


ARTISANAL FISHING ON THE COAST OF ESPÍRITO SANTO STATE, SOUTHEASTERN BRAZIL: AN APPROACH TO SOCIOENVIRONMENTAL OCEANOGRAPHY*

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ABSTRACT

Artisanal fishing is an important traditional activity on the coast of Espírito Santo (ES) State, southeastern Brazil. Despite this, there is a lack of updated data on artisanal fishing and its interfaces with socioenvironmental oceanography. The present study describes the social profile of fishers (gender, age, education, and period of professional activity) and the fishing activity (fishing gear and target species) along the coast of Espírito Santo State. Interviews with semi-structured questionnaires were carried out with 366 artisanal fishers living in 10 fishing communities. The interviewed fishers are mostly male, with low education, who had been fishing for more than 41 years (32%). The fishers described 59 target ethnospecies, with eight being common in 90% (n = 9) of the communities under study. These workers use the following fishing gear: line, longline, gillnet, trawl net, and harpoon. Socioenvironmental oceanography enables obtaining basic information on artisanal fishing, which can support the development of public policies for the sector with a view to maintaining this activity in Espírito Santo State.

Keywords: Artisanal fishers; local perception; small-scale fishing.

PESCA ARTESANAL NO LITORAL DO ESTADO DO ESPÍRITO SANTO, SUDESTE DO BRASIL: UMA ABORDAGEM DA OCEANOGRAFIA SOCIOAMBIENTAL

RESUMO

A pesca artesanal constitui uma importante atividade tradicional no litoral do estado do Espírito Santo (ES), sudeste do Brasil. Apesar disso, existe uma carência de dados atualizados sobre a pesca artesanal e suas interfaces com a Oceanografia Socioambiental. O presente estudo visa descrever o perfil social (sexo, idade, escolaridade e tempo de pesca) e a atividade pesqueira (petrecho de pesca e espécies-alvo) ao longo da costa do ES. Entrevistas com questionário semi-estruturado foram realizadas com 366 pescadores artesanais residentes em 10 comunidades pesqueiras. Os pescadores entrevistados são em sua maioria homens, com baixa escolaridade, que praticam a pesca há mais de 41 anos (32%). Foram descritas 59 etnoespécies-alvo, sendo oito comuns em 90% (n = 9) das comunidades estudadas. Os petrechos de pesca utilizados são: espinhel, linha, rede de emalhe, rede de arrasto e arpão. Por meio da oceanografia socioambiental é possível a obtenção das informações básicas sobre a pesca artesanal que podem contribuir para a elaboração de políticas públicas voltadas ao setor a fim de promover a manutenção da atividade no estado ES.

Palavras-chave: Pescadores artesanais; percepção local; pesca de pequena escala.

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INTRODUCTION

Artisanal fishing consists of small-scale fishing using low endurance vessels and fishing gear. The practice takes place through family labor in coastal and inland areas (FAO, 2012). This activity has a fundamental role in developing countries, supporting the livelihoods and food security of millions of people. It provides approximately 90% of the protein source and approximately 80% of the income for coastal communities (Barnes-Mauthe et al., 2013; McClanahan et al., 2013).

In Brazil, artisanal marine fishing occurs throughout the coastal region and can be an individual or family activity. The practice includes individual means of production or partnerships, where workers can operate both landed and in vessels with gross tonnage less than or equal to 20 (twenty) tonnes (Brasil (2009), Law nº 11.959/09; Brasil (2011), Normative Instruction nº. 2, of January 25, 2011). Despite the lower catching power in comparison to industrial fishing, artisanal fishing represents the largest portion of national fish production (Clauzet et al., 2005; MPA, 2011). Since the practice usually takes place within the family framework, the wives or close relatives of fishers are often responsible for fish processing. This enables the product to be sold through intermediaries in the local market or directly to the final consumers (Ramires et al., 2012; Fernandes et al., 2014; Zappes et al., 2016; Musiello-Fernandes et al., 2018b).

Traditional fishing communities maintain an ancestral relationship with the coastal environment, developing different ways of using local marine fauna (Diegues, 2000; Deepananda et al., 2016). This relationship with the environment guaranteed the oral transmission of traditional knowledge between generations, allowing fishing to continue (Diegues, 2000; Hawkins and Roberts, 2004). From traditional knowledge, Socioenvironmental Oceanography can help to understand the relationship between the ocean and artisanal fishing, acting mainly on the human dimension and its relations with the oceans, seas, and coastal areas (Moura, 2017; Narchi et al., 2019).

