante em todos os segmentos, exceto no V e no VIII. A análise de agrupamento indicou uma maior similaridade entre os segmentos II e III, e entre os segmentos V e VII.

Palavras chave: Estuários, Peixes recifais, Similaridade.

ABSTRACT

The aims of the present study were to list the estuarine fish fauna in Brazil based on data compiled from papers published in periodicals and books, review the valid taxonomic nomenclature of the species and perform an ecological analysis of the similarities in ichthyofauna between segments. Data were compiled from 52 scientific papers and books on estuarine fish assemblages as well as species abundance lists. The studies registered 451 valid species, 225 of which are associated with reef environments and 64 are exclusively freshwater species. Four species listed do not occur on the coast of Brazil: *Lutjanus apodus*, *L. griseus*, *Scartella nuchifilis* and *Scomberomorus maculatus*. Among the 104 families recorded, Sciaenidae was predominant in all segments except segment V and segment VIII. Cluster analysis indicated greater similarity between segments II and segment III as well between segments V and VII.

Key words: Estuaries, Reef fishes, Similarity.

INTRODUCTION

Approximately 1300 species of marine fish occur along the coast of Brazil (MENEZES et al., 2003). It is estimated that 20% of these species use estuarine systems in a relatively permanent fashion (HAIMOVICI; KLIPPEL, 1999), based on some of the categories proposed by Elliot et al. (2007), as feeding, breeding and/or nursery grounds (BLABER, 2000).

Knowledge on fish fauna in estuaries and coastal lakes is generally regional and most studies are contained in documents with restricted divulgation, such as technical reports, monographs, dissertations and theses (VAZZOLER at al., 1999). The aims of the present study were to list the estuarine fish fauna in Brazil based on data compiled from papers published in periodicals and books, review the valid taxonomic nomenclature of species recorded in Brazilian estuaries and perform an ecological analysis of the similarities in ichthyofauna between segments, comparing the physiogeographic characteristics of these segments.

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MATERIAL AND METHODS

The classification proposed Schaeffer-Novelli et al. (1990) was used to determine the limits between estuarine regions (Fig. 1, Tab. 1), which is founded on physiography, climate, degree of mangrove development and other variables (Tab. 2). The descriptions of the abiotic characteristics of each segment (annual precipitation, tide amplitude, evapotranspiration potential and state of mangrove development) were also based on Schaeffer-Novelli et al. (1990).

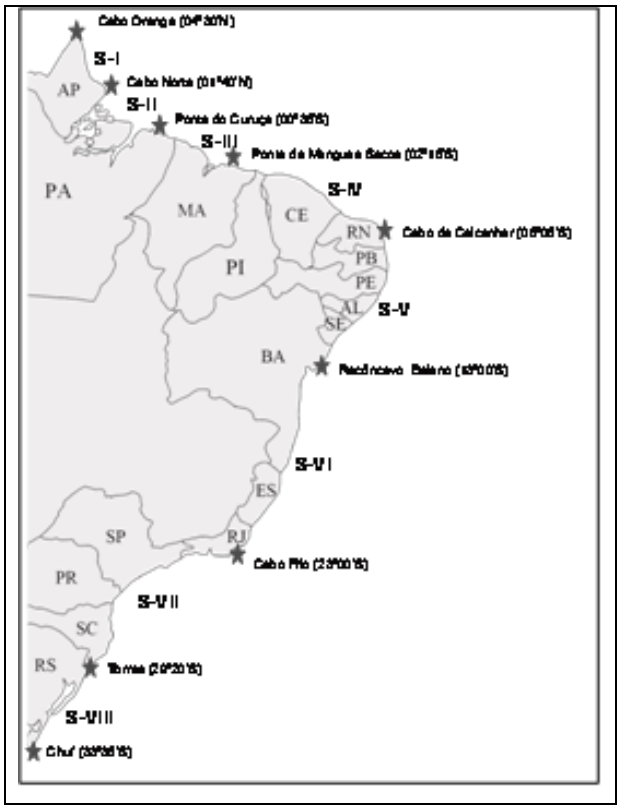

Figure 1 - Limits of each segment (indicated by stars) described by Schaeffer-Novelli (1990); S-I: segment I; S-II: segment II; S-III: segment III; S-IV: segment IV; S-V: segment V; S-VI: segment VI; S-VII: segment VII; S-VIII: segment VIII.

Table 1 - Classification of Brazilian estuaries in segments proposed by Schaeffer-Novelli et al. (1990), with respective limits in geographic coordinates; SEG: segment.

SEG.	LIMITS	COORDINATES
I	Cabo Orange (Amapá) to Cabo Norte (Amapá).	04º30'N to 01º40'N
II	Cabo Norte (Amapá) to Ponta do Curuçá (Pará).	01º40'N to 00º36'S
III	Ponta do Curuçá (Pará) to Ponta de Mangues Secos (Maranhão).	00º36'S to 02º15'S
IV	Ponta de Mangues Secos (Maranhão) to Cabo Calcanhar (Rio Grande do Norte).	02º15'S to 05º08'S
V	Cabo Calcanhar (Rio Grande do Norte) to Recôncavo Baiano (Bahia).	05º08'S to 13º00'S
VI	Recôncavo Baiano (Bahia) to Cabo Frio (Rio de Janeiro).	13º00'S to 23º00'S
VII	Cabo Frio (Rio de Janeiro) to Torres (Rio Grande do Sul).	23º00'S to 29º20'S
VIII	Torres to Chuí (Rio Grande do Sul).	29º20'S to 33º35'S

Table 2 - Abiotic characteristics and state of mangrove development in each segment proposed by Schaeffer-Novelli et al. (1990); AP: annual precipitation, TA: tide amplitude; ETP: evapotranspiration potential; MD: mangrove development.

Characteristic	Segment II	Segment III	Segment IV	Segment V
Physiography	Formed partly by Amazon delta and islands with low relief.	Coastal plain with ample presence of estuaries penetrating several kilometers.	Nearly rectilinear; subjected to high wave energy; beaches with dunes and sandstone reefs.	Narrow and rectilinear; sandy beaches; reefs parallel to coastline; exposed to high wave energy.
Climate	Humid	Humid	Dry, with pronounced dry season.	Dry, with strongly seasonal annual precipitation.
AP (mm)	2900	2000 to 2500	1250	1100 to 1500
TA (m)	2.5	4.3 to 5.2	2 to 2.6	1.3 to 2.2
ETP (mm)	1600	1400	1500 to 1600	1400
MD	Poor, due to influence of freshwater discharge from Amazon River.	Robust development, reaching 20 m.	Underdeveloped due to low freshwater input and prolonged drought; high salinity limits mangrove growth at mouths of rivers.	Development in protected areas associated with estuaries and coastal lakes due to high wave energy on coast.
Physiography	Sandy beaches dominate; mountain near center of segment restricts width of coastal plain; large coastal lakes behind sand dunes to the south; areas of upwelling.	Large stretches of mountains to the north; sandy beaches; coastal plain in southernmost portion formed by straight sandy beaches; coastal lakes formed behind large sand barriers.	Subtropical marine biogeographic transition zone; five estuarine systems with distinct characteristics in terms of shape, size, depth and circulation.	

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Cont.

Characteristic	Segment VI	Segment VII	Segment VIII
Climate	Dry	-	-
AP (mm)	1200	1090 to 1400	1500
TA (m)	0.7 to 1.8	0.24 to 1.8	0.22 to 0.24
ETP (mm)	1180	1000	1000
MD	Large mangrove forests behind beach barriers.	Mangroves exhibit gradient in terms of structure, with taller individuals on margins of estuaries, channels and the downstream portion of some rivers.	Grasses tolerant to saline environments dominate segment.

Data were compiled from 52 scientific papers and books on estuarine fish assemblages as well as species abundance lists (Tab. 3). The review of the taxonomic nomenclature to update scientific names considered improper or synonyms was based on Eschmeyer (2012) and Froese and Pauly (2012).

For each species listed, the environment in which it occurs (FROESE; PAULY, 2012), its possible association with reefs based on Ferreira et al. (1995), Humann and Deloach (2002), Paiva et al. (2008; 2009), Paiva and Araújo (2010), Froese and Pauly (2012) and its frequency of occurrence (FO%) were recorded. The latter was calculated by the ratio between the number of times a particular species occurred within each segment and the total number of segments analyzed, using the formula FO = Ts.100/T, in which Ts is the number of times a given species occurred within each segment and T is the total number of segments. The species were classified as follows: sporadic (14.0 ≤ FO% ≤ 29.0), infrequent (42.0 ≤ FO% ≤ 58.0), frequent (71.0 ≤ FO% ≤ 86.0) and very frequent (FO = 100%).

The matrix produced for the cluster analysis of the segments (SCHAEFFER-NOVELLI et al., 1990) and distribution of the estuarine fish fauna was based on binary data (presence/absence) on the species in each segment, using the Primer 6.0 program. The interpretation of the data involved a visual analysis of the dendogram.

Table 3 - Estuaries analyzed in each segment proposed by Schaeffer-Novelli et al. (1990) and respective references; SEG.: segment.

