ARTISANALLY LANDED ELASMOBRANCHS ALONG THE COAST OF RIO DE JANEIRO, BRAZIL

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RESUMO

Considerando a lacuna de conhecimento em relação aos desembarques de espécies de elasmobrânquios, este estudo teve como objetivo relatar as capturas de elasmobrânquios através da pesca artesanal para obter dados de base a esse respeito. As amostragens foram realizadas de 2016 a 2019 em três colônias de pesca artesanal localizadas no Rio de Janeiro, Tamoios, em Cabo Frio, Itaipu, em Niterói e Copacabana, na região metropolitana do Rio de Janeiro. Um total de vinte e três espécies de doze famílias foi identificado em todos os locais da amostra, incluindo 10 tubarões e 12 raias. Embora Tamoios, em Cabo Frio, sofra os efeitos de um fenômeno de ressurgência, a maior riqueza relativa a elasmobrânquios oceânicas foi observada em Copacabana, que faz parte da Baía de Guanabara, reforçando a biodiversidade significativa dessa baía e a importância de sua recuperação para estratégias de manejo e conservação de elasmobrânquios. Além disso, muitos espécimes pertencentes a diferentes espécies amostradas neste local eram juvenis, como tubarões martelo (*Sphyrna lewini*), tigre (*Galeocerdo cuvier*), mako *Isurus oxyrinchus*), seis fêmeas de cações frango (*Rhizoprionodon lalandii*) contendo embriões ou oocitos e três fêmeas de tubarão-rotador (*Carcharinus brevipinna*) com oócitos maduros, indicando um possível local estratégico de reprodução e assentamento juvenil para várias espécies desembarcadas. A presença de muitas espécies apresentando diferentes graus de vulnerabilidade em relação à conservação e endemismo, especialmente para o Atlântico Sul, reforça a importância desse tipo de avaliação. Além disso, quatro de seis espécies-chave de elasmobrânquios, ou seja, espécies que apresentam um impacto extremamente alto em um ecossistema específico em relação à sua população e críticas para a estrutura e função gerais de um ecossistema, anteriormente observadas na costa sudeste do Brasil, são relatadas aqui, a saber *Galeocerdo cuvier, Sphyrna lewini, S. zygaena* e *Zapteryx brevirostris*, indicando ainda a importância de futuras avaliações sobre o monitoramento da pesca de elasmobrânquias no Brasil.

Palavras-chave: Biodiversidade; tubarões e raias; pesca artesanal.

ABSTRACT

Considering the knowledge gap regarding elasmobranch species landings, this study aimed to report elasmobranch catches from artisanal fisheries to obtain baseline data in this regard. Samplings were carried out from 2016 to 2019 at three artisanal fishing colonies located in Rio de Janeiro, Tamoios, in Cabo Frio, Itaipu, in Niterói, and Copacabana, in the metropolitan region of Rio de Janeiro. A total of twenty-three species from twelve families were identified at all sample sites, comprising 10 sharks and 12 rays. Although Tamoios, in Cabo Frio, is home to an upwelling phenomenon, the highest richness concerning oceanic elasmobranchs was observed at Copacabana, which is a part of Guanabara Bay, reinforcing the significant biodiversity of this bay and the importance of its recovery for elasmobranch management and conservation strategies. In addition, many specimens belonging to different species sampled at this site were juvenile, such as hammerhead sharks (*Sphyrna lewini*), tiger sharks (*Galeocerdo cuvier*), mako sharks (*Isurus oxyrinchus*), six sharpnose sharks (*Rhizoprionodon lalandii*) females containing embryos and/or oocytes and three spinner shark females (*Carcharinus brevipinna*) containing mature oocytes, indicating a possible strategic reproduction and juvenile settlement site for several of the landed species. The presence of many species presenting different vulnerability degrees regarding conservation and endemism, especially for the South Atlantic, reinforces the importance of this type of assessment. In addition, four of six keystone elasmobranch species, i.e. species presenting an extremely high impact on a particular ecosystem relative to its population and critical for the overall structure and function of an ecosystem, previously observed throughout the Southeastern coast of Brazil are reported herein, namely *Galeocerdo cuvier*, *Sphyrna lewini*, *S. zygaena* and *Zapteryx brevirostris*, further indicating the importance of future assessments concerning elasmobranch fisheries monitoring in Brazil.

Key-words: Biodiversity; sharks and rays; artisanal fisheries.

INTRODUCTION

Brazil is home to approximately one million registered artisanal fishers, which contribute to over 50% of the total fish produced in the country (Vasconcellos *et al.* 2007). However, data concerning artisanal fisheries are poor (Kaliloski & Vasconcellos 2012; Previero & Gasalla 2018), making it difficult to identify and assess the effectiveness of conservation management actions (Costa et al., 2018). Elasmobranchs in particular are extremely vulnerable to artisanal fishery (Lack & Sant 2009; Bornatowski *et al.* 2014), either targeted or captured as bycatch (Molina & Cooke 2012; Ferrette *et al.* 2019), as they are long lived organisms displaying slow growth rates, delayed maturation, long gestation, and small litters (Stevens *et al.* 2000; Dulvy *et al.* 2014). Approximately 25% of this class has been reported as threatened with extinction by the International Union for Conservation of Nature (IUCN) (Dulvy *et al.* 2014) and, 47% of these are classified by the IUCN as data deficient, indicating absence of minimal information to be evaluated (Mace *et al.* 2008; Dulvy *et al.* 2014).

In many countries, shark and ray meat are viewed as a low-quality food item and, thus, marketed under generic designations not directly linked to these animals, in order to overcome consumer resistance (Vannuccini 1999; Bornatowski *et al.* 2013, 2015; Dent & Clarke 2015). This is the case in Brazil, where shark and ray meat are sold as *cação* fillets (Bornatowski *et al.* 2018). The lack of consumer knowledge regarding *cação* meat and what it really consists in has increasingly led to overfishing due to attractive shark and ray meat prices (Bornatowski *et al.* 2018) and is of significant ecological concern, as these animals play an important role in maintaining ecosystem equilibrium and health (Heupel *et al.* 2014). In this scenario, due to both targeted and non-targeted fisheries, Brazilian fisheries have reached critical levels for several elasmobranch species (Bornatowski *et al.* 2018) and 33% of all elasmobranchs are categorized as threatened, while 36% are considered data deficient (Instituto Chico Mendes de Conservação da Biodiversidade 2018), overcoming the global rate of threatened species. Most pelagic shark populations are currently depleted in Brazil while coastal species data are very poor (Bornatowski *et al.* 2018).

A constant that determines the difficulty of social and ecological fishing activity management in Brazil is the lack of specific monitoring for each fishing sector, both large and small (artisanal) scale, in the long term, as, although fishery statistics are achieved regionally by some states, most of the country lacks this specificity. However, effective governance between conservation and fisheries can only be effective by filling in the gaps in fisheries data (Kolding *et al.*, 2010). In Brazil, the latest version of the National Fisheries and Aquaculture Statistical Bulletin (Instituto Chico Mendes de Conservação da Biodiversidade, 2011) illustrates the main problem faced by sector managers, of data discontinuity, since this government document has not been updated for eight years. At the state level, the Rio de Janeiro Institute of Fisheries Foundation issues an annual report on Fisheries and Aquaculture where, in addition to unspecific fish categorization, a combination of large and scale small data is noted, making it very difficult, for example, to discern which species are vulnerable to what types of fisheries, leading to significant data deficiency, especially with regard to artisanal fishing.

