



Checklist of marine demersal fishes captured by the pair trawl fisheries in Southern (RJ-SC) Brazil

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Abstract: Demersal fishery resources are abundant on continental shelves, on the tropical and subtropical coasts, making up a significant part of the marine environment. Marine demersal fishery resources are captured by various fishing methods, often unsustainably, which has led to the depletion of their stocks. In order to inventory the marine demersal ichthyofauna on the Southern Brazilian coast, as well as their conservation status and distribution, this study analyzed the composition and frequency of occurrence of fish captured by pair trawling in 117 fishery fleet landings based in the State of São Paulo between 2005 and 2012. The ichthyofauna consisted of 245 species (81 families, 32 orders and 2 classes). Among the species, 50 species were classified as constant, 38 accessory and 157 accidental. Still, 13.47% of the species were listed as endangered; 35.29% of the Chondrichthyes and 11.85% of the Actinopterygii (15.1% of the total species) belong to the endemic fauna of the Biogeographic Province of Argentina. The richness was directly related to the oceanographic features of the study area, which determined the southern boundary of occurrence of several tropical species and the northern boundary of occurrence for temperate species. This is the region with the highest abundance of fishery resources in Brazil.

Keywords: *ichthyofauna, inventory, fishery resources, conservation.*

Lista de peixes demersais marinhos capturados pela pesca de parelha no Sul (RJ-SC) do Brasil

Resumo: Nas costas tropicais e subtropicais, sobre as plataformas continentais, os recursos pesqueiros demersais são abundantes e considerados uma parcela importante do ambiente marinho. Os recursos pesqueiros demersais marinhos são capturados por diversas modalidades de pesca, muitas vezes de forma insustentável, o que vem provocando o esgotamento de seus estoques. Com o objetivo de inventariar a ictiofauna demersal marinha da costa sudeste-sul do Brasil, assim como seu status de conservação e distribuição, foram analisadas a composição e frequência de peixes capturados em 117 cruzeiros de pesca entre 2005 e 2012 pela frota de arrasto de parelha sediada no Estado de São Paulo. A ictiofauna foi composta por 245 espécies (81 famílias, 32 ordens e 02 classes), sendo 50 consideradas como constantes, 38 acessórias e 157 acidentais; 13.47% apresentam algum grau de ameaça; 35.29% dos Chondrichthyes e 11.85% dos Actinopterygii (15.1% do total) pertencem à fauna endêmica da Província Zoogeográfica da Argentina. A riqueza observada está diretamente vinculada às características oceanográficas da área de estudo, sendo estas responsáveis pelo limite meridional de ocorrência de várias espécies tropicais e o limite setentrional de espécies de regiões temperadas. Esta é a região com maior abundância de recursos pesqueiros do Brasil.

Palavras-chave: *ictiofauna, inventário, recursos pesqueiros, conservação.*

Introduction

Demersal fishery resources are abundant on continental shelves, on the tropical and subtropical coasts, making up a significant part of the marine environment. Oceanographic conditions influence the quality and potential of such resources, as well as regionally limit the use of certain types of vessels and fishing gear (Yáñez-Arancibia & Sánchez-Gil 1988, Dias-Neto & Ximenes 1998).

The capture of demersal species has been carried out by artisanal and industrial fishing for several decades and it is one of the most important activities for the fishing industry in Brazil (Castro et al. 2003). Small-scale fishing consists of beach seining, gillnets, long-lines, stern trawlers or double rig trawlers along estuarine and coastal and regions. Industrial fishing is carried out by medium and large-sized vessels using pair trawls and otter trawlnets, stern trawlers or double rig trawlers, gillnets and long-lines, as well as fishing with traps, coves and purse seines (Sudepe 1985, Valentini et al. 1991, Ibama 1993, 1995, Haimovici 1997).

The industrial pair trawling stands out among various modalities and categories of fishing aimed to demersal fish. Species belonging to the family Sciaenidae (Weakfishes), such as *Micropogonias furnieri* (Whitemouth croaker), *Macrondon atricauda* (Southern King Weakfish) and *Cynoscion jamaicensis* (Jamaica weakfish); in addition to species of the family Balistidae, such as *Balistes capricus* (Grey triggerfish) and family Ariidae, such as *Genidens barbatus* (White sea catfish) are the most targeted along with elasmobranchs (Valentini et al. 1991, Ibama 1993, 1995, Haimovici 1997, Castro et al. 2003, 2007, Castro & Tutui 2007).

According to Caddy & Sharp (1986), it is necessary to bear in mind that exploited species are linked to others that may be essential for the economic and biological productivity of the ecosystem. This is the only way to minimize the adverse effects of fishing and not to compromise the system's ability to sustain productive human activity. Therefore, the proper management of exploited resources and aquaculture requires knowledge about the dynamics of communities/populations, their ecological interactions, the integration with physicochemical and biological processes at spatial and temporal scales, as well as changes in fishery dynamics (Yáñez-Arancibia et al. 1985, Davis & Anderson 1989, Aryuthaka & Thumbthimsang 1992, Castelo et al. 2007, Castro & Tutui 2007).

This study provides a checklist of marine demersal ichthyofauna of the southern coasts of Brazil captured by the fishery fleet pair trawling based in the state of São Paulo and comments upon the composition, frequency of occurrence, conservation status and geographical distribution of the recorded species.

Material and Methods

The pair trawling fleet operation area had its limits under the coordinates 23°04'S / 42°20'W near Cabo Frio - RJ and 29°19'S / 49°41'W in Torres - RS. Prior to SMA-SP Resolution No. 69 of 2009, activities were concentrated on the south coast of São Paulo under the coordinates 24°31'S / 46°39'W near Peruibe - SP and 28°37'S / 48°37'W near Cabo de Santa Marta - SC (Figure 1).

The fleet operated between a depth of 14 and 55 meters ($m \pm SD = 29.2 \pm 9.7m$). For each year, the following means \pm standard deviation and amplitudes were observed: $30.4 \pm 8.6m$ (22 and 50m) in 2005; $27.9 \pm 7.5m$ (20 and 42m) in 2006; $33.2 \pm 13.9m$ (14 and 52m) in 2007; 25.2 ± 11.9 (15 and 55m) in 2008; $28.5 \pm 10.9m$ (14 and 50m) in 2009; $30.1 \pm 9.7m$ (26 and 52m) in 2010; $30.4 \pm 6.3m$ (26 and 50m) in 2011; and $30.9 \pm 6.6m$ (26 and 44m) in 2012.

The ichthyofauna from 117 fishery fleet landings of the industrial pair trawling fleet based in the State of São Paulo were sampled from March 2005 to May 2012. The sampling order was randomly. Only landings at the ports located in the municipalities of Santos and Guarujá-SP, Brazil were recorded.

The following sampling routine was performed for qualitative purposes: (a) the whole screening operation of the marketable product was followed up by collecting all rejected material among commercial products and also part of this products; (b) samples of the rejected and discarded products that fishermen sampled during the whole fishing operation were collected for further evaluation in the laboratory; (c) co-ordinates of the most distant bids, as well as of the main fishing grounds and their respective depths, were annotated with the masters. Samples of rejected and discarded fauna were also obtained through 15 shipments to the studied fleet.