The scarcity of information on artisanal fishing is a major problem in Brazil and worldwide (Johannes, 1998; Vasconcellos et al., 2007; Maruyama et al., 2009; Pauly and Zeller, 2016). This type of fishing is highly dynamic, with a lack of basic information on fisheries production (resources and fishing gear) and on the sociocultural and socioeconomic parameters of artisanal fishers (Berkes et al., 2001; Welcomme, 2001). This lack hinders efforts to maintain fishing as a traditional activity, also affecting the effectiveness of management measures and the formulation of public policies to improve the quality of life of those involved (Begossi, 2010; Mills et al., 2011; Basilio and Garcez, 2014).

In Espírito Santo (ES) State, southeastern Brazil, coastal fishing is typically artisanal with a wide variety of artifacts and fishery resources (Pinheiro and Joyeux, 2007; Freitas Netto and Di Benedetto, 2007; Knox and Trigueiro, 2015; Abreu et al., 2020; Musiello-Fernandes et al., 2020). The coast of Espírito Santo State comprises approximately 40 fishing communities, providing approximately 20,000 jobs (Freitas Netto et al., 2002; UFES, 2013). The last official information on fisheries statistics in the state dates from 2011, estimating an annual production of 14,381 tonnes of fish (MPA, 2011). The lack of information on ES marine fisheries justifies the understanding of the social characteristics of the activity from socioenvironmental oceanography. Therefore, this study describes the social profile of artisanal fishers and updates information on the fishery resources and fishing gear on the coast of Espírito Santo State.

MATERIAL AND METHODS

Study areas

The ES coast (18°22'S - 21°19'S) is approximately 520 km long (Martins et al., 2011) (Figure 1). In this region, the northern portion is inserted in the region of Banco de Abrolhos and comprises a wide sedimentary range from the continental shelf. It is noteworthy that the Banco de Abrolhos fights the largest marine biodiversity known in the entire South Atlantic, including in the region the first restricted site in Brazil National Marine Park (Abrolhos Marine National Park) (Leão and Kikuchi, 2001). This range narrows in the north-south direction until the border with Rio de Janeiro State (Albino et al., 2006; Martins and Doxsey, 2006). The climate in the region is pseudoequatorial (type W, West), with tropical rains in the summer and predominant wind from the NE-ENE and SE quadrants (Albino, 1999). The fishing activity takes place within the family framework, being artisanal and with great relevance to the economy of the state. This activity is the main source of income and employment in some coastal cities (Freitas Netto et al., 2002; Knox and Trigueiro, 2015). Information on the economic importance of the activity for the productive sector is outdated. The latest information available was compiled by Souza and Oliveira (2003), projecting a turnover of approximately R\$ 130 million in 2003.

Procedures

Data collection took place through interviews with semi-structured questionnaires (n = 366) between 2015 and 2019. We conducted these interviews individually by applying a standard questionnaire (Schensul et al., 1999) to artisanal fishers registered in 10 fishing communities along the coast of Espírito Santo State (Table 1). This study is registered in the Brazilian National System for the Management of Genetic Heritage and Associated Traditional Knowledge (SISGEN) in compliance with the legislation in force and was approved by the Ethics Committees of the authors' home institutions (Brasil, 2015).

The selection of and approach to the first interviewee took place with the help of a local guide. From the second interviewee on, we applied the snowball technique (Bailey, 1982). At this stage of the research, the snowball technique could be interrupted, minimizing bias in the interviews. Thus, approaching the next interviewee occurred at random from an opportunistic encounter in the region (Zappes et al., 2016). The criteria for participation in the interview were as follows: i) working as artisanal fisherman in one or more of the fishing communities under study; and ii) having family income from fishing.

Data analysis

We organized the collected data into categories according to the questionnaire and the region under study (Ryan and Bernard, 2000). The identification of target species (ethnospecies) of artisanal fisheries followed specialized literature (Freitas Netto et al., 2002; Martins and Doxsey, 2006; Vieira and Gasparini, 2007; Freitas Netto and Di Benedetto, 2007; UFES, 2013; Bolzan, 2014;