SEG.	ESTUARIES (State)	REFERENCES
I	Information unavailable	-
II	Caeté River (Pará)	Barletta (1999)
		Barletta et al. (2003)
		Ferreira et al. (2011)
	São Caetano de Odivelas and Vigia (Pará)	Barros et al. (2011)
	Curuçá River (Pará)	Giarrizzo et al. (2006)
		Giarrizzo and Krumme (2007)
		Joyeux et al. (2008)
III	Cucuruca, Paciência, Mosquitos/Coqueiro and Cachorros Rivers (Maranhão)	Martins-Juras et al. (1987)
	Tibiri River (Maranhão)	Batista and Rego (1996)
	Cucuruca River, Paciência River, Coqueiros Straits, São José Bay and São Marcos Bay (Maranhão)	Castro (1997)
	Paciência River (Maranhão)	Castro (2001)
	Jansen Lake, São Luís (Maranhão)	Castro et al. (2001/2002)
	Caranguejos Island (Maranhão)	Carvalho Neta and Castro (2008)
	Maranhense Gulf (Maranhão)	Carvalho Neta et al (2011)
IV	Jaguaribe River (Ceará)	Alves and Soares-Filho (1996)

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	Ceará to Rio Grande Norte	Araújo et al. (2004)
	Jaguaribe River (Fortim) (Ceará)	Freitas et al. (2006)
	Jaguaribe, Malcozinhado, Catu, Timonha, Ceará, Curu and Mundaú Rivers	Soares Filho et al. (2010)
V	Goiana River, Santa Cruz Channel, Jaguaribe River, Maria Farinha, Doce River, Capibaribe River, Jaboatão River, Jangadas sandbar, Suape Port, Mamucabas River, Una River; all in Pernambuco	Vasconcelos-Filho et al. (2000) Vasconcelos-Filho et al. (2004)
	Rio Grande do Norte to Sergipe	Araújo et al. (2004)
	Formoso River (Pernambuco)	Paiva et al. (2008) Paiva et al. (2009)
	Goiana, Itapessoca, Jaguaribe Rivers; Itamaracá estuary complex; Timbó, Paratibe, Beberibe, Capibaribe, Jaboatão Pirapama Rivers; Suape estuary complex; Maracaípe, Sirinhaém, Formoso, Ilhetas and Mamucabas, Una Rivers; Meireles Stream; Persinunga River; all in Pernambuco	Paiva and Araújo (2010)
	Paraguaçu River (Bahia)	Reis-Filho et al. (2010a)
	Joanes River (Bahia)	Reis-Filho et al. (2010b)
	Goiana River (Pernambuco)	Ramos et al. (2011)
VI	Cacha Pregos – Itaparica Island (Bahia)	Lopes et al. (1998)
	Vitória Bay (Espírito Santo)	Chagas et al. (2006)
VII	Marapendi Lagoon (Rio de Janeiro)	Andreata et al. (1989)
	Tijuca Lagoon (Rio de Janeiro)	Andreata et al. (1990)
	Laguna (Santa Catarina)	Monteiro-Neto et al. (1990)
	Jacarepaguá Lagoon (Rio de Janeiro).	Andreata et al. (1992)
	Santos Bay (São Paulo)	Lopes et al. (1993)
	Sepetiba Bay (Rio de Janeiro)	Araújo et al. (1998)
	Guaratuba Bay (Paraná)	Chaves and Corrêa (1998) Chaves and Vendel (2001)
	Rodrigo de Freitas Lagoon (Rio de Janeiro)	Andreata et al. (2001; 2002a)
	Itajaí Açu River (Santa Catarina)	Hostim-Silva et al. (2002)
	Ribeira Bay – Angra dos Reis (Rio de Janeiro)	Andreatta et al. (2002b)
	Baguaçu tidal creek –Paranaguá Bay (Paraná)	Vendel et al. (2002)
	Sucuriú tidal creek – Paranaguá Bay (Paraná)	Spach et al. (2003)
	Baguaçu tidal creek – Paranaguá Bay(Paraná)	Spach et al. (2004)
	Laranjeiras and Paranaguá Bays (Paraná)	Falcão et al. (2006)
	Saí Sandbar (Santa Catarina)	Vendel and Chaves (2006)
VIII	Patos Lagoon (Rio Grande do Sul).	Garcia and Vieira (1997).

		Garcia and Vieira (2001).
VIII	Mampituba River, Tramandaí-Armazém lagoon complex, Peixe Lake, Patos Lagoon, Chuí Channel (Rio Grande do Sul)	Ramos and Vieira (2001)
	Peixe Lake (Rio Grande do Sul)	Loebmann and Vieira (2005a; 2005b)
	Southwest Atlantic (Rio Grande do Sul)	Fisher et al. (2004)

RESULTS

Studies on estuarine fish are scarce in the northern region (segments I and II), part of the northeastern region (segment IV) and the segment that extends from the region of Recôncavo Baiano in the state of Bahia to Cabo Frio in the state of Rio de Janeiro (segment VI). A larger number of studies were carried out in the states of Maranhão (S-III), Pernambuco (S-V), Rio de Janeiro, Paraná (S-VII) and Rio Grande do Sul (S-VIII).

The studies registered 482 species, 451 of which are valid species (Tab. 4). Two hundred twenty-five species are associated with reef environments and 64 are exclusively freshwater species. The number of species recorded in segments II, III, IV, V, VI, VII and VIII was 143, 133, 129, 240, 112, 245 and 102, respectively.

Fourteen species were classified as very frequent (present in all segments): *Atherinella brasiliensis* (Quoy & Gaimard, 1825); *Caranx latus* Agassiz, 1831; *Centropomus paralellus* Poey, 1860; *Citharichthys spilopterus* Günther, 1862; *Diapterus rhombeus* (Cuvier, 1829); *Eucinostomus argenteus* Baird & Girard, 1855; *Eucinostomus gula* (Quoy & Gaimard, 1824); *Gobionellus oceanicus* (Pallas, 1770); *Lagocephalus laevigatus* (Linnaeus, 1766); *Lycengraulis grossidens* (Agassiz, 1829), *Micropogonias furnieri* (Desmarest, 1823); *Mugil curema* Valenciennes, 1836; *Selene vomer* (Linnaeus, 1758) and *Trichiurus lepturus* Linnaeus, 1758. Fifty-four species were classified as frequent, 97 were classified as infrequent and 286 were classified as sporadic (Tab. 4).

Four species listed do not occur on the coast of Brazil: *Lutjanus apodus* (Walbaum, 1792) for segments IV (Ponta de Mangues Secos, Maranhão to Cabo Calcanhar, Rio Grande do Norte) and V (Cabo Calcanhar, Rio Grande do Norte to Recôncavo Baiano, Bahia); *L. griseus* (Linnaeus, 1758) for segments IV, V, VI (Ponta de Mangues Secos, Maranhão to Cabo Frio, Rio de Janeiro) and VII (Cabo Frio, Rio de Janeiro to Torres, Rio Grande do Sul); *Scartella nuchifilis* (Valenciennes, 1836) for segment V; and *Scomberomorus maculatus* (Mitchill, 1815) for segments II (Cabo Norte, Amapá to Ponta do Curuçá, Pará) and V.

Table 4 - Species of estuarine fish cited for coast of Brazil; Legend: ENVIRON. = environment; M = marine; M-E = marine/estuarine; M-FW-E = marine/freshwater /estuarine, FW = freshwater.

VALID NAME	NAMES CITED	FAMILY	ENVIRON.	Ass.Rec.	%FO
Abudefduf saxatilis (Linnaeus, 1758)		Pomacentridae	M	X	57.1
Acanthostracion polygonius Poey, 1876		Ostraciidae	M	X	14.3
Acanthostracion quadricornis (Linnaeus, 1758)		Ostraciidae	M	X	42.9
Acanthurus bahianus Castelnau, 1855		Acanthuridae	M	X	14.3
Acanthurus chirurgus (Bloch, 1787)		Acanthuridae	M	X	57.1
Acanthurus coeruleus Bloch & Schneider, 1801		Acanthuridae	M	X	14.3
Achirus achirus (Linnaeus, 1758)		Achiridae	M-FW-E		57.1
Achirus declivis Chabanaud, 1940		Achiridae	M-E		57.1
Achirus lineatus (Linnaeus, 1758)		Achiridae	M-E		85.7
Aetobatus narinari (Euphrasen, 1790)		Myliobatidae	M-E	X	28.6
Albula nemoptera (Fowler, 1911)		Albulidae	M-FW-E	X	14.3
Albula vulpes (Linnaeus, 1758)		Albulidae	M-E	X	42.9
Aluterus heudelotii Hollard, 1855		Monacanthidae	M	X	14.3
Aluterus monoceros (Linnaeus, 1758)	*Alutera monocerus*	Monacanthidae	M	X	14.3
Aluterus schoepfii (Walbaum, 1792)	*Alutera schoepfii*	Monacanthidae	M	X	14.3
Amphiarius phrygiatus (Valenciennes, 1840)	*Arius phrygiatus*	Ariidae	M-E		14.3
Amphiarius rugispinis (Valenciennes, 1840)	*Arius rugispinis*	Ariidae	M-E		14.3
Amphichthys cryptocentrus (Valenciennes, 1837)		Batrachoididae	M	X	14.3
Anableps anableps (Linnaeus, 1758)		Anablepidae	FW-E		28.6
Anableps microlepis Müller & Troschel, 1844		Anablepidae	FW-E		14.3

