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Life-history traits, capture dynamics, and conservation status of key species landed by the artisanal gillnet fleet in the southwest Atlantic Ocean

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Abstract The southeast coast of Brazil plays a crucial role in national fishing, where the wide variety of species exploited reflects the multifleet–multispecies characteristics of fishing activity in the region. This study provides a summary based on eight life-history parameters of 70 commercially important species caught using artisanal gillnet fishing (surface and bottom) in the State of Rio de Janeiro. All species were classified according to fishing strategies estimated from the landing profiles (frequency and abundance of species). 29% were classified as the main target, 3% as the primary target, 10% as the secondary target, 24% as bycatch, and the remaining corresponded to specific surface or bottom landings. *Cynoscion jamaicensis* was classified as the main target for both fisheries. Twelve recorded species are threatened with extinction according to IUCN and ICMBio criteria. Strong correlations were identified between species and life-history traits. Principal component analysis separated the species into three groups (elasmobranchs, pelagic, and demersal), accounting for 83.7% of the total variance. Elasmobranchs present slow growth, late reproduction, medium to large size, and high longevity. Pelagic teleosts exhibit rapid growth and higher natural mortality rates, whereas demersal teleosts have intermediate attributes of longevity, somatic and/or reproductive energy investment, fecundity, and trophic level. Reproductive (Fec and L_{50}) and growth parameters (T_{max} and k) require further research. A priority group of 14 species with limited data was identified and requires further investigation. Overall, our results provide a conceptual framework for various management options, considering that variations in life-history strategies are

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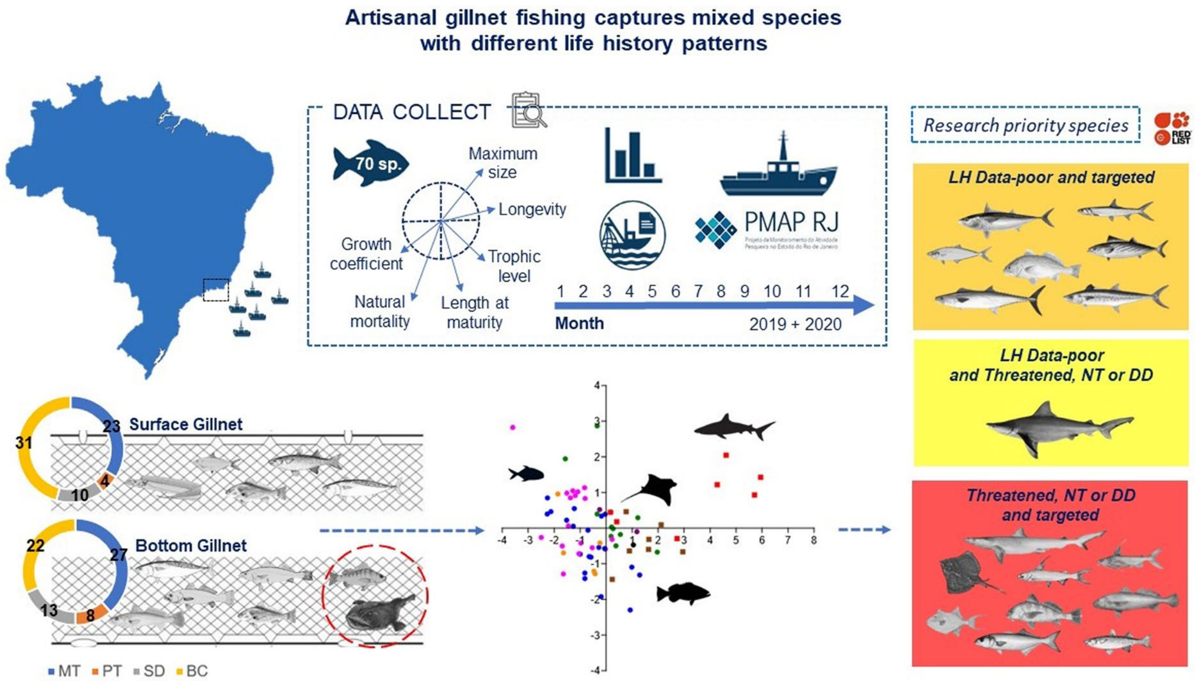
fundamental determinants of population responses to environmental changes and fishing pressures.

Graphical Abstract



Keywords Gillnet · Life-history data · Small-scale multispecies fishery · Research priority · Tropical fish

Introduction

The life-history theory aims to explain the evolution of individual characteristics of organisms as adaptive responses to constraints imposed on populations (Winemiller 2005), emphasizing the dynamic nature of life-history patterns. Thus, changes in life-history parameters can result from both density-independent factors, such as environmental variation and climate change, and density-dependent factors, such as the reduction in biomass by fishing (Sharpe and Hendry 2009; Devine et al. 2012; Claireaux et al. 2018). Considering that the conditions imposed by the environment can differ regionally and annually, it is expected that there will be variations in some life-history attributes such as growth rate, maximum length, size, age of sexual maturation, and natural mortality rates, both among individuals and between populations/stocks of a species (Winemiller and Rose 1992; Thorson et al. 2017).

The patterns observed in life-history parameters resulting from species-specific adaptations allow for a broader understanding of the diversity of strategies adopted by populations or groups of species. This set of attributes enables the recognition of conceptual models describing general patterns of variation, enabling the classification of population types in terms of demographic resilience, production potential, compatibility with density-dependent regulation theory, and tolerance to natural and/or anthropogenic disturbances (Pecuchet et al. 2017; Villagra et al. 2022). According to Winemiller (2005), three typical strategies are often observed among populations: periodic strategies (long-lived, high fecundity (Fec), and high recruitment variation), opportunistic strategies (short life cycle, high reproductive effort, high demographic resilience, and density-dependent recruitment), and equilibrium-type populations (variable size, low Fec, large eggs, parental care, and density-dependent recruitment with lower demographic resilience). These attributes are extremely important and support many ecological models (Thorson et al. 2014).

The interaction between fishing and global climate change, including phenomena such as ocean warming, acidification, and deoxygenation, can significantly affect the physiological performance and adaptation of marine species, shaping their life histories (Pauly et al. 2005; Pauly and Cheung 2018). Several studies addressing life-history parameters and population regulation in marine fish have been conducted to identify the response of species to human exploitation. These studies assessed resilience to capture and species vulnerability to collapse or extinction and emphasized the lack of information on target and non-target species in commercial fisheries (King and McFarlane 2003; Garcia et al. 2007; Juan-Jordá et al. 2013a; Lucena-Frédou et al. 2016).

In the Southwest Atlantic Ocean, along the southeastern coast of Brazil, fishing activities contribute significantly to national production, with the participation of industrial and artisanal fisheries exploiting a wide variety of fishing resources (Thorsonet 2007; Begot and Vianna 2014; Rosso and Pezzuto 2016; FIPERJ 2020a). Artisanal fishing is widely recognized for its historical, cultural, and economic relevance, contributing to the supply of local, regional, and national markets (Monteiro-Neto et al. 2008; FAO 2016; Loto et al. 2018). Artisanal gillnet fishing exploits various population strata in coastal estuarine environments and competes for the same target species as an industrial fleet that operates beyond the continental shelf (Castello 2007; Begot and Vianna 2014; PMAP-RJ 2020).

Various global initiatives are underway for the organization and establishment of control rules, evaluation of management strategies, and application of reference points to understand the limits of stock capture (Wakeford et al. 2020; ICES 2021). However, the situation in Brazil remains concerning because basic information and biological reference points for the management of national fisheries are lacking for many exploited fish stocks (OCEANA 2021). Additionally, the simultaneous expansion of industrial and artisanal fishing areas, coupled with the overlap of gear characteristics (surface and bottom gillnets) and vessels with different fishing capacities targeting the same resources, makes obtaining reliable information and analyzing time–series data challenging (Valentini and Pezzuto 2006; Dias-Neto and Dias 2015). In scenarios with limited data and specific information, life-history patterns are relevant for delineating groups of species with similar strategies to estimate resilience to fishing pressures (Frisk et al. 2001; Fromentin and Fonteneau 2001; Dulvy et al. 2004; Juan-Jordá et al. 2013a). Moreover, life-history data are essential inputs for many risk assessment models, enabling the characterization of productivity from the perspective of estimating species vulnerability (Hobday et al. 2011; Patrick et al. 2010).

Considering the growing concerns regarding the impact of multispecies fisheries and the urgent need for a comprehensive assessment and management of exploited species, this study aimed to compile and evaluate the available knowledge on key species (teleosts and elasmobranchs) from a fishery perspective, focusing on catches by the artisanal gillnet fleet along the coast of Rio de Janeiro. Relevant biological information for the southwestern Atlantic Ocean was compiled, emphasizing the data availability, conservation status of each species, and existing gaps to achieve this objective. This information is expected to help identify actions and develop research priorities aimed at managing exploited stocks, particularly in the context of artisanal fishing. This type of study is crucial for sustainable and effective management, highlighting the economic importance of these resources and ensuring the sustainability of artisanal fishing practices and the conservation of fishery resources.

Material and methods

Data source

Study area, species selection criteria, landing data, and fishery strategy estimates

The dynamics of artisanal gillnet fishery along the coast of the State of Rio de Janeiro (21° 12′ S–41° 0′ W and 24° 0′ S–43° 54′ W) from 2019 to 2020 were investigated using primary fishing production data from Project Monitoramento da Atividade Pesqueira no Estado do Rio de Janeiro (PMAP-RJ), conducted by the Fundação Instituto de Pesca do Estado do Rio de Janeiro (FIPERJ 2023). According to the PMAP-RJ, industrial fisheries are characterized by activities carried out by medium and large vessels (> 20 Gross tonnage—GT) equipped with fish conservation systems onboard and using high-tech fishing equipment designed to operate in coastal and oceanic waters. Artisanal fishing, by exclusion, includes all fishing activities not considered industrial; that is, vessels are typically smaller, with a length of less than 8 m, and lack storage holds, or are small vessels (< 20 GT) using manual fishing gear. These characteristics consider the size of vessels and the methods and technologies used during fishing activities (FIPERJ 2021).

Arraial do Cabo is an important geomorphological landmark where the coastline exhibits an abrupt change in orientation from E–W to NE–W, accompanied by a narrowing of the continental shelf (Rossi-Wongtschowski and Madureira 2006). Morphological conditions and intense northeasterly winds are the main factors responsible for the coastal upwelling of the South Atlantic Central Water (SACW) mass, promoting increased local productivity, especially during spring and summer (Artusi and Figueiredo 2007).

The fishing area (Fig. 1) is situated in a transition region within the southwest Atlantic ocean (SWAO), delineated by the northern limit of the southeastern Brazilian shelf (PCSB), between São Sebastião (state of São Paulo) and Arraial do Cabo (state of Rio de Janeiro), and the southern portion of the eastern Brazilian continental shelf (PCLB), extending to Guarapari (state of Espírito Santo) (Rossi-Wongtschowski and Madureira 2006). In this region, the continental shelf is predominantly composed of sand, silt, and clay, and the water masses result from a mixture of tropical water (TW), the Brazil current (BC), the SACW, and coastal water (Miranda 1982, 1985; Braga and Niencheski 2006).