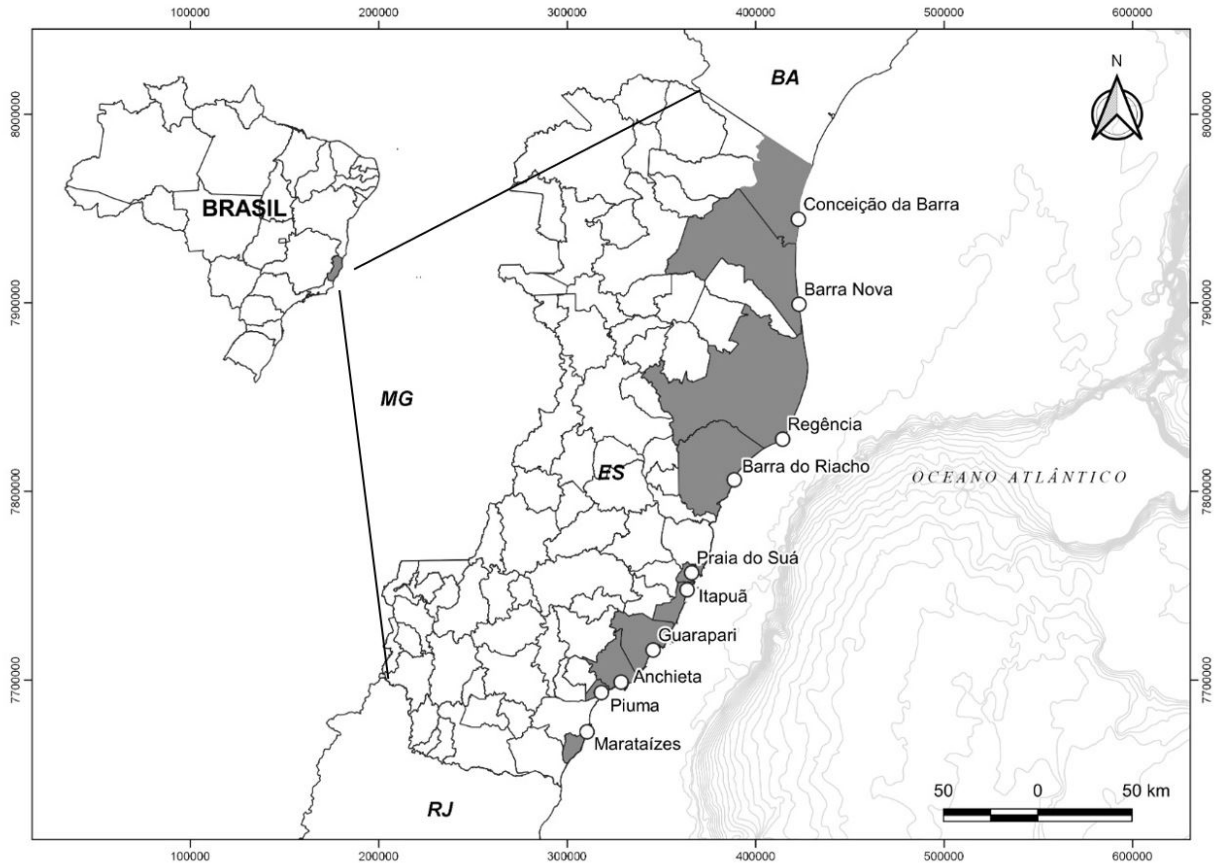


Figure 1. Location of the Espirito Santo coast, southeastern Brazil, highlighting the artisanal fishing communities under study.

Table 1. List of the fishing communities under study and number of fishers interviewed on the coast of Espirito Santo, southeastern Brazil.

City	Community	Number of Interviewees
Conceição da Barra	Conceição da Barra	40
São Mateus	Barra Nova	14
Linhares	Regência	40
Aracruz	Barra do Riacho	40
Vitória	Praia do Sua	33
Vila Velha	Itapuã	15
Guarapari	Guarapari	80
Anchieta	Anchieta-Sede	43
Piúma	Piúma	30
Marataízes	Marataízes	31
Total		366

Basilio et al., 2015; Braga et al., 2018; Musiello-Fernandes et al., 2018a). We analyzed and compared the data through the application of basic descriptive statistics, with the frequency of percentage occurrence in relation to the total number of fishing ports sampled and the total number of interviews conducted.

RESULTS

Fishers were mostly male ($n = 363$; 99%), with only three women among the interviewees. The age of the interviewees ranged between 18 and 82 years, with an average of 49 years (± 13 years) (Table 2). Regarding education, most did not complete elementary school ($n = 202$; 61%), and 3% ($n = 9$) did not attend school [Conceição da Barra ($n = 3$), Regência ($n = 1$), Barra do Riacho ($n = 3$), Anchieta ($n = 1$), and Piúma ($n = 1$)]. The period of professional activity is more expressive in the interval 'over 41 years' ($n = 116$; 32%), followed by the interval of '21-30 years' ($n = 102$; 28%). In all communities, the '<20 years' interval had the lowest proportion of interviewees (Table 3).