The collected specimens were referred to the laboratory in iceboxes. Samples were identified, counted and had their total length measured (in mm). Subsequently, the specimens were fixed in 10% formaldehyde and preserved in 70% ethyl alcohol. Voucher specimens of the some species collected during the study were deposited in the regional collection of fish from the Atlantic Forest coast of the "Acervo Zoológico da Universidade Santa Cecília" (AZUSC), in the city of Santos-SP, Brazil.

Fish species in the samples were identified according to Figueiredo (1977), Figueiredo & Menezes (1978, 1980, 2000), Fischer (1978), Menezes & Figueiredo (1980, 1985), Compagno (1984, 1988), Cervigón et al. (1992), Carvalho-Filho (1999), Moura et al. (2001), Carpenter (2002), Fischer et al. (2004), Marceniuk (2005), Leis (2006), Moura & Lindeman (2007), Sampaio & Nottingham (2008), Carvalho-Filho et al. (2010), Gomes et al. (2010), McBride et al. (2010), Rosa & Gadig (2010), Tavera et al. (2011, 2012), Ruocco et al. (2012), Frable et al. (2013), Menezes et al. (2015), Knudsen & Clements (2016), Last et al. (2016a, b, c); Marceniuk et al. (2016). The systematics and nomenclature followed Nelson et al. (2016) and Eschmeyer et al. (2017), respectively.

Species were classified from their frequencies of occurrence and according to the Dajoz's (1983) scale as "constant" when present in more than 50% of the samples; "accessory" when frequencies ranged from 25 to 50% and "accidental" when frequencies were below 25%.

The conservation status of each species were based on the International Red List of threatened species (IUCN – International Union for Conservation of Nature 2017) and the Brazilian Federal list of threatened species, Ordinance number 445 of the MMA – Brazilian Environment Ministry, December 17th 2014 (MMA 2014).

Species were classified in the biogeographical categories proposed by Floeter et al. (2008) and Luiz Jr. et al. (2008).

Results

Of the 117 fishery fleet landings, the majority occurred in 2011 (20.52%) and the minority in 2010 (5.98%) (Table 1).

The richness consisted of 245 species (Table 2) distributed over 2 classes, 32 orders, 81 families and 170 genera. Out of the total species analyzed, 86.12% of the species belong to Class Actinopterygii and 13.88% to Class Chondrichthyes (Table 3). Of the 81 families comprising the captured ichthyofauna, six families had the highest species richness (33.5% of the total), namely Carangidae (6), Sciaenidae (19), Paralichthyidae (11), Haemulidae and Serranidae (10) and Engraulidae (8).

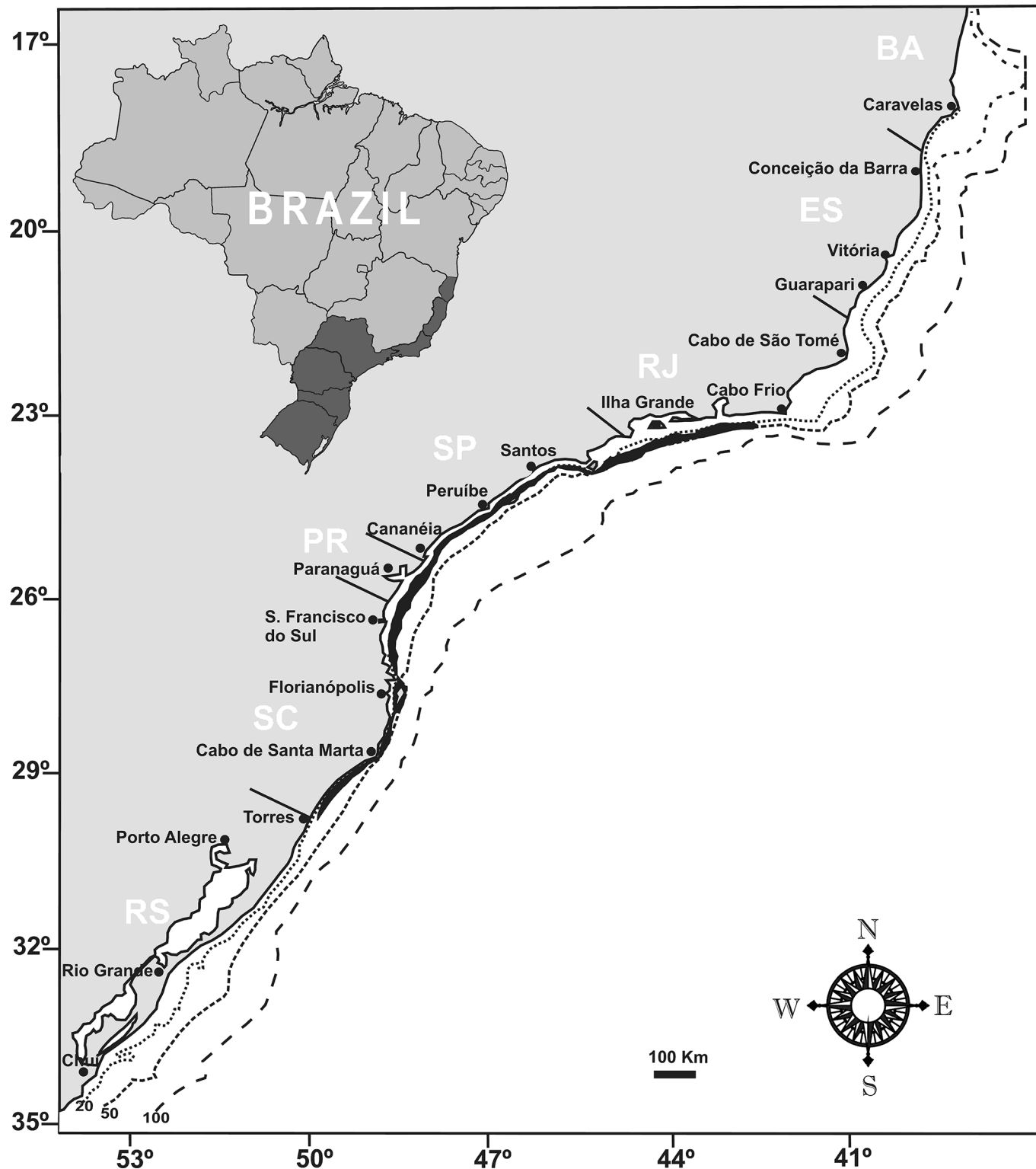


Figure 1. Areas of legal practice of pair trawling fishing in the State of São Paulo (Espírito Santo to Rio Grande do Sul). The study area is highlighted in black.

Table 1. Distribution of the number of fishing operations (N) and percentage (%) in relation to the study period.

