

Marine Record

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Corresponding author:

Jones Santander-Neto;

Email: jones.santander@ifes.edu.br

Chondrichthyan biodiversity in the state of Espírito Santo, Brazil

Jones Santander-Neto¹ , Guilherme dos Santos Lirio²,

José Victor Calenzani de Oliveira Moreira¹ , Otto Bismarck Fazzano Gadig³ 

and Maurício Hostim-Silva² 

¹Instituto Federal do Espírito Santo, Campus Piúma, Rua Augusto Costa de Oliveira, 660, 29285-000, Praia Doce, Piúma, ES, Brasil; ²Universidade Federal do Espírito Santo, Laboratório de Ecologia de Peixes Marinhos -LEPMAR, Rodovia Governador Mário Covas, km 60, 29932-540, Bairro Litorâneo, São Mateus, ES, Brasil and ³Laboratório de Pesquisa de Elasmobrânquios, Instituto de Biociências, Universidade Estadual Paulista, Campus do Litoral Paulista, Praça Infante Dom Henrique, Parque Bitaru, São Vicente, SP 11330-900, Brazil

Abstract

Little is known about the Chondrichthyes fauna of the state of Espírito Santo, southeastern Brazil, notably on the species composition, distribution, and biology. Historically, only a few studies have focused on these issues. Basic taxonomy is one of the main tools employed in cataloguing, organizing, and initiating other, more specific, assessments regarding regional diversity. In this context, this study presents the most comprehensive list of shark and ray species occurring in the state of Espírito Santo to date. The compiled data were obtained from specimens deposited in ichthyological collections, literature reviews, and samplings conducted at fisheries landings and onboard commercial fleet vessels. The findings indicate 79 species, comprising 51 sharks and 28 rays. A total of 53.2% of threatened Brazilian marine elasmobranch species occur in the area, indicating the importance of carrying out local studies focusing on this group. A first record for the Brazilian large-eyed stingray, *Hypanus marianae*, was also observed for the state, increasing the southern limit of the species known distribution, previously considered restricted to the North and Northeast coasts.

Introduction

The Chondrichthyes fishes (sharks, rays, and chimeras) comprise a vertebrate group with long evolutionary and ecological histories, belonging to about 1263 known living species (Compagno, 1984a, 1984b; Compagno, 2001; Compagno *et al.*, 2005; Ebert *et al.*, 2013; Last *et al.*, 2016; Weigmann, 2016; Ebert *et al.*, 2021). Despite such high ecological and morphological diversity and the pivotal role of meso and top predators in aquatic (mainly marine) ecosystems (Heithaus *et al.*, 2022), there are a few faunistic and diversity studies on a regional basis aiming to assess population parameters and build conservation and fisheries management public policies. The Brazilian Chondrichthyes fauna is recognizably rich and diverse, owing to the presence of numerous freshwater ray species belonging to the Potamotrygonidae family, as well as many marine members found along the country's coastline and Exclusive Economic Zone, totalling at least 211 species, consisting of 94 sharks, 104 rays, and eight chimeras (Gadig and Rosa, 2023). These numbers rank Brazil as seventh concerning Chondrichthyes biodiversity worldwide, highlighted by the fact that this diversity is distributed in only one ocean, the Atlantic, unlike other countries that have many of their territories bathed by more than one ocean (Gadig and Rosa, 2023).

Due to Brazil's extensive aquatic environment areas (i.e. watersheds and coastal/marine zones), knowledge concerning the local Chondrichthyes fauna is constantly being updated, with several species not yet described and others currently undergoing the description process (Gadig and Rosa, 2023). The country, however, still lacks a broad enough diagnosis, mainly concerning faunal surveys on a regional scale, in order to subsidize biogeographical studies and meet increasingly urgent demands for the establishment of public policies that act in favour of the management and conservation of this group's biodiversity, such as state-level extinction risk assessments. Adequate knowledge on the faunal elements that make up local diversities allows for Chondrichthyes life cycle-associated studies (habitat use, feeding, reproduction, age, and growth), all of which are considered knowledge gaps for the group in Brazil (Kotas *et al.*, 2023), as well as assessments on their exploitation (historical capture and effort series, mortality, and demography). These studies compose the information mosaic to be employed in Chondrichthyes management, use, and conservation efforts.

In this regard, some memorable studies have left their mark on Espírito Santo chondrofauna history. Ruschi (1965), for example, listed 47 cartilaginous fish species in the state. After four decades, a taxonomic list of Chondrichthyes species occurring in Brazil was published, with Espírito Santo listed among the states that make up the central coast (Lessa *et al.*, 1999), which now presents a slightly known chondrofauna. Over the following decades, some studies, even if not focused on Chondrichthyes, have compiled important records,



contributing to knowledge on this group in Espírito Santo (e.g. Nunan and Senna, 2007; Pinheiro *et al.*, 2015).

The coastline of the state of Espírito Santo comprises about 411 km, with a series of geomorphological features, such as continental shelves presenting varying widths, submerged mountain ranges, coastal and oceanic islands, and deep slopes, which diversify the marine environments under its jurisdiction (Albino *et al.*, 2016). However, although these heterogeneous coastal and marine environments exhibit high biodiversity potential, basic faunal Chondrichthyes composition studies, as well as knowledge on their distribution and biological aspects, are still lacking for the region. As Espírito Santo is one of the priority areas for Chondrichthyes biological inventories and abundance monitoring (Lessa *et al.*, 1999), this is clearly paramount.