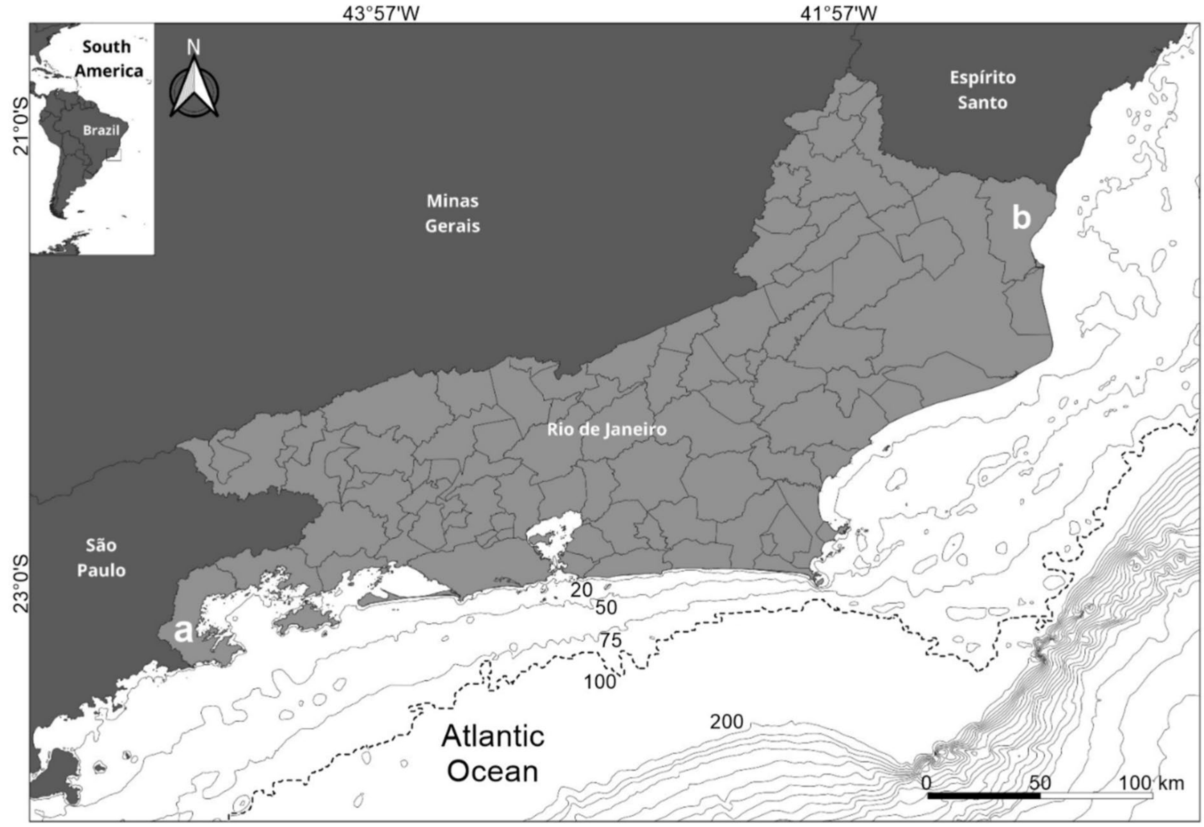


Fig. 1 Map of the study area, indicating the operational limits of the artisanal gillnet fleet in the Southwest Atlantic Ocean (between **a** Paraty and **b** São Francisco de Itabapoana—RJ). The fishing area extends along the entire coastal zone (delimited in gray) up to a depth of 100 m (dashed line)

A total of 398 species were recorded in artisanal gillnet landings (167 surface and 231 bottom) during the period from 2019 to 2020. The fishing landings were monitored daily as part of the Fishing Activity Monitoring Program in the State of Rio de Janeiro (PMAP-RJ), which was implemented across 20 of the 28 coastal municipalities in the state. The number of landings per trip varied by species, ranging from a minimum of one landing to a maximum of 12 landings per month.

Seventy species were selected for the study based on the following criteria: (a) significance as fishery resources landed by the artisanal gillnet fleet in the state of Rio de Janeiro; (b) relative frequency of landings in multiple fisheries (including target species for specific fleets, accessory species of commercial interest, or incidental catches); and (c) occurrence as bycatch in gillnet fishing. The fishery was subsequently divided into bottom gillnet (BGn) and surface gillnet (SGn). The catch per unit effort (CPUE) was calculated as the total biomass (in kilograms) of each species divided by the total number of fishing trips per month, expressed as CPUE = kg/trip. Additionally, the frequency of occurrence (FO%) was determined as the ratio of the number of trips in which a species was caught to the total number of trips for each fishery (BGn and SGn), multiplied by 100. This calculation of FO% aids in interpreting potential seasonal variations in the catch rates of the selected species. Both CPUE and FO% were utilized to characterize the fisheries, with biomass representing the species-specific discharge.

The relative importance of the selected species was assessed from catch profiles by combining the percentage of biomass of each species with the total biomass of each landing (CPUE%) and its FO%. All species were classified by comparing their respective averages (μCPUE% and μFO%) to interpret fishing strategies and identify potential target species (aiming to estimate directed fishing effort). Consequently, the captured species were defined in the following categories: (a) main target (MT), abundant and frequent species ($\text{CPUE\%} \geq \mu\text{CPUE\%}$, $\text{FO\%} \geq \mu\text{FO\%}$); (b) primary target (PT), abundant but infrequent species ($\text{CPUE\%} \geq \mu\text{CPUE\%}$, $\text{FO\%} < \mu\text{FO\%}$); (c) secondary target (SD), non-abundant but frequent species ($\text{CPUE\%} < \mu\text{CPUE\%}$, $\text{FO\%} \geq \mu\text{FO\%}$); and (d) bycatch (BC), non-abundant and infrequent species that were still present in landings ($\text{CPUE\%} < \mu\text{CPUE\%}$, $\text{FO\%} < \mu\text{FO\%}$). All species categorized as main targets (MT) displayed seasonal variations.

Life-history parameters and fishery landings data

Of the 70 species evaluated, 56 were bony, and 14 were cartilaginous. Their life-history traits have been used to discriminate between groups with similar attributes and comprehend how species respond to fishing exploitation (King and McFarlane 2003; Hutchings et al. 2012). We compiled eight relevant life-history traits to estimate and classify the resilience of the species to gillnet fishing exploitation using secondary sources (Table 1). The primary information for this study was extracted from specialized literature focusing on regional, national, and

Table 1 Life history trait attributes of species caught by artisanal gillnet fisheries in the Southwest Atlantic Ocean

Parameter	Code (units)	Definition
Maximum age	T_{max} (years)	Maximum observed age reported
Maximum size	L_{max} (cm)	Maximum total length observed or fork length and disc diametric reported
von Bertalanffy growth coefficient	k (cm.year^{-1})	How rapidly a fish reaches its maximum size
Natural mortality natural	M	Instantaneous natural mortality rate
Size at maturity	L_{50} (cm)	Length at which 50% of the individuals attain gonadal maturity for the first time
The ratio of size at maturity to maximum size	L_{50}/L_{max} (ratio)	Describes somatic and reproductive energetic investment
Fecundity	Fec (n mid-point oocytes or embryos)	Mid-point of the reported range of the number of oocytes (or embryos) per individual for a given spawning event or period
Trophic level	T_{level}	Species position in the food chain

international studies. Additionally, a comprehensive review was conducted using various sources, including dissertations, theses, and recent books in the field, contributing relevant data to advance knowledge on the bioecology of the selected species. Data were obtained from an online database (FishBase, www.fishbase.org). Data from congener species occurring in the study area were consulted when specific information was unavailable to ensure a comprehensive and reliable foundation for analysis. The parameters of species without reliable data were estimated using empirical equations linked to the maximum recorded length (L_{max}), asymptotic length ($L\infty$), longevity (T_{max}), and von Bertalanffy growth coefficient (k) whenever possible (Supplementary Material S1).

Data analysis

Life-history patterns, landing profiles, and functional groups

Spearman's correlation was used to test the relationships between the observed life-history traits. Bivariate plots were used to display variables that exhibited significant relationships at the 5% significance level. Principal component analysis (PCA) with normalized data was performed to investigate the relationships between the life-history parameters. The PCA included all 70 species and six life-history traits that were available for all species (T_{max}, L_{max}, Size at maturity (L_{50}), k, natural mortality (M), and trophic level T_{level}). Two types of graphical scaling were used to interpret the PCA results: (i) a distance biplot, where the eigenvectors were ordered in unit length, enabling an analysis of similarity between objects, and (ii) two correlation biplots (PC1 × PC2 and PC1 × PC3), where the eigenvectors and eigenvalues allowed the visualization of descriptors of grouping (Legendre and Legendre 1998).

The three groups (Elasmobranchii and pelagic and demersal Teleostei) were distinguished based on taxonomic classification, spatial distribution, and behavior concerning the aquatic environment (Nelson 2016). Subsequently, eight functional subcategories were identified within these groups: Elasmobranchii–Shark (SHK) and Ray (RAY), Teleostei–Small Pelagics (SP), Large Pelagic (LP), RockFish (RF), Coastal Demersal (CD), Deep Demersal (DD), and Other Demersal (OD). These groups were validated using discriminant analysis (LDA), with an accuracy rate equal to or exceeding 60% for each group. Additional attributes related to habitat and environmental use were also used to further characterize the species groups formed (Supplementary Material S2) (Froese and Pauly 2021). We used biplots fitted with generalized additive models (GAM) to examine the bivariate relationships between life history traits of species caught by the bottom (BGn) and surface (SGn) gillnet fleets in the Southwest Atlantic. The analysis was conducted using the MGCV package in R (R Development Core Team, 2017), with models fitted using a Gaussian distribution (identity link) and thin-plate regression spline smoothing functions.

The Kruskal–Wallis test and post-hoc rank sum ($p < 0.05$) were used for multiple comparisons (Zar 2010) to assess potential differences in the life-history parameters of common species in both fishing landings (BGn and SGn), grouped according to their functional groups.

Assessment of research priorities

Information gaps and priority species for life-history research in the study area were identified based on the available biological data. The criteria used were as follows: (1) gaps in biological life-history data, (2) current conservation status according to the Red List of Threatened Species (ICMBio 2018; IUCN 2021), and (3) the relative importance of the species as a target (MT or PT) for both fisheries (BGn and SGn) by landing profile. Furthermore, a life-history summary was used to differentiate data-poor species, including empirically estimated values and lacking relevant information, such as the parameters k, L_{50}, or Fec. Additionally, it highlighted which life-history knowledge requires the most information derived from regional research. Data gaps were classified into five categories: deficient data (DD), nonregional data (NRD), regional data (RD), estimated data (ED), and FishBase data (FBD) (values exclusively obtained from the online database—Froese and Pauly 2021).

We compared the IUCN Red List of Threatened Species (IUCN 2019) with the National Red List of Threatened Species provided by ICMBio (ICMBio 2018) to assess the conservation status of the species. Species were categorized and differentiated into threatened (i.e., Critically Endangered, Endangered, and Vulnerable), near-threatened, data-deficient, and least concerned. Finally, a Venn diagram was used to summarize and illustrate the top priorities for research on species that were 1) life-history data-poor, 2) listed as Threatened, Near Threatened, or Data Deficient on the Red List by ICMBio or IUCN, and 3) targets of gillnet fishing (MT or PT) according to the landing profile. Similarly, we set the second highest priority for species with limited life-history data that are targets (MT and PT) of commercial fishing throughout the study area. All statistical analyses were performed using the open-access statistical software PAST version 4.09 (Hammer et al. 2001).

Results

Selected species and fishery landings profile

Among the 70 species analyzed (Table 2), Sciaenidae, Carangidae, Scombridae, and Ariidae contributed the highest number of species (50% of the total). The bottom (BGn) and surface (SGn) gillnet fisheries almost always targeted the same resources, accounting for 84% and 95% of the total biomass of all captured species (14 elasmobranchs and 56 teleosts), respectively. The exceptions were *Conodon nobilis* and *Lophius gastrophysus*, which were recorded in BGn catches (Table 2). Elasmobranchs contributed modestly, representing approximately 3% of the biomass in landings.

Based on catch profiles, abundance, and frequency, the species were classified into four categories according to their role in the fishery. Main target species (MT) represented 29% of the catch, while bycatch (BC) accounted for 24% of the landings, considering both bottom (BGn) and surface (SGn) gillnet fleets. Secondary targets (SD) contributed another 24%, and primary targets (PT) made up 3% of the landings. The remaining landings corresponded to specific surface or bottom catches. However, the classification of these species can vary depending on the type of fishery. For instance, some species categorized as bycatch (BC) in surface gillnets, such as *Rhizoprionodon lalandii* and *Rhizoprionodon porosus*, are considered main targets (MT) in bottom gillnets. Regarding the landing profiles, 27 species were observed in the bottom gillnets (n = 70) and 23 in the surface gillnets (n = 67), both of which were classified as the MT. Twenty species were identified as MTs in both fisheries, with notable contributions from the families Mugilidae (*Mugil liza* and *Mugil curema*) and Sciaenidae (*Cynoscion jamaicensis* and *Micropogonias furnieri*), each representing > 5% of the total discharged biomass. The exception was *Euthynnus alleteratus* (Scombridae), which was considered a primary target at 5.8% of the total biomass. Among elasmobranchs, only *Rhizoprionodon lalandii* and *R. porosus* were recorded as MTs, accounting for less than 2% of the total discharged biomass in the bottom gillnet. In the bottom gill net landings, these species, along with three other MT species (*Cynoscion virescens*, *Oligoplites saliens*, and *Trichiurus lepturus*) comprised 52.4% of the total discharged biomass. The MT species *Ophistonema oglinum*, *Mugil liza*, *Mugil curema*, *Auxis thazard thazard*, *Trichiurus lepturus*, and *Micropogonias furnieri* accounted for 56.7% of the total biomass.