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Anchoa filifera (Fowler, 1915)	*Anchoa hovelli*	Engraulidae	M-E		28.6
Anchoa hepsetus (Linnaeus, 1758)		Engraulidae	M-E		14.3
Anchoa januaria (Steindachner, 1879)		Engraulidae	M-E		28.6
Anchoa lyolepis (Evermann & Marsh, 1900)		Engraulidae	M	X	42.9
Anchoa marinii Hildebrand, 1943		Engraulidae	M		28.6
Anchoa parva (Meek & Hildebrand, 1923)		Engraulidae	M-FW-E		42.9
Anchoa spinifer (Valenciennes, 1848)		Engraulidae	M-FW-E		71.4
Anchoa tricolor (Spix & Agassiz, 1829)		Engraulidae	M-E		28.6
Anchovia clupeoides (Swainson, 1839)		Engraulidae	M-E		57.1
Anchovia surinamensis (Bleeker, 1865)		Engraulidae	FW-E		14.3
Anchoviella brevirostris (Günther, 1868)		Engraulidae	M-E		28.6
Anchoviella guianensis (Eigenmann, 1912)		Engraulidae	FW-E		14.3
Anchoviella lepidentostole (Fowler, 1911)		Engraulidae	M-FW-E		57.1
Anisotremus surinamensis (Bloch, 1791)		Haemulidae	M	X	28.6
Anisotremus virginicus (Linnaeus, 1758)		Haemulidae	M	X	42.9
Antennarius multiocellatus (Valenciennes, 1837)		Antennariidae	M	X	14.3
Antennarius striatus (Shaw, 1794)	*Antenarius scaber; Phrynelox scaber*	Antennariidae	M-E	X	28.6
Apionichthys dumerili Kaup, 1858		Achiridae	M-FW-E	X	14.3
Apogon maculatus (Poey, 1860)		Apogonidae	M	X	14.3
Archosargus probatocephalus (Walbaum, 1792)		Sparidae	M-E	X	85.7
Archosargus rhomboidalis (Linnaeus, 1758)	*Archosargus unimaculatus*	Sparidae	M-E	X	42.9
Aspistor luniscutis (Valenciennes, 1840)	*Arius luniscutis*	Ariidae	M-FW-E		42.9
Aspistor quadriscutis (Valenciennes, 1840)	*Arius quadriscutis*	Ariidae	M-FW-E		28.6
Aspredinichthys filamentosus (Valenciennes, 1840)		Aspredinidae	FW-E		14.3

Aspredinichthys tibicen (Valenciennes, 1840)		Aspredinidae	FW-E		28.6
Aspredo aspredo (Linnaeus, 1758)		Aspredinidae	FW-E		28.6
Astronotus ocellatus (Agassiz, 1831)		Cichlidae	FW		14.3
Astroscopus y-graecum (Cuvier, 1829)		Uranoscopidae	M	X	14.3
Astyanax alburnus (Hensel, 1870)		Characidae	FW		14.3
Astyanax bimaculatus (Linnaeus, 1758)	*Astyanax bimaculatus vittatus*	Characidae	FW		42.9
Astyanax eigenmanniorum (Cope, 1894)		Characidae	FW		14.3
Astyanax fasciatus (Cuvier, 1819)		Characidae	FW		14.3
Astyanax jacuhiensis (Cope, 1894)		Characidae	FW		14.3
Astyanax taeniatus (Jenyns, 1842)		Characidae	FW		14.3
Atherinella brasiliensis (Quoy & Gaimard, 1825)	*Xenomelaniris brasiliensis*	Atherinopsidae	M-E	X	100.0
Atlantoraja platana (Günther, 1880)		Rajidae	M		14.3
Australoheros facetus (Jenyns, 1842)	*Cichlasoma facetum*	Cichlidae	FW		14.3
Awaous tajasica (Lichtenstein, 1822)		Gobiidae	FW-E		28.6
Bagre bagre (Linnaeus, 1766)		Ariidae	M-E		57.1
Bagre marinus (Mitchill, 1815)		Ariidae	M-E	X	42.9
Bairdiella ronchus (Cuvier, 1830)		Sciaenidae	M-E		85.7
Balistes capriscus Gmelin, 1789		Balistidae	M	X	14.3
Balistes vetula Linnaeus, 1758		Balistidae	M	X	14.3
Bathygobius soporator (Valenciennes, 1837)		Gobiidae	M-FW-E	X	85.7
Batrachoides surinamensis (Bloch & Schneider, 1801)		Batrachoididae	M-E	X	42.9
Boridia grossidens Cuvier, 1830		Haemulidae	M		14.3
Bothus ocellatus (Agassiz, 1831)		Bothidae	M	X	28.6

Brachyplatystoma vaillantii (Valenciennes, 1840)		Pimelodidae	FW-E		14.3
Brevoortia aurea (Spix & Agassiz, 1829)		Clupeidae	M		14.3
Brevoortia pectinata (Jenyns, 1842)		Clupeidae	M-E		28.6
Bryx dunckeri (Metzelaar, 1919)	*Syngnathus dunckeri*	Syngnathidae	M	X	14.3
Callichthys callichthys (Linnaeus, 1758)		Callichthyidae	FW		28.6
Cantherhines pullus (Ranzani, 1842)	*Amanses pullus*	Balistidae	M	X	28.6
Canthigaster figuereidoi Moura & Castro, 2002	*Canthigaster rostrata*; *Canthigaster rostratus*	Tetraodontidae	M	X	14.3
Caranx bartholomaei (Cuvier, 1833)		Carangidae	M	X	42.9
Caranx crysos (Mitchill, 1815)		Carangidae	M	X	57.1
Caranx hippos (Linnaeus, 1766)		Carangidae	M-E	X	85.7
Caranx latus Agassiz, 1831		Carangidae	M-FW-E	X	100.0
Caranx ruber (Bloch, 1793)		Carangidae	M	X	14.3
Carcharhinus porosus (Ranzani, 1839)		Carcharhinidae	M-E	X	14.3
Catathyridium garmani (Jordan, 1889)	*Achirus garmani*	Achiridae	M-FW-E		42.9
Cathorops agassizii (Eigenmann & Eigenmann, 1888)	*Cathorops pleurops*	Ariidae	FW	X	28.6
Cathorops spixii (Agassiz, 1829)	*Arius spixii*	Ariidae	M-E		71.4
Centropomus ensiferus Poey, 1860		Centropomidae	M-FW-E		14.3
Centropomus mexicanus Bocourt, 1868		Centropomidae	M-E		14.3
Centropomus parallelus Poey, 1860		Centropomidae	M-FW-E	X	100.0
Centropomus pectinatus Poey, 1860		Centropomidae	M-FW-E		28.6
Centropomus undecimalis (Bloch, 1792)		Centropomidae	M-FW-E	X	85.7
Cetengraulis edentulus (Cuvier, 1829)		Engraulidae	M-E		85.7

Chaetodipterus faber (Broussonet, 1782)		Ephippidae	M-E	X	85.7
Chaetodon ocellatus Bloch, 1787		Chaetodontidae	M	X	14.3
Chaetodon striatus Linnaeus, 1758		Chaetodontidae	M	X	42.9
Characidium rachovii Regan, 1913		Crenuchidae	FW		14.3
Cheilopogon melanurus (Valenciennes, 1847)	*Cypselurus melanurus*	Exocoetidae	M		14.3
Cheirodon ibicuhiensis Eigenmann, 1915		Characidae	FW		14.3
Cheirodon interruptus (Jenyns, 1842)		Characidae	FW		14.3
Chilomycterus antillarum Jordan & Rutter, 1897	*Cyclichthys antillarum*	Diodontidae	M	X	57.1
Chilomycterus reticulatus (Linnaeus, 1758)		Diodontidae	M	X	14.3
Chilomycterus spinosus spinosus (Linnaeus, 1758)	*Cyclichthys spinosus*	Diodontidae	M-E	X	71.4
Chirocentrodon bleekerianus (Poey, 1867)		Pristigasteridae	M-E		42.9
Chloroscombrus chrysurus (Linnaeus, 1766)		Carangidae	M-E	X	85.7
Cichla ocellaris Bloch & Schneider, 1801		Cichlidae	FW-E		14.3
Cichlasoma bimaculatum (Linnaeus, 1758)	*Cichlasoma bimaculatus*	Cichlidae	FW		14.3
Cichlasoma portalegrense (Hensel, 1870)		Cichlidae	FW		14.3
Citharichthys arenaceus Evermann & Marsh, 1900		Paralichthyidae	M		57.1
Citharichthys cornutus (Günther, 1880)		Paralichthyidae	M	X	14.3
Citharichthys macrops Dresel, 1885		Paralichthyidae	M	X	42.9
Citharichthys spilopterus Günther, 1862		Paralichthyidae	M-FW-E	X	100.0
Cnesterodon decemmaculatus (Jenyns, 1842)		Poeciliidae	FW-E		14.3
Colomesus asellus (Müller & Troschel 1849)		Tetraodontidae	FW		14.3
Colomesus psittacus (Bloch & Schneider, 1801)		Tetraodontidae	M-FW-E		57.1
Conger orbignianus Valenciennes, 1837		Congridae	M		14.3
Conodon nobilis (Linnaeus, 1758)		Haemulidae	M	X	57.1

Corydoras paleatus (Jenyns, 1842)		Callichthyidae	FW		14.3
Cosmocampus elucens (Poey, 1868)	*Syngnathus elucens*	Syngnathidae	M	X	14.3
Crenicichla lepidota Heckel, 1840		Cichlidae	FW		14.3
Crenicichla saxatilis (Linnaeus, 1758)		Cichlidae	FW		14.3
Ctenogobius boleosoma (Jordan & Gilbert, 1882)	*Gobionellus boleosoma*	Gobiidae	M-FW-E	X	57.1
Ctenogobius shufeldti (Jordan & Eigenmann, 1887)	*Gobionellus schufeldti*	Gobiidae	FW-E		57.1
Ctenogobius smaragdus (Valenciennes, 1837)	*Gobionellus smaragdus*	Gobiidae	M	X	71.4
Ctenogobius stigmaticus (Poey, 1860)	*Gobionellus stigmaticus*	Gobiidae	M		42.9
Ctenosciaena gracilicirrhus (Metzelaar, 1919)		Sciaenidae	M		14.3
Cyclopsetta chittendeni Bean, 1895		Paralichthyidae	M	X	14.3
Cynoponticus savanna (Bancroft, 1831)		Muraenesocidae	M-E		14.3
Cynoscion acoupa (Lacepède, 1801)		Sciaenidae	M-FW-E		71.4
Cynoscion guatucupa (Cuvier, 1830)	*Cynoscion striatus*	Sciaenidae	M		14.3
Cynoscion jamaicensis (Vaillant & Bocourt, 1883)		Sciaenidae	M-E		42.9
Cynoscion leiarchus (Cuvier, 1830)		Sciaenidae	M-E		85.7
Cynoscion microlepidotus (Cuvier, 1830)		Sciaenidae	M-E		85.7
Cynoscion steindachneri (Jordan, 1889)		Sciaenidae	M-FW-E		28.6
Cynoscion virescens (Cuvier, 1830)		Sciaenidae	M-E		14.3
Cyphocharax gilbert (Quoy & Gaimard, 1824)	*Pseudocurimata gilbert gilbert*	Curimatidade	FW		14.3
Cyphocharax saladensis (Meinken, 1933)		Curimatidade	FW		14.3
Cyphocharax voga (Hensel, 1870)		Curimatidade	FW		14.3
Dactylopterus volitans (Linnaeus, 1758)		Dactylopteridae	M-E	X	42.9
Dasyatis americana Hildebrand & Schroeder, 1928		Dasyatidae	M-E	X	14.3
Dasyatis centroura (Mitchill, 1815)		Dasyatidae	M-E	X	14.3