The fishers described 59 fishery resources (ethnospecies) and the respective artifacts used for their capture (Table 4). All ethnospecies were present in more than one fishing community, with the following being the most frequent: robalo, sarda, xixarro, pescada, pescadinha, cação, baiacú-arara, corvina, dourado, e camarões sete barbas, VM (camarão-rosa) and VG (camarão-branco). Regarding fishing modalities, the workers described five different fishing gear types: line, longline, gillnet, trawl net, and underwater fishing. The fishers mentioned using at least four fishing gear in all locations and practiced underwater fishing only in Guarapari (Figure 2). The area of fleet operation

Table 2. Profile of artisanal fishers interviewed on the coast of Espírito Santo State, southeastern Brazil.

Variable / Location	Community										TOTAL
	Conceição da Barra	Barra Nova	Regência	Barra do Riacho	Vitória	Itapuã	Guarapari	Anchieta	Piúma	Marataízes	
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Gender											
Male	40 (100)	14 (100)	38 (95)	40 (100)	33 (100)	14 (93)	80 (100)	43 (100)	30 (100)	31 (100)	363 (99)
Female	0 (0)	0 (0)	2 (5)	0 (0)	0 (0)	1 (7)	0 (0)	0 (0)	0 (0)	0 (0)	3 (1)
Age range (years)											
<20	0 (0)	0 (0)	0 (0)	2 (5)	0 (0)	0 (0)	0 (0)	0 (0)	1 (3)	1 (3)	4 (1)
21-30	0 (0)	1 (7)	4 (10)	3 (8)	4 (12)	1 (7)	6 (8)	5 (12)	7 (23)	5 (16)	36 (10)
31-40	5 (13)	5 (36)	12 (30)	7 (18)	2 (6)	1 (7)	9 (11)	11 (26)	3 (10)	6 (19)	61 (17)
41-50	12 (30)	3 (21)	11 (28)	10 (26)	11 (33)	2 (13)	22 (28)	9 (21)	10 (33)	11 (35)	101 (28)
51-60	16 (40)	4 (29)	8 (20)	9 (23)	14 (42)	6 (40)	26 (33)	10 (23)	7 (23)	6 (19)	106 (29)
61-70	6 (15)	1 (7)	3 (8)	4 (10)	2 (6)	4 (27)	11 (14)	6 (14)	2 (7)	1 (3)	40 (11)
>71	1 (3)	0 (0)	2 (5)	5 (13)	0 (0)	1 (7)	6 (8)	2 (5)	0 (0)	1 (3)	18 (5)

Legend: n: number of artisanal fishers interviewed.

Table 3. Education and period of professional activity of the artisanal fishers interviewed on the coast of Espírito Santo State, southeastern Brazil.

Variable / Location	Community										TOTAL
	Conceição da Barra	Barra Nova	Regência	Barra do Riacho	Praia do Suá	Itapuã	Guarapari	Anchieta	Piúma	Marataízes	
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
Education											
Did not study	3 (8)	0 (0)	1 (3)	3 (8)	0 (0)	0 (0)	0 (0)	1 (2)	1 (3)	0 (0,0)	9 (2)
Incomplete Elementary School	30 (75)	0 (0)	17 (43)	19 (48)	18 (55)	5 (33)	68 (85)	13 (30)	21 (70)	29 (93)	220 (60)
Complete Elementary School	1 (3)	0 (0)	0 (0)	2 (5)	6 (18)	4 (27)	0 (0)	2 (5)	3 (10)	0 (0)	18 (5)
Incomplete High School	3 (8)	10 (71)	4 (10)	6 (15)	3 (9)	2 (13)	0 (0)	17 (40)	1 (3)	1 (3)	47 (13)
Complete High School	3 (8)	4 (29)	16 (40)	9 (23)	6 (18)	4 (27)	8 (10)	9 (16)	4 (13)	1 (3)	64 (17)
Incomplete Higher Education	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Complete Higher Education	0 (0)	0 (0)	2 (5)	1 (3)	0 (0)	0 (0)	1 (1)	1 (2)	0 (0)	0 (0)	5(1)
Did not answer	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0(0)	3 (4)	0 (0)	0 (0)	0 (0)	3 (1)
Period of professional activity (years)											
<20	2 (5)	3 (21)	10 (25)	8 (20)	2 (6)	3 (21)	19 (24)	8 (19)	4 (13)	8 (26)	67 (18)
21-30	11 (28)	6 (43)	14 (35)	11 (28)	10 (30)	2 (14)	21 (26)	14 (33)	7 (23)	7 (23)	103 (28)
31-40	11 (28)	3 (21)	9 (23)	8 (20)	12 (36)	3 (21)	12 (15)	10 (23)	4 (13)	8 (26)	80 (22)
>41	16 (40)	2 (14)	7 (18)	13 (33)	9 (27)	7 (50)	28 (35)	11 (26)	15 (50)	8 (26)	116 (32)