Opisthonema oglinum, *Lophius gastrophysus*, *Umbrina canosai*, *Umbrina coroides*, *Euthynnus alletteratus*, and *Sarda Positronia* were the main species classified as PTs in the bottom gillnet catches, totaling 8.6% of the discharged biomass, with the highest occurrence between September and March (spring and summer). A single elasmobranch species, *Atlantoraja castelnaui*, was recorded as PT (summer), accounting for less than 2% of the total landed biomass. Four teleosts were recorded as PTs in surface gillnet fishing, representing approximately 9.6% of the total biomass, with seasonal peaks in abundance during discharge for *Euthynnus alletteratus* between October and January (spring and summer), *Scomberomorus cavalla* between November and April (spring and autumn), *Sarda sarda* in January and February (summer), and *Coryphaena hippurus* between March and May (late summer and autumn).

A total of 13 species were classified as secondary targets (SD, not very abundant but frequent): 11 teleosts and 2 elasmobranchs, corresponding to 3.1% of the biomass discharged by the bottom network. *Percophis brasiliensis* and *Pseudobates horkelii* were frequently discharged with higher biomasses in summer and autumn. While carangids (*Caranx crysos*, *Caranx hippos*, *Caranx latus*, *Caranx lugubris*, *Caranx ruber*, *Decapterus punctatus*, and *Selar crumenophthalmus*) showed trends of higher abundance during captures in autumn and winter, despite being frequently caught throughout the year. In surface gillnet fishing, 10 species were classified

Table 2 List of 70 selected species from the artisanal bottom (BGn) and surface (SGn) gillnet fleet landed in the Southwest Atlantic Ocean

Family	Species name	Common name	Code	CPUE (Mean)		% Kg		Fishery	
				BGn	SGn	BGn	SGn	BGn	SGn
Lamnidae	***Isurus oxyrinchus***	**Shortfin mako**	**Isuoxy**	**< 0.1**	**< 0.1**	**< 0.1**	**< 0.1**	**BC**	**BC**
Carcharhinidae	***Carcharhinus leucas***	**Bull shark**	**Carleu**	**< 0.1**	**< 0.1**	**< 0.1**	**< 0.1**	**BC**	**BC**
	Carcharhinus plumbeus	**Sandbar shark**	**Carplu**	**< 0.1**	**< 0.1**	**< 0.1**	**< 0.1**	**BC**	**BC**
	Rhizoprionodon lalandii	**Brazilian sharpnose shark**	**Rhilal**	**0.5**	**0.1**	**0.7**	**0.2**	**MT**	**BC**
	Rhizoprionodon porosus	**Caribbean sharpnose shark**	**Rhipor**	**0.5**	**0.1**	**0.7**	**0.2**	**MT**	**BC**
Sphyrnidae	***Sphyrna lewini***	**Scalloped hammerhead**	**Sphlew**	**0.1**	**< 0.1**	**0.1**	**< 0.1**	**BC**	**BC**
	Sphyrna zygaena	**Smooth hammerhead**	**Sphzyg**	**0.1**	**< 0.1**	**0.1**	**< 0.1**	**BC**	**BC**
Squatinidae	***Squatina guggenheim***	**Angular angel shark**	**Squgug**	**0.1**	**< 0.1**	**0.1**	**< 0.1**	**BC**	**BC**
	Squatina occulta	**Hidden angel shark**	**Squocc**	**0.1**	**< 0.1**	**0.1**	**< 0.1**	**BC**	**BC**
Arhynchobatidae	***Atlantoraja castelnaui***	**Spotback skate**	**Atlcas**	**0.5**	**< 0.1**	**0.8**	**< 0.1**	**PT**	**BC**
Rhinobatidae	***Pseudobatos horkelii***	**Brazilian guitarfish**	**Psehork**	**0.2**	**< 0.1**	**0.2**	**< 0.1**	**SD**	**BC**
Trygonorrhinidae	***Zapteryx brevirostris***	**Lesser guitarfish**	**Zapbrev**	**0.2**	**< 0.1**	**0.2**	**< 0.1**	**SD**	**BC**
	Rhinoptera brasiliensis	**Brazilian cownose ray**	**Rhibra**	**< 0.1**	**< 0.1**	**< 0.1**	**< 0.1**	**BC**	**BC**
Gymnuridae	***Gymnura altavela***	**Spiny butterfly ray**	**Gymalt**	**< 0.1**	**< 0.1**	**< 0.1**	**< 0.1**	**BC**	**BC**
Elopidae	*Elops saurus*	Ladyfish	Elosau	0.7	0.2	1.0	0.4	PT	BC
Clupeidae	*Opisthonema oglinum*	Atlantic thread herring	Ophogl	1.2	17.2	1.7	23.7	PT	MT
	Sardinella brasiliensis	Brazilian sardine	Sarbra	<0.1	1.3	0.1	2.0	BC	MT
Ariidae	*Bagre bagre*	Coco sea catfish	Bagbag	0.3	0.6	0.4	0.9	MT	MT
	Bagre marinus	Gafftopsail catfish	Bagmar	0.7	0.6	1.1	0.9	MT	MT
	Genidens barbus	White sea catfish	Genbar	0.3	0.6	0.4	0.9	MT	MT
	Genidens genidens	Guri sea catfish	Gengen	0.3	0.6	0.4	0.9	MT	MT
	Cathorops spixii	Madamango sea catfish	Catspi	0.3	0.6	0.4	0.9	MT	MT
Mugilidae	*Mugil curema*	White mullet	Mugcu	1.2	8.4	1.7	12.2	MT	MT
	Mugil liza	Lebranche mullet	Mugliz	1.2	8.4	1.7	12.2	MT	MT
Coryphaenidae	*Coryphaena hippurus*	Common dolphinfish	Corhip	<0.1	0.5	<0.1	0.8	BC	PT
Carangidae	*Caranx crysos*	Blue runner	Carcry	0.1	0.1	0.2	0.2	SD	SD
	Caranx hippos	Crevalle jack	Carhip	0.3	0.2	0.4	0.3	SD	BC
	Caranx latus	Horse-eye jack	Carlat	0.1	0.1	0.2	0.2	SD	SD
	Caranx lugubris	Black jack	Carlug	0.1	0.1	0.2	0.2	SD	SD
	Caranx ruber	Bar jack	Carrub	0.1	0.1	0.2	0.2	SD	SD
	Chloroscombrus chrysurus	Atlantic bumper	Chlchr	0.1	<0.1	0.1	0.0	BC	BC
	Decapterus punctatus	Round scad	Decpun	0.1	0.1	0.2	0.2	SD	SD
	Selar crumenophthalmus	Bigeye scad	Selcru	0.2	0.1	0.2	0.2	SD	SD
	Oligoplites saliens	Castin leatherjacket	Olisal	1.3	1.7	2.0	2.3	MT	MT
	Uraspis secunda	Cottonmouth jack	Urasec	0.1	0.1	0.2	0.2	SD	SD
Sphyranidae	*Sphyraena tome*	Barracuda	Sphtom	0.0	<0.1	0.1	<0.1	BC	BC
Trichiuridae	*Trichiurus lepturus*	Largehead hairtail	Trilep	1.2	2.2	1.8	2.9	MT	MT

Table 2 (continued)

Family	Species name	Common name	Code	CPUE (Mean)		% Kg		Fishery	
				BGn	SGn	BGn	SGn	BGn	SGn
Scombridae	*Auxis thazard thazard*	Frigate tuna	Auxtha	2.0	2.1	2.8	2.9	MT	MT
	Euthynnus alletteratus	Little tunny	Eutallet	1.1	4.4	1.5	5.8	PT	PT
	Katsuwonus pelamis	Skipjack tuna	Katpel	0.1	0.2	0.2	0.4	BC	BC
	Sarda sarda	Atlantic bonito	Sarsar	0.6	0.6	0.9	0.9	PT	PT
	Scomber colias	Atlantic chub mackerel	Scocol	0.1	< 0.1	0.1	< 0.1	BC	BC
	Scomberomorus brasiliensis	Serra Spanish mackerel	Scobra	1.4	1.1	2.1	1.4	MT	MT
	Scomberomorus cavalla	King mackerel	Scocav	0.1	1.7	0.1	2.3	BC	PT
Stromateidae	*Peprilus paru*	American harvestfish	Peppar	0.2	< 0.1	0.3	< 0.1	BC	BC
Percophidae	*Percophis brasiliensis*	Brazilian flathead	Perbra	0.2	0.2	0.3	0.3	SD	BC
Centropomidae	*Centropomus parallelus*	Fat snook	Cenpar	0.3	1.0	0.5	1.4	MT	MT
	Centropomus undecimalis	Common snook	Cenun	0.9	1.8	1.2	2.5	MT	MT
Pomatomidae	*Pomatomus saltatrix*	Bluefish	Pomsal	1.4	1.4	2.1	2.0	MT	MT
Priacanthidae	*Heteropriacanthus cruentatus*	Glasseye	Hetcru	0.7	1.0	1.0	1.5	MT	MT
	Priacanthus arenatus	Atlantic bigeye	Priaare	0.7	1.0	1.0	1.5	MT	MT
Haemulidae	***Conodon nobilis***	**Barred grunt**	**Connob**	**0.1**		**0.2**		**BC**	
Ephippidae	*Chaetodipterus faber*	Atlantic spadefish	Chafab	0.2	0.2	0.3	0.3	BC	BC
Sciaenidae	*Cynoscion acoupa*	Acoupa weakfish	Cynaco	1.2	0.6	1.7	0.9	MT	MT
	Cynoscion guatucupa	Stripped weakfish	Cyngua	1.6	0.4	2.4	0.5	MT	SD
	Cynoscion jamaicensis	Jamaica weakfish	Cynjam	4.0	0.4	5.8	0.5	MT	MT
	Cynoscion leiarchus	Smooth weakfish	Cynlei	1.9	1.4	2.8	2.1	MT	MT
	Cynoscion virescens	Green weakfish	Cynvir	1.6	0.4	2.4	0.5	MT	SD
	Menticirrhus americanus	Southern kingfish	Mename	0.1	< 0.1	0.2	< 0.1	SD	BC
	Menticirrhus littoralis	Gulf kingcroaker	Menlit	0.1	< 0.1	0.2	< 0.1	SD	BC
	Micropogonias furnieri	Whitemouth croaker	Micfur	17.2	1.9	25.2	2.8	MT	MT
	Nebris microps	Smalleye croaker	Nebmic	0.9	0.3	1.3	0.5	MT	SD
	Paralonchurus brasiliensis	Banded croaker	Parbra	3.0	0.0	4.3	0.0	MT	BC
	Pogonias courbina	Southern black drum	Pogcro	0.2	0.5	0.3	0.7	BC	MT
	Umbrina canosai	Argentine croaker	Umbcan	0.6	< 0.1	0.8	< 0.1	PT	BC
	Umbrina coroides	Sand drum	Umbcor	0.6	< 0.1	0.8	< 0.1	PT	BC
Sparidae	*Diplodus argenteus*	South American silver porgy	Diparg	0.1	< 0.1	0.1	< 0.1	BC	BC
	Pagrus pagrus	Red porgy	Pagpag	0.1	< 0.1	0.2	< 0.1	BC	BC
Lophiidae	***Lophius gastrophysus***	**Blackfin goosefish**	**Lopgas**	**1.2**		**1.7**		**PT**	
Balistidae	*Balistes capriscus*	Grey triggerfish	Balmar	0.7	0.1	1.0	0.2	MT	BC

Family and species reference according to Nelson (2016). Common name and six-letter identifier as species code. Average CPUE (kg/trip/month) and proportion of total biomass discharged (%kg)*(*> 5%). Commercial categories by landing profiles: Main target (MT), primary target (PT), secondary target (SD), and bycatch (BC). Bold highlights indicate species recorded only in BGn landings

as SD, representing approximately 2.6% of the total discharged biomass. The teleosts *Cynoscion guatucupa*, *Cynoscion virescens*, and *Nebris microps* showed constant biomass throughout the months and were superior to other carangids classified as SD, showing a higher tendency for being discharged in summer.