Understanding the diversity of Chondrichthyes is, in fact, of strategic importance under an ecosystem approach, as these animals occupy predator or meso-predator niches (Heithaus *et al.*, 2022) and exhibit certain biological characteristics that make them highly susceptible to mortality by unnatural factors, such as fisheries and habitat degradation (Dulvy *et al.*, 2021). Therefore, this study aims to present a comprehensive and revised list of shark and ray species recorded so far for the state of Espírito Santo, Southeastern Brazil, based on species records from museums, bibliographic reviews, and fisheries monitoring.

Material and methods

The present study was carried out in the state of Espírito Santo, which is located in the southeast region of Brazil, bordering the state of Bahia to the north and Rio de Janeiro to

the south, between geographic coordinates 18°20'45.8"S/ 39°40'49.6"W and 21°18'04"S/ 40°57'24"W (Figure 1). Espírito Santo is a coastal state, and covers an area of approximately 411 km (Albino *et al.*, 2016), and also includes the oceanic islands of Trindade and Martim Vaz in its territory.

The data used for the preparation of the list of Chondrichthyes species in Espírito Santo was based on three main sources:

- 1) Local specimens deposited in scientific collections, namely the Professor Mello Leitão Biology Museum (MBML), the National Museum of Rio de Janeiro (MNRJ), the Zoology Museum at the University of São Paulo (MZUSP), the Ichthyological Collections belonging to the Federal University of Espírito Santo (CIUFES) and the Department of Zoology at the State University of Rio de Janeiro (DZ-UERJ), and the Fish Collection belonging to the Ecology and Socio-Environmental Development Nucleus at the Federal University of Rio de Janeiro (NPM).
- 2) A literature data review carried out by consulting articles, monographs, dissertations, theses, technical reports, books, and book chapters, alongside online databases and exchanges with researchers, abstracts released at scientific and occasional events, and any other documents that indicate elasmobranch occurrences in the state of Espírito Santo. This search was initially carried out through traditional species survey references that indicated the occurrence of elasmobranchs in the state (i.e. Ruschi, 1965; Lessa *et al.*, 1999; Revizee documents). Subsequently, we searched the curriculum of researchers who monitored fisheries or sampled fish, as well as looking for references from these documents to look for older references that had not appeared in the searches to try to go back historically to who had made the first record of an elasmobranch in the state. The bibliographic material underwent a critical data evaluation considering the current nomenclature and obvious mistakes and/or uncertainties in the identification or capture location.

- 3) Sampling at fisheries landings and fisheries monitoring onboard commercial vessels: (1) Between October 2016 and January 2023, 33 fisheries landings monitoring and 33 onboard fisheries monitoring in southern Espírito Santo (Marataízes, Itapemirim, Piúma, Anchieta and Guarapari municipalities) of surface gillnet, surface longline, bottom trawling and beach hauling fishing were made; (2) Observations of 12 onboard fisheries monitoring in bottom gillnet fishing vessels were carried out monthly between April 2018 and March 2019 in northern Espírito Santo (Conceição da Barra, São Mateus, and Linhares municipalities). Elasmobranchs were identified at the lowest taxonomic level possible in the field or at the laboratory for specimens that were difficult to identify in the field. The species were identified based on Bigelow and Schroeder (1948, 1953 – for general sharks and rays); Figueiredo (1977 – for southeast Brazilian sharks and rays); Garrick (1982 - *Carcharhinus* spp. Blainville, 1816); Compagno (1984a, 1984b – general sharks); Gadig (2001 - Brazilian sharks); Gomes *et al.* (2010 - southeast Brazilian sharks and rays); Rosa and Gadig (2010 - Brazilian *Mustelus* spp. Linck, 1790); Last *et al.* (2016 - general rays); Soares *et al.* (2016 - Scyliorhinidae); Viana *et al.* (2016 – for *Squalus* spp. Linnaeus, 1758).

Sampling was conducted under the approval of the Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio, license #14258/5). In most cases, animal welfare laws, guidelines or policies were not applicable because no live fish was sampled or collected, with the specimens being sold to the public by fishermen.

Extinction risks were established at both the Brazilian and global levels, with the former employing the Brazilian Chondrichthyes Species Assessment (ICMBio, 2016) and, for endangered species, the most recent legislation that recognizes the National List of Endangered Species (Ministério do Meio Ambiente (GM/MMA), 2022), while the latter considered the International Union for the Conservation of Nature (IUCN) Threat Status Assessment (2022).

To establish a relationship between the most abundant orders, families, and genera, we made a bar graph with the R Program (version 4.3.3) (R Core Team, 2024) and the ggplot2 package (Wickham, 2016). For a better understanding of which orders were represented, illustrative images were taken from the website Phylopic.org (Keeseey, 2024) and included in the chart using the Adobe Photoshop 2020 program. To construct the pie donut chart containing the classification of species extinction risks at a national and global level, we used, for shaping the graph, in addition to the previous program and package, the webr package (Moon, 2020).

Results

The data obtained in our assessment indicated 10 orders, 28 families, 42 genera, and 79 species of elasmobranchs occurring on the coast of Espírito Santo, totalling 51 sharks and 28 rays (Table 1). The richest group was noted as the Carcharhiniformes order, comprising 29 species, 18 of them belonging to the Carcharhinidae family, five Sphyrnidae, three Triakidae, and three Scyliorhinidae. The Myliobatiformes order was the second most representative, consisting of 15 species, namely Dasyatidae (5), Myliobatidae (3), Mobulidae (3), Gymnuridae (2), and Aetobatidae (1) (Figure 2). Among the main sources of species records, the highlight was the review of literature data with 68 species, followed by landing and boarding sampling with 34 species and finally specimens collected in museums with 26 species (Table 1).