However, no recent evaluation of artisanally landed sharks and rays are available for many artisanal fisheries regions, such as those located in the metropolitan region of Rio de Janeiro, and the Região dos Lagos region, which comprises over 1500 registered artisanal fishers from at least eight cities (Saquarema, Maricá, Araruama, Iguaba Grande, São Pedro da Aldeia, Cabo Frio, Búzios and Arraial do Cabo) (FIPERJ 2015).

In this context, this study aimed to assess artisanally landed sharks and rays along the coast of Rio de Janeiro, RJ, Brazil through fisheries monitoring, fisher interviews and photographs taken by the fishers and the researchers.

MATERIAL AND METHODS

The state of Rio de Janeiro (22° 54' 13" S, 43° 12'35" W), is located in southeastern Brazil, occupying the 4th place in terms of economy and 3rd in population size in the national ranking (IBGE, 2019), extremely important in a socio-economic context.

A total of 28 artisanal fisher colonies are distributed throughout the state of Rio de Janeiro, from São Francisco do Itabapoana to Paraty (FIPERJ, 2019), with the main fishing ports located at Niterói, São Gonçalo, Cabo Frio and Angra dos Reis.

Samplings were carried out at two artisanal fishing unions and one fisher association located in Rio de Janeiro, namely the Z-13 fishing colony/union, in Copacabana (22 ° 59 '10 "S, 43 ° 11' 19" W), in the metropolitan Rio de Janeiro area, the Associação de Pesca de Tamoios (Tamoios Fishers Association), located in the Pontal de Santo Antônio, in Cabo Frio (22° 35' 55.0" S, 41° 59' 40.9" W), on the Southeastern coast of the state, and the Z-7 fishing colony/union, at

Itaipu (22º53'14"S, 43º22'48"W), in Niterói (Figure 1).

Located in the central region of the state, artisanal fisher colonies Z-13 and Z-7, at Copacabana and Itaipu, respectively, operate in fishing areas that undergo strong influences from Guanabara Bay, an eutrophic estuarine environment, mainly in the regions most associated with oceanic waters. On the other hand, the Associação de Pesca de Tamoios, in Cabo Frio is located in an area characterized by a significant upwelling phenomenon, where deep South Atlantic Central Waters rise continuously, resulting in a high abundance of nectonic species, making this area one of the most productive fishing areas in the state of Rio de Janeiro (Valentin, 2001).

No standardized sampling effort was carried out in this study, due to logistic reasons. All specimens were caught within the fishing spectrum of the respective sites, no further that 15 km from the fishing colonies.

Samples from the Z-7 Itaipu colony, which consists of 130 associated fishers, were obtained from January to July 2016, comprising 10 visits at random. Initial visits by the researchers to this colony enabled the development of both a close relation with the fishers and elasmobranch landings, so, in the absence of the research team, fishers would send photographs of elasmobranchs whenever these animals were landed. Elasmobranch landing data for Itaipu were obtained from Brito (2016). Concerning Tamoios, periodic visits were made every three months to the Associação de Pesca de Tamoios, from 2017 to 2018. At Tamoios, landing assessments were always performed by the research team, through sample collections and photographic records, without the aid of local fishermen.

Data collection at the Z-13 colony was carried out from September 2018 to September 2019. Observations and species identification through the scientific literature (Gomes *et al.* 2010) were performed through frequent visits to the colony, of at least 3 times a week, according to sea conditions, obtaining photographic records and/or tissue samples of the sampled animals. In the absence of the research team, fishers would send photographs of elasmobranchs whenever these animals were landed.

The same fishing gear, gillnets, was used in all three regions. Only the amount of cloths and mesh size differ among the fishing colonies. All nets had an average height of two meters. At Copacabana, 50 mm mesh gillnets are used for bottom and mid-column fishing, with about 8 cloths per boat, resulting in about 400 to 500m nets for each boat. At Tamoios, a mesh size between 40 and 45mm is used, with varying amounts of cloths according to boat size, of about 100m each, reaching up to 10 cloths in a single boat. At Itaipu, gillnets with mesh sizes varying from 40 to 80 mm are used for mid-column and bottom fishing. No information on net lengths are available for this colony. All elasmobranchs were captured as by-catch, due to the non-selectivity of the fishing methodology, even at different depths.

RESULTS

A total of twenty-three species from twelve families were identified at all sample sites. Data concerning the Order, Family, popular names, global and national Conservation States, and geographic distribution of the artisanally landed elasmobranchs
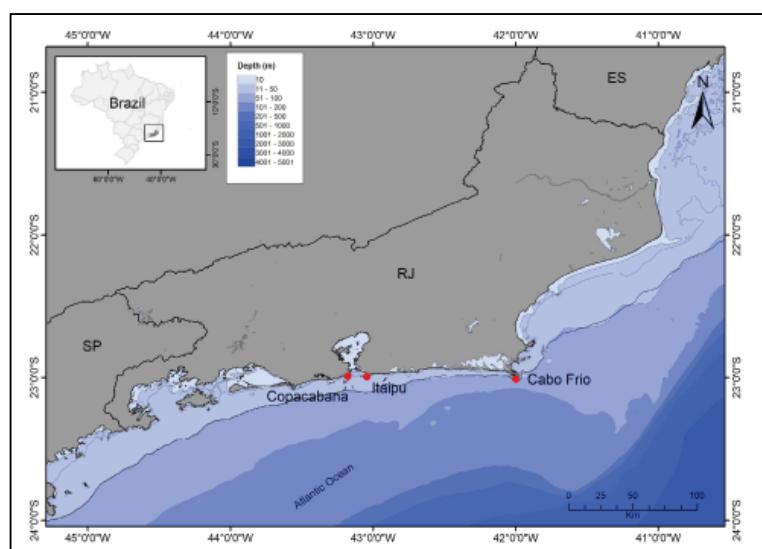

Figure 1. Map of the three artisanal fisher colony locations assessed in the present study concerning elasmobranch by-catches.

Table 1. Details on the Order, Family, popular names, global and national conservation status, and geographic distribution of elasmobranch species landed at three artisanal fishing colonies in the state of Rio de Janeiro, Brazil, from 2016 to 2019. Conservation statuses were obtained from the IUCN and ICMBio websites, available at www.iucnredlist.org and http://www.icmbio.gov.br/.

Order	Family	Species	Common Name		Conservation status		Distribution
			English	Portuguese	Global (IUCN)	Brazil (ICMBIO)	
Squatiniformes	Squatinidae	*Squatina guggenheim* (Marini, 1936)	Angular angelshark	Cação-anjo	Endangered	Critically endangered	Endemic (Rio de Janeiro, Brazil to Argentina)
Lammiformes	Lamnidae	*Isurus oxyrinchus* (Rafinesque, 1810)	Shortfin mako	Tubarão-mako, Anequim	Endangered	Endangered	Global
Carcharhiniformes	Carcharhinidae	*Rhizoprionodon porosus* (Poey, 1861)	Caribbean sharpnose shark	Cação-frango, Cação-noné	Least Concern	Vulnerable	Miami, USA to Mar del Plata, Argentina
		Rhizoprionodon lalandii (Muller & Henle 1839)	Brazilian Sharpnose shark	Cação-frango, Cação-noné	Data Deficient	Vulnerable	Nicaragua to Florianópolis, Brazil
		Galeocerdo cuvier (Péron & LeSueur in LeSueur, 1822)	Tiger shark	Tubarão-tigre, Tintureira	Near Threatened	Near Threatened	Cosmopolitan
		Carcharhinus falciformis (Müller & Henle 1839)	Silky shark	Tubarão-lombo-preto	Vulnerable	Near Threatened	Cosmopolitan
		Carcharhinus brevipinna (Muller & Henle, 1839)	Spinner shark	Tubarão-galha-Preta	Near Threatened	Near Threatened	Cosmopolitan
	Sphyrnidae	*Sphyrna lewini* (Griffith & Smith, 1834)	Scalloped hammerhead Shark	Tubarão-martelo, Panã, Panam	Endangered	Critically endangered	Cosmopolitan
		Sphyrna zygaena (Linnaeus, 1758)	Smooth hammerhead shark	Tubarão-martelo, Panã, Panam	Vulnerable	Critically endangered	Cosmopolitan
Rajiformes	Arhynchobatidae	*Atlantoraja castelnaui* (Ribeiro, 1907)	Spotback skate	Raia-de-emplastro, Raia-chita	Endangered	Endangered	Endemic (Rio de Janeiro, Brazil to Northern Argentina)
		Rioraja agassizi (Müller & Henle, 1841)	Rio skate	Raia-santa	Vulnerable	Endangered	Endemic (Southeastern Brazil to Northern Argentina)
	Rajidae	*Gurgesiella dorsalifera* (McEachran & Compagno, 1980)	Onefin skate	Raia-emplastro de-fundo	Vulnerable	Vulnerable	Endemic (Southeastern and Southern Brazil)