Finally, in the bottom gill net landings, 22 species (9 elasmobranchs and 13 teleosts) were classified as BC, accounting for approximately 2.3% of the discharged biomass. In surface gillnet fishing, 31 species (14 elasmobranchs and 17 teleosts) were classified as BC species, representing 2.4% of the landed biomass.

Functional groups and life-history patterns

A synthesis of the life-history traits of all species selected for both fisheries was performed, grouping the species according to their functional attributes (Table 3). The groups observed were 9 sharks (SHK), 5 rays (RAY), and 28 pelagic teleosts, including 17 classified as small pelagic (SP) and 11 as large pelagic (LP); 4 rockfish (RF); 20 coastal demersal (CD), 1 deep demersal (DD), and 2 other demersals (OD) (Sup. Mat. S2). Most biological parameters in the study area were poorly documented, requiring the use of data from other regions or congener species. For example, data on T_{max}, k, and M were missing for more than 40% of the species. It was necessary to obtain estimates using empirical equations and/or data from co-generic species (Table 3 and Sup. Mat. S1).

Both fishing fleets (BGn and SGn) operated on the same resources and exhibited diverse life-history attributes (Table 4). We highlighted elasmobranchs and teleosts, which occupy distinct habitats in the adult stages and play various ecological roles, among the catches (Sup. Mat. S2). The selected species belonged to different trophic guilds (zooplanktophagous, phytoplanktophagous, iliophagous, herbivorous, invertivorous, omnivorous, and piscivorous), reflecting various feeding habits according to habitat use and age. A wide range of trophic levels was observed, from the lowest, represented by *Mugil liza* and *Mugil curema* ($T_{level} = 2.00$), to the highest, represented by *Coryphaena hippurus*, *Caranx lugubris*, *Lophius gastrophysus*, *Atlantoraja castelnaui* ($T_{level} = 4.50$).

The T_{max} varied over one order of magnitude from the shortest life cycle species (*Ophistonema oglinum*, *Selar crumenophthalmus*, *Oligoplites saliens*, *Cynoscion jamaicensis*, *Auxis Thazard Thazard*, approximately 4 years) to the longest-lived species reported (*Pogonias courbina*, approximately 43 years). The maximum recorded lengths (L_{max}) ranged from 25.5 cm (*Sardinella brasiliensis*) to 382 cm (*Sphyrna lewini*). Growth rates (k) include fast (*Caranx crysos*, $k = 0.65$ years^{-1}) and slow growth rates (*Micropogonias furnieri*, $k = 0.05$ years^{-1}). The estimated M values were highly heterogeneous, with the lowest values for A*tlantoraja castelnaui*, *Genidens barbus,* and *Genidens genidens*, and the highest for *Caranx crysos* and *Caranx ruber*. The L_{50} followed a typical pattern among the set of taxa; elasmobranchs mostly presented higher values than teleost fish. The Fec also varied greatly (Table 4) from low reproductive potential (i.e., *Rhinoptera brasiliensis* and *Rhizoprionodon lalandii*, species with few embryos and a long reproductive cycle) to species with widespread and parceled spawning (i.e., *Cynoscion acoupa*, species with approximately 14 million oocytes on average at each reproductive event). The somatic and reproductive investment (L_{50}/L_{max}) ranged from 0.24 (*Conodon nobilis*) to 0.93 (*Rhizoprionodon porosus*). However, this quotient had a positive linear variation and was highly correlated, especially with sexual maturation size, even in fish that change sex during their lifetime (i.e., protogynous species such as *Pagrus pagrus,* and protandrous species such as *Diplodus argenteus*, *Centropomus undecimalis*, and *Centropomus Paralelus*).

The relationships among life-history parameters revealed that most of these exhibited statistically significant correlations. In particular, the parameter T_{max} was positively correlated with L_{max} and negatively correlated with M, k, and Fec (Fig. 2). The analysis revealed that M demonstrated a positive association with the parameter k but a negative correlation with T_{max} and L_{max} (Table 5). These observations indicate notable patterns, especially in species with longer life cycles, such as elasmobranchs and some demersal teleosts, which tend to reach larger sizes due to slower growth rates and lower losses from natural mortality (Fig. 2a, b, e, g, j).

The L_{50} parameter showed a positive correlation with T_{max} and L_{max} and an inverse correlation with k and M, highlighting the dependence of the sexual maturation process on the developmental strategies of each species. This pattern reveals that long-lived fish, which reach large lengths, tend to take longer to reach sexual maturity, whereas smaller fish exhibit early reproductive strategies and invest less time in growth before initiating the reproductive process. The L_{50}/L_{max} ratio was also positively correlated with L_{50}, suggesting a high reproductive investment in some

Table 3 Life history traits for all 70 fish species (Nelson, 2016) landed by the artisanal bottom gillnet (BGn) and surface (SGn) fishing fleet in the Southwest Atlantic Ocean

Species name	Functional group	Life-history traits							T_{level}	Fishery		IUCN	ICMBio
		T_{max}	L_{max}	k	M	L_{50}	L_{50}/L_{max}	Fec		BGn	SGn		
Isurus oxyrinchus	**Shark**	**28.0**	**275.5**	**0.15**	**0.24**	**196.1**	**0.71**	**8.0**	**4.3**	**x**	**x**	**EM**	**NT**
Carcharinus leucas	**Shark**	**30.0**	**149.0**	**0.12**	**0.20**	**107.6**	**0.72**	**7.5**	**4.2**	**x**	**x**	**VU**	**NT**
Carcharinus plumbeus	**Shark**	**33.0**	**382.1**	**0.07**	**0.12**	**204.0**	**0.42**	**5.0**	**4.2**	**x**	**x**	**EN**	**CR**
Rhizoprionodon lalandii	**Shark**	**7.2**	**80.0**	**0.23**	**0.22**	**62.1**	**0.78**	**5.0**	**4.3**	**x**	**x**	**VU**	**NT**
Rhizoprionodon porosus	**Shark**	**9.3**	**100.5**	**0.30**	**0.30**	**65.0**	**0.93**	**8.0**	**4.0**	**x**	**x**	**VU**	**DD**
Sphyrna lewini	**Shark**	**20.0**	**118.4**	**0.16**	**0.27**	**265.0**	**0.66**	**21.5**	**4.4**	**x**	**x**	**CR**	**CR**
Sphyrna zygaena	**Shark**	**29.0**	**339.0**	**0.07**	**0.13**	**275.0**	**0.81**	**14.5**	**4.3**	**x**	**x**	**VU**	**CR**
Squatina guggenheim	**Shark**	**12.0**	**90.0**	**0.21**	**0.35**	**75.0**	**0.83**	**4.5**	**4.4**	**x**	**x**	**EN**	**CR**
Squatina occulta	**Shark**	**21.0**	**130.0**	**0.14**	**0.24**	**110.0**	**0.85**	**5.5**	**4.3**	**x**	**x**	**CR**	**CR**
Atlantoraja castelnaui	**Ray**	**29.0**	**116.0**	**0.06**	**0.10**	**105.0**	**0.91**	**7.0**	**4.5**	**x**	**x**	**CR**	**CR**
Pseudobatos horkelii	**Ray**	**21.0**	**102.0**	**0.19**	**0.33**	**78.0**	**0.76**	**5.5**	**3.5**	**x**	**x**	**CR**	**CR**
Zapteryx brevirostris	**Ray**	**28.0**	**136.0**	**0.19**	**0.32**	**79.6**	**0.59**		**3.8**	**x**	**x**	**EN**	**VU**
Rhinoptera brasiliensis	**Ray**	**18.0**	**143.0**	**0.12**	**0.21**	**71.7**	**0.50**	**3.0**	**3.9**	**x**	**x**	**VU**	**CR**
Gymnura altavela	**Ray**	**10**	**56**	**0.11**	**0.198**	**42.3**	**0.73**	**7.5**	**3.5**	**x**	**x**	**EN**	**CR**
Elops saurus	Small pelagic teleost	13.0	42.0	0.22	0.22	23.4	0.56		4.1	x	x	LC	NE
Opisthonema oglinum	Small pelagic teleost	3.5	39.5	0.32	0.52	19.6	0.50	582793.0	4.5	x	x	LC	LC
Sardinella brasiliensis	Small pelagic teleost	10.7	25.5	0.26	0.70	15.8	0.62	30522.0	3.1	x	x	DD	DD
Bagre bagre	Coastal demersal teleost	6.0	55.0	0.16	0.58	15.9	0.29		4.0	x	x	LC	NT
Bagre marinus	Coastal demersal teleost	25.0	47.0	0.17	0.74	33.0	0.70	22.0	3.5	x	x	LC	DD
Genidens barbus	Coastal demersal teleost	23.1	98.0	0.13	0.13	43.0	0.44	272.0	3.8	x	x	NE	EN
Genidens genidens	Coastal demersal teleost	11.0	49.7	0.32	0.08	15.9	0.32		3.6	x	x	LC	LC
Cathorops spixii	Coastal demersal teleost	6.5	32.5	0.44	0.72	17.1	0.53	42.0	3.5	x	x	NE	LC
Mugil curema	Small pelagic teleost	8.9	40.9	0.39	0.78	24.8	0.61	591040.0	2.0	x	x	LC	DD
Mugil liza	Small pelagic teleost	10.0	81.5	0.30	0.56	35.0	0.43	3650000.0	2.0	x	x	DD	NT
Coryphaena hippurus	Large pelagic teleost	4.2	177.9	0.48	0.63	67.7	0.38	1134500.0	4.5	x	x	LC	LC
Caranx crysos	Small pelagic teleost	4.4	33.5	0.65	1.14	20.4	0.61	1546000.0	3.6	x	x	LC	LC
Caranx hippos	Large pelagic teleost	13.0	86.3	0.18	0.42	32.5	0.38		3.6	x	x	LC	LC
Caranx latus	Large pelagic teleost	12.4	105.0	0.23	0.37	56.0	0.63	4380480.0	4.2	x	x	NE	LC
Caranx lugubris	Large pelagic teleost	5.3	86.5	0.12	0.53	38.0	0.44	1512776.0	4.5	x	x	LC	LC
Caranx ruber	Small pelagic teleost	15.0	45.5	0.14	1.14	31.0	0.42	1000000.0	4.3	x	x	LC	LC
Chloroscombrus chrysurus	Small pelagic teleost	4.0	45.3	0.18	0.32	21.6	0.44	1312500.0	3.9	x	x	LC	LC
Decapterus punctatus	Small pelagic teleost	9.2	31.0	0.31	0.65	11.0	0.35	34700.0	4.4	x	x	LC	LC

Table 3 (continued)