	2005	2006	2007	2008	2009	2010	2011	2012	Total
N	10	17	13	18	20	7	24	8	117
%	8.5	14.5	11.1	15.3	17.0	5.9	20.5	6.8	100

Table 2. Ichthyofauna caught by the pair trawling fleet of the state of São Paulo, Dajoz scale (DS): Co = constant, Ac = accessory, Ad = accidental; geographic distribution (GD): CT = circumtropical, TA = Trans-Atlantic (both sides of the Atlantic), WA = Western Atlantic (Northern and Southwestern Atlantic), SWA = Southern West Atlantic (from northern Brazil to Argentina), SSWA = Southern South West Atlantic (species with affinity to temperate areas occurring from Argentina and Uruguay to southern Brazil), Ca = Caribbean (from Florida to Venezuela), Br = Brazilian Province (the area between the Orinoco Delta in Venezuela and Santa Catarina in Brazil) and EP = Eastern Pacific; conservation status in the IUCN Red List (IUCN 2017), in the Brazilian list (MMA 2014): X = Not Evaluated; LC = Least Concern; DD = Data Deficient; VU = Vulnerable; NT = Near-Threatened; END = Endangered, CR = Critically Endangered; vouchers.

Order/ Family/ Species	DS	GD	IUCN	MMA	Voucher
CARCHARHINIFORMES					
Triakidae					
<i>Mustelus schmitti</i> Springer, 1939	Ad	SSWA	END	CR	AZUSC3405
Carcharhinidae					
<i>Carcharhinus brachyurus</i> (Günther, 1870)	Ad	CT	NT		AZUSC3791
<i>Carcharhinus falciformis</i> (Bibron, 1839)	Ad	CT	VU		AZUSC3354
<i>Carcharhinus limbatus</i> (Valenciennes, 1839)	Ad	CT	NT		AZUSC3350
<i>Galeocerdo cuvier</i> (Péron & Lesueur, 1822)	Ad	CT	NT		AZUSC3383
<i>Rhizoprionodon lalandii</i> (Valenciennes, 1839)	Co	WA	DD		AZUSC3293
<i>Rhizoprionodon porosus</i> (Poey, 1861)	Ad	Ca+SWA	LC		AZUSC4811
Sphyrnidae					
<i>Sphyrna lewini</i> (Griffith & Smith, 1834)	Ad	CT	END	CR	AZUSC0893
<i>Sphyrna zygaena</i> (Linnaeus, 1758)	Ad	CT	VU	CR	AZUSC3780
SQUATINIFORMES					
Squatinae					
<i>Squatina guggenheim</i> Marini, 1936	Ac	SSWA	END	CR	AZUSC3203
TORPEDINIFORMES					
Torpedinidae					
<i>Tetronarce puelcha</i> (Lahille, 1926)	Ad	SSWA	DD	VU	AZUSC3543
Narcinidae					
<i>Narcine brasiliensis</i> (Olfers, 1831)	Co	WA	DD		AZUSC3424
RAJIFORMES					
Rajidae					
<i>Atlantoraja castelnaui</i> (Miranda Ribeiro, 1907)	Ac	SSWA	END	END	AZUSC3147
<i>Atlantoraja cyclophora</i> (Regan, 1903)	Ad	SSWA	VU		AZUSC3346
<i>Atlantoraja platana</i> (Günther, 1880)	Ad	SSWA	VU		AZUSC3349
<i>Psammobatis extenta</i> (Garman, 1913)	Ad	SSWA	LC		AZUSC3446
<i>Psammobatis lentiginosa</i> McEachran, 1983	Ad	SSWA	DD		AZUSC3442
<i>Rioraja agassizii</i> (Müller & Henle, 1841)	Co	SSWA	VU	END	AZUSC3432
<i>Sympterygia bonapartii</i> Müller & Henle, 1841	Ad	SSWA	DD	END	AZUSC3782
PRISTIFORMES					
Rhinobatidae					
<i>Pseudobatos horkelii</i> (Müller & Henle, 1841)	Ac	SSWA	CR	CR	AZUSC3454
<i>Pseudobatos percellens</i> (Walbaum, 1792)	Co	TA	NT		AZUSC3456
<i>Zapteryx brevirostris</i> (Müller & Henle, 1841)	Co	WA	VU	VU	AZUSC3591
MYLIOBATIFORMES					
Dasyatidae					
<i>Hypanus americanus</i> (Hildebrand & Schroeder, 1928)	Ac	WA	DD		AZUSC3355
<i>Dasyatis hypostigma</i> Santos & Carvalho, 2004	Co	SSWA	DD		AZUSC3359
<i>Hypanus guttatus</i> (Bloch & Schneider, 1801)	Ad	Ca+Br	DD		AZUSC3358
<i>Pteroplatytrygon violacea</i> (Bonaparte, 1832)	Ad	CT	LC		AZUSC3786

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Gymnuridae

<i>Gymnura altavela</i> (Linnaeus, 1758)	Co	TA	VU	CR	AZUSC3387
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Myliobatidae

<i>Aetobatus narinari</i> (Euphrasen, 1790)	Ad	CT	NT		AZUSC3291
<i>Mobula hypostoma</i> (Bancroft, 1831)	Ad	CT	DD	VU	AZUSC3400
<i>Mobula thurstoni</i> (Lloyd, 1908)	Ad	CT	NT	VU	AZUSC3403
<i>Myliobatis freminvillei</i> Lesueur, 1824	Ad	WA	DD	END	AZUSC3412
<i>Myliobatis goodei</i> Garman, 1885	Ad	WA	DD	CR	AZUSC3418
<i>Rhinoptera bonasus</i> (Mitchill, 1815)	Ad	WA	NT		AZUSC3783
<i>Rhinoptera brasiliensis</i> Müller, 1836	Ad	WA	END	CR	AZUSC0877

ELOPIFORMES

Elopidae

<i>Elops smithi</i> McBride, Rocha, Ruiz-Carus & Bowen, 2010	Ad	WA	DD		AZUSC1360
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ALBULIFORMES

Albulidae

<i>Albula vulpes</i> (Linnaeus, 1758)	Ac	WA	NT		AZUSC1742
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ANGUILLIFORMES

Muraenidae

<i>Gymnothorax conspersus</i> Poey, 1867	Ad	WA	X		AZUSC3719
<i>Gymnothorax funebris</i> Ranzani, 1839	Ad	WA	LC		AZUSC2108
<i>Gymnothorax moringa</i> (Cuvier, 1829)	Ad	WA	LC		AZUSC2710
<i>Gymnothorax ocellatus</i> Agassiz, 1831	Ac	Ca+SWA	LC		AZUSC2010
<i>Muraena retifera</i> Goode & Bean, 1882	Ad	WA	LC		AZUSC2299

Ophichthidae

<i>Echiophis intertinctus</i> (Richardson, 1848)	Ad	WA	LC		AZUSC2109
<i>Ophichthus ophis</i> (Linnaeus, 1758)	Ad	TA	LC		AZUSC2256
<i>Ophichthus gomesii</i> (Castelnau, 1855)	Ac	WA	LC		AZUSC3673

Muraenosocidae

<i>Cynoponticus savanna</i> (Bancroft, 1831)	Ad	Ca+Br	LC		AZUSC3761
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Congridae

<i>Conger orbignianus</i> Valenciennes, 1837	Ad	SSWA	X		AZUSC1120
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CLUPEIFORMES

Pristigasteridae

<i>Chirocentrodon bleekerianus</i> (Poey, 1867)	Ac	Ca+Br	LC		AZUSC1488
<i>Pellona harroweri</i> (Fowler, 1917)	Co	Ca+Br	LC		AZUSC1477