Legend: n = number of artisanal interviewed.

Table 4. List of ethnospecies, scientific names and fishing gear reported by fishers in fishing communities in Espírito Santo State, southeastern Brazil.

Ethnospecies	Probable Family	Probable Scientific Name	Community*	Fishing gears**
Anchova	Pomatomidae	<i>Pomatomus saltatrix</i>	AC, BR, GU, MA, Pi, IT, PS	LI, LL, GN, LO
Arioco	Lutjanidae	<i>Lutjanus synagris</i>	CB, BN, OS	LI, GN
Arraia	Dasyatidae; Rajidae; Rhinobatidae; Myliobatidae		AC, BR, CB, Pi, RE, PS	LL, GN
Atum	Scombridae	<i>Thunnus</i> spp.	GU, Pi, AC, OS	LI, GN
Badejo	Serranidae	<i>Mycteroperca bonaci</i>	AC, BR, CB, GU, MA, OS	LI, LL
Bagre	Ariidae	<i>Bagre bagre</i>	BR, BN, CB, Pi, RE	LI, LL, GN
Baiacú-arara	Tetraodontidae	<i>Lagocephalus laevigatus</i>	BR, CB, GU, RE, AC, BN, MA, Pi, IT, PS	LI, LL, GN
Beijupira	Rachycentridae	<i>Rachycentron canadum</i>	AC, CB	LI, LL, GN
Bonito	Scombridae	<i>Katsuwonus pelamis</i>	BR, GU, Pi	LI, GN
Caçõ	Lamnidae; Carcharhinidae; Triakidae; Sphyrnidae; Alopiidae		MA, AC, BR, BN, CB, GU, Pi, RE, OS	LI, LL, GN, LI
Caçari	Aridae	<i>Apistor grandicassis</i>	BR, CB, RE	LL, GN
Calafate	Aridae	<i>Notarius grandicassis</i>	CB	GN
Camarão sete barbas	Peneidae	<i>Xiphopenaeus kroyeri</i>	AC, BR, BN, CB, GU, MA, Pi, RE, OS	TN
Camarão VM ou rosa VG	Peneidae	<i>Farfantepenaeus paulensis</i> , <i>F. subtilis</i> , <i>F. brasiliensis</i>	AC, BR, BN, CB, GU, MA, Pi, RE, OS	TN
Camarão VG ou Branco	Peneidae	<i>Litopenaeus schmitti</i>	AC, BR, BN, CB, GU, MA, Pi, RE, OS	TN
Cangoá	Sciaenidae	<i>Stellifer</i> sp.	BR	LI
Carapeba	Gerreidae	<i>Diapterus</i> sp.	BR, GU, Pi, RE	GN
Caratinga	Gerreidae	<i>Diapterus rhombeus</i>	AC	GN
Cavala	Scombridae	<i>Scomberomorus cavalla</i>	GU	LI
Cherne	Serranidae	<i>Epinephelus niveatus</i>	BR, GU, OS	LI
Cioba	Lutjanidae	<i>Lutjanus analis</i>	MA, BR, CB, MA, OS	LI, LL
Corvina	Sciaenidae	<i>Micropogonias furnieri</i>	MA, AC, BR, CB, GU, Pi, RE, IT	LI, GN
Dentão	Lutjanidae	<i>Lutjanus jocu</i>	AC, BN, CB, GU, PS	LI, LL, GN
Dorminhoco	Lobotidae	<i>Lobotes surinamensis</i>	AC, BR, CB, Pi, RE	LI, LL, GN
Dourado	Coryphaenidae	<i>Coryphaena hippurus</i>	AC, BR, CB, GU, MA, IT	LL
Escamuda	Sciaenidae	<i>Cynoscion</i> sp.	CB	GN
Garoupa	Serranidae	<i>Epinephelus morio</i>	AC, BR, CB, GU, MA, PS	LI, LL
Graçaí	Carangidae	<i>Caranx latus</i>	Pi	GN
Guaivira	Carangidae	<i>Oligoplites saliens</i>	BR, CB, Pi, RE	LI, LL, GN
Lagosta	Palinuridae	<i>Panulirus argus</i> , <i>P. laevicaudas</i>	GU	UF
Linguado	Paralichthyida	<i>Paralichthys patagonicus</i>	CB, Pi	GN
Meca/Marlim	Xiphiidae	<i>Xiphias gladius</i>	AC, BR, Pi	LI, LL
Mero	Serranidae	<i>Epinephelus itajara</i>	GU	LI
Namorado	Pinguipedidae	<i>Pseudopercis semifasciatus</i>	BR, GU	LI