A first record for the Brazilian large-eyed stingray, *Hypanus marianae* (Gomes *et al.*, 2000), was observed for Espírito Santo (Figure 3). A total of 43 specimens were identified during the

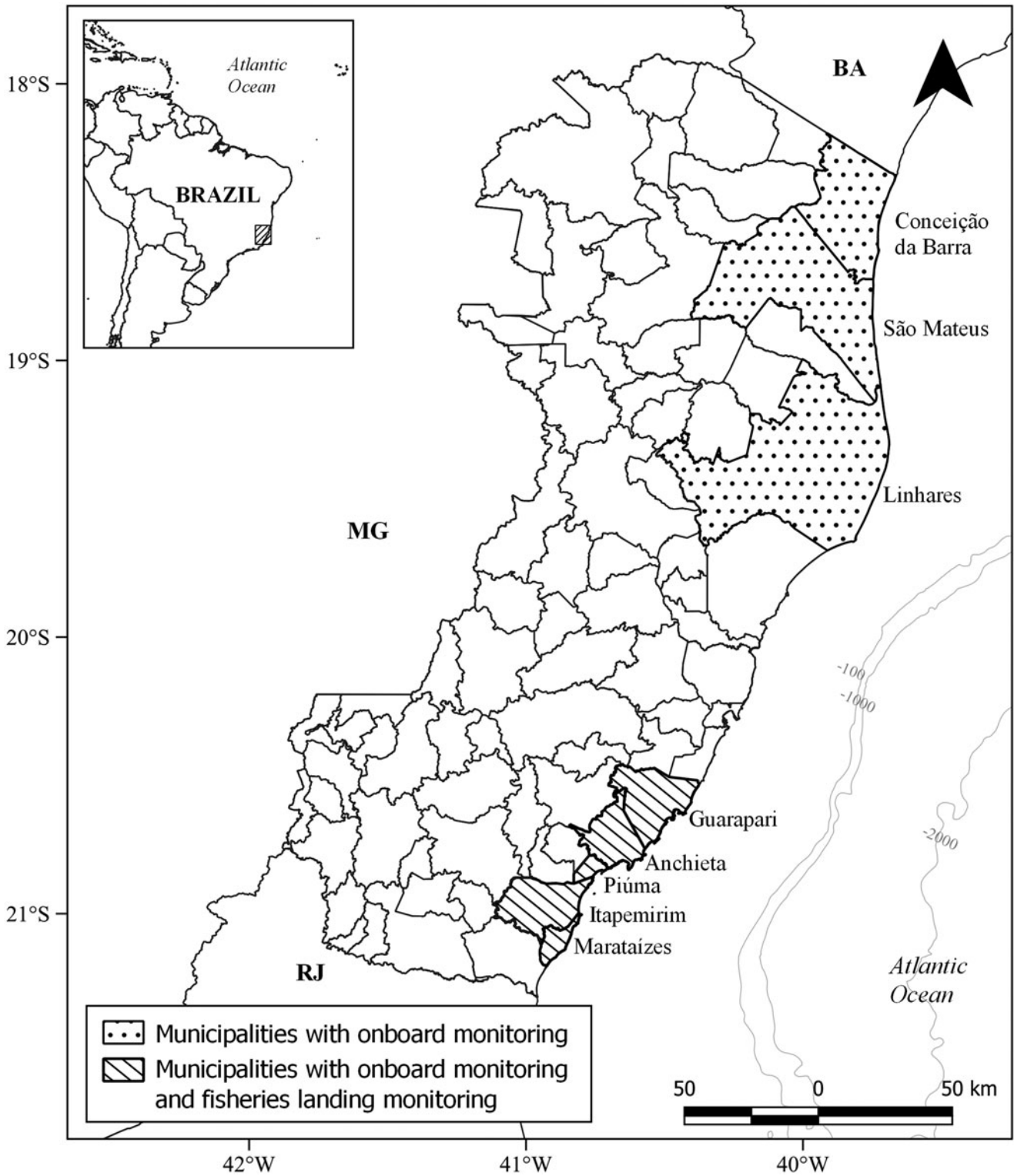


Figure 1. Map of Espírito Santo state, Brazil, indicating municipalities with onboard monitoring to the north (area with dots) and municipalities with onboard monitoring and fisheries landing monitoring to the south (area with lines).

onboard monitoring, 10 females and 33 males, with disc widths between 25.5 and 36 cm, captured with bottom gillnets at depths ranging from 16 to 49.8 m.

According to the Brazilian risk of extinction categorization, 42 species are listed as threatened, with 17 as Vulnerable, seven as Endangered, and 18 as Critically Endangered. When considering the global categorization, 52 species are listed as threatened, with 20 categorized as Vulnerable, 21 as Endangered, and 11 as Critically Endangered (Figure 4).