Engraulidae

<i>Anchoa filifera</i> (Fowler, 1915)	Ad	Ca+Br	LC		AZUSC1490
<i>Anchoa marinii</i> Hildebrand, 1943	Ad	SSWA	LC		AZUSC4620
<i>Anchoa spinifer</i> (Valenciennes, 1848)	Ad	Ca+Br+EP	LC		AZUSC4621
<i>Anchoa tricolor</i> (Spix & Agassiz, 1829)	Ad	SWA	LC		AZUSC4625
<i>Anchovia clupeoides</i> (Swainson, 1839)	Ad	Ca+Br	LC		AZUSC1476
<i>Anchoviella lepidentostole</i> (Fowler, 1911)	Ad	Br	LC		AZUSC1487
<i>Engraulis anchoita</i> Hubbs & Marini, 1935	Ad	SSWA	X		AZUSC2160
<i>Lycengraulis grossidens</i> (Spix & Agassiz, 1829)	Ad	Br+SSWA	LC		AZUSC4663

Clupeidae

<i>Brevoortia pectinata</i> (Jenyns, 1842)	Ad	SSWA	LC		AZUSC3897
<i>Harengula clupeola</i> (Cuvier, 1829)	Co	WA	LC		AZUSC1328

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<i>Opisthonema oglinum</i> (Lesueur, 1818)	Ad	WA	LC		AZUSC1327
<i>Sardinella brasiliensis</i> (Steindachner, 1879)	Ad	SSWA	X		AZUSC2164
SILURIFORMES					
Ariidae					
<i>Aspistor luniscutis</i> (Valenciennes, 1840)	Co	Br	X		AZUSC1976
<i>Bagre bagre</i> (Linnaeus, 1766)	Ac	Ca+Br	LC		AZUSC1367
<i>Bagre marinus</i> (Mitchill, 1815)	Ad	WA	LC		AZUSC4602
<i>Cathorops spixii</i> (Agassiz, 1829)	Ad	Ca+Br	X		AZUSC1518
<i>Genidens barbatus</i> (Lacepède, 1803)	Co	Br+SSWA	X	END	AZUSC1371
<i>Genidens genidens</i> (Cuvier, 1829)	Co	Br+SSWA	LC		AZUSC1756
AULOPIIFORMES					
Synodontidae					
<i>Synodus bondi</i> Fowler, 1939	Co	WA	LC		AZUSC2090
<i>Trachinocephalus myops</i> (Forster, 1801)	Ac	CT	LC		AZUSC1470
GADIFORMES					
Merlucciidae					
<i>Merluccius hubbsi</i> Marini, 1933	Ad	SSWA	X		AZUSC1288
Gadidae					
<i>Urophycis brasiliensis</i> (Kaup, 1858)	Ad	SSWA	X		AZUSC2122
HOLOCENTRIFORMES					
Holocentridae					
<i>Holocentrus adscensionis</i> (Osbeck, 1765)	Ad	TA	LC		AZUSC1699
OPHIDIIFORMES					
Ophidiidae					
<i>Genypterus brasiliensis</i> Regan, 1903	Ad	SSWA	X		AZUSC0905
<i>Ophidion holbrookii</i> Putnam, 1874	Ac	WA	LC	CR	AZUSC1352
<i>Raneya brasiliensis</i> (Kaup, 1856)	Ac	SSWA	X		AZUSC1811
BATRACHOIDIFORMES					
Batrachoididae					
<i>Opsanus beta</i> (Goode & Bean, 1880)	Ad	Ca	LC		AZUSC3144
<i>Porichthys porosissimus</i> (Cuvier, 1829)	Co	SSWA	X		AZUSC1146
<i>Thalassophryne montevidensis</i> (Berg, 1893)	Ad	SWA	X		AZUSC3088
MUGILIFORMES					
Mugilidae					
<i>Mugil curema</i> Valenciennes, 1836	Ad	TA+EP	LC		AZUSC1814
<i>Mugil liza</i> Valenciennes, 1836	Ad	WA	DD		AZUSC2698
Polynemidae					
<i>Polydactylus oligodon</i> (Günther, 1860)	Ad	WA	LC		AZUSC2089
<i>Polydactylus virginicus</i> (Linnaeus, 1758)	Ac	WA	LC		AZUSC2011
BELONIFORMES					
Exocoetidae					
<i>Cheilopogon melanurus</i> (Valenciennes, 1847)	Ad	TA	LC		AZUSC2709
Hemiramphidae					
<i>Hemiramphus balao</i> Lesueur, 1821	Ad	TA	LC		AZUSC4008
<i>Hemiramphus brasiliensis</i> (Linnaeus, 1758)	Ad	TA	LC		AZUSC4604
<i>Hyporhamphus unifasciatus</i> (Ranzani, 1841)	Ad	WA+EP	LC		AZUSC4618

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Belonidae

<i>Ablennes hians</i> (Valenciennes, 1846)	Ad	CT	LC	AZUSC2020
<i>Strongylura marina</i> (Walbaum, 1792)	Ad	WA	LC	AZUSC4672
<i>Strongylura timucu</i> (Walbaum, 1792)	Ad	WA	LC	AZUSC4603
<i>Tylosurus acus</i> (Lacepède, 1803)	Ad	TA	LC	AZUSC4619

CARANGIFORMES

Coryphaenidae

<i>Coryphaena hippurus</i> Linnaeus, 1758	Ad	CT	LC	AZUSC4601
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Rachycentridae

<i>Rachycentron canadum</i> (Linnaeus, 1766)	Ad	CT	LC	AZUSC2244
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Echeneidae

<i>Echeneis naucrates</i> Linnaeus, 1758	Ad	CT	LC	AZUSC3232
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Carangidae

<i>Alectis ciliaris</i> (Bloch, 1787)	Ad	CT	LC	AZUSC1389
<i>Caranx crysos</i> (Mitchill, 1815)	Ac	TA	LC	AZUSC1319
<i>Caranx hippos</i> (Linnaeus, 1766)	Ac	TA	LC	AZUSC1658
<i>Caranx latus</i> Agassiz, 1831	Ad	TA	LC	AZUSC1322
<i>Chloroscombrus chrysurus</i> (Linnaeus, 1766)	Co	TA	LC	AZUSC1344
<i>Decapterus punctatus</i> (Cuvier, 1829)	Ad	TA	LC	AZUSC1792
<i>Hemicaranx amblyrhynchus</i> (Cuvier, 1833)	Ac	WA	LC	AZUSC1928
<i>Oligoplites palometa</i> (Cuvier, 1832)	Ad	Ca+Br	LC	AZUSC3037
<i>Oligoplites saliens</i> (Bloch, 1793)	Co	Ca+SWA	LC	AZUSC1317
<i>Oligoplites saurus</i> (Bloch & Schneider, 1801)	Ad	WA	LC	AZUSC3771
<i>Parona signata</i> (Jenyns, 1841)	Ad	SSWA	X	AZUSC3604
<i>Pseudocaranx dentex</i> (Bloch & Schneider, 1801)	Ac	CT	LC	AZUSC1329
<i>Selar crumenophthalmus</i> (Bloch, 1793)	Ad	Ca+Br	LC	AZUSC2447
<i>Selene setapinnis</i> (Mitchill, 1815)	Co	WA	LC	AZUSC1323
<i>Selene vomer</i> (Linnaeus, 1758)	Co	WA	LC	AZUSC1388
<i>Seriola dumerili</i> (Risso, 1810)	Ad	CT	LC	AZUSC3668
<i>Seriola fasciata</i> (Bloch, 1793)	Ad	TA	LC	AZUSC3677
<i>Seriola lalandi</i> Valenciennes, 1833	Ad	CT	LC	AZUSC2634
<i>Trachinotus carolinus</i> (Linnaeus, 1766)	Co	WA	LC	AZUSC1336
<i>Trachinotus falcatus</i> (Linnaeus, 1758)	Ad	WA	LC	AZUSC3149
<i>Trachinotus goodei</i> Jordan & Evermann, 1896	Ac	WA	LC	AZUSC2016
<i>Trachinotus marginatus</i> Cuvier, 1832	Ad	SSWA	X	AZUSC2678
<i>Trachurus lathami</i> Nichols, 1920	Ad	WA	LC	AZUSC1122
<i>Uraspis secunda</i> (Poey, 1860)	Ad	CT	LC	AZUSC1963