Legend: *Communities: CB = Conceição da Barra, BN = Barra Nova, RE = Regência, BR = Barra do Riacho, PS = Praia do Suá, IT = Itapuã, GU = Guarapari, AC = Anchieta, Pi = Piúma, Ma = Marataizes; **Fishing gears: TN - Trawl net; LI - Line; GN - Gillnet; LL - Longline; UF - Underwater fishing.

Table 4. Continued...

Ethnospecies	Probable Family	Probable Scientific Name	Community*	Fishing gears**
Olho de boi/Olhete	Carangidae	<i>Seriola dumerili</i>	GU, MA, AC, Pi, OS	LI, LL
Olho de cão	Priacanthidae	<i>Priacanthus arenatus</i>	AC	LI
Pampo	Carangidae	<i>Trachinotus</i> sp.	CB, Pi, RE	GN
Pargo	Sparidae	<i>Pagrus pagrus</i>	BR, CB, GU, MA, Pi, PS	LI, LL, GN
Pargo pena	Sparidae	<i>Calamus pennatula</i>	AC	LI
Pargo rosa	Sparidae	<i>Pagrus pagrus</i>	AC	LI
Parú	Pomacanthidae, Stromateidae e Ephippidae	<i>Pomacanthus paru</i> ; <i>Peprilus paru</i> ; <i>Chaetodipterus faber</i>	GU	LI
Peixe espada	Trichiuridae	<i>Trichiurus lepturus</i>	BR, RE	GN
Peixe galo	Carangidae	<i>Selene</i> sp.	CB, Pi	LI, GN
Peroá	Balistidae	<i>Balistes vetula</i> , <i>Balistes capriscus</i>	AC, BR, CB, GU, MA, IT	LI, LL, GN
Pescada	Sciaenidae	<i>Macrondon ancylodon</i>	AC, BR, CB, GU, Pi, RE, MA, IT, PS	LI, LL, GN
Pescadinha	Sciaenidae	<i>Cynoscion virescens</i> ; <i>C. jamaicensis</i> ; <i>C. microlepidotus</i> ; <i>Isopisthus parvipinnis</i> ; <i>Nebris microps</i>	BR, BN, CB, GU, Pi, RE, MA, CB, IT, PS	LI, GN
Pula-pula, Vaquara	Scombridae	<i>Thunnus atlanticus</i>	AC, GU	LI, LL
Realito	Lutjanidae	<i>Rhomboplites auroruben</i>	AC, BR, MA	LI
Robalo	Centropomidae	<i>Centropomus undecimalis</i> , <i>C. parallelus</i>	AC, BR, BN, CB, GU, Pi, RE	LI, GN
Roncador	Haemulidae	<i>Conodon nobilis</i>	BR, RE	LI, LL, GN
Sarda	Scombridae	<i>Scomberomorus cavalla</i> , <i>S. brasiliensis</i>	AC, BR, BN, CB, GU, Pi, RE, IT, PS	LI, LL, GN, HP,UF
Sardinha	Clupeidae	<i>Sardinella brasiliensis</i>	IT	TN
Sargo	Haemulidae	<i>Anisotremus</i> sp.	AC, CB, Pi, OS	GN
Siri	Portunidae	<i>Callinectes</i> sp.	BR, AC	GN
Sirioba	Lutjanidae	<i>Lutjanus analis</i>	AC, CB, GU	LI, LL
Tainha	Mugilidae	<i>Mugil liza</i>	BR, RE, Pi, IT	GN
Vermelho	Lutjanidae	<i>Lutjanus analis</i>	AC, CB, GU, OS	LI, GN
Xaréu	Carangidae	<i>Caranx hippos</i>	CB, Pi, RE, OS	LI, LL, GN
Xixarro	Carangidae	<i>Caranx crysos</i>	AC, BR, BN, CB, GU, Pi, RE, IT, PS	LI, LL, GN