Dasyatis geijskesi Boseman, 1948		Dasyatidae	M-E		14.3
Dasyatis guttata (Bloch & Schneider, 1801)		Dasyatidae	M	X	71.4
Dasyatis sayi (Lesueur, 1817)		Dasyatidae	M		28.6
Diapterus auratus Ranzani, 1842	*Diapterus olisthostomus*	Gerreidae	M-E	X	85.7
Diapterus rhombeus (Cuvier, 1829)		Gerreidae	M-E	X	100.0
Diodon holocanthus Linnaeus, 1758		Diodontidae	M	X	14.3
Diodon hystrix Linnaeus, 1758		Diodontidae	M	X	14.3
Diplectrum formosum (Linnaeus, 1766)		Serranidae	M	X	14.3
Diplectrum radiale (Quoy & Gaimard, 1824)		Serranidae	M-E	X	85.7
Diplodus argenteus (Valenciennes, 1830)		Sparidae	M	X	14.3
Distocyclus conirostris (Eigenmann & Allen, 1942)		Sternopygidae	FW		14.3
Dormitator maculatus (Bloch, 1792)		Eleotridae	M-FW-E		57.1
Echeneis naucrates Linnaeus, 1758		Echeneidae	M-E	X	57.1
Eigenmannia virescens (Valenciennes, 1836)		Sternopygidae	FW		28.6
Eleotris pisonis (Gmelin, 1789)		Eleotridae	M-FW-E		57.1
Elops saurus Linnaeus, 1766		Elopidae	M-E	X	71.4
Engraulis anchoita Hubbs & Marini, 1935		Engraulidae	M		14.3
Entomacrodus nigricans Gill, 1859		Blenniidae	M	X	14.3
Epinephelus itajara (Lichtenstein, 1822)		Serranidae	M-E	X	85.7
Epinephelus marginatus (Lowe, 1834)		Serranidae	M	X	28.6
Epinephelus nigritus (Holbrook, 1855)		Serranidae	M	X	14.3
Epinephelus niveatus (Valenciennes, 1828)		Serranidae	M	X	14.3
Erotelis smaragdus (Valenciennes, 1837)		Eleotridae	M-E		14.3
Etropus crossotus Jordan & Gilbert, 1882	*Citharichthys crossotus*	Paralichthyidae	M-E	X	71.4

Etropus longimanus Norman, 1933		Paralichthyidae	M	X	28.6
Eucinostomus argenteus Baird & Girard, 1855		Gerreidae	M-FW-E	X	100.0
Eucinostomus gula (Quoy & Gaimard, 1824)	*Gerres gula*	Gerreidae	M-FW-E	X	100.0
Eucinostomus melanopterus (Bleeker, 1863)		Gerreidae	M-FW-E	X	85.7
Eugerres brasilianus (Cuvier, 1830)		Gerreidae	M	X	57.1
Eugerres lineatus (Humboldt, 1821)		Gerreidae	M		14.3
Evorthodus lyricus (Girard, 1858)		Gobiidae	M-FW-E		28.6
Fistularia petimba Lacepède, 1803		Fistulariidae	M-E	X	14.3
Fistularia tabacaria Linnaeus, 1758		Fistulariidae	M-E	X	28.6
Galeorhinus galeus (Linnaeus, 1758)	*Galeorhinus vitaminicus*	Triakidae	M		14.3
Genidens barbus (Lacepède, 1803)	*Netuma barba*	Ariidae	M-E		42.9
Genidens genidens (Cuvier, 1829)		Ariidae	M-E		42.9
Genyatremus luteus (Bloch, 1790)		Haemulidae	M-E		71.4
Geophagus brasiliensis (Quoy & Gaimard, 1824)		Cichlidae	FW-E		28.6
Gerres cinereus (Walbaum, 1792)		Gerreidae	M-FW-E	X	28.6
Ginglymostoma cirratum (Bonatore, 1788)		Ginglymostomatidae	M-E	X	14.3
Gnatholepis thompsoni Jordan, 1904		Gobiidae	M	X	14.3
Gobioides broussonnetii Lacepède, 1800		Gobiidae	M-FW-E		100.0
Gobionellus oceanicus (Pallas, 1770)		Gobiidae	M-FW-E		42.9
Gobionellus stomatus Starks, 1913		Gobiidae	E		14.3
Gobiosoma hemigymnum (Eigenmann & Eigenmann, 1888)		Gobiidae	M		28.6

Guavina guavina (Valenciennes, 1837)		Eleotridae	M-FW-E		57.1
Gymnothorax funebris Ranzani, 1839	*Lycodontis funebris*	Muraenidae	M	X	57.1
Gymnothorax moringa (Cuvier, 1829)	*Lycodontis moringa*	Muraenidae	M	X	14.3
Gymnothorax nigromarginatus (Girard, 1858)		Muraenidae	M	X	14.3
Gymnothorax ocellatus Agassiz, 1831		Muraenidae	M	X	57.1
Gymnotus carapo Linnaeus, 1758		Gymnotidae	FW		28.6
Gymnura altavela (Linnaeus, 1758)		Gymnuride	M-E	X	14.3
Gymnura micrura (Bloch & Schneider, 1801)		Gymnuride	M-E	X	57.1
Haemulon aurolineatum Cuvier, 1830		Haemulidae	M	X	42.9
Haemulon chrysargyreum Günther, 1859		Haemulidae	M	X	14.3
Haemulon flavolineatum (Desmarest, 1823)		Haemulidae	M	X	28.6
Haemulon parra (Desmarest, 1823)		Haemulidae	M	X	28.6
Haemulon plumierii (Lacepède, 1801)		Haemulidae	M	X	14.3
Haemulon squamipinna Rocha & Rosa, 1999		Haemulidae	M	X	14.3
Haemulon steindachneri (Jordan & Gilbert (1882)		Haemulidae	M	X	57.1
Halichoeres poeyi (Steindachner, 1867)		Labridae	M	X	14.3
Harengula clupeola (Cuvier, 1829)		Clupeidae	M-E	X	42.9
Harengula jaguana Poey, 1865		Clupeidae	M-E		28.6
Hemicaranx amblyrhynchus (Cuvier, 1833)		Carangidae	M		42.9
Hemiramphus balao Lesueur, 1821		Hemiramphidae	M-E		42.9
Hemiramphus brasiliensis (Linnaeus, 1758)		Hemiramphidae	M	X	42.9
Hippocampus erectus Perry, 1810	*Hippocampus hudsonius*	Syngnathidae	M	X	28.6
Hippocampus reidi Ginsburg, 1933		Syngnathidae	M-E	X	42.9
Hirundichthys affinis (Gunther, 1866)		Exocoetidae	M		14.3

Histrio histrio (Linnaeus, 1758)		Antennariidae	M	X	14.3
Holocentrus adscensionis (Osbeck, 1765)		Holocentridae	M	X	14.3
Hoplias malabaricus (Bloch, 1794)		Erythnidae	FW		57.1
Hoplosternum littorale (Hancock, 1828)		Callichthyidae	FW		14.3
Hyphessobrycon bifasciatus Ellis, 1911		Characidae	FW		14.3
Hyphessobrycon boulengeri (Eigenmann, 1907)		Characidae	FW		14.3
Hyphessobrycon igneus Miquelarena, Menni, López & Casciotta, 1980		Characidae	FW		14.3
Hyphessobrycon luetkenii (Boulenger, 1887)		Characidae	FW		14.3
Hyphessobrycon meridionalis Ringuelet, Miquelarena & Menni, 1978		Characidae	FW		14.3
Hypleurochilus fissicornis (Quoy & Gaimard, 1824)		Blenniidae	M		14.3
Hyporhamphus roberti roberti (Valenciennes, 1847)		Hemiramphidae	M-E		28.6
Hyporhamphus unifasciatus (Ranzani, 1841)		Hemiramphidae	M-E	X	71.4
Hypostomus plecostomus (Linnaeus, 1758)	*Plecostomus plecostomus*	Loricariidae	FW		42.9
Hypostomus watwata Hancock, 1828	*Hypostomus verres*	Loricariidae	FW		14.3
Isogomphodon oxyrhynchus (Muller & Henle, 1839)		Carcharhinidae	M-E		14.3
Isopisthus parvipinnis (Cuvier, 1830)		Sciaenidae	M-E		71.4
Jenynsia lineata (Jenyns, 1842)		Anablepidae	FW		28.6
Jenynsia multidentata (Jenyns, 1842)		Anablepidae	FW		28.6
Kryptolebias ocellatus (Hensel, 1868)	*Rivulus ocellatus*	Rivulidae	FW-E		14.3
Labrisomus nuchipinnis (Quoy & Gaimard, 1824)		Labrisomidae	M	X	42.9
Lactophrys trigonus (Linnaeus, 1758)		Ostraciidae	M	X	42.9
Lagocephalus laevigatus (Linnaeus, 1766)		Tetraodontidae	M-E		100.0
Larimus breviceps Cuvier, 1830		Sciaenidae	M-E	X	71.4
Leporinus friderici (Bloch, 1794)		Anostomidae	FW		14.3