Discussion

This study aimed to carry out a Chondrichthyes survey for the state of Espírito Santo through local specimens deposited in scientific collections, a literature review, and samples disembarked and shipped from various fisheries along the state’s coast. As a detailed biodiversity investigation was proposed, all bibliographic material underwent a critical evaluation to precisely define the fauna attributed to the state. In addition, some exclusions of

Table 1. Checklist of Chondrichthyes species known in Espírito Santo, Brazil

Taxon	Evidence	1st record	BR	IUCN
Hexanchiformes				
Hexanchidae				
<i>Heptranchias perlo</i> (Bonnaterre, 1788)	Li	Nunan and Senna (2007)	DD	NT
Squaliformes				
Dalatidae				
<i>Isistius brasiliensis</i> (Quoy & Gaimard, 1824)	Li	Ruschi (1965)	LC	LC
<i>Squaliolus laticaudus</i> Smith & Radcliffe, 1912	Li	Nunan and Senna (2007)	LC	LC
Etmopteridae				
<i>Etmopterus bigelowi</i> Shirai & Tachikawa, 1993	Li	Nunan and Senna (2007)	LC	LC
<i>Etmopterus lucifer</i> Jordan & Snyder, 1902	Li	Gomes <i>et al.</i> (2010)	LC	LC
<i>Etmopterus pusillus</i> (Lowe, 1839)	Li	Séret and Andreatta (1992)	-	LC
Somniosidae				
<i>Centroscymnus coelolepis</i> Barbosa du Bocage & de Brito Capello, 1864	Li	Nunan and Senna (2007)	LC	NT
<i>Centroscymnus owstonii</i> Garman, 1906	Mus	MNRJ-40549; 2000	LC	VU
<i>Somniosus antarcticus</i> Whitley, 1939	Li	Nunan and Senna (2007)	LC	LC
Squalidae				
<i>Cirrhigaleus asper</i> (Merrett, 1973)	Li	Nunan and Senna (2007)	DD	DD
<i>Squalus albicaudus</i> Viana, de Carvalho & Gomes, 2016	Li	Viana <i>et al.</i> (2016)	-	DD
<i>Squalus lobularis</i> Viana, de Carvalho & Gomes, 2016	Li	Viana <i>et al.</i> (2016)	-	DD
Squatiniformes				
Squatinidae				
<i>Squatina occulta</i> Vooren & da Silva, 1992	Li; Mus	Vaz and Carvalho (2013)	CR	CR
<i>Squatina varii</i> Vaz & de Carvalho, 2018	Li	Vaz and Carvalho (2018)	-	LC
Orectolobiformes				
Orectolobidae				
<i>Ginglymostoma cirratum</i> (Bonnaterre, 1788)	Li; Mus; Co	Nichols and Murphy. (1913)	VU	VU
Rhincodontidae				
<i>Rhincodon typus</i> Smith, 1828	Li	Pinheiro <i>et al.</i> (2009)	VU	EN
Lamniformes				
Alopiidae				
<i>Alopias superciliosus</i> Lowe, 1841	Li; Co	Pinheiro <i>et al.</i> (2015)	EN	VU
<i>Alopias vulpinus</i> (Bonnaterre, 1788)	Li	Amorim (1992)	CR	VU
Lamnidae				
<i>Carcharodon carcharias</i> (Linnaeus, 1758)	Li	Miranda-Ribeiro (1919)	VU	VU
<i>Isurus oxyrinchus</i> Rafinesque, 1810	Li; Co	Martins <i>et al.</i> (2005a)	CR	EN
<i>Isurus paucus</i> Guitart, 1966	Li; Co	Pinheiro <i>et al.</i> (2015)	DD	EN
Odontaspidae				
<i>Carcharias taurus</i> Rafinesque, 1810	Li; Co	Ruschi (1965)	CR	CR
Carcharhiniformes				
Carcharhinidae				
<i>Carcharhinus acronotus</i> (Poey, 1860)	Li; Co	Martins <i>et al.</i> (2005a)	VU	EN
<i>Carcharhinus brachyurus</i> (Günther, 1870)	Li; Co	Amorim (1992)	DD	VU
<i>Carcharhinus brevipinna</i> (Müller & Henle, 1839)	Mus	CIUFES-1515; 2007	VU	VU
<i>Carcharhinus falciformis</i> (Müller & Henle, 1839)	Li; Mus; Co	MNRJ-6893; 1944	CR	VU
<i>Carcharhinus galapagensis</i> (Snodgrass & Heller, 1905)	Li	Pinheiro <i>et al.</i> (2015)	CR	LC
<i>Carcharhinus glaucus</i> (Linnaeus, 1758)	Li; Co	Ruschi (1965)	NT	NT

(Continued)

Table 1. (Continued.)