Species name	Functional group	Life-history traits							T_{level}	Fishery		IUCN	ICMBio
		T_{max}	L_{max}	k	M	L_{50}	L_{50}/L_{max}	Fec		BGn	SGn		
Selar crumenophthalmus	Small pelagic teleost	3.0	31.0	0.24	0.60	11.4	0.37	472237.0	3.8	x	x	LC	LC
Oligoplites saliens	Small pelagic teleost	4.0	60.0	0.48	0.39	32.9	0.55	1015253.0	3.8	x	x	LC	LC
Uraspis secunda	Small pelagic teleost	7.9	50.0	0.36	0.62	19.1	0.38		4.0	x	x	LC	LC
Sphyraena tome	Small pelagic teleost	5.0	28.5	0.22	0.39	12.0	0.42	56750.0	3.9	x	x	NE	DD
Trichiurus lepturus	Other demersal teleost	7.0	145.0	0.13	0.20	60.5	0.46	102000.0	4.2	x	x	LC	LC
Auxis thazard thazard	Large pelagic teleost	4.0	49.4	0.47	0.90	34.5	0.69	9990987.0	4.4	x	x	LC	LC
Euthynnus alletteratus	Large pelagic teleost	8.0	100.0	0.19	0.17	35.0	0.35	2200000.0	4.0	x	x	LC	LC
Katsuwonus pelamis	Large pelagic teleost	6.0	81.9	0.24	0.47	43.2	0.53	2000000.0	4.0	x	x	LC	LC
Sarda sarda	Large pelagic teleost	7.0	77.0	0.22	0.22	38.0	0.49	1150000.0	4.3	x	x	LC	LC
Scomber colias	Small pelagic teleost	5.0	42.5	0.22	0.39	11.0	0.26	855,391.0	3.5	x	x	LC	LC
Scomberomorus brasiliensis	Large pelagic teleost	8.0	80.5	0.11	0.32	42.0	0.52	2063.0	4.4	x	x	LC	LC
Scomberomorus cavalla	Large pelagic teleost	15.0	114.8	0.16	0.34	70.0	0.61	2280000.0	4.4	x	x	LC	LC
Peprilus paru	Small pelagic teleost		41.2	0.38	0.69	22.9	0.53	759750.0	4.1	x	x	LC	LC
Percophis brasiliensis	Other demersal teleost	9.6	27.5	0.30	0.53	14.3	0.52		3.1	x	x	NE	LC
Centropomus parallelus	Small pelagic teleost	18.6	63.0	0.19	0.41	20.4	0.32	1144738.0	4.2	x	x	LC	LC
Centropomus undecimalis	Large pelagic teleost	29.3	140.0	0.11	0.26	45.5	0.33	650458.0	4.2	x	x	LC	LC
Pomatomus saltatrix	Small pelagic teleost	9.0	67.0	0.32	0.58	35.5	0.63	4267870.0	4.1	x	x	VU	NT
Heteropriacanthus cruentatus	Rockfish teleost	6.4	50.7	0.45	0.62	29.4	0.58		3.6	x	x	LC	LC
Priacanthus arenatus	Rockfish teleost	6.0	53.5	0.17	0.34	31.2	0.41		4.0	x	x	LC	LC
Conodon nobilis	**Coastal demersal teleost**	**10.0**	**51.0**	**0.17**	**0.30**	**12.0**	**0.24**		**3.5**	**x**		**LC**	**LC**
Chaetodipterus faber	Rockfish teleost	7.0	44.5	0.34	0.58	25.3	0.56	119050.0	3.5	x	x	LC	LC
Cynoscion acoupa	Coastal demersal teleost	10.7	100.0	0.27	0.41	40.7	0.41	14340373.0	4.1	x	x	VU	NT
Cynoscion guatucupa	Coastal demersal teleost	5.0	35.0	0.21	0.25	23.3	0.67	2791000.0	3.7	x	x	LC	LC
Cynoscion jamaicensis	Coastal demersal teleost	4.0	31.3	0.34	0.34	20.0	0.64	554354.0	3.8	x	x	LC	LC
Cynoscion leiarchus	Coastal demersal teleost	11.0	47.8	0.15	0.15	32.4	0.68	342000.0	3.1	x	x	LC	LC
Cynoscion virescens	Coastal demersal teleost	12.0	100.0	0.24	0.52	27.2	0.27		4.0	x	x	LC	LC
Menticirrhus americanus	Coastal demersal teleost	8.0	48.3	0.35	0.53	23.0	0.48		3.9	x	x	LC	DD
Menticirrhus littoralis	Coastal demersal teleost	13.6	36.9	0.22	0.39	20.3	0.55	747300.0	3.1	x	x	LC	DD
Micropogonias furnieri	Coastal demersal teleost	26.0	58.0	0.05	0.22	34.1	0.59	591040.0	3.1	x	x	LC	LC
Nebris microps	Coastal demersal teleost	7.4	39.0	0.39	1.70	23.3	0.60		3.6	x	x	LC	LC
Paralonchurus brasiliensis	Coastal demersal teleost	10.0	40.5	0.30	0.30	15.8	0.39	86034.0	3.4	x	x	LC	LC

Table 3 (continued)

Species name	Functional group	Life-history traits							T_{level}	Fishery		IUCN	ICMBio
		T_{max}	L_{max}	k	M	L_{50}	L_{50}/L_{max}	Fec		BGn	SGn		
Pogonias courbina	Coastal demersal teleost	43.0	100.0	0.11	0.75	26.8	0.27	2532000.0	3.4	x	x	LC	EN
Umbrina canosai	Coastal demersal teleost	26.0	43.0	0.36	0.20	20.0	0.47	1450000.0	3.9	x	x	LC	LC
Umbrina coroides	Coastal demersal teleost	14.9	35.0	0.36	0.97	21.3	0.61		3.1	x	x	LC	LC
Diplodus argenteus	Coastal demersal teleost	8.0	52.4	0.20	0.35	23.0	0.44		3.6	x	x	LC	LC
Pagrus pagrus	Coastal demersal teleost	14.0	69.0	0.29	0.49	38.7	0.56	966200.0	4.2	x	x	LC	DD
Lophius gastrophysus	**Deep demersal teleost**	**13.0**	**75.8**	**0.13**	**0.15**	**44.1**	**0.58**	**605415.0**	**4.5**	**x**		**LC**	**NT**
Balistes capriscus	Rockfish teleost	11.0	46.0	0.18	0.27	16.9	0.37	10000.0	3.5	x	x	VU	NT

Scientific nomenclature, functional groups (Sup. Mat. S2), and parameters: T_{max} (years); L_{max} (cm); k (cm.year^{-1}); M (no unit); L_{50} (cm); L_{50}/L_{max} (ratio); Fec (n mid-point); T_{level} (no unit). Conservation status according to the red list of threatened species: critically endangered (CR), endangered (EN), vulnerable (VU), near threatened (NT), least concern (LC), data deficient (DD) (IUCN 2021; ICMBio 2018). Not evaluated (NE). Reference data source: See Supplemental Data Set S2

The species Conodon nobilis and Lophius gastrophysus are in bold to indicate species captured exclusively by bottom gillnets. The other species in bold are highlighted to represent the elasmobranch group

species such as elasmobranchs. In contrast, Fec was negatively correlated with T_{max}, indicating a decrease in reproductive potential with age. Additionally, the trophic level showed a positive correlation with L_{max} and L_{50}, indicating that larger-sized species occupy higher trophic levels, as observed in elasmobranchs and some pelagic fish.

These relationships provide valuable insights into the interactions among the life-history parameters of the studied species as well as the formation of distinct guilds. Bivariate relationships among life-history parameters (Fig. 2), exhibiting more significant covariance among the selected species, revealed a clear separation of functional groups. Some demersal species, such as *Pogonias courbina*, *Micropogonias furnieri*, *Genidens barbus*, and *Genidens genidens*, which have long life cycles and low growth rates, were dispersed (Fig. 2d). However, a group of small pelagic species with the shortest lifespans was observed on the left side of the graphs, indicating short life cycles, low trophic levels, early maturation, and high rates of natural mortality (Fig. 2a, i, e, n). Species representative of the elasmobranch group, characterized by larger size, older age, slow growth, late maturation, and low Fec, were notably separated, as observed on the right side of the bivariate plots (Fig. 2a, g, h). The other groups/species exhibited intermediate attributes between the observed behavioral limits. This analysis contributes to a deeper understanding of the distinct characteristics of these functional groups in the context of the life strategies of species.

Interspecific analysis

PCA of the six life-history traits clarified the contrast among the 70 species, revealing a pattern associated with body size, length at maturity, growth rates, maximum age, and trophic level (elasmobranchs vs. teleosts) (Fig. 3A and 3B). The first two PCA axes explained 69.7% of the total variance, with the highest contributions recorded for L_{max}, L_{50} (PC1), and k (PC2). The third axis explained 15.1% of the total variance, differentiating the species mainly in terms of T_{level} and T_{max} (Table 6). The formed clusters indicated a gradient from species of larger size, higher trophic level, and long and late maturation (i.e., elasmobranchs, and some demersal teleosts) to those with moderate to fast growth (i.e., pelagic teleosts)

Table 4 Statistical summary of eight life history traits of elasmobranchs and teleosts, presenting means, standard deviations (SD), sample sizes (n), minimum and maximum values, and coefficient of variation (CV)

Life history traits	n	Mean	SD	Min	Max	CV
Elasmobranchs						
Maximum age—T_{max} (years)	14	21.11	8.73	7.20	33.00	41.35
Maximum size—L_{max} (cm)	14	173.07	107.59	58.90	382.10	62.17
von Bertalanffy growth coefficient—k (cm.year $^{-1}$)	14	0.15	0.07	0.06	0.30	44.93
Natural mortality—M	14	0.23	0.08	0.10	0.35	34.38
Length at maturity—L_{50} (cm)	14	122.24	74.34	42.30	275.00	60.82
Ratio of size at maturity to maximum size—L_{50}/L_{max} (ratio)	14	0.73	0.15	0.42	0.93	20.14
Fecundity—F_{ec} (n mid-point oocytes or embryos)	13	0.000008	0.000001	0.000003	0.000022	0.000005
Trophic level—T_{level}	14	4.12	0.33	3.49	4.50	7.95
Teleosts						
Maximum age—T_{max} (years)	55	10.88	7.54	3.00	43.00	69.32
Maximum size—L_{max} (cm)	56	62.16	32.28	25.50	177.90	51.93
von Bertalanffy growth coefficient—k (cm.year $^{-1}$)	56	0.26	0.12	0.05	0.65	44.84
Natural mortality—M	56	0.48	0.24	0.08	1.14	51.29
Length at maturity—L_{50} (cm)	56	28.91	13.66	11.00	70.00	47.24
Ratio of size at maturity to maximum size—L_{50}/L_{max} (ratio)	56	0.48	0.12	0.24	0.70	25.65
Fecundity—F_{ec} (n mid-point oocytes or embryos)	42	1.61567	0.41359	0.00002	14.34037	2.68039
Trophic level—T_{level}	56	3.78	0.53	2.00	4.50	13.93

(Fig. 3C). Axis I primarily reflects variations in body size (L_{max}) and length at maturity (L_{50}). This axis is associated with species that are larger and have later maturation, which is typical of elasmobranchs, as they tend to have longer life cycles, larger body sizes, and reach maturity at older ages. Axis II captures differences in growth rates (k). Species such as *Coryphaena hippurus* and *Caranx crysos* contribute positively to this axis due to their relatively faster growth rates and shorter life spans, while *Micropogonias furnieri* contributes negatively due to its slower growth rate. This axis thus differentiates species based on their growth strategies, with faster-growing pelagic species contrasted against slower-growing demersal species. Axis III explains variations based on trophic level (T_{level}) and maximum age (T_{max}), further separating species with high trophic levels and long-life spans from those with lower trophic levels and shorter life spans. This distinction provides insight into the ecological roles of the species, from apex predators to lower trophic levels.

The three predefined groups were highlighted and validated through discriminant analysis (LDA), as supported by previous analyses. The classification matrix values (LDA) revealed an overall reclassification of 68.5% of groups using distinct strategies, reaching 79% for elasmobranchs, 69% for pelagic species, and 59% for demersal species. The combined analysis of the PCA axes, coded by the three groups (Fig. 3b and c), along with the species separation patterns in the ordination, supports the LDA analysis and highlights three distinct strategies: (i) slow-growing elasmobranchs, sharks, and rays, notably represented by the families Carcharinidae, Sphyrnidae, Lamnidae, Squatinidae, and Rajidae, along with large pelagics, such as *Coryphaena hippurus* and *Scomberomorus cavalla*, characterized by a higher length at maturity. (ii) Fast-growing pelagic teleosts, represented by carangids such as *Caranx crysos*, *Oligoplites saliens*, *Uraspis secunda*, other small pelagics such as *Ophistonema oglinum* and *Pomatomus saltatrix*, and coastal demersal teleosts such as *Nebris micros*, *Cathorops spixii*, and *Umbrina coroides*. iii) Slow-growing and long-lived demersal teleosts, represented by species such as *Micropogonias furnieri*, *Pogonias courbina*, *Lophius gastrophysus*, *Genidens barbus*, and *Centropomus undecimalis* (Fig. 3).

