ANALYSIS OF THE ONSHORE COMPETITIVE RECREATIONAL FISHERY IN SERGIPE

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ABSTRACT

This study aimed at identifying the species caught in competitive fishing events and to analyze the profile of recreational fishers in Sergipe. Sampling took place during nine rounds of the XXI *Campeonato Sergipano de Pesca da ASPA-BV* in 2014. Sampled fishes were identified, measured, weighed, and had their sex and maturation stage identified. A total of 2,794 fishes (449 kg) were caught, from which 61.7% were sampled. The most commonly caught species were *Sciades proops, Menticirrhus littoralis,* and *Polydactylus virginicus.* The minimum catch size (TL_{min}) was set at 15 cm. At this size, many specimens of these three species were immature and thus we suggest an increase of the minimum size to 20 cm. A questionnaire was used to describe the profile of local anglers. All recreational fishers interviewed (75) were males, 16-64 years old and mainly with monthly mean income of 6-10 minimum wages. All surveyed anglers go fishing in coastal and estuarine regions, 52 in fresh water and 40 in oceanic areas. The main target species cited by respondents, which are also caught, were mojarra, snook, jacks, and mackerels, and the main baits used were *Litopenaeus vannamei*, *Mugil* spp., and Clupeiformes.

Key words: recreational fishery; sport fishery; championship; competition; fish.

ANÁLISE DA PESCA ESPORTIVA COMPETITIVA DE BEIRA DE PRAIA EM SERGIPE

RESUMO

Este estudo teve como objetivo identificar as espécies capturadas em eventos de pesca competitiva e analisar o perfil do pescador esportivo em Sergipe. As amostragens foram realizadas durante nove etapas do XXI Campeonato Sergipano de Pesca da ASPA-BV em 2014. Os peixes amostrados foram identificados, medidos, pesados, sexados e seu estágio de maturação avaliado. No campeonato foram capturados 2794 peixes (449 kg), sendo amostrados 61,7%. As espécies capturadas mais comuns foram *Sciades proops, Menticirrhus littoralis* e *Polydactylus virginicus*. O tamanho mínimo de captura (CT_{min}) estabelecido foi 15 cm. Com esse tamanho, um grande número de exemplares das três espécies encontra-se imaturo, sugerindo-se um aumento do tamanho mínimo para 20 cm. Um questionário foi usado para descrever o perfil dos pescadores esportivos. Todos eles (75) eram homens, com 16-64 anos e renda mensal dominante de 6-10 salários mínimos. Todos pescadores entrevistados praticam pesca na região costeira e estuarina, 52 em água doce e 40 em região oceânica. As principais espécies-alvo citadas pelos respondentes, que também são capturadas, foram carapeba, robalo, xaréu, cavala e serra, e as iscas mais usadas são *Litopenaeus vannamei, Mugil* spp. e Clupeiformes.

Palavras-chave: pesca amadora; pesca esportiva; campeonato; competição; peixe

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INTRODUCTION

Recreational fisheries are still perceived as an inoffensive practice in ecological terms and, as such, have received less attention than commercial fisheries (LEWIN *et al*., 2006). On the other hand, countries such as the United States, Canada and some in Europe have given large importance to this activity, trying to better understand its practice, and regulating and stimulating their growth (MATLOCK *et al*., 1988). It is estimated that there are about 33.1 million recreational fishers in the United States (UNITED STATES DEPARTMENT OF THE INTERIOR/FISH AND WILDLIFE SERVICE, 2011). In North America, 31,000 competitive fishing events take place annually in both marine and continental waters (SCHRAMM Jr. *et al*., 1991).

In Brazil, recreational fisheries have developed mainly in the last two decades (SHRESTHA *et al*., 2002; FREIRE *et al*., 2012). Due to its large amount of fresh waters (12% of Earth's total) and a very extensive coastline, Brazil has the potential to become one of the main destinations for anglers worldwide (GEO BRASIL, 2007). Besides, this country carries the highest richness of freshwater fish species in the world (3,331 species) and one of the highest number of marine fish species (1,214; FROESE and PAULY, 2016). In 2014, approximately 370 thousand recreational fishing licenses were issued in Brazil (Michel Machado, IBAMA/MS, personal communication). However, it is estimated there are about 10 million recreational fishers in the country (FREIRE *et al*., 2012). From 2009 to 2015, the Ministry of Fisheries and Aquaculture (MPA) was responsible for managing Brazilian fisheries, including recreational fisheries. Later, this responsibility was handed to the Ministry of Agriculture, Livestock and Supply (MAPA).