Order	Family	Species	Common Name		Conservation status		Distribution
			English	Portuguese	Global (IUCN)	Brazil (ICMBIO)	
Torpediniformes	Narcinidae	Narcine brasiliensis (Olfers, 1831)	Lesser numbfish; Brazilian electric ray	Raia-elétrica, Raia-choqueira	Data Deficient	Data Deficient	Endemic (Southeastern Brazil to Northern Argentina)
Myliobatiformes	Dasyatidae	Dasyatis hypostigma (Santos & Carvalho, 2004)	Groovebelly stingray	Raia-prego, Raia-manteiga	Data Deficient	Data Deficient	Endemic (Southeastern and Southern Brazil)
		Hypanus guttatus (Bloch & Schneider, 1801)	Longnose stingray	Raia-prego, Raia-manteiga	Data Deficient	Data Deficient	Caribbean and South America
		Hypanus americanus (Hildebrand and Schroeder, 1928)	Southern stingray	Raia-prego, Raia-manteiga	Data Deficient	Data Deficient	Philadelphia (USA) to São Paulo, Brazil
		Pteroplatytrygon violacea (Bonaparte, 1832)	Pelagic stingray	Raia-roxa, Raia-pelágica	Least Concern	Least Concern	Global
	Myliobatidae	Aetobatus narinari (Euphrasen, 1790)	Spotted Eagle Ray	Raia Chita, Raia pintada	Near Threatened	Near Threatened	Global
		Myliobatis goodei (Garman, 1885)	Southern eagle ray	Raia-sapo	Data Deficient	Critically endangered	North Carolina (USA) to Patagonia (Argentina)
	Gymnuridae	Gymnura altavela (Linnaeus, 1758)	Spiny butterfly ray	Raia-borboleta	Vulnerable	Critically endangered	Eastern and Western Atlantic Coasts; Mediterranean Sea
Rhinopristiformes	Rhinobatidae	Pseudobatos horkelii (Muller & Henle, 1841)	Brazilian guitarfish	Raia-viola	Critically Endangered	Critically Endangered	Endemic (Espírito Santo, Brazil to Buenos Aires, Argentina)
		Pseudobatos percellens (Muller & Henle, 1841)	Southern guitarfish	Raia-viola	Near Threatened	Near Threatened	Caribbean and South America
	Trygonorhinidae	Zapteryx brevirostris (Muller & Henle, 1841)	Shortnose guitarfish	Raia-viola-de-focinho-curto, Raia-cachorro	Vulnerable	Vulnerable	Endemic (Espírito Santo, Brazil to Mar del Plata, Argentina)

Table 2. Elasmobranch individuals landed at three artisanal fishing colonies in the state of Rio de Janeiro, Brazil, from 2016 to 2019.

Species	Sample Code	Sample Site	Collection Day	Source
Squatina guggenheim	SC013†	Cais de Tamoios, Cabo Frio	-	-
(Marini, 1936)	HDRG045†	Colônia de Pesca Z-13, Posto 6, Copacabana	20/12/18	Sample
	VB05*	Colônia de Pesca Z-7, Itaipu	06/03/16	Photo
Isurus oxyrinchus	HDRG008†	Colônia de Pesca Z-13, Posto 6, Copacabana	30/09/18	Sample
(Rafinesque, 1810)	VB19*	Colônia de Pesca Z-7, Itaipu	07/08/16	Photo
Rhizoprionodon porosus	DZ-UERJ#	Cais de Tamoios, Cabo Frio	08/11/17	Sample
(Poey, 1861)	DZ-UERJ#	Cais de Tamoios, Cabo Frio	14/12/17	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	14/12/17	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	14/12/17	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	14/12/17	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	14/12/17	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	14/12/17	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	14/12/17	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	01/02/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	01/02/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	01/02/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	01/02/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	01/02/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	18/01/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	18/01/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	18/01/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	18/01/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	18/01/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	18/01/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	18/01/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	15/06/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	15/06/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	15/06/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	13/07/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	13/07/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	13/07/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	13/07/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	13/07/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	13/07/18	Sample

Species	Sample Code	Sample Site	Collection Day	Source
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	16/08/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	16/08/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	16/08/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	16/08/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	16/08/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	16/08/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	16/08/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	16/08/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	16/08/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	16/08/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	16/08/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	16/08/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	16/08/18	Sample
	HDRG062†	Cais de Tamoios, Cabo Frio	19/01/19	Sample
	HDRG063†	Cais de Tamoios, Cabo Frio	19/01/19	Sample
	HDRG064†	Cais de Tamoios, Cabo Frio	19/01/19	Sample
	HDRG066†	Cais de Tamoios, Cabo Frio	19/01/19	Sample
	HDRG067†	Cais de Tamoios, Cabo Frio	19/01/19	Sample
	HDRG069†	Cais de Tamoios, Cabo Frio	19/01/19	Sample
	HDRG070†	Cais de Tamoios, Cabo Frio	19/01/19	Sample
	HDRG071†	Cais de Tamoios, Cabo Frio	19/01/19	Sample
	HDRG084†	Cais de Tamoios, Cabo Frio	07/02/19	Sample
	HDRG085†	Cais de Tamoios, Cabo Frio	07/02/19	Sample
	HDRG086†	Cais de Tamoios, Cabo Frio	07/02/19	Sample
	HDRG087†	Cais de Tamoios, Cabo Frio	07/02/19	Sample
	HDRG088†	Cais de Tamoios, Cabo Frio	07/02/19	Sample
	HDRG089†	Cais de Tamoios, Cabo Frio	07/02/19	Sounce
	HDRG090†	Cais de Tamoios, Cabo Frio	07/02/19	Sample
	HDRG091†	Cais de Tamoios, Cabo Frio	07/02/19	Sample
	HDRG092†	Cais de Tamoios, Cabo Frio	07/02/19	Sample
	HDRG093†	Cais de Tamoios, Cabo Frio	07/02/19	Sample
	HDRG094†	Cais de Tamoios, Cabo Frio	07/02/19	Sample
	HDRG095†	Cais de Tamoios, Cabo Frio	07/02/19	Sample
	HDRG180†	Cais de Tamoios, Cabo Frio	29/06/19	Sample
Rhizoprionodon lalandii	DZ-UERJ#	Cais de Tamoios, Cabo Frio	08/11/17	Sample
(Muller & Henle 1839)	DZ-UERJ#	Cais de Tamoios, Cabo Frio	08/11/17	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	14/12/17	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	14/12/17	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	14/12/17	Sample