Lile piquitinga (Schreiner & Miranda Ribeiro, 1903)		Clupeidae	FW-E		42.9
Lobotes surinamensis (Bloch, 1790)		Lobotidae	M-E	X	28.6
Lonchurus lanceolatus (Bloch, 1788)		Sciaenidae	M-E		14.3
Loricaria parnahybae Steindachner, 1907		Loricariidae	FW		14.3
Loricariichthys anus (Valenciennes, 1835)		Loricariidae	FW		14.3
Lutjanus alexandrei Moura & Lindeman, 2007		Lutjanidae	M	X	14.3
Lutjanus analis (Cuvier, 1828)		Lutjanidae	M-E	X	71.4
Lutjanus apodus (Walbaum, 1792)		Lutjanidae	M-E	X	28.6
Lutjanus cyanopterus (Cuvier, 1828)		Lutjanidae	M-E	X	28.6
Lutjanus griseus (Linnaeus, 1758)		Lutjanidae	M-FW-E	X	57.1
Lutjanus jocu (Bloch & Schneider, 1801)		Lutjanidae	M-FW-E	X	71.4
Lutjanus synagris (Linnaeus, 1758)		Lutjanidae	M	X	85.7
Lutjanus vivanus (Cuvier, 1828)		Lutjanidae	M	X	14.3
Lycengraulis batesii (Günther, 1868)	*Lycengraulis barbouri*	Engraulidae	FW-E		28.6
Lycengraulis grossidens (Agassiz, 1829)		Engraulidae	M-FW-E	X	100.0
Macrodon ancylodon (Bloch & Schneider, 1801)		Sciaenidae	M-E		42.9
Macropsobrycon uruguayanae Eigenmann, 1915		Characidae	FW		14.3
Megalops atlanticus Valenciennes, 1847	*Tarpon atlanticus*	Megalopidae	M-FW-E	X	57.1
Melichthys niger (Bloch, 1786)	*Melichthys piceus*	Balistidae	M	X	14.3
Menticirrhus americanus (Linnaeus, 1758)	*Menticirrhus martinicensis*	Sciaenidae	M-E		71.4
Menticirrhus littoralis (Holbrook, 1847)		Sciaenidae	M-E		71.4
Microdesmus bahianus Dawson, 1973		Microdesmidae	M	X	14.3
Microdesmus longipinnis (Weymouth,1910)		Microdesmidae	M		14.3
Microgobius carri Fowler, 1945		Gobiidae	M	X	14.3

Microgobius meeki Evermann & Marsh, 1899		Gobiidae	M		57.1
Microphis brachyurus lineatus (Kaup, 1856)	*Oostethus lineatus*	Syngnathidae	M-FW-E	X	57.1
Micropogonias furnieri (Desmarest, 1823)		Sciaenidae	M-E		100.0
Mimagoniates inequalis (Eigenmann, 1911)		Characidae	FW		14.3
Mobula hypostoma (Bancroft, 1831)		Myliobatidae	M	X	14.3
Monacanthus ciliatus (Mitchill, 1818)		Monacanthidae	M	X	14.3
Mugil cephalus Linnaeus, 1758		Mugilidae	M-FW-E	X	28.6
Mugil curema Valenciennes, 1836		Mugilidae	M-FW-E	X	100.0
Mugil curvidens Valenciennes, 1836		Mugilidae	M		14.3
Mugil gaiamardianus Desmarest, 1831		Mugilidae	M		71.4
Mugil incilis Hancock, 1830		Mugilidae	M-E		57.1
Mugil liza Valenciennes, 1836	*Mugil brasiliensis*	Mugilidae	M-FW-E	X	71.4
Mugil platanus Günther, 1880		Mugilidae	M-E		42.9
Mugil trichodon Poey, 1875		Mugilidae	M-FW-E		71.4
Mullus argentinae Hubbs & Marini, 1933		Mullidae	M		14.3
Mycteroperca acutirostris (Valenciennes, 1828)		Serranidae	M	X	28.6
Mycteroperca bonaci (Poey, 1860)		Serranidae	M	X	71.4
Mycteroperca microlepis (Goode & Bean, 1879)		Serranidae	M-E	X	28.6
Myrichthys ocellatus (Lesueur, 1825)		Ophichthidae	M	X	14.3
Myrophis punctatus Lütken, 1852		Ophichthidae	M-E	X	57.1
Narcine brasiliensis (Olfers, 1831)		Narcinidae	M	X	57.1
Nebris microps Cuvier, 1830		Sciaenidae	M-E		14.3
Notarius grandicassis (Valenciennes, 1840)	*Arius grandicassis*	Ariidae	M-E		28.6

Ocyurus chrysurus (Bloch, 1791)		Lutjanidae	M	X	28.6
Odontesthes argentinensis (Valenciennes, 1835)		Atherinopsidae	M-FW-E		14.3
Odontesthes bonariensis (Valenciennes, 1835)		Atherinopsidae	M-FW-E		28.6
Odontesthes incisa (Jenyns, 1841)	*Austroatherina incisa*	Atherinopsidae	M-FW-E		14.3
Odontognathus mucronatus Lacepède 1800		Pristigasteridae	M-FW-E		28.6
Ogcocephalus vespertilio (Linnaeus, 1758)		Ogcocephalidae	M	X	57.1
Oligoplites palometa (Cuvier, 1832)		Carangidae	M-FW-E	X	71.4
Oligoplites saliens (Bloch, 1793)		Carangidae	M-E	X	57.1
Oligoplites saurus (Bloch & Schneider, 1801)		Carangidae	M-E	X	71.4
Oligosarcus jenynsii (Günther, 1864)		Characidae	FW		14.3
Oligosarcus robustus Menezes, 1969		Characidae	FW		14.3
Oncopterus darwini Steindachner, 1874		Pleuronectidae	M		14.3
Ophichthus cylindroideus (Ranzani, 1840)		Ophichthidae	M		14.3
Ophichthus gomesii (Castelnau, 1855)		Ophichthidae	M		28.6
Ophichthus ophis (Linnaeus, 1758)		Ophichthidae	M	X	14.3
Ophichthus parilis (Richardson, 1848)		Ophichthidae	M		14.3
Ophioscion punctatissimus Meek & Hildebrand, 1925		Sciaenidae	M		28.6
Opisthonema oglinum (Lesueur, 1818)		Clupeidae	M	X	71.4
Opistognathus cuvierii Valenciennes, 1836		Opistognathidae	M	X	14.3
Oreochromis niloticus (Linnaeus, 1758)		Cichlidae	FW-E		14.3
Orthopristis ruber (Cuvier, 1830)		Haemulidae	M-E	X	57.1
Parablennius pilicornis (Cuvier, 1829)		Blenniidae	M	X	14.3
Paralichthys brasiliensis (Ranzani, 1842)		Paralichthyidae	M-E	X	71.4
Paralichthys orbignyanus (Valenciennes, 1839)	*Paralichthys orbignyana*	Paralichthyidae	M-E		42.9

Paralichthys patagonicus Jordan, 1889	*Paralichthys bicyclophorus*	Paralichthyidae	M		28.6
Paralichthys triocellatus Miranda Ribeiro, 1903		Paralichthyidae	M		14.3
Paralichthys tropicus Ginsburg, 1933		Paralichthyidae	M	X	14.3
Paralonchurus brasiliensis (Steindachner, 1875)		Sciaenidae	M-E		42.9
Parapimelodus nigribarbis (Boulenger, 1889)		Pimelodidae	FW		14.3
Pareques acuminatus (Bloch & Schneider, 1801)	*Equetus acuminatus*	Sciaenidae	M	X	14.3
Pellona flavipinnis (Valenciennes, 1837)		Pristigasteridae	FW-E		28.6
Pellona harroweri (Fowler, 1917)		Pristigasteridae	M-E		42.9
Pempheris schomburgkii Müller & Troschel, 1848		Pempheridae	M	X	14.3
Peprilus paru (Linnaeus, 1758)		Stromateidae	M-E	X	42.9
Phalloceros caudimaculatus (Hensel, 1868)		Poeciliidae	FW		14.3
Phalloptychus januarius (Hensel, 1868)		Poeciliidae	FW		28.6
Phtheirichthys lineatus (Menziens, 1791)		Echeneidae	M		14.3
Pimelodella australis Eigenmann, 1917		Heptapteridae	FW		14.3
Pimelodella cristata (Müller & Troschel 1849)		Heptapteridae	FW		28.6
Pimelodella lateristriga (Lichtenstein, 1823)		Heptapteridae	FW		14.3
Pimelodus blochii Valenciennes, 1840		Pimelodidae	FW		14.3
Pimelodus maculatus Lacepède, 1803		Pimelodidae	FW		28.6
Plagioscion squamosissimus (Heckel, 1840)		Sciaenidae	FW		14.3
Platanichthys platana (Regan, 1917)		Clupeidae	FW-E		57.1
Poecilia reticulata Peters, 1859		Poeciliidae	FW-E		14.3
Poecilia vivipara Bloch & Schneider, 1801		Poeciliidae	FW-E		71.4
Pogonias cromis (Linnaeus, 1766)		Sciaenidae	M-E	X	28.6
Polydactylus oligodon (Günther, 1860)		Polynemidae	M-E	X	28.6