According to FREIRE (2005), recreational fisheries in Brazil are organized around fishing clubs (mainly for coastal fisheries), which promote several competitive fishing events throughout the country. Many of these clubs are affiliated to the Brazilian Confederation of Fishing and Underwater Sports (CBPDS) and follow their rules. However, there are many clubs and associations that have their own set of rules. In the southeastern region, many competitive events targeting billfishes and tuna-like fishes are common (see, e.g., ARFELLI *et al*., 1994; AMORIM and SILVA, 2005). Coastal fishing events are common along almost the entire Brazilian coast. Pâmpano Esporte Clube (PEC) was the first fishing club to be established in the northeastern region (1954 in the State of Rio Grande do Norte). FREIRE (2010) estimated that at least 88 fishing clubs are found in northeastern Brazil, which organized around 100 competitive fishing events each year.

There are not many studies related to onshore recreational fisheries in Brazil. FREIRE *et al.* (2016) currently revised all the information available for the country. In the northeastern region, only four were found: one for the entire region (FREIRE, 2005), one for Ilhéus, in the state of Bahia (PINTO-NASCIMENTO, 2008), one for the state of Rio Grande do Norte (ALVES, 2011), and one for the state of Sergipe (FREIRE *et al*., 2014). The study previously conducted in Sergipe presented only total catches originating from competitive fishing events taking place in that state, as the club that organizes most of these events does not collect information by species. Thus, this study was carried out aiming at characterizing the fish fauna caught in competitive fishing events taking place along the coast of the state of Sergipe. Additionally, the profile of local recreational fishers was described.

METHODS

Fishes caught in a total of nine rounds of the XXI *Campeonato Sergipano de Pesca* promoted by the *Associação Sergipana de Pesca Amadora Bons Ventos* (ASPA-BV) in 2014 were sampled. These rounds took place in six beaches spread along the coast of the state of Sergipe (Table 1). The second round occurred in Costa Azul Beach in the state of Bahia and was not included in this study. There was no event in April, as ASPA-BV was involved in the organization of the *Gincana Norte-Nordeste de Pesca*, or in July due to bad weather commonly observed during this month. In all events, only rod and reel were used and five rods at most were allowed to be in the water at the same time, independently of the number of anglers in each team. There was no restriction of hook size.

After each round, all fishes caught by each team were taken to a weighing area in closed plastic bags. After being weighed, fishes were collected only from anglers who agreed to donate their entire catch. Most of the specimens smaller than 15 cm were not sampled, as they were usually released right after their capture (according to the rules of the event, specimens with total length smaller than 15 cm - TL_{min} – are not accounted in the results). All sampled specimens were identified to the lower

possible taxon in the *Laboratório de Ecologia Pesqueira* at the *Universidade Federal de Sergipe*. Each specimen was measured using an ichthyometer (precision: 1 mm): total length (TL; cm), standard length (SL; cm), and fork length (FL; cm). Total weight (TW; g) for each specimen was obtained using a digital scale (precision: 0.01 g). The stage of gonadal maturation was defined according to VAZZOLER (1996) into four stages: I – immature, II – In development, III – Mature, and IV – Spent. Seasonal trends in catches by recreational and artisanal fishers were compared. For artisanal fisheries, catch data per species and per month available in THOMÉ-SOUZA *et al.* (2012, 2013, 2014a, 2014b) for each municipality were added and presented in a graph together with monthly recreational catches.

In order to analyze the profile of local recreational fishers, questionnaires were distributed among the participants in different rounds of the XXI *Campeonato Sergipano de Pesca da ASPA-BV*, including open- and close-ended questions related to socio-economic aspects as well as to their fishing habits.

Table 1 . Sampling area (beach) and date of all ten rounds of the XXI *Campeonato Sergipano de Pesca da ASPA - Bons Ventos* taking place in the states of Sergipe and Bahia in 2014. There was no fishing event in February, April or July in Sergipe. *This round occurred in the state of Bahia. Thus, it was not included in this study.