ISTIOPHORIFORMES

Sphyraenidae

<i>Sphyraena guachancho</i> Cuvier, 1829	Co	TA	LC	AZUSC1341
<i>Sphyraena tome</i> Fowler, 1903	Ac	SSWA	X	AZUSC1602

Xiphiidae

<i>Xiphias gladius</i> Linnaeus, 1758	Ad	CT	LC	AZUSC4598
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PLEURONECTIFORMES

Paralichthyidae

<i>Citharichthys arenaceus</i> Evermann & Marsh, 1900	Ac	WA	LC	AZUSC4623
<i>Citharichthys macrops</i> Dresel, 1885	Ad	WA	LC	AZUSC1678

<i>Cyclopsetta chittendeni</i> Bean, 1895	Ad	Ca+Br	LC	AZUSC1651
<i>Etropus crossotus</i> Jordan & Gilbert, 1882	Ad	WA+EP	LC	AZUSC2159
<i>Etropus longimanus</i> Norman, 1933	Ad	SSWA	X	AZUSC4622
<i>Paralichthys brasiliensis</i> (Ranzani, 1842)	Ac	SWA	X	AZUSC1521
<i>Paralichthys orbignyanus</i> (Valenciennes, 1839)	Ad	SSWA	X	AZUSC1926
<i>Paralichthys patagonicus</i> Jordan, 1889	Ac	SSWA+EP	X	AZUSC1392
<i>Syacium papillosum</i> (Linnaeus, 1758)	Ad	WA	LC	AZUSC1549
<i>Syacium micrurum</i> Ranzani, 1842	Ad	WA	LC	AZUSC3036
<i>Xystreureys rasile</i> (Jordan, 1891)	Ad	SSWA	X	AZUSC4600
Bothidae				
<i>Bothus ocellatus</i> (Agassiz, 1831)	Ad	WA	LC	AZUSC3086
<i>Bothus robinsi</i> Topp & Hoff, 1972	Ad	WA	LC	AZUSC2088
Achiridae				
<i>Achirus declivis</i> Chabanaud, 1940	Ad	WA	LC	AZUSC2245
<i>Gymnachirus nudus</i> Kaup, 1858	Ac	WA	LC	AZUSC1949
<i>Trinectes paulistanus</i> (Miranda Ribeiro, 1915)	Ad	Ca+Br	LC	AZUSC4664
SYNGNATHIFORMES				
Fistulariidae				
<i>Fistularia petimba</i> Lacepède, 1803	Ad	TA	LC	AZUSC1330
<i>Fistularia tabacaria</i> Linnaeus, 1758	Co	TA	LC	AZUSC2018
Dactylopteridae				
<i>Dactylopterus volitans</i> (Linnaeus, 1758)	Co	TA	LC	AZUSC1147
SCOMBRIFORMES				
Gempylidae				
<i>Thyrsopterus lepidopoides</i> (Cuvier, 1832)	Ad	SSWA	X	AZUSC1148
Trichiuridae				
<i>Evoxymetopon taeniatus</i> Gill, 1863	Ad	Ca+SWA+EP	LC	AZUSC2939
<i>Trichiurus lepturus</i> Linnaeus, 1758	Co	CT	LC	AZUSC1391
Scombridae				
<i>Scomber japonicus</i> Houttuyn, 1782	Ad	CT	LC	AZUSC2286
<i>Scomberomorus brasiliensis</i> Collette, Russo & Zavala-Camin, 1978	Co	Ca+Br	LC	AZUSC1369
<i>Scomberomorus cavalla</i> (Cuvier, 1829)	Ad	WA	LC	AZUSC4599
<i>Thunnus alalunga</i> (Bonnaterre, 1788)	Ad	CT	NT	AZUSC1933
Centrolophidae				
<i>Seriola porosa</i> Guichenot, 1848	Ad	SWA+EP	X	AZUSC2636
Stromateidae				
<i>Peprilus xanthurus</i> (Quoy & Gaimard, 1825)	Co	SWA	X	AZUSC1333
TRACHINIFORMES				
Pinguipedidae				
<i>Pseudoperca semifasciata</i> (Cuvier, 1829)	Ad	SSWA	X	AZUSC2119
Percophidae				
<i>Percophis brasiliensis</i> Quoy & Gaimard, 1825	Ad	SSWA	X	AZUSC1145
Uranoscopidae				
<i>Astroscopus sexspinosus</i> (Steindachner, 1876)	Ad	SSWA	X	AZUSC2113
<i>Astroscopus y-graecum</i> (Cuvier, 1829)	Ad	WA	LC	AZUSC2014
LABRIFORMES				