Legend: *Communities: CB = Conceição da Barra, BN = Barra Nova, RE = Regência, BR = Barra do Riacho, PS = Praia do Suá, IT = Itapuã, GU = Guarapari, AC = Anchieta, Pi = Piúma, Ma = Marataízes; **Fishing gears: TN - Trawl net; LI - Line; GN - Gillnet; LL - Longline; UF - Underwater fishing.

correlated with the fishing gear and the target species. The workers mentioned using line items in deeper regions (>30 m) or in reef areas to capture pelagic species such as dourado, meca, pula-pula, atuns and the like or demersal species such as cioba, cherne e pargo. On the other hand, for coastal fishing (up to 30 m), the fishers mentioned using trawl gear (camarão sete barbas) and underwater fishing.

DISCUSSION

Most artisanal coastal fishers in Espírito Santo State are men. This profile is typical of marine fishing in Brazil, whereas in some freshwater environments, women may account for half the fishing effort (Woortmann, 1992; Gomes et al., 2009; Alencar and Maia, 2011). In marine fishing, women usually work in



Figure 2. Example of fishing activity in Espírito Santo. Trawled fishing fleet from A) Anchieta and B) Praia do Suá. C) Types of shrimp caught and traded. D) Landed cação.

continental or coastal regions in activities such as cleaning and marketing fish and hunting crustaceans and mollusks (on beaches and mangroves). This is because in addition to fishing practices, domestic activities and children care are also the responsibility of women, which indicates work overload. In the coastal/marine region, although women do not develop activities in the same spaces as men, they occupy an important niche, acting in the aforementioned functions (Manesch, 1995; Dias and Oliveira, 2015; Musiello-Fernandes et al., 2018b; Abreu et al., 2020).

The low representation of younger fishermen is probably due to the family's incentive to study so they can obtain better opportunities in the labor market (Pereira, 2008). Evangelista-Barreto et al. (2014) point out that older fishermen started fishing in the 1970s and 1980s, where the national economic reality was different. Currently, public policies such as scholarships support young people, encouraging studies. The reduction of artisanal fishermen in each generation can contribute to the loss of an important cultural heritage associated with traditional knowledge, beliefs and knowledge (Berkes and Turner, 2006).

The education of the interviewees was low; most of the fishermen did not complete elementary school. The results of the demographic

census of the adult population in Espírito Santo State (IBGE, 2017) show that the education of fishermen is lower (by almost 50%) than that of the general population. This demonstrates that public policies and social investments do not equally include fishermen and other sectors of society. Studies report this fact in all coastal regions of Brazil (Costa, 1977; Alves and Nishida, 2003; Bail and Branco, 2007; Zappes et al., 2016). Fishing is not an activity with a prerequisite for age and/or education (Ceregato and Petrer Junior, 2003). Thus, young people start working as fishers to help support the family. However, over time, the activity becomes their main occupation (Alves and Nishida, 2003). Furthermore, another predominant factor is the overlapping of study hours and fishing activity, which hinders the frequency of regular courses at educational institutions (Santos, 2005).

The workers described 59 target ethnospecies of artisanal fishery along the Espírito Santo coast. This pattern of diversity of fishery resources is typical of activity in tropical coastal areas (Schorr, 2005). Fishers identify and exploit fishery resources according to the cultural terms specific to each society (O'Riordan and Turner, 1997). Ten of the aforementioned resources are target ethnospecies (baiacú-arara, cação, camarões sete barbas, VM

and VG, pescada, pescadinha, robalo, sarda and xixarro) in at least eight communities; in other words, they are captured from north to south of the state. Most of these resources (e.g., robalo [*C. undecimalis*, *C. parallelus*], sarda [*S. cavalla*, *S. brasiliensis*], cações [Lamnidae; Carcharhinidae; Triakidae; Sphyrnidae; Alopiidae], pescada [*Macrodon ancylodon*], corvina [*Micropogonias furnieri*]) are part of the cuisine in the local culture, mainly used for the culinary dish ‘moqueca capixaba’.