Taxon	Evidence	1st record	BR	IUCN
<i>Carcharhinus leucas</i> (Müller & Henle, 1839)	Li	Ruschi (1965)	VU	VU
<i>Carcharhinus limbatus</i> (Müller & Henle, 1839)	Li; Co	Carvalho (1950)	NT	VU
<i>Carcharhinus longimanus</i> (Poey, 1861)	Li; Co	Ruschi (1965)	VU	CR
<i>Carcharhinus obscurus</i> (Lesueur, 1818)	Li; Mus; Co	MNRJ-6892; 1944	EN	EN
<i>Carcharhinus perezii</i> (Poey, 1876)	Li; Co	Gasparini and Floeter (2001)	VU	EN
<i>Carcharhinus plumbeus</i> (Nardo, 1827)	Li; Mus	MNRJ-6892; 1944	CR	EN
<i>Carcharhinus porosus</i> (Ranzani, 1839)	Li; Mus	MNRJ-6963; 1944	CR	CR
<i>Carcharhinus signatus</i> (Poey, 1868)	Li; Co	Amorim (1992)	EN	EN
<i>Galeocerdo cuvier</i> (Péron & Lesueur, 1822)	Li; Co	Ruschi (1965)	NT	NT
<i>Negaprion brevirostris</i> (Poey, 1868)	Li, Co	Martins, 2018	EN	VU
<i>Rhizoprionodon lalandii</i> (Müller & Henle, 1839)	Mus; Co	MNRJ-7806; 1944	NT	VU
<i>Rhizoprionodon porosus</i> (Poey, 1861)	Mus; Co	UERJ-1780, 1997	DD	VU
Sphyrnidae				
<i>Sphyrna lewini</i> (Griffith & Smith, 1834)	Li; Co	Pinheiro <i>et al.</i> (2015)	CR	CR
<i>Sphyrna mokarran</i> (Rüppell, 1837)	Li; Co	Amorim (1992)	CR	CR
<i>Sphyrna tiburo</i> (Linnaeus, 1758)	Li; Mus	MNRJ-6898; 1944	CR	EN
<i>Sphyrna tudes</i> (Valenciennes, 1822)	Li	Ruschi (1965)	CR	CR
<i>Sphyrna zygaena</i> (Linnaeus, 1758)	Li; Co	Ruschi (1965)	CR	VU
Triakidae				
<i>Mustelus canis</i> (Mitchill, 1815)	Li	Ruschi (1965)	EN	NT
<i>Mustelus higmani</i> Springer & Lowe, 1963	Mus	MZUSP-9972; 1969	LC	EN
<i>Mustelus norrisi</i> Springer, 1939	Mus; Co	UERJ-1806; 1997	DD	NT
Scylliorhinidae				
<i>Apristurus parvipinnis</i> Springer & Heemstra, 1979	Li; Mus	MNRJ-30192; 1999	LC	LC
<i>Apristurus profundorum</i> (Goode & Bean, 1896)	Li; Mus	MNRJ-30195; 2000	DD	LC
<i>Scylliorhinus haeckelii</i> Miranda Ribeiro, 1907	Li	Ruschi (1965)	LC	DD
Torpediniformes				
Nacinae				
<i>Narcine brasiliensis</i> (Olfers, 1831)	Li; Co	Ruschi (1965)	VU	NT
Rhinopristiformes				
Trygonorhinidae				
<i>Zapteryx brevirostris</i> (Müller and Henle, 1841)	Li; Mus; Co	MNRJ-7803; 1944	VU	EN
Pristidae				
<i>Pristis pectinata</i> Latham, 1974	Li	Ruschi (1965)	CR	CR
<i>Pristis pristis</i> (Linnaeus, 1758)	Li; Mus	MCZ-S667; 1865	CR	CR
Myliobatiformes				
Aetobatidae				
<i>Aetobatus narinari</i> (Euphrasen, 1790)	Li; Mus; Co	CIUFES-807; 2007	DD	EN
Dasyatidae				
<i>Dasyatis hypostigma</i> Santos & Carvalho, 2004	Li	Gomes <i>et al.</i> (2010)	DD	EN
<i>Hypanus berthaltzuae</i> Petean, Naylor & Lima, 2020	Mus; Co	MBML-11937; 2016	VU	VU
<i>Hypanus guttatus</i> (Bloch & Schneider, 1801)	Li; Mus; Co	MBML-3991; 2006	LC	NT
<i>Hypanus marianae</i> (Gomes, Rosa and Gadig, 2000)	Co	Present study	VU	EN
<i>Pteroplatytrygon violacea</i> (Bonaparte, 1832)	Li	Pinheiro <i>et al.</i> (2015)	DD	LC
Gymnuridae				
<i>Gymnura micrura</i> (Bloch & Schneider, 1801)	Mus	MNRJ-7805; 1944	NT	NT

(Continued)

Table 1. (Continued.)

Taxon	Evidence	1st record	BR	IUCN
<i>Gymnura valenciennii</i> Duméril (1865)	Li; Co	Ruschi (1965)	CR	EN
Mobulidae				
<i>Mobula birostris</i> (Walbaum, 1792)	Li	Ruschi (1965)	VU	EN
<i>Mobula hypostoma</i> (Bancroft, 1831)	Li	Ruschi (1965)	*	EN
<i>Mobula mobular</i> Bonnaterre, 1788	Li	Pinheiro <i>et al.</i> (2015)	VU	EN
Myliobatidae				
<i>Myliobatis freminvillei</i> Lesueur, 1824	Li; Co	Ruschi (1965)	EN	VU
<i>Rhinoptera bonasus</i> (Mitchill, 1815)	Li; Co	Ruschi (1965)	DD	VU
<i>Rhinoptera brasiliensis</i> Müller, 1836	Li; Co	Ruschi (1965)	CR	VU
Rhinobatidae				
<i>Pseudobatos horkelii</i> (Müller and Henle, 1841)	Li; Co	Ruschi (1965)	CR	CR
<i>Pseudobatos percellens</i> (Walbaum, 1792)	Li; Mus; Co	MNRJ-6907; 1944	VU	EN
Rajiformes				
Arhynchobatidae				
<i>Atlantoraja castelnaui</i> (Miranda Ribeiro, 1907)	Li; Mus	Ruschi (1965)	EN	CR
<i>Atlantoraja cyclophora</i> (Regan, 1903)	Li	Ruschi (1965)	VU	EN
<i>Atlantoraja platana</i> (Günther, 1880)	Mus	MNRJ-6881, 1944	DD	EN
<i>Rioraja agassizii</i> (Müller and Henle, 1841)	Li; Mus	MNRJ-6880, 1944	VU	VU
Rajidae				
<i>Malacoraja obscura</i> Carvalho, Gomes & Gadig 2005	Li; Mus	MNRJ-28289; 2005	LC	LC
<i>Psammobatis rutrum</i> Jordan 1891	Li	Gomes <i>et al.</i> (2010)	DD	LC
<i>Rajella sadowskii</i> (Kreff & Stehmann, 1974)	Li	Séret and Andreata (1992)	DD	LC
Gurgesiellidae				
<i>Gurgesiella dorsalifera</i> McEachran & Compagno, 1980	Li	Séret and Andreata (1992)	LC	VU