Species	Sample Code	Sample Site	Collection Day	Source
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	14/12/17	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	01/02/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	01/02/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	01/02/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	01/02/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	01/02/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	01/02/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	01/02/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	13/07/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	13/07/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	16/08/18	Sample
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	DZ-UERJ#	Cais de Tamoios, Cabo Frio	16/08/18	Sample
	DZ-UERJ#	Cais de Tamoios, Cabo Frio	16/08/18	Sample
	HDRG005*	Colônia de Pesca Z-13, Posto 6, Copacabana	30/09/18	Photo
	HDRG006*	Colônia de Pesca Z-13, Posto 6, Copacabana	30/09/18	Photo
	HDRG007*	Colônia de Pesca Z-13, Posto 6, Copacabana	30/09/18	Photo
	HDRG011*	Colônia de Pesca Z-13, Posto 6, Copacabana	09/10/18	Photo
	HDRG035†	Colônia de Pesca Z-13, Posto 6, Copacabana	06/12/18	Sample
	HDRG036†	Colônia de Pesca Z-13, Posto 6, Copacabana	06/12/18	Sample
	HDRG037†	Colônia de Pesca Z-13, Posto 6, Copacabana	06/12/18	Sample
	HDRG038†	Colônia de Pesca Z-13, Posto 6, Copacabana	06/12/18	Sample
	HDRG039†	Colônia de Pesca Z-13, Posto 6, Copacabana	06/12/18	Sample
	HDRG046†	Colônia de Pesca Z-13, Posto 6, Copacabana	20/12/18	Sample
	HDRG065†	Cais de Tamoios, Cabo Frio	19/01/19	Sample
	HDRG068†	Cais de Tamoios, Cabo Frio	19/01/19	Sample
	HDRG165†	Colônia de Pesca Z-13, Posto 6, Copacabana	22/06/19	Sample
	HDRG166†	Colônia de Pesca Z-13, Posto 6, Copacabana	22/06/19	Sample
	HDRG167†	Colônia de Pesca Z-13, Posto 6, Copacabana	22/06/19	Sample

Species	Sample Code	Sample Site	Collection Day	Source
	HDRG168†	Colônia de Pesca Z-13, Posto 6, Copacabana	22/06/19	Sample
	HDRG169†	Colônia de Pesca Z-13, Posto 6, Copacabana	25/06/19	Sample
	HDRG170†	Colônia de Pesca Z-13, Posto 6, Copacabana	25/06/19	Sample
	HDRG171†	Colônia de Pesca Z-13, Posto 6, Copacabana	25/06/19	Sample
	HDRG172†	Colônia de Pesca Z-13, Posto 6, Copacabana	25/06/19	Sample
	HDRG173†	Colônia de Pesca Z-13, Posto 6, Copacabana	25/06/19	Sample
	HDRG216†	Colônia de Pesca Z-13, Posto 6, Copacabana	12/09/19	Sample
	HDRG217†	Colônia de Pesca Z-13, Posto 6, Copacabana	12/09/19	Sample
	HDRG218†	Colônia de Pesca Z-13, Posto 6, Copacabana	12/09/19	Sample
Galeocerdo cuvier (Péron & LeSueur in LeSueur, 1822)	HDRG251†	Colônia de Pesca Z-13, Posto 6, Copacabana	05/04/18	Sample
	HDRG250†	Colônia de Pesca Z-13, Posto 6, Copacabana	20/09/19	Sample
Carcharhinus falciformis (Müller & Henle 1839)	VB17*	Colônia de Pesca Z-7, Itaipu	12/07/16	Photo
Carcharhinus brevipinna (Muller & Henle, 1839)	HDRG072†	Colônia de Pesca Z-13, Posto 6, Copacabana	21/01/19	Sample
	HDRG073†	Colônia de Pesca Z-13, Posto 6, Copacabana	22/01/19	Sample
	HDRG074†	Colônia de Pesca Z-13, Posto 6, Copacabana	23/01/19	Sample
	HDRG127†	Colônia de Pesca Z-13, Posto 6, Copacabana	11/04/19	Sample
	HDRG140†	Colônia de Pesca Z-13, Posto 6, Copacabana	16/04/19	Sample
	HDRG190*	Colônia de Pesca Z-13, Posto 6, Copacabana	26/07/19	Photo
	HDRG191*	Colônia de Pesca Z-13, Posto 6, Copacabana	26/07/19	Photo
	VB06*	Colônia de Pesca Z-7, Itaipu	11/05/16	Photo
	VB12*	Colônia de Pesca Z-7, Itaipu	01/06/16	Photo
	VB18*	Colônia de Pesca Z-7, Itaipu	20/07/16	Photo
Sphyrna lewini (Griffith & Smith, 1834)	SC006†	Cais de Tamoios, Cabo Frio	16/01/18	Sample
	HDRG010†	Colônia de Pesca Z-13, Posto 6, Copacabana	04/10/18	Sample
	HDRG013†	Colônia de Pesca Z-13, Posto 6, Copacabana	13/10/18	Sample

Species	Sample Code	Sample Site	Collection Day	Source
	HDRG034†	Colônia de Pesca Z-13, Posto 6, Copacabana	06/12/18	Sample
	HDRG183*	Colônia de Pesca Z-13, Posto 6, Copacabana	08/07/19	Photo
	HDRG184*	Colônia de Pesca Z-13, Posto 6, Copacabana	08/07/19	Photo
	HDRG185*	Colônia de Pesca Z-13, Posto 6, Copacabana	11/07/19	Photo
	HDRG189*	Colônia de Pesca Z-13, Posto 6, Copacabana	26/07/19	Photo
	HDRG220†	Colônia de Pesca Z-13, Posto 6, Copacabana	14/09/19	Sample
	VB07*	Colônia de Pesca Z-7, Itaipu	21/05/16	Photo
	VB08*	Colônia de Pesca Z-7, Itaipu	21/05/16	Photo
	VB09*	Colônia de Pesca Z-7, Itaipu	21/05/16	Photo
	VB11*	Colônia de Pesca Z-7, Itaipu	21/05/16	Photo
	VB13*	Colônia de Pesca Z-7, Itaipu	25/06/16	Photo
	VB16*	Colônia de Pesca Z-7, Itaipu	12/07/16	Photo
	VB03*	Colônia de Pesca Z-7, Itaipu	Sem data	Photo
Sphyrna zygaena	HDRG192†	Colônia de Pesca Z-13, Posto 6, Copacabana	16/08/19	Sample
(Linnaeus, 1758)	HDRG219†	Colônia de Pesca Z-13, Posto 6, Copacabana	14/09/19	Sample
	VB15*	Colônia de Pesca Z-7, Itaipu	12/07/16	Photo
	VB01*	Colônia de Pesca Z-7, Itaipu	Sem data	Photo
	VB02*	Colônia de Pesca Z-7, Itaipu	Sem data	Photo
Atlantoraja castelnaui	SC007†	Cais de Tamoios, Cabo Frio	18/01/18	Sample
(Ribeiro, 1907)	SC008†	Cais de Tamoios, Cabo Frio	16/01/18	Sample
	HDRG009*	Colônia de Pesca Z-13, Posto 6, Copacabana	02/10/18	Photo
	HDRG012*	Colônia de Pesca Z-13, Posto 6, Copacabana	11/10/18	Photo
	HDRG040†	Colônia de Pesca Z-13, Posto 6, Copacabana	13/12/18	Sample
	HDRG041†	Colônia de Pesca Z-13, Posto 6, Copacabana	13/12/18	Sample
	HDRG048†	Colônia de Pesca Z-13, Posto 6, Copacabana	08/01/19	Sample
	HDRG200*	Colônia de Pesca Z-13, Posto 6, Copacabana	08/09/19	Photo
	HDRG232*	Colônia de Pesca Z-13, Posto 6, Copacabana	17/09/19	Photo
	HDRG233*	Colônia de Pesca Z-13, Posto 6, Copacabana	17/09/19	Photo