Polydactylus virginicus (Linnaeus, 1758)		Polynemidae	M-E	X	85.7
Polyprion americanus (Bloch & Schneider, 1801)		Polyprionidae	M		14.3
Pomacanthus arcuatus (Linnaeus, 1758)		Pomacanthidae	M	X	14.3
Pomacanthus paru (Bloch, 1787)		Pomacanthidae	M	X	71.4
Pomadasys corvinaeformis (Steindachner, 1868)		Haemulidae	M-E	X	57.1
Pomadasys crocro (Cuvier, 1830)		Haemulidae	M-FW-E		42.9
Pomadasys ramosus (Poey, 1860)		Haemulidae	M-E		28.6
Pomatomus saltatrix (Linnaeus, 1766)	*Pomatomus saltator*	Pomatomidae	M-E	X	28.6
Porichthys porosissimus (Cuvier, 1829)		Batrachoididae	M	X	28.6
Priacanthus arenatus Cuvier, 1829		Priacanthidae	M	X	14.3
Prionotus punctatus (Bloch, 1793)	*Prionotus alipionis*	Triglidae	M-E	X	85.7
Pristis perotteti (Muller & Henle, 1841)		Pristidae	M-FW-E		14.3
Pristobrycon striolatus (Steindachner, 1908)		Characidae	FW		14.3
Prochilodus nigricans (Steindachner, 1908)		Prochilodontidae	FW		14.3
Pseudauchenipterus nodosus (Bloch, 1794)		Auchenipteridae	FW		28.6
Pseudocorynopoma doriae Perugia, 1891		Characidae	FW		14.3
Pseudupeneus maculatus (Bloch, 1793)		Mullidae	M	X	42.9
Pterengraulis atherinoides Linnaeus, 1766		Engraulidae	FW-E		28.6
Pygocentrus nattereri Kner 1858	*Serrasalmus nattereri*	Characidae	FW		28.6
Ramnogaster arcuata (Jenyns, 1842)		Clupeidae	M		14.3
Remora remora (Linnaeus, 1758)		Echeneidae	M	X	14.3
Rhamdia quelen (Quoy & Gaimard, 1824)		Heptapteridae	FW		28.6
Rhinesomus triqueter (Linnaeus, 1758)	*Lactophrys triqueter*	Ostraciidae	M	X	14.3
Rhinobatos horkelii Müller & Henle, 1841		Rhinobatidae	M		14.3

Rhinobatos percellens (Walbaum, 1792)		Rhinobatidae	M	X	28.6
Rhinoptera bonasus (Mitchill, 1815)		Myliobatidae	M-E	X	42.9
Rhinosardinia amazonica (Steindachner, 1879)		Clupeidae	FW-E		57.1
Rhizoprionodon lalandii (Müller & Henle, 1839)		Carcharhinidae	M	X	28.6
Rhizoprionodon porosus (Poey, 1861)		Carcharhinidae	M-FW-E	X	42.9
Rioraja agassizii (Müller & Henle 1841)	*Raja agassizi*	Rajidae	M		14.3
Rypticus randalli Courtenay, 1967		Serranidae	M	X	42.9
Rypticus saponaceus (Bloch & Schneider, 1801)		Serranidae	M	X	42.9
Sardinella aurita Valenciennes, 1847		Clupeidae	M		14.3
Sardinella brasiliensis (Steindachner, 1879)	*Sardinella janeiro*	Clupeidae	M-E		42.9
Scartella cristata (Linnaeus, 1758)		Blenniidae	M	X	14.3
Scartella nuchifilis (Valenciennes, 1836)		Blenniidae	M		14.3
Scarus trispinosus Valenciennes, 1840		Scaridae	M	X	14.3
Schizodon fasciatus Spix & Agassiz, 1829		Anostomidae	FW		14.3
Sciades couma (Valenciennes, 1840)	*Arius couma*	Ariidae	M-FW-E		42.9
Sciades herzbergii (Bloch, 1794)	*Arius herzbergii*	Ariidae	M-FW-E		57.1
Sciades parkeri (Traill, 1832)	*Arius parkeri; Aspistor parkeri*	Ariidae	M-E		57.1
Sciades passany (Valenciennes, 1840)	*Arius passany*	Ariidae	M-E		14.3
Sciades proops (Valenciennes, 1840)	*Hexanematichthys proops; Arius proops*	Ariidae	M-FW-E		57.1
Scomberomorus brasiliensis Collette, Russo & Zavala-Camin, 1978		Scombridae	M	X	57.1
Scomberomorus cavalla (Cuvier, 1829)		Scombridae	M	X	28.6
Scomberomorus maculatus (Mitchill, 1815)		Scombridae	M	X	28.6
Scomberomorus regalis (Bloch, 1793)		Scombridae	M	X	28.6
Scorpaena brasiliensis Cuvier, 1829		Scorpaenidae	M	X	28.6

Scorpaena isthmensis Meek & Hildebrand, 1928		Scorpaenidae	M	X	28.6
Scorpaena plumieri Bloch, 1789		Scorpaenidae	M	X	57.1
Selene setapinnis (Mitchill, 1815)		Carangidae	M-E	X	42.9
Selene vomer (Linnaeus, 1758)		Carangidae	M-E	X	100.0
Serranus atrobranchus (Cuvier, 1829)		Serranidae	M	X	14.3
Serranus auriga (Cuvier, 1829)	*Dules auriga*	Serranidae	M	X	14.3
Serranus flaviventris (Cuvier, 1829)		Serranidae	M	X	28.6
Serrasalmus spilopleura Kner, 1858		Characidae	FW		14.3
Sparisoma amplum (Ranzani, 1841)		Scaridae	M	X	28.6
Sparisoma axillare (Steindachner, 1878)		Scaridae	M	X	28.6
Sparisoma radians (Valenciennes, 1840)		Scaridae	M	X	14.3
Sphoeroides greeleyi Gilbert, 1900		Tetraodontidae	M-E	X	71.4
Sphoeroides nephelus (Goode & Bean,1882)		Tetraodontidae	M-E	X	42.9
Sphoeroides spengleri (Bloch, 1785)		Tetraodontidae	M-E	X	57.1
Sphoeroides testudineus (Linnaeus, 1758)		Tetraodontidae	M-E	X	71.4
Sphoeroides tyleri Shipp, 1972		Tetraodontidae	M	X	14.3
Sphyraena barracuda (Edwards, 1771)		Sphyraenidae	M-E	X	28.6
Sphyraena guachancho Cuvier, 1829		Sphyraenidae	M-E	X	28.6
Sphyraena sphyraena (Linnaeus, 1758)		Sphyraenidae	M		14.3
Sphyraena tome Fowler, 1903		Sphyraenidae	M		14.3
Sphyrna lewini (Griffith & Smith, 1834)		Sphyrnidae	M-E	X	14.3
Sphyrna tiburo (Linnaeus, 1758)		Sphyrnidae	M-E	X	28.6
Sphyrna tudes (Valenciennes, 1822)		Sphyrnidae	M		14.3
Stegastes fuscus (Cuvier, 1830)		Pomacentridae	M	X	28.6

Stegastes variabilis (Castelnau, 1855)	*Pomacentrus variabilis*	Pomacentridae	M	X	28.6
Steindachnerina elegans (Steindachner, 1875)	*Pseudocurimata elegans*; *Curimata elegans*	Curimatidade	FW		28.6
Stellifer brasiliensis (Schultz, 1945)		Sciaenidae	M		71.4
Stellifer microps (Steindachner, 1864)	*Ophioscion micros*	Sciaenidae	M-E		28.6
Stellifer naso (Jordan, 1889)		Sciaenidae	M-E		28.6
Stellifer rastrifer (Jordan, 1889)		Sciaenidae	M-E		71.4
Stellifer stellifer (Bloch, 1790)		Sciaenidae	M-E		57.1
Stephanolepis hispidus (Linnaeus, 1766)		Monacanthidae	M	X	28.6
Stephanolepis setifer (Bennett, 1831)		Monacanthidae	M	X	14.3
Strongylura marina (Walbaum, 1792)		Belonidae	M-FW-E	X	42.9
Strongylura timucu (Walbaum, 1792)		Belonidae	M-FW-E	X	71.4
Syacium micrurum Ranzani, 1842		Paralichthyidae	M	X	28.6
Syacium papillosum (Linnaeus, 1758)		Paralichthyidae	M	X	28.6
Symphurus diomedeanus (Goode & Bean, 1885)		Cynoglossidae	M		28.6
Symphurus jenynsi Evermann & Kendall, 1906		Cynoglossidae	M		14.3
Symphurus plagusia (Bloch & Schneider, 1801)		Cynoglossidae	M-E		71.4
Symphurus tessellatus (Quoy & Gaimard, 1824)		Cynoglossidae	M-E		57.1
Sympterygia bonapartii Müller & Henle, 1841		Rajidae	M		14.3
Synbranchus marmoratus Bloch 1795		Symbranchidae	FW-E		14.3
Syngnathus folletti Herald, 1942		Syngnathidae	M		28.6
Syngnathus typhle Linnaeus, 1758	*Syngnathus pelagicus*	Syngnathidae	M-E	X	42.9
Synodus foetens (Linnaeus, 1766)		Synodontidae	M-E	X	71.4
Synodus poeyi Jordan, 1887		Synodontidae	M	X	14.3
Thalassophryne maculosa Günther, 1861		Batrachoididae	M	X	28.6