Round	Beach	State	Date
1	Coqueirinho	Sergipe	12/01/2014
2*	Costa Azul	Bahia	22-23/02/2014
3	Praia da Costa	Sergipe	09/03/2014
4	Jubiabá	Sergipe	04/05/2014
5	Coqueirinho	Sergipe	08/06/2014
6	Jatobá	Sergipe	31/08/2014
7	Caueira	Sergipe	28/09/2014
8	Praia da Costa	Sergipe	19/10/2014
9	Jatobá	Sergipe	30/11/2014
10	Abaís	Sergipe	14/12/2014

RESULTS

Ichthyofauna

In all nine rounds of the XXI *Campeonato Sergipano de Pesca da ASPA-BV* taking place in Sergipe in 2014, 2794 fishes were caught (about 449 kg). Out of this total, 1725 fishes were sampled (61.7%), which belonged to 14 families (including 28 identifications to the species level and one identification to the genus level). The families with more species caught were: Carangidae (6 species), Ariidae (4), Haemulidae (4), Tetraodontidae (4), and Sciaenidae (2) (Table 2). All remaining families were represented by only one species. Species with the highest catches in number were: *Sciades proops* (74.7%), *Menticirrhus littoralis* (8.2%), *Polydactylus virginicus* (5.6%), *Aspistor quadriscutis* (2.1%), *Conodon nobilis* (1.9%), *Caranx hippos* (1.5%), *Sphoeroides testudineus* (1.2%), and *Hypanus guttatus* (1.0%) (Table 3). The results for the top three species will be presented in more detail.

Sciades proops

The total length of the specimens caught ranged from 12.0 to 60.5 cm (mean = 19.2 cm; Figure 1). Most of the specimens were immature, with only two females ready to spawn (TL: 45.5 and 50.5 cm).

The highest catches in the championship were observed in May, September, October, and December (Figure 2). Monthly commercial (artisanal) catches varied among years, but for both artisanal and recreational fisheries, a pattern of lower catches during the winter seemed to emerge (Figure 3).

Menticirrhus littoralis

The total length of *M. littoralis* caught in Sergipe was 13.2-33.0 cm (mean = 23.9 cm; Figure 4). Many individuals were immature and females reached larger length. The number of females (74) was higher than males (11). Most of the females were in stage III (mature), with mature individuals found in all months studied.

Menticirrhus littoralis was one of the main species caught (142 individuals). The highest recreational catches were observed in January and December, which correspond to the austral summer (Figure 5). The comparison with artisanal catches was not possible as only 'papa-terra' is reported in the local catch statistics and *Stellifer rastrifer, Stellifer brasiliensis,* and *Menticirrhus americanus* are reported under this same common name (THOMÉ-SOUZA *et al*., 2014a, b; ARAÚJO *et al*., 2016).

Polydactylus virginicus

In the championship that took place in 2014, the total length of P. *virginicus* ranged between 13.9 and 27.5 cm (mean = 20.6 cm; Figure 6). Out of the 96 individuals sampled, 41 were females, 19 males, 14 hermaphrodites, and 22 could not be sexed. A total of 48.4% of the specimens were mature.

The highest number of specimens caught by anglers was observed in December (Figure 7). There was no correspondence between months with highest catches for recreational and artisanal fisheries (THOMÉ-SOUZA *et al*., 2014a, b; ARAÚJO *et al*., 2016).

Profile of the recreational fishers

A total of 75 anglers who are members of ASPA-BV and participated in the XXI Campeonato Sergipano de Pesca da ASPA-BV were surveyed (50% of all members of the club). All respondents were males, with ages between 16 and 64 years (97.3% adults and 2.6% teenagers). Most of the anglers belonged to the age class of 32-48 years (46.6%). The most common professions of anglers affiliated to ASPA-BV were: business man, seller, real estate broker, and public service worker. However, many other professions were cited: merchant, maintenance worker, radiology technician, dentist, physiotherapist, architect, oil and gas technician, gastronomer, veterinary, safety technician, biochemist, webmaster, professor, and general supervisor. Monthly income for most of the anglers was equivalent to 6-10 minimum wages (34.6%; minimum wage in 2014 was R$ 724.00 = US$ 341.00), but they could vary from two to more than 20.

Even though the fishing license for recreational fishers is mandatory for all fishers older than 18 (retired fishers are required to get the fishing license, but without paying for it), five of them did not have license. Out of the 70 license-holders, 65 had a license type-A (not for fishing on boats) and 5 had type-B licenses (allow for fishing on boats).