Types of evidence: Li, Literature; Mu, Museum (species recorded in ichthyological collections); Co, Collected. CR, Critically Endangered; EN, Endangered; VU, Vulnerable; NT, Near Threatened; LC, Least Concern; DD, Data Deficient; NE, Not Evaluated; BR, national assessment; IUCN, IUCN red list assessment.

*The species is listed as threatened (VU) according to ICMBio (2016) but was not included with this risk in the Ministério do Meio Ambiente (GM/MMA), 2022.

species previously recorded for Espírito Santo were conducted, detailed below.

Species belonging to the Holocephali subclass (chimeras) were not reported for Espírito Santo, as most of the data compiled herein indicate that records for this subclass are based on more accessible marine environments (pelagic zones and shallower areas) and consider that the representatives of this group inhabit deeper regions. However, Costa *et al.* (2000), in a demersal survey carried out by the REVIZEE Program, cite a *Chimaera* sp. Linnaeus, 1758 record for the central coast, although they do not indicate the sampling location (campaign carried out between 11° and 22° South) within a wide area involving the states of Bahia, Espírito Santo, and Rio de Janeiro. Studies in environments other than those routinely sampled by fisheries, such as slopes and deeper zones, therefore, display high potential for validating the occurrence of *Chimaera* sp. or that of other chimera species in the state of Espírito Santo.

Some large oceanic sharks, *Hexanchus griseus* (Bonaterre, 1788), *Lamna nasus*, *Odontaspis noronhai* Maul, 1955, and *Carcharhinus altimus* (Springer, 1950), cited by Amorim and Arfelli (1992), were also not included in the list, as their capture locations were also not reported, and the study covered a wide area beyond the limits of the state of Espírito Santo. It is possible that these species occur or have occurred in the past in Espírito Santo, but the lack of capture location precision associated with the low number of sampled individuals from these species led us to not include them in the

state's fauna list. On the other hand, the occurrence of *Carcharhinus brachyurus* (Günther, 1870), *Alopias vulpinus* (Bonaterre, 1788), *Carcharhinus signatus* (Poe, 1868), and *Sphyrna mokarran* (Rüppell, 1837) cited by Amorim and Arfelli (1992) in the state of Espírito Santo was confirmed during the data collection carried out in the present study.

In another case, *Somniosus pacificus* Bigelow, Schroeder, 1944, was previously recorded for Espírito Santo (Nunan and Senna, 2007). However, an image analysis identified the species as *Somniosus antarcticus* Whitley, 1939. This mistake in the identification of *S. pacificus* for the South Atlantic is also noted elsewhere (De Astarloa *et al.*, 1999) and was later corrected to *S. antarcticus* Whitley, 1939 by Yano *et al.* (2007).

For a long time, Brazilian specimens belonging to the genus *Squalus* were classified within species complexes, represented by three groups, namely *acanthias* (comprising *Squalus acanthias* Linnaeus, 1758, well defined), *megalops/cubensis*, and *blainvillei/mitsukurii* (Marques, 1999; Gadig, 2001; Gomes *et al.*, 2010). Viana *et al.* (2016) presented a revisionary study in this area in the western South Atlantic, describing four new species (*S. albicaudus*, *S. bahiensis*, *S. lobularis*, and *S. quasimodo*), allowing a more precise and exhaustive diagnosis features for the identification of Brazilian representatives. According to distributional data and descriptions carried out by Viana *et al.* (2016), only *Squalus albicaudus* and *S. lobularis* were recorded for Espírito Santo, whereas *S. mitsukurii* Jordan & Snyder, 1903,