Thalassophryne montevidensis (Berg, 1893)		Batrachoididae	M	X	14.3
Thalassophryne nattereri Steindachner, 1876		Batrachoididae	M-E	X	42.9
Thalassophryne punctata Steindachner, 1876		Batrachoididae	M	X	14.3
Thyrsitops lepidopoides (Cuvier, 1832)		Gempylidae	M		14.3
Tilapia rendalli (Boulenger, 1897)		Cichlidae	FW-E		14.3
Tomeurus gracilis Eigenmann, 1909		Poeciliidae	FW		14.3
Tomicodon fasciatus (Peters, 1859)		Gobiesocidae	M	X	14.3
Trachelyopterus galeatus (Linnaeus 1766)	*Trachycorystes galeatus*	Auchenipteridae	FW		28.6
Trachinocephalus myops (Forster, 1801)		Synodontidae	M	X	28.6
Trachinotus carolinus (Linnaeus, 1766)		Carangidae	M-E	X	85.7
Trachinotus cayennensis Cuvier, 1832		Carangidae	M-E		14.3
Trachinotus falcatus (Linnaeus, 1758)		Carangidae	M-E	X	71.4
Trachinotus goodei Jordan & Evermann, 1896		Carangidae	M	X	14.3
Trachinotus marginatus Cuvier, 1832		Carangidae	M	X	28.6
Trachurus lathami Nichols, 1920		Carangidae	M	X	14.3
Trichiurus lepturus Linnaeus, 1758		Trichiuridae	M-E	X	100.0
Trinectes maculatus (Bloch & Schneider, 1801)		Achiridae	M-FW-E		14.3
Trinectes microphthalmus (Chabanaud, 1928)	*Achirus microphthalmus*	Achiridae	M-E		42.9
Trinectes paulistanus (Miranda Ribeiro, 1915)		Achiridae	M-E		71.4
Triportheus angulatus (Spix & Agassiz, 1829)	*Triportheus angulatus angulatus*	Characidae	FW		14.3
Tylosurus acus acus(Lacepède, 1803)		Belonidae	M	X	28.6
Tylosurus crocodilus (Péron & Lesueur, 1821)		Belonidae	M	X	14.3
Ulaema lefroyi (Goode, 1874)	*Eucinostomus lefroyi*	Gerreidae	M	X	42.9
Umbrina canosai Berg, 1895		Sciaenidae	M-E		14.3

Umbrina coroides Cuvier, 1830	Sciaenidae	M-E		28.6
Upeneus parvus Poey, 1852	Mullidae	M	X	14.3
Uraspis secunda (Poey, 1860)	Carangidae	M	X	28.6
Urophycis brasiliensis (Kaup, 1858)	Phycidae	M		28.6
Xiphophorus hellerii Heckel 1848	Poeciliidae	FW-E		14.3
Zapteryx brevirostris (Müller & Henle, 1841)	Rhinobatidae	M	X	14.3

Table 5 displays the most specious of the 104 families recorded. Sciaenidae was predominant in all segments except segment V (Cabo Calcanhar, Rio Grande do Norte to Recôncavo Baiano, Bahia), where it was numerically equivalent to Haemulidae, and segment VIII (Torres to Chuí, Rio Grande do Sul), where Characidae predominated.

Cluster analysis indicated greater similarity between segments II (Cabo Norte, Amapá to Ponta do Curuçá, Pará) and segment III (Ponta do Curuçá, Pará to Ponta de Mangues Secos, Maranhão) as well between segments V (Cabo Calcanhar, Rio Grande do Norte to Recôncavo Baiano, Bahia) and VII (Cabo Frio, Rio de Janeiro to Torres, Rio Grande do Sul) (Fig. 2).

Table 5 - Most specious families of estuarine fish cited for Brazil and number of species recorded in each segment proposed by Schaeffer-Novelli et al. (1989); S-II: segment II; S-IV: segment IV; S-V: segment V; S-VI: segment VI; S-VII: segment VII; S-VIII: segment VIII.

	Family	Brazil	S-II	S-III	S-IV	S-V	S-VI	S-VII	S-VIII
1	Sciaenidae	29	19	14	11	14	8	19	8
2	Characidae	22	1	1	4	1	0	1	17
3	Carangidae	19	10	11	9	12	5	18	7
4	Engraulidae	18	12	5	2	9	3	11	2
5	Ariidae	16	11	9	9	8	0	6	2
6	Haemulidae	16	2	4	8	14	3	11	0
7	Serranidae	14	2	4	4	6	5	13	2
8	Paralichthyidae	14	6	2	2	9	7	11	2
9	Gobiidae	14	8	3	3	8	7	11	5
10	Clupeidae	11	1	4	3	6	3	6	6

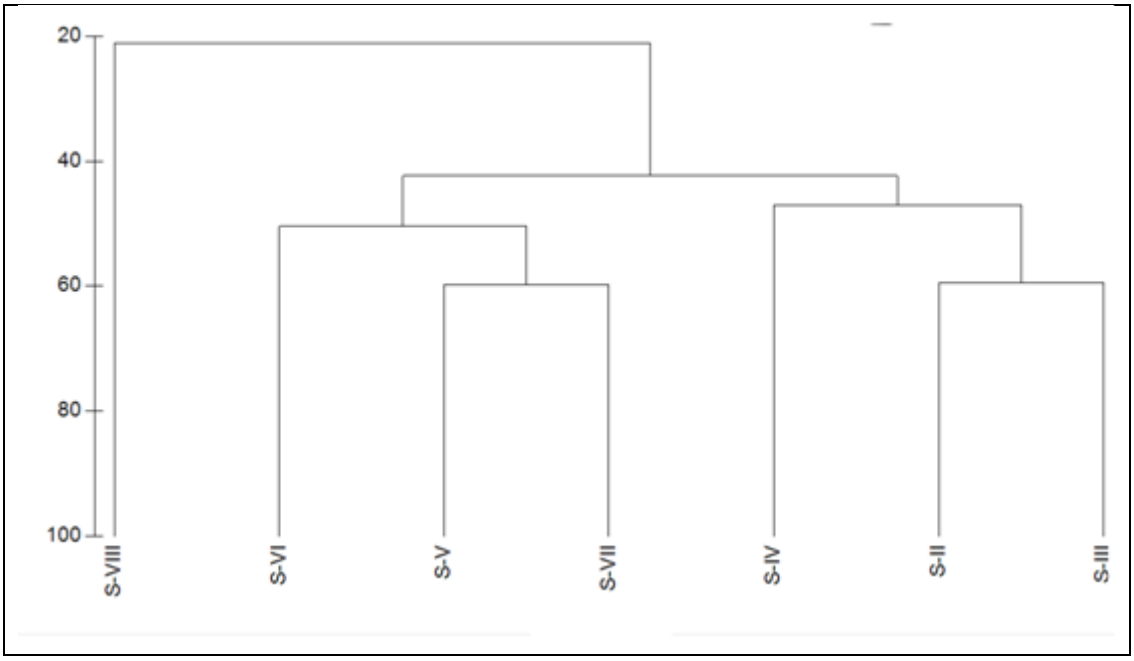

Figure 2 - Similarity analysis of fish fauna in estuaries on Brazilian coast in segments proposed by Schaeffer-Novelli et al. (1990); S-II: segment II; S-III: segment III; S-IV:

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segment IV; S-V: segment V; S-VI: segment VI; S-VII: segment VII; S-VIII: segment VIII.

DISCUSSION

More than 3000 species of freshwater fish and 1200 species of marine fish are recorded for Brazil (FROESE; PAULY, 2012). Comparing the number of valid species compiled in the present study (451) with the total number of marine fish, approximately 30% occur in estuarine systems. This figure is 50% higher than the percentage estimated by Haimovici and Klippel (1999). Among the 363 species of fish associated with reefs in Brazil (FROESE; PAULY, 2012), 62% were recorded in estuaries in the present study. These findings suggest connectivity between estuaries and other ecosystems, such as rivers and reefs, and underscore the role of estuaries in the lifecycle of coastal fish.

Most families found in estuaries of the Atlantic Ocean have widely distributed representatives, with differences on the genus and species level (VIEIRA; MUSICK, 1994). A number of families, including the most specious (Sciaenidae and Carangidae), occur in all estuaries analyzed, varying only with regard to the distribution of species per segment. In segment V (Cabo Calcanhar to Recôncavo Baiano), Haemulidae was numerically equivalent to Sciaenidae. In segment VI (Recôncavo Baiano to Cabo Frio), Sciaenidade was dominant, followed by Paralichthyidae and Gobiidae, whereas Characidae dominated in segment VIII (Torres to Chuí). According to Nelson (2006), Sciaenidae and Carangidae have broad distribution in the South Atlantic, where they exploit a large variety of habitats. Juveniles and adults of different species of these families use estuarine areas for growth and feeding (MENEZES; FIGUEIREDO, 1980). Representatives of Haemulidae occur predominantly in tropical and subtropical seas. The genera *Haemulon* and *Anisotremus* are found more in areas with corals and rocks, whereas *Pomadasys*, *Genyatremus*, *Boridia*, *Conodon* and *Orthopristis* are more characteristic of sandy beaches and estuarine areas (MENEZES; FIGUEIREDO, 1980), as demonstrated in segments III (Ponta do Curuçá, Pará to Ponta de Mangues Secos, Maranhão), IV (Ponta de Mangues Secos, Maranhão to Cabo Calcanhar, Rio Grande do Norte), V (Cabo Calcanhar, Rio Grande do Norte to Recôncavo Baiano, Bahia) and VII (Cabo Frio, Rio de Janeiro to Torres, Rio Grande do Sul).