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Labridae

Xyrichtys novacula (Linnaeus, 1758) Ad WA LC AZUSC1157

Scaridae

Nicholsina usta (Valenciennes, 1840) Ad WA LC AZUSC3644

Sparisoma axillare (Steindachner, 1878) Ad Br DD VU AZUSC1828

Sparisoma frondosum (Agassiz, 1831) Ad Ca+Br DD VU AZUSC1799

PERCIFORMES

Centropomidae

Centropomus parallelus Poey, 1860 Ad WA LC AZUSC1372

Centropomus undecimalis (Bloch, 1792) Ac WA LC AZUSC1363

Gerreidae

Diapterus auratus Ranzani, 1842 Ad WA LC AZUSC3898

Diapterus rhombeus (Cuvier, 1829) Co Ca+Br LC AZUSC1325

Eucinostomus argenteus Baird & Girard, 1855 Ac WA+EP LC AZUSC1326

Eucinostomus gula (Quoy & Gaimard, 1824) Ad WA LC AZUSC1359

Eucinostomus melanopterus (Bleeker, 1863) Ad TA LC AZUSC1625

Eugerres brasiliensis (Cuvier, 1830) Ad WA LC AZUSC1875

Polyprionidae

Polyprion americanus (Bloch & Schneider, 1801) Ad CT DD CR AZUSC3656

Mullidae

Pseudupeneus maculatus (Bloch, 1793) Ad WA LC AZUSC1661

Upeneus parvus Poey, 1852 Ac WA LC AZUSC1351

Kyphosidae

Kyphosus vaigiensis (Quoy & Gaimard, 1825) Ad TA LC AZUSC3867

Kyphosus sectatrix (Linnaeus, 1758) Ad TA LC AZUSC0372

Serranidae

Diplectrum formosum (Linnaeus, 1766) Co WA LC AZUSC1331

Diplectrum radiale (Quoy & Gaimard, 1824) Ac WA LC AZUSC1355

Dules auriga Cuvier, 1829 Ad SSWA X AZUSC1140

Epinephelus itajara (Lichtenstein, 1822) Ad WA CR CR AZUSC1043

Epinephelus marginatus (Lowe, 1834) Ad WA+EP END VU AZUSC2377

Epinephelus morio (Valenciennes, 1828) Ad WA NT VU AZUSC3646

Hyporthodus niveatus (Valenciennes, 1828) Ac WA VU VU AZUSC1600

Mycteroperca acutirostris (Valenciennes, 1828) Ad Ca+Br LC AZUSC1646

Rypticus randalli Courtenay, 1967 Ad Ca+Br LC AZUSC3721

Serranus atrobranchus (Cuvier, 1829) Ad WA LC AZUSC3676

Pomatomidae

Pomatomus saltatrix (Linnaeus, 1766) Co CT VU AZUSC1630

Priacanthidae

Priacanthus arenatus Cuvier, 1829 Co TA LC AZUSC1339

Pomacanthidae

Pomacanthus paru (Bloch, 1787) Ad WA LC AZUSC1342

Malacanthidae

Caulolatilus chrysops (Valenciennes, 1833) Ad WA LC AZUSC1605

Haemulidae

Anisotremus surinamensis (Bloch, 1791) Ad WA DD AZUSC1688

Anisotremus virginicus (Linnaeus, 1758) Ac WA LC AZUSC1343

Rotundo, M.M. et al.

<i>Boridia grossidens</i> Cuvier, 1830	Ad	SSWA	X	AZUSC1912
<i>Conodon nobilis</i> (Linnaeus, 1758)	Co	WA	LC	AZUSC1320
<i>Genyatremus cavifrons</i> (Cuvier, 1830)	Ad	Ca+Br	DD	AZUSC1968
<i>Haemulon aurolineatum</i> Cuvier, 1830	Ac	WA	LC	AZUSC1398
<i>Haemulon steindachneri</i> (Jordan & Gilbert, 1882)	Ac	Ca+SWA	LC	AZUSC1913
<i>Orthopristis ruber</i> (Cuvier, 1830)	Co	Ca+SWA	LC	AZUSC1138
<i>Haemulopsis corvinaeformis</i> (Steindachner, 1868)	Co	Ca+SWA	LC	AZUSC1345
<i>Pomadasys crocro</i> (Cuvier, 1830)	Ad	WA	DD	AZUSC3099
Lutjanidae				
<i>Lutjanus analis</i> (Cuvier, 1828)	Ad	WA	NT	AZUSC2789
<i>Lutjanus griseus</i> (Linnaeus, 1758)	Ad	WA	LC	AZUSC3100
<i>Lutjanus jocu</i> (Bloch & Schneider, 1801)	Ad	WA	DD	AZUSC4542
<i>Lutjanus synagris</i> (Linnaeus, 1758)	Ad	WA	NT	AZUSC4321
<i>Rhomboplites aurorubens</i> (Cuvier, 1829)	Ad	WA	VU	AZUSC1423
SCORPAENIFORMES				
Scorpaenidae				
<i>Scorpaena brasiliensis</i> Cuvier, 1829	Ac	WA	LC	AZUSC1599
<i>Scorpaena isthmensis</i> Meek & Hildebrand, 1928	Ad	WA	LC	AZUSC3711
<i>Scorpaena plumieri</i> Bloch, 1789	Ac	WA	LC	AZUSC1611
Triglidae				
<i>Prionotus nudigula</i> Ginsburg, 1950	Ad	SSWA	X	AZUSC1609
<i>Prionotus punctatus</i> (Bloch, 1793)	Co	Ca+SWA	LC	AZUSC1141
MORONIFORMES				
Ephippidae				
<i>Chaetodipterus faber</i> (Broussonet, 1782)	Co	WA	LC	AZUSC1334
ACANTHURIFORMES				
Sciaenidae				
<i>Ctenosciaena gracilicirrhus</i> (Metzelaar, 1919)	Co	Ca+Br	LC	AZUSC1142
<i>Cynoscion acoupa</i> (Lacepède, 1801)	Ad	Ca+SWA	LC	AZUSC3202
<i>Cynoscion guatucupa</i> (Cuvier, 1830)	Ac	SSWA	X	AZUSC1143
<i>Cynoscion jamaicensis</i> (Vaillant & Bocourt, 1883)	Co	Ca+SWA	LC	AZUSC1386
<i>Cynoscion leiarchus</i> (Cuvier, 1830)	Co	Ca+Br	LC	AZUSC1966
<i>Cynoscion virescens</i> (Cuvier, 1830)	Co	Ca+Br	LC	AZUSC1358
<i>Isopisthus parvipinnis</i> (Cuvier, 1830)	Co	Ca+Br	LC	AZUSC1390
<i>Larimus breviceps</i> Cuvier, 1830	Co	Ca+Br	LC	AZUSC1318
<i>Macrodon atricauda</i> (Günther, 1880)	Co	Br+SSWA	X	AZUSC1498
<i>Menticirrhus americanus</i> (Linnaeus, 1758)	Co	WA	LC	AZUSC1430
<i>Menticirrhus littoralis</i> (Holbrook, 1847)	Ad	WA	LC	AZUSC4730
<i>Micropogonias furnieri</i> (Desmarest, 1823)	Co	Ca+SWA	LC	AZUSC1144
<i>Nebris microps</i> Cuvier, 1830	Ac	Br	LC	AZUSC1467
<i>Paralonchurus brasiliensis</i> (Steindachner, 1875)	Co	Ca+SWA	LC	AZUSC1425
<i>Pogonias cromis</i> (Linnaeus, 1766)	Ad	WA	LC	END AZUSC3206
<i>Stellifer brasiliensis</i> (Schultz, 1945)	Ad	Br	X	AZUSC1486
<i>Stellifer rastrifer</i> (Jordan, 1889)	Ad	Br+SSWA	LC	AZUSC1520
<i>Umbrina canosai</i> Berg, 1895	Ad	SSWA	X	AZUSC1123
<i>Umbrina coroides</i> Cuvier, 1830	Ad	WA	LC	AZUSC1365