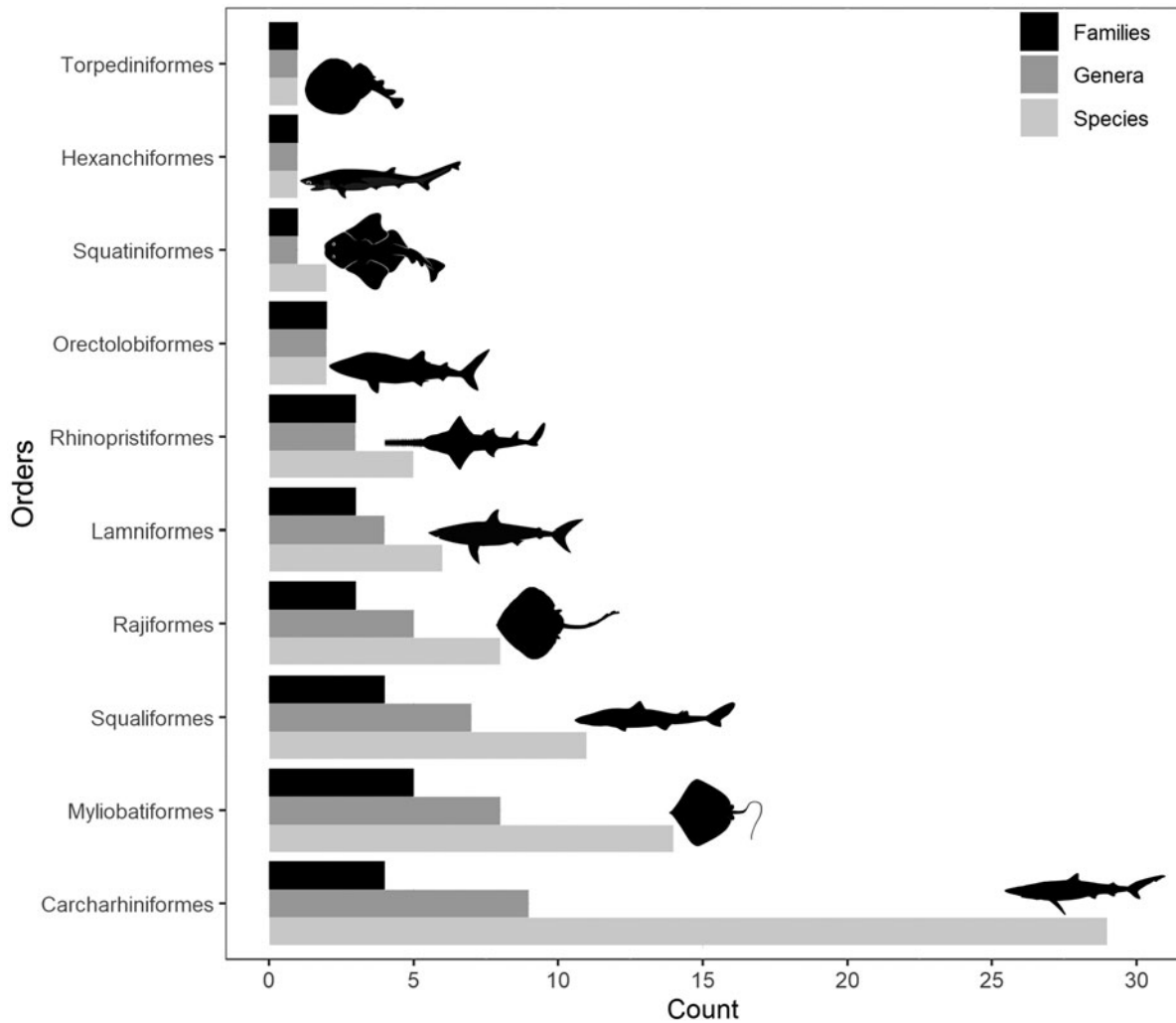


Figure 2. Count of families, genus and species of Chondrichthyes orders recorded in Espírito Santo state, Brazil.

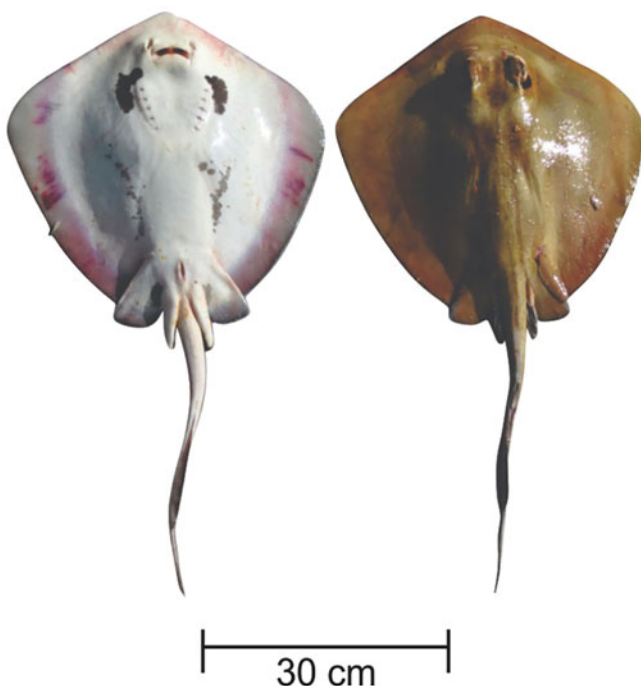


Figure 3. Male specimen of *Hypanus marianae* measuring 35 cm disc width and captured in December, 2018 northern Espírito Santo state, Brazil.

S. megalops (MacLeay, 1881), *S. cubensis* Howell Rivero, 1936, and *S. blainville* (Risso, 1827), previously cited as occurring in the state of Espírito Santo (e.g. Ruschi, 1965; Lessa *et al.*, 1999; Martins *et al.*, 2005b; Nunan and Senna, 2007), are now no longer part of the Brazilian fauna.

Another three species listed by Ruschi (1965) do not match their respective natural geographic areas and were, therefore, not included here, as follows: (1) *Potamotrygon motoro* (Müller and Henle, 1841), a freshwater ray species occurring in Brazil only in the Amazonas, Mearim, and Parnaíba river basins (Lasso *et al.*, 2016). The only evidence of this species is a specimen listed at the Prof. Mello Leitão Biology Museum (MBML-2048), however, with the capture site indicated as in the city of Manaus, in the Brazilian Amazon; (2) *Paratrygon ajereba* (Müller and Henle, 1841), another freshwater stingray distributed only in the Brazilian Amazon river basin (Lasso *et al.*, 2016); and (3) *Leucoraja erinacea* (Mitchill, 1825), which displays a restricted geographical distribution on the east coast of Canada and northern USA (Last *et al.*, 2016). Ruschi (1965) also recorded *Squatina squatina* (Linnaeus, 1758), a restricted species from the Mediterranean Sea and Northwest African continent (Morey *et al.*, 2019), possibly a mistaken identification of one of the *Squatina* genus species present in Espírito Santo since the angel sharks taxonomy in the western South Atlantic was solved in the 1990s (Vooren and da Silva, 1991).