Species	Sample Code	Sample Site	Collection Day	Source
	HDRG234*	Colônia de Pesca Z-13, Posto 6, Copacabana	17/09/19	Photo
	HDRG235*	Colônia de Pesca Z-13, Posto 6, Copacabana	17/09/19	Photo
	HDRG236*	Colônia de Pesca Z-13, Posto 6, Copacabana	17/09/19	Photo
	HDRG237*	Colônia de Pesca Z-13, Posto 6, Copacabana	17/09/19	Photo
	HDRG238*	Colônia de Pesca Z-13, Posto 6, Copacabana	17/09/19	Photo
	VB14*	Colônia de Pesca Z-7, Itaipu	06/07/16	Photo
Rioraja agassizi (Müller & Henle, 1841)	SC009†	Cais de Tamoios, Cabo Frio	16/01/18	Sample
	SC010†	Cais de Tamoios, Cabo Frio	16/01/18	Sample
	SC011†	Cais de Tamoios, Cabo Frio	16/01/18	Sample
	HDRG077†	Colônia de Pesca Z-13, Posto 6, Copacabana	23/01/19	Sample
Gurgesiella dorsalifera (McEachran & Compagno, 1980)	SC014†	Cais de Tamoios, Cabo Frio	16/01/18	Sample
Narcine brasiliensis (Olfers, 1831)	HDRG221†	Colônia de Pesca Z-13, Posto 6, Copacabana	15/09/19	Sample
Dasyatis hypostigma (Santos & Carvalho, 2004)	HDRG001*	Colônia de Pesca Z-13, Posto 6, Copacabana	22/09/18	Photo
	HDRG019*	Colônia de Pesca Z-13, Posto 6, Copacabana	03/11/18	Photo
	HDRG020*	Colônia de Pesca Z-13, Posto 6, Copacabana	03/11/18	Photo
	HDRG021*	Colônia de Pesca Z-13, Posto 6, Copacabana	03/11/18	Photo
	HDRG022*	Colônia de Pesca Z-13, Posto 6, Copacabana	03/11/18	Photo
	HDRG023*	Colônia de Pesca Z-13, Posto 6, Copacabana	03/11/18	Photo
	HDRG024*	Colônia de Pesca Z-13, Posto 6, Copacabana	03/11/18	Photo
	HDRG025*	Colônia de Pesca Z-13, Posto 6, Copacabana	03/11/18	Photo
	HDRG026*	Colônia de Pesca Z-13, Posto 6, Copacabana	03/11/18	Photo
	HDRG027*	Colônia de Pesca Z-13, Posto 6, Copacabana	10/11/18	Photo
	HDRG028*	Colônia de Pesca Z-13, Posto 6, Copacabana	10/11/18	Photo
	HDRG029*	Colônia de Pesca Z-13, Posto 6, Copacabana	18/11/18	Photo
	HDRG030*	Colônia de Pesca Z-13, Posto 6, Copacabana	18/11/18	Photo

Species	Sample Code	Sample Site	Collection Day	Source
	HDRG128†	Colônia de Pesca Z-13, Posto 6, Copacabana	11/04/19	Sample
	HDRG141†	Cais de Tamoios, Cabo Frio	18/05/19	Sample
	HDRG142†	Cais de Tamoios, Cabo Frio	18/05/19	Sample
	HDRG186*	Colônia de Pesca Z-13, Posto 6, Copacabana	11/07/19	Photo
	HDRG187*	Colônia de Pesca Z-13, Posto 6, Copacabana	11/07/19	Photo
	HDRG188*	Colônia de Pesca Z-13, Posto 6, Copacabana	11/07/19	Photo
	HDRG193*	Colônia de Pesca Z-13, Posto 6, Copacabana	17/08/19	Photo
	HDRG196*	Colônia de Pesca Z-13, Posto 6, Copacabana	25/08/19	Photo
	HDRG197*	Colônia de Pesca Z-13, Posto 6, Copacabana	25/08/19	Photo
	HDRG201†	Colônia de Pesca Z-13, Posto 6, Copacabana	09/09/19	Sample
	HDRG205†	Colônia de Pesca Z-13, Posto 6, Copacabana	11/09/19	Sample
	HDRG206†	Colônia de Pesca Z-13, Posto 6, Copacabana	11/09/19	Sample
	HDRG212†	Colônia de Pesca Z-13, Posto 6, Copacabana	12/09/19	Sample
	HDRG213†	Colônia de Pesca Z-13, Posto 6, Copacabana	12/09/19	Sample
	HDRG214†	Colônia de Pesca Z-13, Posto 6, Copacabana	12/09/19	Sample
	HDRG215*	Colônia de Pesca Z-13, Posto 6, Copacabana	12/09/19	Photo
	HDRG239*	Colônia de Pesca Z-13, Posto 6, Copacabana	17/09/19	Photo
	HDRG240*	Colônia de Pesca Z-13, Posto 6, Copacabana	17/09/19	Photo
	HDRG241*	Colônia de Pesca Z-13, Posto 6, Copacabana	17/09/19	Photo
	HDRG242*	Colônia de Pesca Z-13, Posto 6, Copacabana	17/09/19	Photo
	HDRG243*	Colônia de Pesca Z-13, Posto 6, Copacabana	17/09/19	Photo
	HDRG246*	Colônia de Pesca Z-13, Posto 6, Copacabana	18/09/19	Photo
Hypanus guttatus (Bloch & Schneider, 1801)	HDRG202†	Colônia de Pesca Z-13, Posto 6, Copacabana	10/09/19	Sample
	HDRG208*	Colônia de Pesca Z-13, Posto 6, Copacabana	11/09/19	Photo
	HDRG209*	Colônia de Pesca Z-13, Posto 6, Copacabana	11/09/19	Photo

Species	Sample Code	Sample Site	Collection Day	Source
	HDRG210*	Colônia de Pesca Z-13, Posto 6, Copacabana	11/09/19	Photo
	HDRG211*	Colônia de Pesca Z-13, Posto 6, Copacabana	12/09/19	Photo
	HDRG222*	Colônia de Pesca Z-13, Posto 6, Copacabana	17/09/19	Photo
	HDRG223*	Colônia de Pesca Z-13, Posto 6, Copacabana	17/09/19	Photo
	HDRG224*	Colônia de Pesca Z-13, Posto 6, Copacabana	17/09/19	Photo
	HDRG225*	Colônia de Pesca Z-13, Posto 6, Copacabana	17/09/19	Photo
	HDRG226*	Colônia de Pesca Z-13, Posto 6, Copacabana	17/09/19	Photo
	HDRG227*	Colônia de Pesca Z-13, Posto 6, Copacabana	17/09/19	Photo
	HDRG228*	Colônia de Pesca Z-13, Posto 6, Copacabana	17/09/19	Photo
	HDRG229*	Colônia de Pesca Z-13, Posto 6, Copacabana	17/09/19	Photo
Hypanus americanus (Hildebrand and Schroeder, 1928)	HDRG198†	Colônia de Pesca Z-13, Posto 6, Copacabana	08/09/19	Sample
	HDRG199†	Colônia de Pesca Z-13, Posto 6, Copacabana	08/09/19	Sample
	HDRG203†	Colônia de Pesca Z-13, Posto 6, Copacabana	10/09/19	Sample
	HDRG204†	Colônia de Pesca Z-13, Posto 6, Copacabana	10/09/19	Sample
	HDRG230*	Colônia de Pesca Z-13, Posto 6, Copacabana	17/09/19	Photo
	HDRG231*	Colônia de Pesca Z-13, Posto 6, Copacabana	17/09/19	Photo
	HDRG244*	Colônia de Pesca Z-13, Posto 6, Copacabana	18/09/19	Photo
	HDRG245*	Colônia de Pesca Z-13, Posto 6, Copacabana	18/09/19	Photo
Pteroplatytrygon violacea (Bonaparte, 1832)	HDRG123*	Colônia de Pesca Z-13, Posto 6, Copacabana	08/04/19	Photo
Gymnura altavela (Linnaeus, 1758)	HDRG003*	Colônia de Pesca Z-13, Posto 6, Copacabana	27/09/18	Photo
	HDRG004*	Colônia de Pesca Z-13, Posto 6, Copacabana	27/09/18	Photo
	HDRG015*	Colônia de Pesca Z-13, Posto 6, Copacabana	19/10/18	Photo
	HDRG016*	Colônia de Pesca Z-13, Posto 6, Copacabana	19/10/18	Photo