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Acanthuridae					
<i>Acanthurus chirurgus</i> (Bloch, 1787)	Ad	TA	LC		AZUSC2120
SPARIFORMES					
Lobotidae					
<i>Lobotes surinamensis</i> (Bloch, 1790)	Ad	CT	LC		AZUSC2635
Sparidae					
<i>Archosargus aries</i> (Valenciennes, 1830)	Ad	WA	X		AZUSC3239
<i>Archosargus rhomboidalis</i> (Linnaeus, 1758)	Ac	WA	LC		AZUSC1361
<i>Calamus penna</i> (Valenciennes, 1830)	Ad	WA	LC		AZUSC3035
<i>Calamus pennatula</i> Guichenot, 1868	Ad	WA	LC		AZUSC3089
<i>Diplodus argenteus</i> (Valenciennes, 1830)	Co	SWA	LC		AZUSC1366
<i>Pagrus pagrus</i> (Linnaeus, 1758)	Co	TA	LC		AZUSC1426
LOPHIIFORMES					
Lophiidae					
<i>Lophius gastrophysus</i> Miranda Ribeiro, 1915	Ad	WA	LC		AZUSC1608
Antennariidae					
<i>Antennarius striatus</i> (Shaw, 1794)	Ad	WA	LC		AZUSC3143
Ogcocephalidae					
<i>Ogcocephalus vespertilio</i> (Linnaeus, 1758)	Ac	Ca+SWA	X		AZUSC2707
TETRAODONTIFORMES					
Ostraciidae					
<i>Acanthostracion quadricornis</i> (Linnaeus, 1758)	Ad	WA	LC		AZUSC2117
Balistidae					
<i>Balistes capriscus</i> Gmelin, 1789	Co	CT	VU		AZUSC1347
Monacanthidae					
<i>Aluterus monoceros</i> (Linnaeus, 1758)	Ac	CT	LC		AZUSC1362
<i>Aluterus heudelotii</i> Hollard, 1855	Ad	CT	LC		AZUSC4517
<i>Stephanolepis hispidus</i> (Linnaeus, 1766)	Co	TA	LC		AZUSC1332
Molidae					
<i>Mola mola</i> (Linnaeus, 1758)	Ad	CT	VU		AZUSC3950
Tetraodontidae					
<i>Lagocephalus laevigatus</i> (Linnaeus, 1766)	Co	TA	LC		AZUSC1373
<i>Lagocephalus lagocephalus</i> (Linnaeus, 1758)	Ad	CT	LC		AZUSC3234
<i>Sphoeroides greeleyi</i> Gilbert, 1900	Ad	Ca+Br	LC		AZUSC2522
<i>Sphoeroides spengleri</i> (Bloch, 1785)	Ad	TA	LC		AZUSC3330
<i>Sphoeroides testudineus</i> (Linnaeus, 1758)	Ad	WA	LC		AZUSC2163
Diodontidae					
<i>Chilomycterus spinosus</i> (Linnaeus, 1758)	Co	SWA	LC		AZUSC1139

Table 3. Total number of ichthyofaunal taxa captured by the pair trawling fleet based in the State of São Paulo.

Class	Chondrichthyes	Actinopterygii
Order	6	26
Family	11	70
Genus	22	148
Species	34	211

From the frequency of occurrence (FO) and the classification proposed by Dajoz (1983) the ichthyofauna consisted of 50 species (20.41%) classified as constants; 38 (15.5%) accessory species and 157 (64.08%) accidental species. Seventeen species (6.34%) had 100% frequency throughout the sample period: *Dactylopterus volitans* (Flying gurnard), *Prionotus punctatus* (Bluewing searobin), *Chloroscombrus chrysurus* (Atlantic bumper), *Oligoplites saliens* (Castin leatherjacket), *Selene setapinnis* (Atlantic moonfish), *S. vomer* (Lookdown), *Conodon nobilis* (Barred grunt), *Orthopristis ruber* (Corocoro grunt), *Diplodus argenteus* (South American silver porgy), *Cynoscion jamaicensis* (Jamaica weakfish), *Menticirrhus americanus* (Southern kingcroaker), *Micropogonias furnieri* (Whitemouth croaker), *Chaetodipterus faber* (Atlantic spadefish), *Trichiurus lepturus* (Largehead hairtail), *Balistes capriscus* (Grey triggerfish), *Stephanolepis hispidus* (Planehead filefish) and *Chilomycterus spinosus* (Southern burrfish).

When considering only the Critical, Endangered and Vulnerable categories, both by the IUCN (2017) criteria and by Brazilian federal Legislation (MMA 2014) we observed a total of 33 threatened species (13.47%) in this study. Also, when considering only the threat categories and choosing the most conservative classification, three distinct and worrying scenarios are drawn by correlating the conservation status with the frequency of occurrence (constant, accessory and accidental) (Table 4).

Most of the captured species (35.51%) during this study were distributed in the Atlantic Ocean (WA), followed by the SSWA (15.10%), circumtropical (CT) species (13.06%), Trans-Atlantic (TA) species (11.02%), Ca+Br (9.8%), Ca+SWA (4.9%), SWA (2.45%), Br (2.04%), Br+SSWA (2.04%), and WA+EP (1.63%). One species (0.41% of the total) was found in each of the following areas: TA+EP, SWA+EP, SSWA+EP, Ca+Br+EP, Ca+SWA+EP, and Ca.

Discussion

The richness of demersal organisms is directly related to the continental shelf width, sediment types, oceanographic conditions, the geological events that shaped the continental shelf, as well as its positioning relative to the equator characterizing the environmental temperature (Lowe-McConnell 1987, Longhurst & Pauly 2007).

Although many results of this study can be explained by the oceanographic features of the pair trawling fleet operation area in the state of São Paulo, biotic factors interfere with the species distribution through inter- and intraspecific relations, such as the predator-prey effect and the competitive interactions for food (Sanders 1969, Moyle & Cech 1998, Menge & Olson 1990, Barry et al. 1996, Akin et al. 2003).

Overall, the widest and largest continental shelf is in southern Brazil, consisting of muddy sediment and under the influence of the oscillation of the subtropical convergence between the warm waters

Table 4. Checklist of the threatened species captured according to the International Union for Conservation of Nature (IUCN 2017) and the Brazilian list (MMA 2014) and their frequency of occurrence (Dajoz 1983).

	Accidental	Accessory	Constant
Critically endangered	<i>Mustelus schmitti</i> <i>Sphyrna lewini</i> <i>Sphyrna zygaena</i> <i>Myliobatis goodei</i> <i>Rhinoptera brasiliensis</i> <i>Epinephelus itajara</i> <i>Polyprion americanus</i>	<i>Pseudobatos horkelii</i> <i>Squatina guggenheim</i> <i>Ophidion holbrooki</i>	<i>Gymnura altavela</i>
Endangered	<i>Sympterygia bonapartii</i> <i>Myliobatis freminvillei</i> <i>Epinephelus marginatus</i> <i>Pogonias cromis</i>	<i>Atlantoraja castelnaui</i>	<i>Rioraja agassizii</i> <i>Genidens barbatus</i>
Vulnerable	<i>Carcharhinus falciformis</i> <i>Atlantoraja cyclophora</i> <i>Atlantoraja platana</i> <i>Tetronarce puelcha</i> <i>Mobula hypostoma</i> <i>Mobula thurstoni</i> <i>Sparisoma axillare</i> <i>Sparisoma frondosum</i> <i>Epinephelus morio</i> <i>Rhomboplites aurorubens</i> <i>Mola mola</i>	<i>Hyporthodus niveatus</i>	<i>Zapteryx brevirostris</i> <i>Pomatomus saltatrix</i> <i>Balistes capriscus</i>