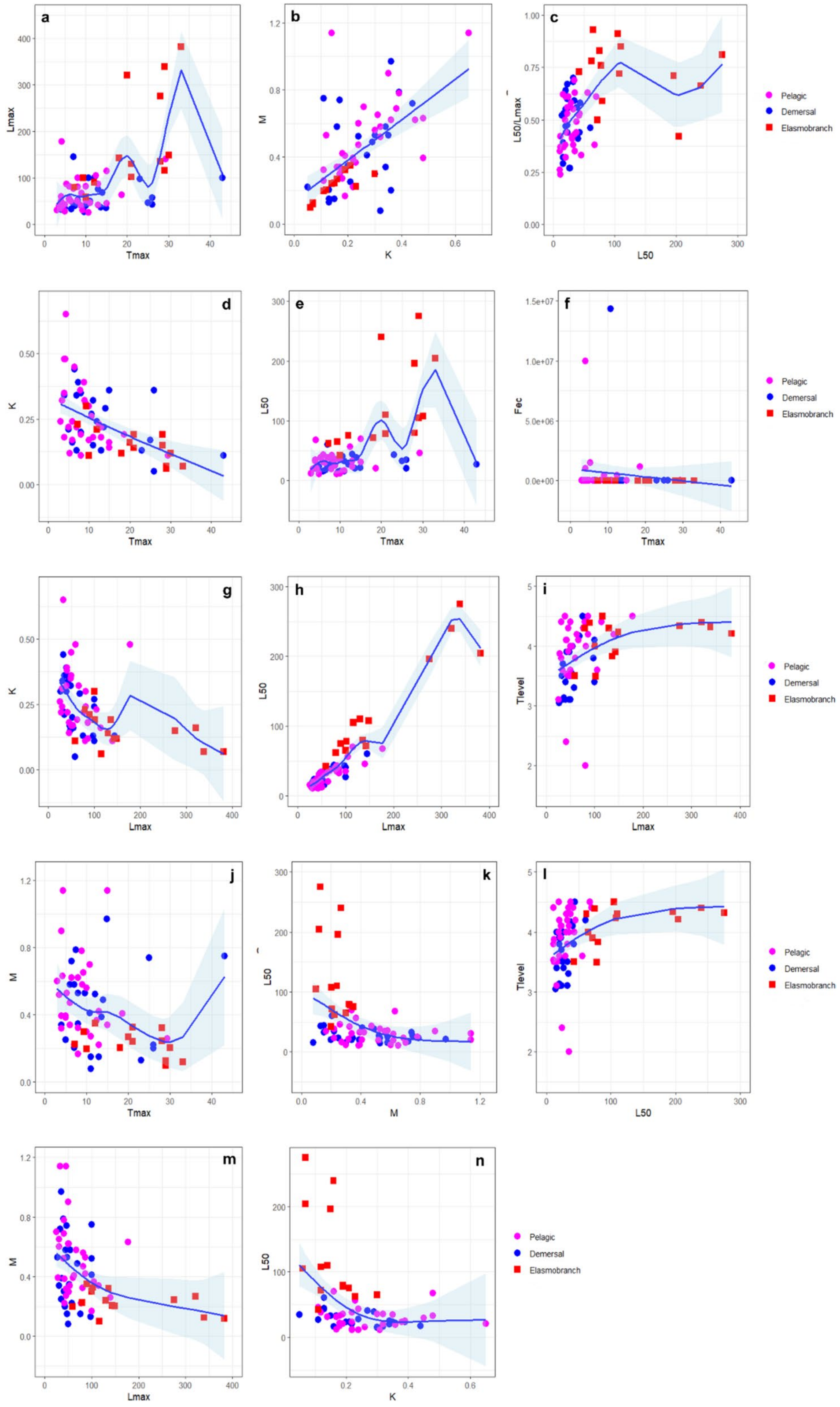
Differences were more evident when species/groups common to both fisheries (BGn and SGn, n = 47) were compared to functional groups and life-history characteristics. T_{max} ($H = 18.7$, $p = 0.009$), L_{max} ($H = 42.0$, $p < 0.001$), and L_{50} ($H = 50.4$, $p < 0.001$) were significantly higher for SHK, RAY, and OD, respectively (Fig. 4a, b, e). Significant differences were also observed for M ($H = 22.5$, $p = 0.002$), with RAY, SHK, and DD showing lower values compared to other functional groups (Fig. 4d). Therefore, k was significantly different ($H = 17.8$, $p = 0.013$), with a trend of higher values among teleosts (CD and SP) (Fig. 4c). Fec also showed significant differences ($H = 33.5$, $p < 0.001$), with higher values recorded among pelagics and coastal demersal teleosts (Fig. 4g). The L_{50}/L_{max} ratio also presented significant differences ($H = 22.8$, $p = 0.002$) with higher energy investment for elasmobranchs (RAY and SHK) compared to teleosts (Fig. 4f). Moreover, T_{level} exhibited significant differences ($H = 34.0$, $p < 0.001$), with higher values for species with typically carnivorous feeding habits (SHK and LP) (Fig. 4h).

Gaps and priorities

The compiled database (i.e., eight life-history parameters for the 70 species) showed that only 47% of the information was available in regional bibliographies (Fig. 5). Only 11 species (16%) had all biological parameter information collected from the study area categorized as regional data (RD). Species with non-regional references (NRD) accounted for 22% of the dataset. Occasionally, some parameters were estimated or obtained from secondary data sources, such as Tlevel, retrieved from the FishBase database (FBD). L_{max} is the parameter with the most information regarding regional populations. However, basic information on the 19 species in the study area is still required. Natural mortality values mostly came from regional data (RD) and were estimated (ED). Although k, T_{max}, and L_{50} are commonly reported, more regional information is necessary given that a noticeable portion of these data was estimated through indirect techniques (based on length). Regional studies on the reproductive aspects. Information on Fec is limited, and much data are still lacking for the analyzed species, even when consulted in online databases (FBD-FishBase). Approximately 50% of the analyzed species had regional data for T_{max}. Nevertheless, for one species, this parameter remains unknown, whereas others rely on non-regional data (NRD) and estimated data (ED).

We assessed the main research priorities among the 68 species landed by both bottom (BGn) and surface (SGn) gillnet fisheries using a Venn diagram. The criteria for prioritization were: (1) conservation status (ICMBio and IUCN), (2) species with limited life-history data versus species with rich data, and (3) target (MT and PT) versus non-target species for the gillnet fisheries. The first priority group consisted of species with gaps in biological knowledge for regional populations, which are also targets (MT and PT) for at least one of these fisheries (BGn or SGn): *Euthynnus alletteratus*, *Oligoplites saliens*, *Sarda sarda*, *Scomberomorus brasiliensis*, *Scomberomorus cavala*, *Elops saurus*, and *Umbrina canosai*. The second priority group included a single elasmobranch species, *Carcharhinus plumbeus*, classified as Critically Endangered (CR). Despite not being the MT or PT, it was recorded in both fisheries as BC and lacks sufficient biological data for the study region.

Additionally, we highlight 13 other species that are intensively landed in gillnet fisheries and are classified as Threatened or Near Threatened, including elasmobranchs such as *Atlantoraja castelnaui* (CR), *Rhizoprionodon lalandii* (NT), *Rhizoprionodon porosus* (DD), and teleosts such as *Bagre bagre* (NT), *Bagre marinus* (DD), *Balistes capriscus* (NT), *Cynoscion acoupa* (NT), *Genidens barbus* (EN), *Mugil curema* (DD), *Mugil liza* (NT), *Pogonias courbina* (EN), *Pomatomus saltatrix* (NT), and *Sardinella brasiliensis* (DD) (ICMBio, 2018). However, when applying the IUCN threatened species criteria (2021), a decrease in the number of target species (MT and PT) classified as Threatened or Near Threatened was observed, with the persistence of 8 species (elasmobranchs *Atlantoraja castelnaui*—CR, *Rhizoprionodon lalandii*—NT, and *Rhizoprionodon porosus*, along with teleosts *Balistes capriscus*—NT, *Cynoscion acoupa*—NT, *Mugil liza*—NT, *Pomatomus saltatrix*—NT, and *Sardinella brasiliensis*—DD). In summary, of the 68 species, 14 require studies on their biological parameters based on regional research, and 28 were classified on the Brazilian Red List as Vulnerable, Threatened, Critically Endangered, Near Threatened, or Data Deficient (Table 3 and Fig. 6).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Tmax
b
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Pelagic
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◂**Fig. 2** Bivariate relationships between pairs of life history traits for species landed by the artisanal bottom (BGn) and surface (SGn) gillnet fleet in the Southwest Atlantic Ocean. Units: L_{max} (cm), T_{max} (years), k (cm year $^{-1}$), M (no unit), L_{50} (cm), L_{50}/L_{max} (no unit), Fec (million), T_{level} (no unit). Symbols distinguish teleost pelagic (pink circles), demersal (blue circles) and elasmobranch (red squares). The blue line and the blue shading indicate the fitted Generalized Additive Model and 95% Bayesian confidence intervals, respectively

Discussion

Our results present a comprehensive synthesis and review of the biological knowledge of species occurring and distributed in the western and eastern Atlantic Ocean, as well as species with a circumglobal distribution. As the main findings, we highlighted the patterns of covariation among the life-history parameters of species captured with similar fishing gear but with differentiated capture strategies (surface and bottom gillnets). Furthermore, categorizing species according to catch profile, based on CPUE (kg/trip) and frequency of occurrence, revealed that most of the variation in life-history traits could be explained by three key attributes: L_{max}, k, and L_{50}. These attributes were crucial in defining the three groups with distinct life strategies: elasmobranchs characterized by slow growth, late reproduction, medium to large sizes, and high longevity; pelagic teleosts showing rapid growth and higher rates of natural mortality; and demersal teleosts exhibiting intermediate attributes in terms of longevity, somatic and/or reproductive energy investment, Fec, and trophic level. These results corroborate the observations of other authors (Fromentin and Fonteneau 2001; Juan-Jordan et al. 2013; Frédou et al. 2016; Beukhof et al. 2019), emphasizing the significance of these attributes in explaining the variation in life-history parameters across different species.

Gillnet fishing is one of the most widespread methods along the Brazilian coast, widely used by the artisanal fleet due to its ease of handling and low acquisition and maintenance costs (Alves et al. 2012). The four catch categories used in this study (MT, PT, Sd, and BC), based on Catch Per Unit Effort (CPUE) and Frequency of Occurrence (FO%), provided insights into the most relevant species for artisanal gillnet fishing along the coast of Rio de Janeiro. This survey identified species such as *Mugil liza*, *Mugil curema*, and *Micropogonias furnieri* as MT in both fisheries (showing the highest mean CPUE values and percentage by weight). Additionally, other species classified as MT suggest seasonal variations in catch patterns, indicating both similar catch profiles and distinct functional groups—such as pelagic species (Mugilidae, Scombridae, and Pomatomidae) and demersal teleosts (Ariidae, Trichiuridae, and Sciaenidae) (See Table 2). According to Cergole et al. (2005), the whitemouth croaker (*Micropogonias furnieri*) is abundant year-round due to its reproductive strategies and movement patterns, remaining consistently available for fishing (FIPERJ 2019; FIPERJ 2020a). In contrast, species of the *Mugil* genus are more abundant at the end of summer, throughout autumn, and in early winter, when they form reproductive aggregations and become more accessible for fishing (Tubino et al. 2021; Cardoso et al. 2023). Thus, similar seasonal variations are likely for other species, given the distinct strategies and life histories that influence catch profiles. Differences observed in the catch of the same species in surface and bottom gillnet fisheries also indirectly reveal seasonal variability. The overlap of fishing areas, combined with declining yields for several target species, makes both fishing strategies reliant on a broader range of species to increase profitability (Afonso and Chaves 2021). These findings support the occurrence of fishing seasons and highlight the impact of seasonality and gear selection on catch trends and species availability in southeastern Brazil (Dias et al. 2022). They also underscore the need for management strategies that consider the complexity of multi-species fisheries, as proposed by Pio et al. (2016), as well as the conservation challenges for threatened species like elasmobranchs, since many of the evaluated species were classified as bycatch. This situation emphasizes the urgency of establishing sustainable policies to maintain fish stocks and local biodiversity.