Species	Sample Code	Sample Site	Collection Day	Source
	HDRG017*	Colônia de Pesca Z-13, Posto 6, Copacabana	19/10/18	Photo
	HDRG047†	Colônia de Pesca Z-13, Posto 6, Copacabana	20/12/18	Sample
	HDRG096*	Colônia de Pesca Z-13, Posto 6, Copacabana	02/04/19	Photo
	HDRG147*	Colônia de Pesca Z-13, Posto 6, Copacabana	31/05/19	Photo
	HDRG161*	Colônia de Pesca Z-13, Posto 6, Copacabana	12/06/19	Photo
	HDRG162*	Colônia de Pesca Z-13, Posto 6, Copacabana	12/06/19	Photo
	HDRG181†	Cais de Tamoios, Cabo Frio	29/06/19	Sample
	HDRG194*	Colônia de Pesca Z-13, Posto 6, Copacabana	25/08/19	Photo
	HDRG195*	Colônia de Pesca Z-13, Posto 6, Copacabana	25/08/19	Photo
	HDRG248*	Colônia de Pesca Z-13, Posto 6, Copacabana	19/09/19	Photo
Aetobatus narinari (Euphrasen, 1790)	HDRG253*	Cais de Tamoios, Cabo Frio	19/01/19	Photo
Myliobatis goodei (Garman, 1885)	HDRG25†	Cais de Tamoios, Cabo Frio	29/06/19	Sample
Pseudobatos horkelii (Muller & Henle, 1841)	SC001†	Cais de Tamoios, Cabo Frio	18/01/18	Sample
	SC002†	Cais de Tamoios, Cabo Frio	18/01/18	Sample
	SC003†	Cais de Tamoios, Cabo Frio	01/02/18	Sample
	SC004†	Cais de Tamoios, Cabo Frio	01/02/18	Sample
	SC005†	Cais de Tamoios, Cabo Frio	01/02/18	Sample
	HDRG044†	Colônia de Pesca Z-13, Posto 6, Copacabana	13/12/18	Sample
	HDRG056†	Colônia de Pesca Z-13, Posto 6, Copacabana	17/01/19	Sample
	HDRG057†	Colônia de Pesca Z-13, Posto 6, Copacabana	17/01/19	Sample
	HDRG058†	Colônia de Pesca Z-13, Posto 6, Copacabana	17/01/19	Sample
	HDRG174†	Cais de Tamoios, Cabo Frio	29/06/19	Sample
	HDRG175†	Cais de Tamoios, Cabo Frio	29/06/19	Sample
	HDRG176†	Cais de Tamoios, Cabo Frio	29/06/19	Sample
	HDRG177†	Cais de Tamoios, Cabo Frio	29/06/19	Sample
	HDRG178†	Cais de Tamoios, Cabo Frio	29/06/19	Sample
	VB10*	Colônia de Pesca Z-7, Itaipu	21/05/16	Photo
Pseudobatos percellens	HDRG014*	Colônia de Pesca Z-13, Posto 6, Copacabana	13/10/18	Photo

Species	Sample Code	Sample Site	Collection Day	Source
(Muller & Henle, 1841)	HDRG018*	Colônia de Pesca Z-13, Posto 6, Copacabana	25/10/18	Photo
	HDRG031*	Colônia de Pesca Z-13, Posto 6, Copacabana	29/11/18	Photo
	HDRG032*	Colônia de Pesca Z-13, Posto 6, Copacabana	29/11/18	Photo
	HDRG033*	Colônia de Pesca Z-13, Posto 6, Copacabana	29/11/18	Photo
	HDRG042†	Colônia de Pesca Z-13, Posto 6, Copacabana	13/12/18	Sample
	HDRG043†	Colônia de Pesca Z-13, Posto 6, Copacabana	13/12/18	Sample
	HDRG049†	Colônia de Pesca Z-13, Posto 6, Copacabana	08/01/19	Sample
	HDRG050†	Colônia de Pesca Z-13, Posto 6, Copacabana	08/01/19	Sample
	HDRG051†	Colônia de Pesca Z-13, Posto 6, Copacabana	11/01/19	Sample
	HDRG052†	Colônia de Pesca Z-13, Posto 6, Copacabana	11/01/19	Sample
	HDRG059†	Colônia de Pesca Z-13, Posto 6, Copacabana	17/01/19	Sample
	HDRG060†	Colônia de Pesca Z-13, Posto 6, Copacabana	17/01/19	Sample
	HDRG061†	Colônia de Pesca Z-13, Posto 6, Copacabana	17/01/19	Sample
	HDRG082*	Colônia de Pesca Z-13, Posto 6, Copacabana	01/02/19	Photo
	HDRG083*	Colônia de Pesca Z-13, Posto 6, Copacabana	01/02/19	Photo
	HDRG124*	Colônia de Pesca Z-13, Posto 6, Copacabana	11/04/19	Photo
	HDRG125*	Colônia de Pesca Z-13, Posto 6, Copacabana	11/04/19	Photo
	HDRG126*	Colônia de Pesca Z-13, Posto 6, Copacabana	11/04/19	Photo
	HDRG129*	Colônia de Pesca Z-13, Posto 6, Copacabana	15/04/19	Photo
	HDRG130*	Colônia de Pesca Z-13, Posto 6, Copacabana	15/04/19	Photo
	HDRG131*	Colônia de Pesca Z-13, Posto 6, Copacabana	15/04/19	Photo
	HDRG132*	Colônia de Pesca Z-13, Posto 6, Copacabana	15/04/19	Photo
	HDRG133*	Colônia de Pesca Z-13, Posto 6, Copacabana	15/04/19	Photo
	HDRG134*	Colônia de Pesca Z-13, Posto 6, Copacabana	15/04/19	Photo

Species	Sample Code	Sample Site	Collection Day	Source
	HDRG135*	Colônia de Pesca Z-13, Posto 6, Copacabana	15/04/19	Photo
	HDRG136*	Colônia de Pesca Z-13, Posto 6, Copacabana	15/04/19	Photo
	HDRG137*	Colônia de Pesca Z-13, Posto 6, Copacabana	15/04/19	Photo
	HDRG138*	Colônia de Pesca Z-13, Posto 6, Copacabana	15/04/19	Photo
	HDRG139*	Colônia de Pesca Z-13, Posto 6, Copacabana	15/04/19	Photo
	HDRG179†	Cais de Tamoios, Cabo Frio	29/06/19	Sample
Zapteryx brevirostris	HDRG075†	Colônia de Pesca Z-13, Posto 6, Copacabana	23/01/19	Sample
(Muller & Henle, 1841)	HDRG076†	Colônia de Pesca Z-13, Posto 6, Copacabana	23/01/19	Sample
	HDRG247*	Colônia de Pesca Z-13, Posto 6, Copacabana	19/09/19	Photo
	HDRG249†	Colônia de Pesca Z-13, Posto 6, Copacabana	20/09/19	Sample
	SC012†	Cais de Tamoios, Cabo Frio	18/01/18	Sample

* indicates a photo source; † indicates a sample source.; # UERJ Ichthyological Collection.

are presented in Table 1, while data concerning elasmobranch individuals landed at three artisanal fishing colonies in the state of Rio de Janeiro, Brazil, from 2016 to 2019 are presented in Table 2.