Recently, a study carried out a molecular review of the genus *Gymnura* van Hasselt, 1823, which was used to reconstruct the

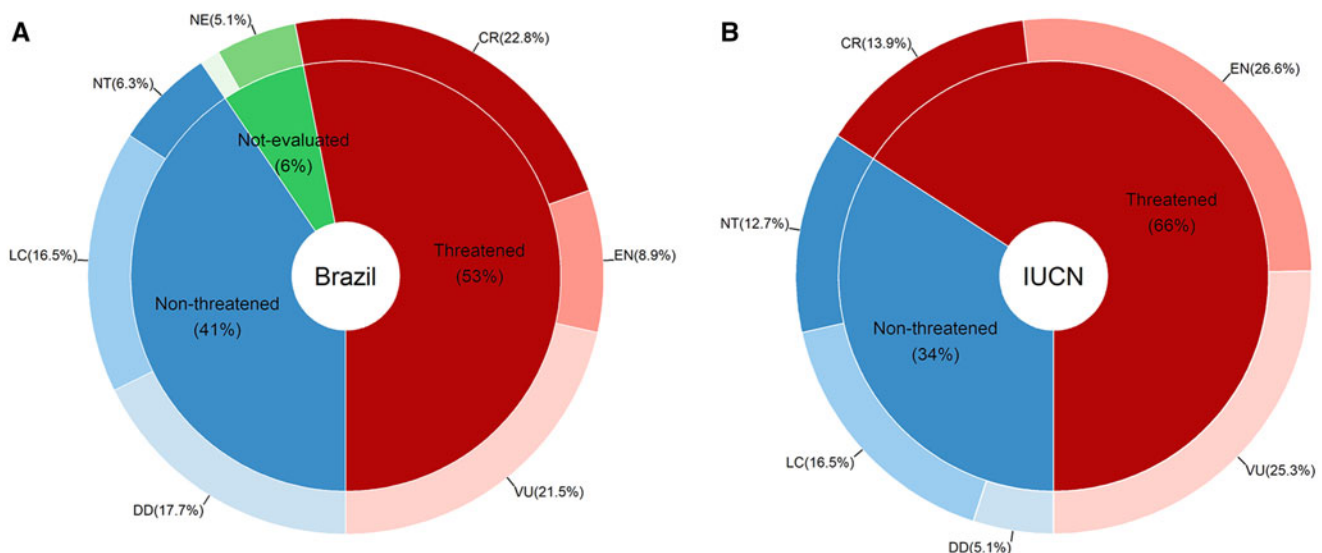


Figure 4. Extinction risk categories according to **A** national assessment and **B** IUCN red lists. CR: Critically Endangered; EN: Endangered; VU: Vulnerable; NT: Near Threatened; LC: Least Concern; DD: Data Deficient; NE: Not Evaluated.

evolutionary history of the Gymnuridae family (Gales *et al.*, 2024). According to the work, the lineage of *Gymnura altavela* present in the southeast and south of Brazil had already been classified as *Gymnura hirundo* (Lowe, 1843) from individuals collected in this region (Ribeiro, 1907; Bigelow and Schroeder, 1953) and later synonymized as *G. altavela*. However, the type specimen of *G. hirundo* comes from the island of Madeira in the eastern Atlantic. They indicated, therefore, that the *G. altavela* present in the western South Atlantic is *Gymnura valenciennii* (initially described as *Pteroplatea valenciennii*) by Duméril (1865) and later synonymized as *G. altavela*.

Data on shipments carried out on the northern coast of the state of Espírito Santo indicated the first record for the Brazilian large-eyed stingray *H. marianae*, representing the southernmost record of this endemic tropical species, as it had been recorded as far south only as the state of Bahia (Gomes *et al.*, 2000). This record reinforces the need for further monitoring efforts in Espírito Santo, as the first records for species from more easily sampled places, such as *H. marianae*, were obtained from fisheries monitoring.

The species compiled herein represent 43% of marine elasmobranchs in Brazil (see Gadig and Rosa, 2023), indicating a relatively high diversity in Espírito Santo when considering the state's size compared to the entire country. The state displays significant potential for the inclusion of new species, mainly due to its high but not yet investigated marine environment diversity. This indicates that further research focused on elasmobranchs and investigations in environments difficult to access, such as slopes and deeper areas, may increase the number of known Chondrichthyes species for the state of Espírito Santo.

A concerning number of threatened species was noted with regard to the national and global red list conservation status, with 52.5% of the fauna recorded for the state of Espírito Santo categorized as threatened in Brazil and 65% of the fauna recorded for the state of Espírito Santo categorized as threatened globally. An Ordinance was recently published (Ministério do Meio Ambiente (GM/MMA), 2022) listing 60 elasmobranch species as threatened with extinction at some level. This indicates that the Chondrichthyes Espírito Santo fauna comprises 70% of the 60 threatened species in Brazil, reinforcing the need for further research and conservation in the state, as mentioned by other studies (Lessa *et al.*, 1999).

Data. The datasets generated and analysed during the current study are not publicly available due to additional work currently in progress but are available from the corresponding author on reasonable request.

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