In comparison to other families of the order Characiformes, Characidae is the largest and most complex (BRITSKI et al., 1988), with the species of this family distributed throughout practically all freshwater environments (LUCENA, 1993). In the present study, the majority of characids were present in segment VIII (Torres to Chuí, Rio Grande do Sul), with greater representativity in Peixe Lake. The northernmost and southernmost portions of this lake are connected by channels and wetlands, giving it characteristics of a pre-limnic zone (LOEBMANN; VIEIRA, 2005a), which would explain the dominance of characids in this segment. Loebmann and Vieira (2005a) report three large groups of species in Peixe Lake (Rio Grande do Sul): limnic, estuarine and marine. The presence of species of limnic species is associated with the channels and wetlands, which have waters with a low degree of salinity (< 0.1). These waters favor a greater percentage of freshwater fish (31.4%) in segment VIII, represented mainly by Characidae, which is one of the most abundant freshwater families in the state of Rio Grande do Sul (FISHER et al., 2004). Moreover, *Micropogonias furnieri* (Desmarest, 1823) is the species with the greatest amount of biomass in Patos Lagoon and systematically uses the entire lake environment throughout its ontogeny (VIEIRA et al., 1998).

Regarding frequency of occurrence, *A. brasiliensis*, *C. latus*, *C. paralellus*, *C. spilopterus*, *D. rhombeus*, *E. argenteus, E. gula*, *G. oceanicus*, *L. laevigatus*, *L. grossidens*, *M. furnieri*, *Mugil curema*, *S. vomer* and *T. lepturus* were present in all segments analyzed. Indeed, Menezes et al. (2003) and Froese and Pauly (2012) report these species to be widely distributed along the coast of Brazil.

Four species listed in the present study are not actually recorded for the Brazilian coast: *Scartella nuchifilis* (Valenciennes, 1836), *Scomberomorus maculatus* (Mitchill, 1815), *Lutjanus apodus* (Walbaum, 1792) and *L. griseus* (Linnaeus, 1758). Froese and Pauly (2012) state that *Scartella nuchifilis* is endemic to the Ascension Islands of the East Atlantic and that *S. brasiliensis* has been confused with *S. maculatus* in the Caribbean and on the Atlantic coast of

South America. Moura and Lindeman (2007) report that *L. alaxandrei* has often been confused with two fish restricted to the Caribbean and the eastern coast of the United States of America (*L. griseus* and *L. apodus*), as these species have characteristics in common with *L. alexandrei*, such as the scale distribution pattern and coloration. It was once believed that *L. griseus* and *L. apodus* occur on the coast of Brazil, but all specimens identified in the country as these two species were actually *L. alexandrei* (MOURA; LINDEMAN, 2007).

The cluster analysis revealed that the fish fauna in segment VIII (Torres to Chuí, Rio Grande do Sul) differs from that of the other segments (approximately 20% similarity) and similarities were found between segments II (Cabo Orange to Cabo Norte, Amapá) and III (Ponta do Curuçá, Pará to Ponta de Mangues Secos, Maranhão) as well as between segments V (Cabo Calcanhar, Rio Grande do Norte to Recôncavo Baiano, Bahia) and VII (Cabo Frio, Rio de Janeiro to Torres, Rio Grande do Sul).

Segment VIII corresponds to a tropical-subtropical biogeographic transition zone, where five estuarine systems with distinct characteristics in terms of shape, size, depth and circulation are found, and also exhibits vegetation made up of grasses tolerant to saline environments (SCHAEFFER-NOVELLI et al., 1990). According to Ramos and Vieira (2001), estuaries in the state of Rio Grande do Sul are affected by both tropical and temperate masses of water, the latter of which limits the number of tropical species in these estuaries. This was confirmed in the present study by the occurrence of 38 exclusive species in S-VIII, corresponding to 37.2% of the total number of species in this segment.

Tropical fauna occurs where the minimum water temperature is higher than 20ºC, whereas subtropical fauna is found in waters with temperatures below 16ºC (RAMOS; VIEIRA, 2001). According to Vieira and Musick (1993, 1994), water temperatures between 16 and 18ºC enable the exchange of tropical and temperate estuarine fish fauna. For instance, *Ctenogobius boleosoma* (Jordan & Gilbert, 1882) and *Bathygobius soporator* (Valenciennes, 1837) are characteristic of tropical climates (FROESE; PAULY, 2012), but occur in estuaries at higher latitudes (Mampituba River to Tramandaí-Armazém lagoon system) (RAMOS; VIEIRA, 2001). On the other hand, the influence of temperate coastal waters is greater in Patos Lagoon and the Chuí Channel, allowing the presence of exclusive species in these areas (RAMOS; VIEIRA, 2001), such as *Australoheros facetus* (Jenyns, 1842), *Corydoras paleatus* (Jenyns, 1842) and all species of the genus *Hyphessobrycon* recorded here.

Segments II and III are formed by part of the Amazon Delta and islands with low relief, exhibiting a coastal plain with the ample presence of estuaries. The mangroves exhibit considerable structural development, reaching as high as 20 meters (SCHAEFFER-NOVELLI et al., 1990). The fish fauna in these two segments was represented by 194 species. Some species recorded for northern Brazil are restricted to the equatorial Atlantic (MENEZES et al., 2003), as demonstrated by the distribution of 43 species recorded exclusively in segments II and III. *Anableps anableps* (Linnaeus, 1758), *Aspistor quadriscutis* (Valenciennes, 1840), *Aspredinichthys tibicen* (Valenciennes, 1840), *Aspredo aspredo* (Linnaeus, 1758), *Cynoscion steindachneri* (Jordan, 1889), *Lycengraulis batesii* (Günther, 1868), *Pseudauchenipterus nodosus* (Bloch, 1794), *Pterengraulis atherinoides* (Linnaeus, 1766) and *Stellifer naso* (Jordan, 1889) are common in these segments and have also been reported in rivers of the Brazilian Amazon forest (FROESE; PAULY, 2012).

Among the countries of South America, *Pimelodella cristata* (Müller & Troschel, 1849) is only cited for Guyana, French Guyana, Peru, Argentina and Suriname. In contrast, *Anchoa hepsetus* (Linnaeus, 1758) and *Mugil cephalus* Linnaeus, 1758 are reported to be widely distributed, the former occurring from the state of Massachusetts in the USA to southern Uruguay and the latter classified as cosmopolitan (FROESE; PAULY, 2012). The fact that the two latter species have not been recorded in segments IV and VIII may be due to the small fishing effort and the lack of standardization among the types of gear employed by the authors of the studies.

Among the physiographic characteristics common to segments V and VII, Schaeffer-Novelli et al. (1990) describe the presence of sandy beaches, the structural development of mangroves in protected areas associated with estuaries and coastal lakes and the occurrence of

reefs parallel to the coastline in segment V. In contrast, Hostim-Silva (2006) report that rocky beaches of the southern region are the main ecosystems for reef fish, where a high degree of structural complexity is found.

A large number of species occurred in segments V and VII, in which the fish fauna exhibited approximately 60% similarity. Reef environments are found throughout the entire coast of Brazil, making part of the Tropical Atlantic System (FERREIRA et al., 2004), but their formation and type vary depending on the latitudinal gradient (FLOETER et al., 2001). The occurrence of sandstone or rocky reefs is recorded from the state of Ceará (northeastern Brazil) to Rio Grande do Sul (southern Brazil) (GUERRA; MANSO, 2004). However, coral reefs are only found from Parcel de Manuel Luís in the state of Maranhão (00º53'S; 44º16'W) to the region of Abrolhos in the state of Bahia (18º01'S; 39º17'W) (FERREIRA; MAIDA, 2006).

The cluster uniting segments V and VII was possibly defined by the presence of species associated with coral and sandstone reefs. Among the 118 species found in segment V and/or segment VII, 62.0% are also included in the category of reef fish (FERREIRA et al., 1995; HUMANN; DELOACH, 2002; PAIVA; ARAÚJO, 2010; FROESE; PAULY, 2012). The diversity, abundance and biomass of fish increase in accordance with the complexity of the habitats (LOWE-MCCONNELL, 1999), as in the case of reef environments.

The community of reef fish in northeastern Brazil is influenced by the South Equatorial Current and the considerable diversity of corals (FLOETER et al., 2001), which favor an increase in the number of fish dependent on reef environments in estuarine zones. This is demonstrated by the occurrence of typical reef fish in estuarine environments, such as *Abudefduf saxatilis* (Linnaeus, 1758), *Acanthostracion quadricornis* (Linnaeus, 1758), *Acanthurus chirurgus* (Bloch, 1787), *Cantherhines pullus* (Ranzani, 1842) and *Chaetodon striatus* Linnaeus. Moreover, among the 61 exclusive species in segment V, 41% are associated with reefs, which lends support to this hypothesis.

The reefs of southeastern Brazil are subject to seasonal upwelling caused by the South Atlantic Central Water, which lowers the water temperature (< 18°C) and raises the nutrient content in waters near the shore (EKAU; KNOPPERS, 1999; FLOETER et al., 2001). Thus, the reef fish fauna in these areas appears to be the richest in Brazil due to the presence of both tropical and subtropical species (HOSTIM-SILVA, 2006). Thus, species associated with reefs account for 59% of those that are exclusive to segment VII. One may suggest that, while reef communities favor the diversity of fish fauna in the northeastern region, the influence of upwelling events increases the diversity in the southeastern region.

CONCLUSIONS

The findings of the present study demonstrate a scarcity of studies on estuarine fish fauna in some regions of Brazil, such as the northern region and segment IV (part of the state of Maranhão to part of the state of Rio Grande do Norte). Moreover, it was possible to quantify the important portion of fish from other ecosystems, such as reefs and freshwater environments, which may use estuaries as feeding, breeding and nursery grounds. Thus, the degradation of estuarine ecosystems could considerably compromise fish diversity in both the estuaries themselves as well as the environments connected to these systems. The findings of the present study can be of assistance to management and environmental monitoring projects and underscore the need for conservation policies aimed at the conservation of interconnected ecosystems, such as mangroves and coral reefs.

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