Frequency data for each elasmobranch species landed at the Tamoios, Z-7 and Z-13 artisanal colonies is displayed in Figure 2. It is important to note that no standardized sampling effort was carried out in this study, so no frequency proportion extrapolation in possible for the analyzed areas.
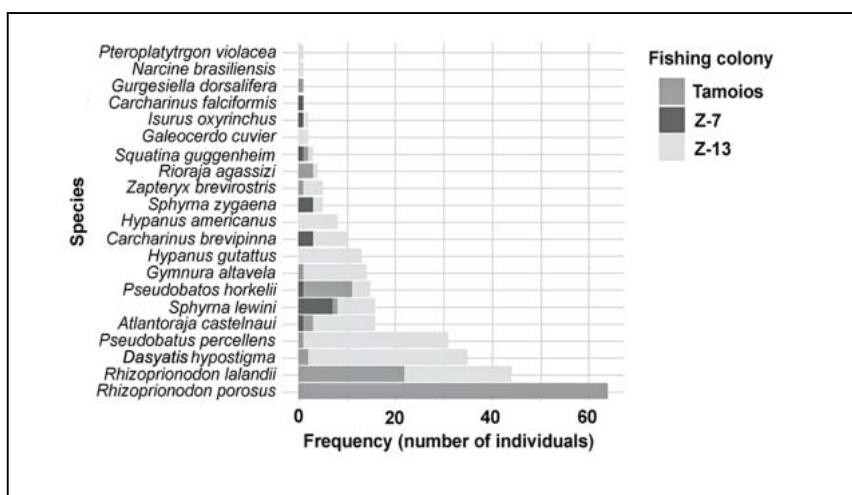
Figure 2. Frequency data for each elasmobranch species landed at the Tamoios, Z-7 and Z-13 artisanal colonies.
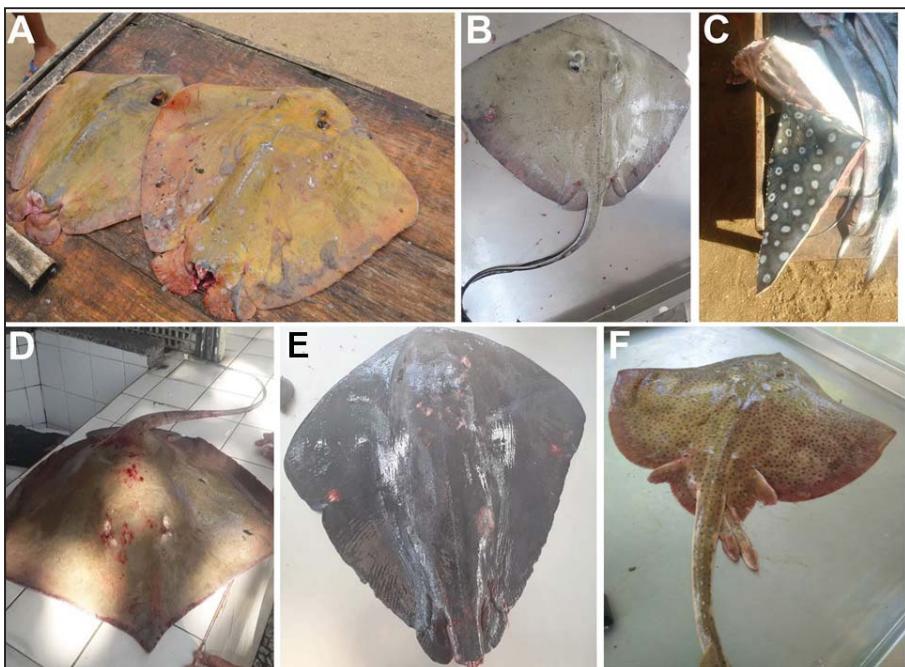
Figure 3. Ray species identified during this study. (A) *Dasyatis hypostigma*; (B) *Hypanus americanus*; (C) *Aetobatus narinari*; (D) *Hypanus guttatus*; (E) *Pteroplatrygon violacea*; (F) *Atlantoraja castelnaui*.
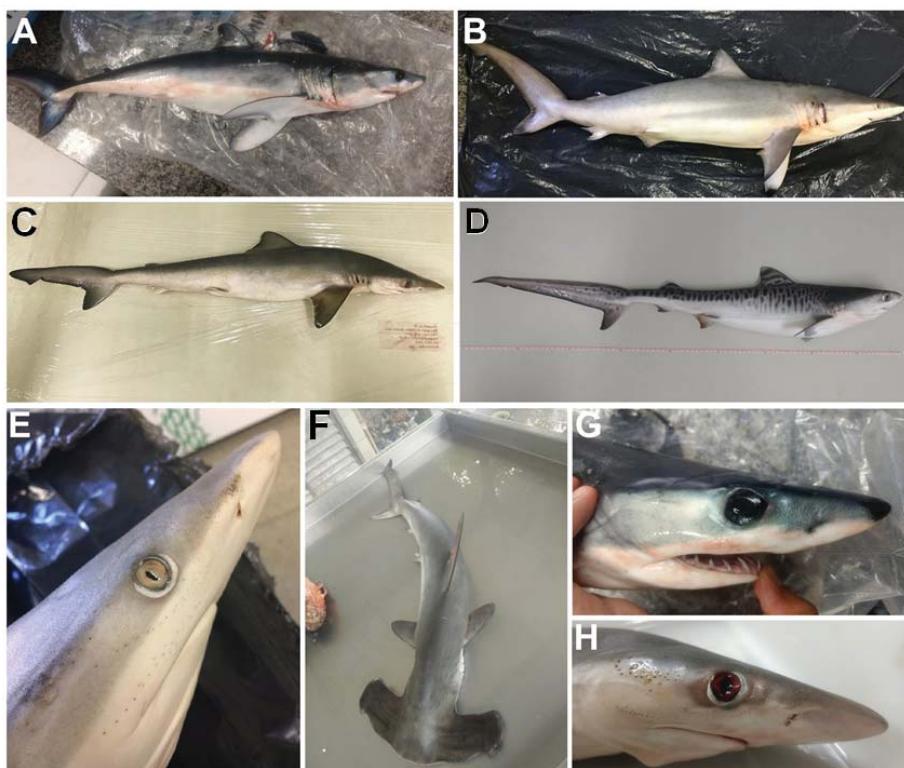
Figure 4. Shark species identified during this study. (A) *Isurus oxyrinchus*; (B) *Carcharhinus brevipinna*; (C) *Rhizoprionodon lalandii*; (D) *Galeocerdo cuvier*; (E) Eye detail - *Carcharhinus brevipinna*; (F) *Sphyrna lewini*.; (G) Eye detail - *Isurus oxyrinchus*; (H) Eye detail - *Rhizoprionodon lalandii*.

Figure 3 illustrates elasmobranch landings and weighing by artisanal fishers for marketing, while Figures 4 and 5 illustrate some of the rays and sharks, respectively, identified during this study.