We compiled information on the 70 species, defined and identified functional subgroups, and recorded biological gaps in knowledge that enabled us to highlight priorities for life-history research on certain commercially important species. Most tropical fisheries target multiple species and require management approaches that are adapted to high diversity (Dias-Neto 2011; Lira et al. 2022). Understanding the fundamental aspects of life-history characteristics is essential for the conservation of fish stocks through ecosystem-based approaches in this scenario

Table 5 Spearman's correlation matrix. **($p < 0.05$); ns: not significant

	T_{max}	L_{max}	k	M	L_{50}	L_{50}/L_{max}	Fec	T_{level}
T_{max}								
L_{max}	0.49*							
k	−0.55*	−0.55*						
M	−0.39*	−0.47*	0.59*					
L_{50}	0.47*	0.88*	−0.48*	−0.43*				
L_{50}/L_{max}	0.18 ^{ns}	−0.13 ^{ns}	−0.03 ^{ns}	0.14 ^{ns}	0.51*			
Fec	−0.27*	−0.11 ^{ns}	0.19 ^{ns}	0.23 ^{ns}	−0.13 ^{ns}	−0.20 ^{ns}		
T_{level}	0.03 ^{ns}	0.48*	−0.27 ^{ns}	−0.17 ^{ns}	0.49*	−0.08 ^{ns}	−0..03 ^{ns}	

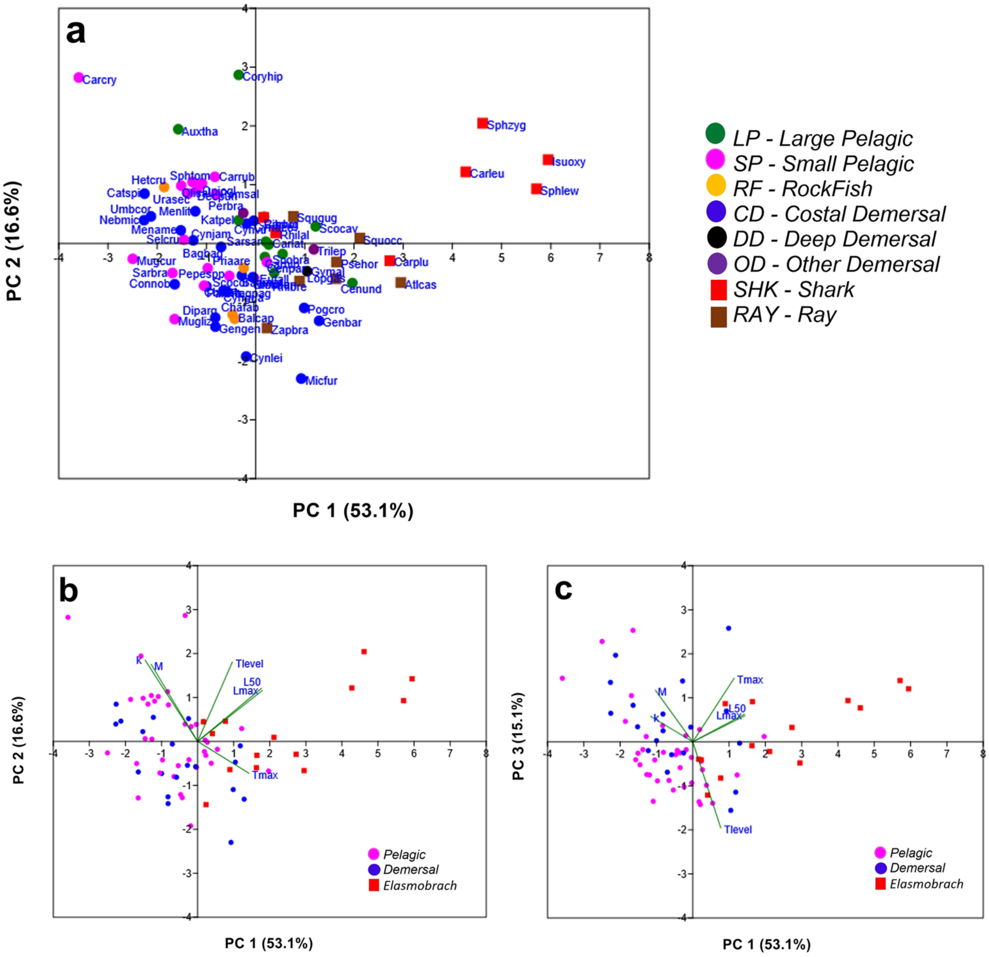


Fig. 3 **a** Principal component analysis (PCA) of life-history traits and 70 fish species caught by bottom (BGn) and surface (SGn) gillnet fleet in the Southwest Atlantic Ocean, grouped as follows: SHK—Shark and RAY—Ray, LP—Large pelagic; SP—small pelagic; RF—Rockfish, CD—Coastal demersal; DD—Deep demersal; OD—Other demersal. **b** Correlation biplot (PC 1 × PC 2) showing the separation of three groups: elasmobranchs, teleost pelagic and demersal. **c** Correlation vectors of the six life history traits between the functional groups

Table 6 PCA statistics for 70 fish species based on five life-history traits

Life history traits	PC 1	PC 2	PC 3
Maximum age—T_{max} (anos)	0.39	0.20	0.50
Maximum size—L_{max} (cm)	0.50	0.32	0.21
von Bertalanffy growth coefficient—k ($cm.ano^{-1}$)	−0.40	0.51	0.20
Natural Mortality—M	−0.36	0.48	0.41
Size at first maturity—L_{50} (cm)	0.49	0.33	0.22
Trophic level—T_{level}	0.27	0.50	−0.68
Eigenvalue	3.20	0.90	0.90
% Variance explained	53.10	16.60	15.10

of catch overlap and technical interaction in fisheries combined with limited data and fishing monitoring programs (King and McFarlane 2003; Fonteles-Filho 2011). Both artisanal gillnet fleets (BGn and SGn) evaluated in this study exhibited similar operational dynamics, including the depth of operation, that is, over the continental shelf up to approximately 100 m. Most of the captured species were common to both fisheries, reinforcing the overlap in the operating areas of the fleets. This dynamic is concerning, as it may lead to increased fishing pressure and risks of overexploitation due to the high fishing effort used on both target and non-target species (Cergole et al. 2005), especially for threatened species.

Although our analyses were limited to less than half the total number of species caught by artisanal gillnet fishing on the southeastern coast of Brazil, it is possible to gain a general overview of the availability and absence of data for various commercially important species. The high diversity in species and life-history traits observed in both landings confirms the reality of multispecies fishing in the region (Begot and Vianna 2014). In this context, medium-to-large-sized species with short and/or long life spans, fast and/or slow growths, and low and/or high Fec were captured in both fisheries (BGn and SGn). This form of fishing pressure on certain species can affect their population regulation, involving processes that increase mortality rates and decrease recruitment when abundance is high or decrease mortality rates and increase recruitment when abundance is low (Pauly et al. 2002; Fonteles-Filho 2011).

The set of analyses applied to the life-history parameters of the evaluated species supported the distinct dimensions of the taxa (elasmobranchs and teleosts) and functional groups using the three identified strategies. The first is composed of elasmobranchs with slow growth, late maturation, and a long lifespan; the second is composed of pelagic teleosts with rapid growth, a high natural mortality rate, and early maturation in some cases; and the third is formed by demersal fish with a variable and/or intermediate life cycle in terms of somatic or reproductive energy investment, Fec, and trophic level (Winemiller et al. 2015). Within the teleost taxon, both groups exhibit diverse life strategies, including large versus small sizes, slow versus rapid growth, and a slow life-history in temperate waters versus a rapid life-history in tropical waters. These strategies are intrinsically linked to the characteristics of the study area, which is characterized as a zoogeographic transition zone owing to geomorphological, oceanographic, and climatic factors (subtropical-tropical waters) (Valentin 1984; Paiva and Andrade-Tubino 1998; Caires 2014). Additionally, these groups reflect a variety of adaptive responses to fishing pressures and environmental changes (Rose et al. 2001; Ramírez et al. 2022), mainly multifleet catches from artisanal gillnets in the southeastern region.

The parameters L_{max}, L_{50}, and k were the main drivers of the formation of a gradient between the taxonomic groups of elasmobranchs and teleosts observed in the PCA. Additionally, LDA showed acceptable reclassification values, enabling the subdivision of the teleost group into pelagic and demersal categories, considering other life-history traits. Juan-Jordá et al. (2013a, b) and Frédou et al. (2015) corroborated that the maximum size and growth rate are determining attributes for the separation of species groups with distinct strategies. According to Brown and Sably (2006), variations in body size indicate that competition and predation play fundamental roles in species adaptation, leading to evolution to achieve optimal sizes that fill specific niches in nature (Winemiller et al. 2015). Therefore, we can consider size as a fundamental determinant and restriction on the evolution of the life history of fish species, classifying them along a small–large continuum (Sably and Brown 2007), where elasmobranchs represent larger sizes, highlighting their correlation with size-dependent reproductive aspects, that is, the size at first sexual maturity (L_{50}). However, the growth rate is related to time and life cycle, enabling species to be ordered

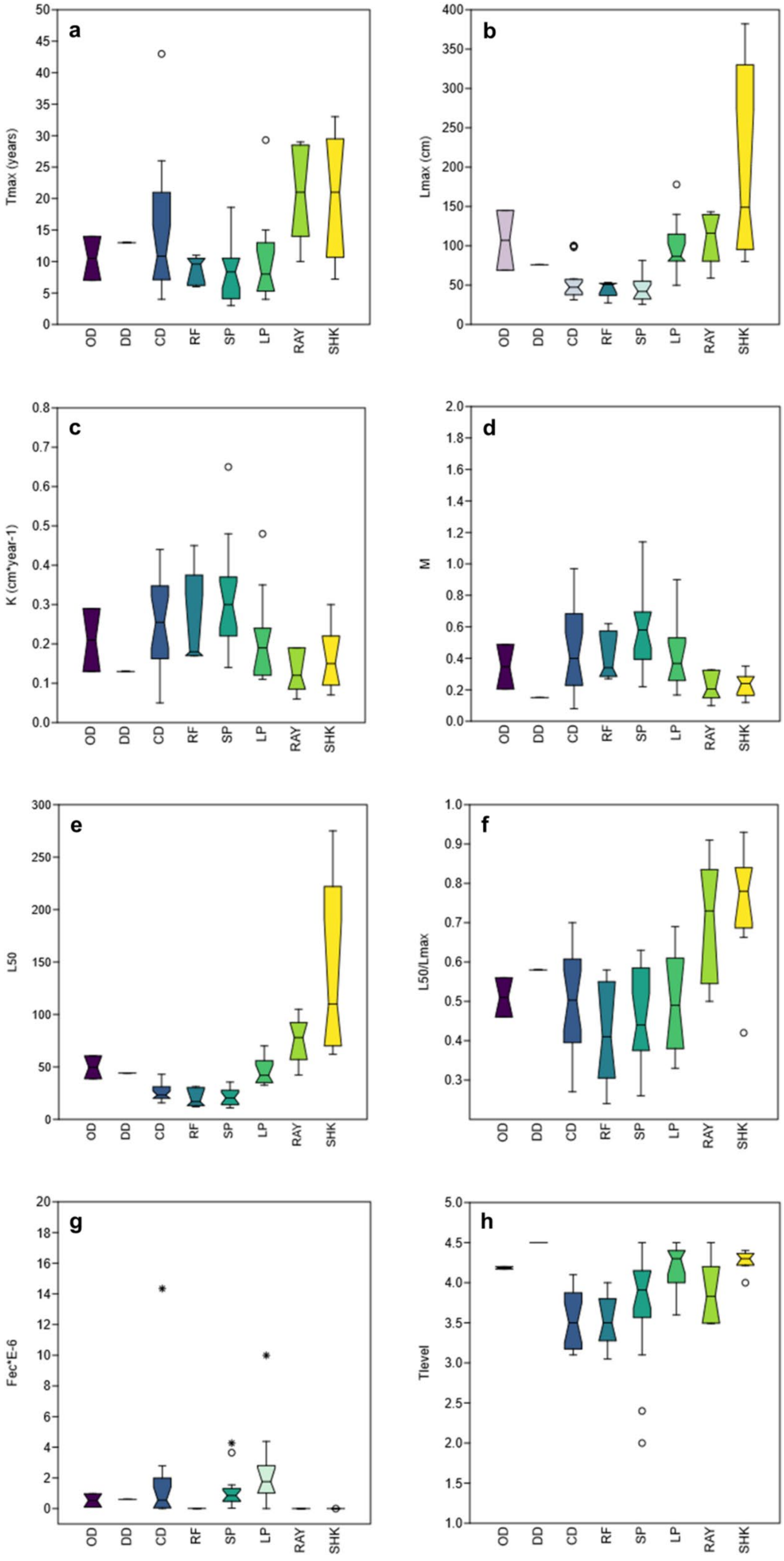


Fig. 4 Life history traits and functional groups for 68 fish species captured by the artisanal bottom gillnet (BG) and surface (SGn) fishing fleet in the Southwest Atlantic Ocean. SHK—Shark; RAY—ray; LP—large pelagic; SP—small pelagic; RF—rockfish; CD—coastal demersal; DD—deep demersal; OD—other demersal. Black lines: median. Boxplots: 1st and 3rd quartiles. Whiskers: min–max range. Dots: outliers and extreme values (*). Notches display the confidence interval (CI 95%) around the median