In this study, eight communities mentioned dourado (*Coryphaena hippurus*) and camarão sete barbas (*Xiphopenaeus kroyeri*), which are the main fishery resources in the state (UFES, 2013). Dourado is an oceanic epipelagic species caught by different fishing activities, including industrial, traditional, and sports fishing in tropical and subtropical regions worldwide (Dallagnolo and Andrade, 2008). The species performs great food and reproductive migrations, with capture peaks in the summer. Its distribution depends on the temperature of the water surface (Mahon, 1999). In Espírito Santo State, its annual production is approximately 2,836,808 kg, despite being captured in an extensive area of the South Atlantic Ocean (UFES, 2013).

Fishing of camarão sete-barbas takes place in most Brazilian states, in coastal areas up to 30 m deep (Costa et al., 2003). In ES, state production was 2,667,015 kg in 2011, with trawl being the main fishing net for its capture (UFES, 2013). This is a resource with several fisheries management mechanisms, both at the national and state levels (Medeiros et al., 2013). Among these mechanisms, the closed season is the most popular, which annually suspends the fishing of the species on the ES coast for a period of three months, between January 1st and March 31st. Despite being an important management measure, it is necessary to improve the dialogue with the fishing sector in Espírito Santo State for legislation to be efficient (Musiello-Fernandes et al., 2017). This fishery is carried out by trawl, with major impacts on aquatic biota and deserves attention from managers (Pinheiro and Martins, 2009).

The interviewees also mentioned baiacu (*Lagocephalus laevigatus*) as a target ethnospecies, constituting an important fishery resource in the state. In the last official information available for fisheries statistics, this resource was among the top 10 in state production (UFES, 2013). This species has a wide geographical distribution in the tropical Atlantic Ocean (Shipp, 1981), and its meat has good quality (Costa-Neto, 2000). However, the species is not an important fishery resource in Brazil, with consumption and commercialization limited to a few fishing communities (Hanazaki and Begossi, 2000; Freitas Netto et al., 2002). The low consumption of baiacu is due to the presence of the toxic substances tetrodotoxin (TTX) and saxitoxin (STX), which puts it among the most toxic fish species in the Atlantic Ocean (Freitas, 1999). In ES, the consumption and commercialization of this fish is only possible because fishers carefully remove the venom site, benefiting the product for sale (Musiello-Fernandes, pers. obs.).

The present study recorded the fishing and marketing of mero (*Epinephelus itajara*) in Guarapari city in the coastal mesoregion of Espírito Santo State. This species has sensitive biological characteristics (e.g., longevity, reproduction, growth, and mortality) and is vulnerable to surface and underwater fishing (Giglio et al., 2016). The Red List of Endangered Species of the IUCN (International Union for the Conservation of Nature and

Natural Resources) classifies mero as ‘critically endangered’ (Craig et al., 2009). In Brazil, a 2002 law prohibits the capture of this species in Brazilian jurisdictional waters, as well as its landing, transportation, and commercialization (IBAMA, 2002).

Some studies have reported the diverse fishing gear used in artisanal fishing in Espírito Santo State (Freitas Netto et al., 2002; Martins and Doxsey, 2006; Freitas Netto and Di Benedetto, 2007; Abreu et al., 2020). It is noteworthy that the same fishing operation can use more than one fishing gear, characterizing multispecific fisheries. Another characteristic pattern of fishing activity in the state is dynamism in the use of fishing gear, as it may vary on seasonal (annual) or nictemeral (daily) scales. Moreover, factors such as tides and moon phases also influence activity (Pinheiro and Joyeux, 2007; Barboza and Pezzuti, 2011).

CONCLUSIONS

Along the coast of Espírito Santo State, fishing is typically artisanal, takes place from a variety of fishing gear that capture dozens of species, which is expected in tropical waters. Most of these fishers are men with decades of experience in the activity and, consequently, accumulated knowledge about their practice. In this sense, we suggest the participation of fishers in discussions on fisheries co-management. This participation of fishers can reduce conflicts in fishing and increase the effectiveness of the measures already in place, such as in fishing for camarão sete barbas and mero. Such policies can contribute to a management that allows the maintenance of the main fishing resources, as well as the sustainable maintenance of artisanal fishing. This union of scientific data and cultural data allows co-management and consequent valorization of local culture and identity.

On the other hand, there are few younger fishers, which can interfere with the continuity of this activity. It is necessary to encourage and value the artisanal fishing culture in the region, giving the opportunity for the children of fishermen to continue the activity. Mainly, with opportunities for studies and educational improvement in fishing communities.

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