DISCUSSION

The present study reports a preliminary assessment carried out during three years regarding artisanal fishing elasmobranch landing at three locations throughout the coast of Rio de Janeiro. Although the Associação de Pesca de Tamoios, in Cabo Frio is home to the previously described upwelling phenomenon, the highest richness concerning oceanic elasmobranchs was recorded at the Z-13 colony, in Copacabana, located in the metropolitan region of Rio de Janeiro. This sampling site is a part of Guanabara Bay, and the results presented herein reinforce the significant biodiversity of the bay and the importance of its recovery for elasmobranch management and conservation strategies.

In addition, many specimens belonging to different species sampled from this site (*Sphyrna zygaena, Sphyrna lewini, Carcharinus brevipinna, Isurus oxyrinchus* and *Galeocerdo cuvier)* were juvenile (Araujo, pers. obs.), while three spinner shark females (*Carcharinus brevipinna*) with mature oocytes were also noted (Araujo, pers. obs.), indicating that this may be a strategic reproduction and juvenile settlement site for several of the landed species. This is further supported by the record of six females of *Rhizoprionodon lalandii*, a coastal species, containing embryos and/or oocytes, as well as the high presence of juvenile hammerhead sharks (*Sphyrna lewini*), indicating potential development area (Motta et al., 2005). It is noteworthy both Itaipu and Copacabana are inserted in the estuarine Guanabara Bay, while Tamoios is located the São João River, both a strong indication of an elasmobranch breeding area, as reported by Plumlee et al. (2018) and Parsons and Hoffmayer (2007). In addition to species that are more commonly caught by gillnets, more pelagic and cosmopolitan species such as Tiger (*Galeocerdo cuvier*) and Mako (*Isurus oxyrinchus*) sharks were also caught by the same fishing methodology, all juveniles, once again indicating potential elasmobranch breeding and development areas.

In its most recent report, the Rio de Janeiro Institute for Fisheries Foundation (FIPERJ) reported that, in 2016, the species identified as *cação-frango* (Sharpnose shark, *Rhizoprionodon* sp.) was the most representative species regarding total landings, with a production of 5,212,8 kg, followed by *cação-anjo* (angel shark, *Squatina* sp.), at 2,661.5 kg and, finally, *cação-martelo* (hammerhead shark, *Sphyrna* sp.),

totaling 1,004kgs (Fundação Instituto de Pesca do Estado do Rio de Janeiro 2016). However, the data reported herein cannot be quantitatively compared to FIPERJ data, as FIPERJ provides mixed and generalized information containing artisanal, semi-industrial and industrial fishing data, where artisanal fishing represents only a portion of the catch. In addition, the different range of fishing fleets should also be taken into account, as a limiting factor for the habitat range of certain species, such as hammerhead sharks and angelfish, due to depths and distance from the shore. It is also noteworthy that FIPERJ accounts for the weight of a certain species and data per individual, which may overestimate the data, as an adult fish may weigh more than 10 juvenile individuals.

Concerning species vulnerability, *Squatina occulta* and *Squatina guggenheim*, are classified as critically endangered and endangered, respectively, according to the IUCN. In addition, *Squatina guggenheim*, was reported as reaching critically low levels and populational declines during the 1990s (Boeckman & Vooren, 1997; Vooren 1997; Lessa et al. 1999), indicating significant vulnerability for this species. In turn, all six hammerhead shark species distributed along the Brazilian coast are currently nationally listed as threatened (Instituto Chico Mendes de Conservação da Biodiversidade 2018). Given that the present study identified several *Squatina guggenheim*, *Sphyrna lewini* and *Sphyrna zygaena* individuals, it is clear that environmental education actions, measures to avoid the capture of this species or release actions alongside fishers at these locations are required, in order to sensitize them to the inherent impact of capturing these species and avoid further damage.

A significant amount of landed elasmobranch species is unidentified, or identified solely by their common names by the fishers, which also change according to fishery region (FIPERJ, 2016). For example, many unidentified species may belong to the *cação* category, the Brazilian generic name for most shark species, representing a significant amount of the 3.1 tons landed in 2016 for which no scientific identification was carried out. The same is probably true for rays, as these animals are distributed into categories with popular names such as *raia-manteiga* (stingrays) (about 1 ton) or *raia-pintada* (spotted rays) (3 tons) (FIPERJ, 2016). Thus, many species may be easily confused, making it difficult to create an elasmobranch management plan, and species identification is paramount. In addition, it is important to note the significant elasmobranch role as a fishing resource in Brazil, attributed to the current market incentive for the consumption of shark meat, due to, mainly, low costs, leading to social and economic,

as well as ecological, concerns (Bornatowski *et al.* 2018).

Rio de Janeiro extractive marine fisheries represent about 2.5% of total shark landings caught per year in Brazil (Ministério da Pesca e Aquicultura 2014). However, in 2010 alone, in the Southwest Atlantic region, about 33% more sharks were fished in reality compared to lower figures reported by Southwest Atlantic governments to the Food and Agriculture Organization of the United Nations (FAO), attributed to artisanal, illegal and discarded fisheries (Pauly & Zeller, 2016). Allied to the lack of knowledge on the commercial and artisanal exploitation of these animals, the lack of information on the occurrence of shark species makes it difficult to employ conservation strategies aiming at the preservation and management of this resource. One way to circumvent the reported difficulties is the scientific monitoring of the artisanal fishermen colonies and performing a scientific approach towards the ecological knowledge of these fishermen, which, besides contributing to landing monitoring, enables taxonomic, physiological and genetic elasmobranch studies, furthering knowledge concerning the population ecology and geographical distribution of the group. In recent years, several studies have been conducted in Brazil addressing these issues (Palmeira et al. 2013; Barbosa-Filho *et al.* 2014, 2016, 2017; Bornatowski *et al.* 2015; Gemaque et al. 2017; Feitosa *et al.* 2018), denoting the relevance of information of this nature to the management and conservation of this threatened zoological group.

Dulvy *et al.* (2014) estimated that about a quarter of the world's shark and ray species are threatened by overfishing, and although the state of Rio de Janeiro is flagged as one of the world's priority shark conservation areas (Lucifora *et al.* 2011), the results presented herein indicate high amounts of threatened species being caught as by-catch. From an ecosystem perspective, it is well known that the presence of top predators and mesopredators as trophic regulators is essential for the functioning of ecosystem interaction webs (Stevens *et al.* 2000). Thus, declines in shark and ray population stocks may lead detrimental effects on marine communities (Myers *et al.* 2007; Bornatowski *et al.* 2014). The main documented phenomenon implies in the deregulation of lower trophic level maintenance exerted by top predator pressure, known as the top-down effect, thus affecting not only the ecosystem in question, but also the fishing industry itself (Ferretti *et al.* 2010).

In this regard, it is important to take into account the presence of keystone species. Keystone species are defined as species which "have an extremely high impact on a particular ecosystem relative to its population, and are also critical for the overall structure and function of an ecosystem, and influence which other types of organisms make up that ecosystem" (Humphries et al., 2017). Six keystone elasmobranch species have been previously observed throughout the Southeastern coast of Brazil (Bornatowski *et al.* 2014), and the present study reports four of them, namely *Galeocerdo cuvier*, *Sphyrna lewini*, *S. zygaena* and *Zapteryx brevirostris*, further indicating the importance of future assessments concerning elasmobranch fisheries monitoring in Brazil. In addition, due to the continuity of oceanographic conditions between the Brazilian Southeast and South, it is probable that the species reported herein display an extended ecosystem importance to the South, implicating in further social and economic concerns.

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