of the Brazilian current and the cold waters of the Malvinas current. The region has upwelling zones that during the summer and spring cause the South Atlantic Central Water (SACW) to penetrate the shelf reaching the coastal areas with a thermocline of 10 and 15 meters. During the winter, SACW retracts and Tropical Water (TW) fills the space. There is significant water input from continental drainage. Due to such characteristics, the region represents the Southern boundary of occurrence of several tropical species (e.g.: *Hypanus guttatus*, *H. americanus*, *Anchoa tricolor*, *Rypticus randalli*) and the Northern boundary of temperate species (e.g.: *Atlantoraja castelnaui*, *A. cyclophora*, *Sardinella brasiliensis*, *Boridia grossidens*). Moreover, the region has the highest abundance of fishery resources in Brazil (Pires-Vanin et al. 1993, Matsuura 1995, Castro & Menezes 1998, Menezes et al. 2003, Braga & Niencheski 2006, Castro et al. 2006, Castro et al. 2008, Amaral & Nallin 2011, Menezes 2011).

According to Menezes et al. (2003), 1,297 species of marine fish, belonging to 36 orders and 192 families, occur in Brazil. The results of this study showed the Southern demersal ichthyofauna accounted for 18.9% of species recorded in Brazil. The families Carangidae, Sciaenidae, Paralichthyidae, Haemulidae, Serranidae and Engraulidae showed high number of species, with most species being demersal, benthic or benthopelagic (Lowe-McConnell 1987).

According to Dajoz's (1983) scale, we could hypothesize that the common richness of the ichthyofauna by landing is approximately 90 species (constant + accessory). However, this value differs from that observed in landings, which ranged from 49 to 104 species (mean and standard deviation = 68.65 ± 13.20), mainly due to the high number of accidental species.

According to criteria adopted by the International Union for Conservation of Nature (IUCN 2017), species classified as least concern (64.08%) were predominant, followed by not-evaluated species (14.69%), data deficient (8.16%), vulnerable and near-threatened (4.90%), endangered (2.45%) and critically endangered (0.82%). Based on Brazilian federal legislation (MMA 2014), only 10.61% of the species are threatened regarding the conservation status: 4.49% endangered, 3.67% vulnerable and 2.45% endangered. Proportionally, Class Chondrichthyes had higher number of highly endangered species (23.53% critically endangered, 11.76% endangered and 20.59% vulnerable). Based on the three scenarios observed regarding the conservation status of the captured species, the actions of fishery management are priority for the pair trawling fishing operating in the Zoogeographic Province of Argentina. We emphasize this study was carried out in the period before the prohibitions on the capture of several endangered species (MMA 2014); therefore, the continuous monitoring of the composition of this fishing modality is necessary. We also point out there were restrictions of fishing area for pair trawling fishing in the State of São Paulo (SMA 2009). Such restrictions occurred during the last 3 years of this study, which again emphasizes the need for continuous monitoring to verify changes in the composition of the species captured by this type of fishery.

According to Kotas (1991), the pair trawling fishing is characterized as active, multispecies and difficult to manage due to the large number of species captured. The most used management technique in these cases is the restriction of areas and/or periods (High et al. 1969, Caddy 1982), which often causes economic and social

problems. There are other ways of ensuring greater selectivity and more sustainability in these fisheries without losing their economic viability, such as adequacy of fishing nets and the use of bycatch reduction devices (BRD). Several BRD models have been developed and tested in different types of environments worldwide, many of which are summarized in the study by Broadhurst (2000). Thus, studies on fishing technology aiming at minimizing the capture of endangered species are essential for biodiversity maintenance.

Caires (2014) listed 120 species (76.67% Actinopterygii and 23.33% Chondrichthyes) as endemic to the zoogeographic province of Argentina. Out of the 92 species of Actinopterygii listed, 24 species (26%) were observed in this study, namely: *Conger orbignianus* (Congridae), *Sardinella brasiliensis* (Clupeidae), *Merluccius hubbsi* (Merlucciidae), *Urophycis brasiliensis* (Gadidae), *Genypterus brasiliensis* and *Raneya brasiliensis* (Ophidiidae), *Porichthys porosissimus* and *Thalassophryne montevidensis* (Batrachoididae), *Parona signata* and *Trachinotus marginatus* (Carangidae), *Sphyrnaena tome* (Sphyrnaenidae), *Etropus longimanus*, *Paralichthys orbignyanus*, *P. patagonicus* and *Xystreureys rasile* (Paralichthyidae), *Thyrstlops lepidopoides* (Gempylidae), *Pseudopercis semifasciata* (Pinguipedidae), *Percophis brasiliensis* (Percophidae), *Astroscoptes sexspinosus* (Uranoscopidae), *Dules auriga* (Serranidae), *Boridia grossidens* (Haemulidae), *Prionotus nudigula* (Triglidae), *Cynoscion guatucupa* and *Umbrina canosai* (Sciaenidae). Among the 28 species of Chondrichthyes, 11 species (39.3%) were captured in the present study, namely: *Mustelus schmitti* (Triakidae), *Squatina guggenheim* (Squatinae), *Atlantoraja castelnaui*, *A. cyclophora*, *A. platana*, *Psammobatis extenta*, *P. lentiginosa*, *Rioraja agassizii* and *Sympterygia bonapartii* (Rajidae), *Pseudobatos horkelii* (Rhinobatidae) and *Dasyatis hypostigma* (Dasyatidae). Due to the distribution (Southeast region of Brazil to Argentina), we also consider the following species endemic to the zoogeographic province of Argentina: *Tetronarce puelcha* (Torpedinidae), *Anchoa marinii* and *Engraulis anchoita* (Engraulidae) and *Brevoortia pectinata* (Clupeidae). Thus, 35.29% of Chondrichthyes and 11.85% of Actinopterygii (15.1% of the total) belong to the endemic fauna of zoogeographic province of Argentina.

The importance of the zoogeographic province of Argentina in the diversity of marine and estuarine fish fauna of Southern Brazil was evidenced in two other studies carried out in the Laje de Santos Marine State Park (Luiz Jr et al. 2008) and in the Paranaguá estuarine complex (Passos et al. 2012). The similarity in species composition was low (<50%) due to the different types of environments (rocky reefs, continental shelf and estuary). Totally, 427 species were observed, out of which 46 species (10.77%) are endemic to zoogeographic province of Argentina, being the fourth geographic distribution with the highest number of species, only behind the Western Atlantic with 169 species (39.58%), circumtropical with 52 species (12.18%) and trans-Atlantic with 50 species (11.71%). There was higher rate of endemism in the zoogeographic province of Argentina among marine demersal species (14.29%), followed by estuarine (10.95%) and reef (4.69%) species.

Based on the results of this work, we highlight the need for studies addressing other aspects of exploited communities, such as diversity analysis, spatial and seasonal distribution, as well as on impacts on explored demersal fishes, such as types of fishing, pollution, degradation of coastal areas and the introduction of exotic species.

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Author Contributions

Matheus Marcos Rotundo: collaborated with the identification, data analysis, and writing of the manuscript.

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Conflicts of interest

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

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