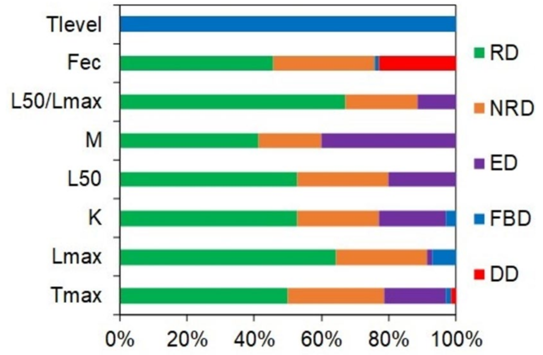
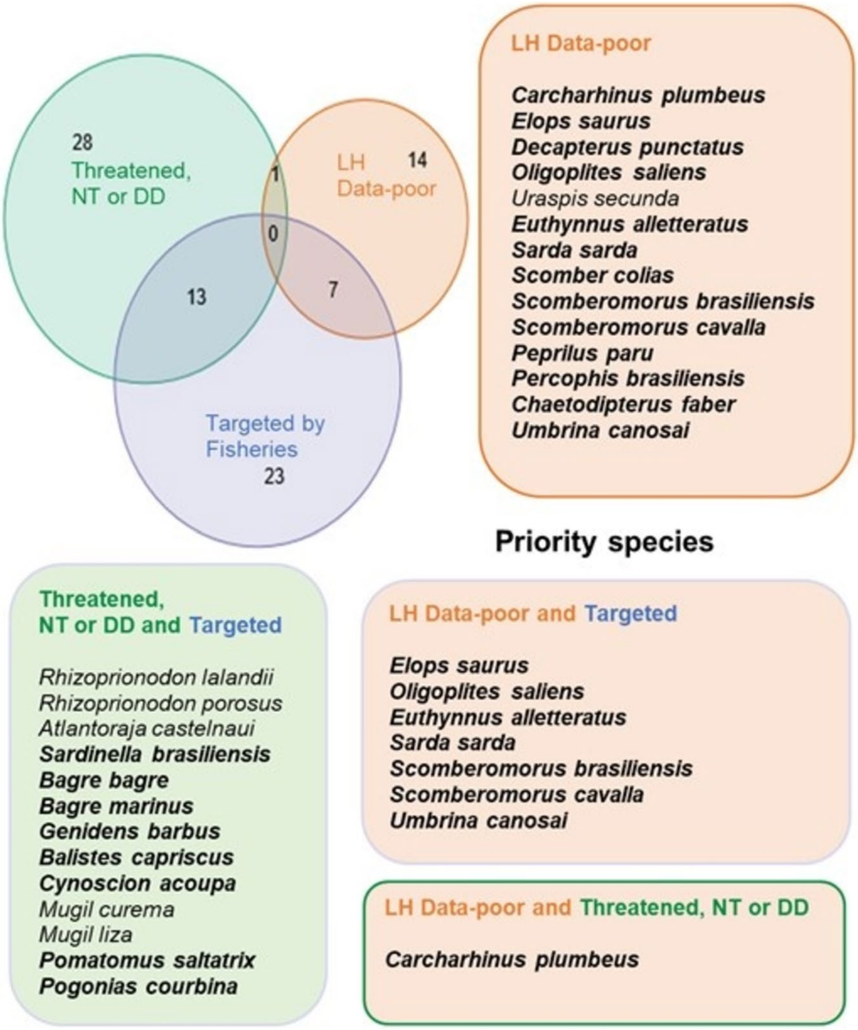


Fig. 5 Life-history information for 70 species of fish caught by the artisanal bottom gillnet (BGn) and surface (SGn) fishing fleet in the Southwest Atlantic Ocean. Percentage of dataset available, DD: deficient data; NRD: non-regional data; RD: regional data; ED: estimated data; FBD: FishBase data

along a slow-fast continuum of life histories (independent of body size) (Juan-Jordá et al. 2013a, b). The exact role of growth constants may vary among fish species, as different fish have specific life and growth strategies that are adapted to their ecological environment. The relationship between the size of a fish and its growth constant (k) plays a crucial role in determining the growth strategy of a species. A low value of (k) is generally associated with a longer lifespan, enabling fish to grow at a slower pace over time. Alternatively, a high value of (k) can result in a shorter lifespan as the fish quickly reaches its maximum size. These characteristics are correlated with distinct growth strategies, where species with a high (k) are considered "r" strategists, characterized by a high reproductive rate and early sexual maturity,

Fig. 6 Venn diagram of life history research priorities for 68 species landed in both gillnet fisheries. In bold, species observed in both red lists (ICMBio and IUCN), and other ICMBio criteria species. Species grouped by fishing strategies to identify targeted efforts (MT: main target or PT: primary target) and species listed as Endangered (Endangered, Critically Endangered, Vulnerable), Near Threatened (NT) or Data Deficient (DD) for both figures



while those with a low (k) are “K” strategists, exhibiting slower growth, delayed sexual maturity, and more significant parental investment (Winemiller 1992).

After analyzing the observed patterns of the selected life-history parameters, we confirmed the existence of three life strategy trends, the first of which was composed of elasmobranchs with slow growth (sharks and rays), representing larger species with late maturation. According to Winemiller and Rose (1992), these ecological representatives can be classified as equilibrium strategists because they also exhibit low Fec and a lower intrinsic capacity for population renewal (turnover). These species, although less susceptible to environmental variations, are more sensitive to population depletion and stock collapse and can withstand only low to moderate capture rates (Musick 1999b; King and McFarlane 2003; Mai 2021). In contrast to the first group, we observed fast-growing pelagic species, which can be conceptualized as opportunistic species, with representatives exhibiting early maturation, a higher intrinsic rate of population renewal, and a broader range of responses to environmental variations (Winemiller and Rose 1992; MacFarlane et al. 2000). Therefore, potential fluctuations in distribution and abundance over time make these species susceptible to rapid depletion, which requires greater attention to the fishing removal rate necessary to maintain the minimum critical biomass for spawning (King and McFarlane 2003; Winemiller 2005). A third group was identified, mainly composed of slow-growing, long-lived species, referred to as coastal and oceanic demersal teleosts, exhibiting rapid and high-amplitude changes in biomass that display intermediate life-history characteristics.

Knowledge of life-history parameters can provide an initial framework to support management by grouping species according to their life-history characteristics. This aids in establishing an understanding of the likely nature of population dynamics and their compensatory responses to environmental impacts and fishing pressures (Jennings et al. 1999; Frédou et al. 2015). We identified notably divergent life-history patterns among elasmobranchs, pelagic teleosts, and some demersal teleosts. Elasmobranchs accounted for 12.9% and 22% of the bycatch species that landed in the BGn and SGn fleets, respectively. This group exhibits a set of life-history characteristics that reflect a low replenishment potential, resulting in serious implications for population sustainability and making them highly susceptible to overfishing (Frisk et al. 2001; Cortés et al. 2009). According to Dulvy et al. (2021), approximately a quarter of the elasmobranch fauna is categorized as extinction threats based on the criteria of the International Union for Conservation of Nature (IUCN). Furthermore, 47% of the previously described species had insufficient data for assessment (Dulvy et al. 2014).

Overfishing is a global threat (FAO 2022), combined with habitat loss and degradation, climate change has profoundly altered marine animal populations (Hutchings 2000; Lotze et al. 2006; Polidoro et al. 2012), especially sharks and rays (Stevens et al. 2000; Simpfendorfer et al. 2002; Dudley and Simpfendorfer 2006; Ferretti et al. 2010). Several species are either intentionally caught (MT, PT, or SD) or incidentally caught (BC) in fisheries that target other resources. In the southeastern region of Brazil, the scarcity of information on species, inefficient management, and low resilience to excessive fishing efforts have led to significant reductions in some stocks, such as *Squatina guggenheim*, *Squatina occulta*, *Pseudobatos horkelli*, *Atlantoraja castelnaui*, and *Sphyrna lewini*, which are critically endangered (Vooren and Klippel 2005; Martins and Schwingel 2003; Perez et al. 2009; Frédou et al. 2016). Our results point to a wide range of life-history characteristics for shark and ray species landed by both fisheries (BGn and SGn), highlighting the need for efficient management to ensure the sustainability of these resources. This underscores the importance of further studies on the life histories of the species within this group. Despite its historical and socio-economic importance and evident contribution to fish production, artisanal fishing has been neglected by official bodies facing significant challenges in terms of recognition, support, and appropriate regulation (FAO 2022). This has led to a scarcity of information on this activity. Moreover, the availability of biological information on a species is strongly related to its commercial importance. For example, target species, such as some Scombriformes species (*Thunnus alalunga*, *Thunnus obesus*, *Thunnus albacares*, among others), are highly valued and consequently tend to have better-documented life histories better documented (Marín et al. 1998; Ward et al. 2009; Fredou et al. 2016).

In the present study, we confirmed commercially important species have relatively high knowledge, such *as Katsuwonus pelamis*, *Auxis thazard thazard*, Mugil liza, *Mugil curema*, *Pomatomus saltatrix*, *Ophistonema oglinum*, *Centropomus paralellus*, *Centropomus undecimalis*, *Trichiurus lepturus*, *Cynoscion leiarchus*, *Micropogonias furnieri*, and *Lophius gastrophysus*. Despite their significant value and relative frequency of landings, species such as *Umbrina canosai*, *Umbrina coroides*, *Sarda sarda*, *Euthynnus alletteratus*, and *Scomberomorus cavala* require regional biological information. For these species, basic parameters such as L_{max} were not found in the study area. This knowledge gap has also been observed in other elasmobranchs (*Carcharhinus leucas*, *Carcharhinus plumbeus*, and *Rhinoptera brasiliensis*). For the Scombridae and Carangidae families, we found the highest number of species (50% and 67%, respectively), requiring regional research on the eight life-history traits addressed in this study. However, we observed that out of the 13 Sciaenidae species, only two required regional data for all life-history parameters.

Based on our data, we identified sets of priority species for life-history research. The Venn diagram, based on both Red Lists (ICMBio and IUCN), indicates priority groups and species with a deficit in regional biological data, relative importance as target species in both fisheries, and extinction risk classification. Basic biological information on both taxa (elasmobranchs and teleosts) is lacking. We suggest that research efforts should prioritize knowledge of reproductive biology, including studies on Fec and maturity (size at maturity and age at maturity). We also emphasize the importance of understanding longevity parameters (number of cohorts) and other size-derived estimates such as k and M, highlighting the need for precise and accurate studies on age-specific growth rates for most analyzed species.

The compiled information can contribute to the development of models for stock assessment and assist in prioritizing and implementing management measures that are essential for promoting the sustainable use of exploited species. Current trends indicate that achieving economically viable and ecologically sustainable fishing requires a combination of management strategies (Worm et al. 2009; Woods et al. 2015). In this sense, we recommend continuous investment in research on the biological aspects of commercial species, the implementation of systematic and continuous data collection on fishing activities, and a review of the number of fishing licenses, enforcement, and implementation of fishing exclusion zones, considering environmental aspects and climatic events.

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Data availability Data will be made available on request.

Declarations

Conflict of interest The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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