All anglers go fishing in other occasions besides fishing competitive events. "Molinete" (spinning reel) is used by all anglers, "carretilha" (reel) by a smaller number (21.8%), and handline by only 8.0%. The width of the nylon used in competitions ranges from 0.14 to 0.50 mm, but this range is wider in daily fishing activities (0.14-0.70 mm). The hook size chosen depends on the activity (championship or daily activity), with larger sizes used in daily activities, and also on the objective of the angler, i.e., catch many fishes, large fishes or a preferred species (Figure 8). Hooks are made mainly of nickel (used by all anglers), followed by stainless steel (64% of the anglers). J-type hooks are preferred (100%) in relation to circular hooks (12% of the surveyed anglers). Hooks used by all anglers carry barbs.

The most used baits during the championships were: "camarão cinza" or whiteleg shrimp (*Litopenaeus vannamei*; 100%), "tainha" or mullet (*Mugil* spp.; 93%) and "sardinha" or sardine (Clupeidae/Engraulidae; 46%). Other natural baits used less frequently were: *Callichirus major*, *Polydactylus* spp., *Menticirrhus* spp., "tatuí" (*Emerita portoricensis*), "maçunim" (*Anomalocardia brasiliana*), and unidentified squid. In daily activities, 68% of the surveyed anglers use artificial lures when fishing in rivers or offshore.

Anglers usually prefer fishing during periods of full and new moon (41.3%), and a smaller proportion during the first quarter (36.0%) de third quarter (16.0%). A total of 6.7% fish in any moon phase. A total of 77.3% goes fishing during the weekends, 16.0% whenever is possible, and 6.7% every day. Most of the anglers consume or give away their fishes (68%). Catch and release is practiced by 40.0% of the surveyed anglers.

All anglers go fishing in coastal and estuarine waters, 52 also in fresh waters, 40 in oceanic waters and only two are also spearfishers. Main targeted and caught species are *Diapterus* spp., *Centropomus* spp., *Caranx hippos*, *Caranx latus*, *Scomberomorus cavala*,

and *Scomberomorus brasiliensis* (Table 3). Main species targeted offshore are billfishes, *Thunnus* spp., and *Coryphaena hippurus*.

Most of the anglers learned how to fish with a friend (52%) or their father (38%). Currently, 100% go fishing with friends and 26.6% with their father. The main concern cited by anglers was lack of fishes (50.6%), followed by shrimp trawling, gillnet, and prohibition of recreational fishing in some protected areas in the state of Sergipe. Lack of renovation was also mentioned by some anglers, which means that not many children are involved in this activity.

Table 2. Species and their respective families caught in all rounds of the XXI *Campeonato Sergipano de Pesca da ASPA-BV* that took place in coastal areas off the state of Sergipe in 2014, their Portuguese and English common names, number of specimens caught, and relative frequency in number (%), and range of total length (cm; minimum-maximum). In bold are the most common species. *"Xarelete" is used for small specimens and "xaréu" for large specimens.

FAMILY/SPECIES	PORTUGUESE NAME	ENGLISH NAME*	NUMBER	REL.FREQ. (%)	TOTAL LENGTH (cm)
Ariidae					
Sciades proops	**Bagre branco**	**Crucifix sea catfish**	**1288**	**74.7**	**12.0−60.5**
Aspistor quadriscutis	Bagre amarelo	Bressou catfish	21	1.2	13.5−28.2
Bagre bagre	Bagre veleiro	Coco sea catfish	6	0.3	24.0−41.5
Bagre marinus	Bagre fidalgo	Gafftopsail sea catfish	2	0.1	20.5−20.8
Carangidae					
Caranx hippos	Xarelete/xaréu*	Crevalle jack	26	1.5	12.0−26.8
Trachinotus goodei	Barbari	Great pompano	11	0.6	14.0−25.5
Trachinotus carolinus	Pampo	Florida pompano	3	0.2	15.6−37.7
Caranx latus	Xarelete/xaréu*	Horse-eye jack	4	0.2	14.3−16.7
Chloroscombus chrysurus	Garapau	Atlantic bumper	2	0.1	15.5−17.1
Oligoplites saurus	Solteira	Leatherjacket	1	<0.1	22.5
Haemulidae					
Conodon nobilis	Coroca	Barred grunt	33	1.9	11.0−36.5
Genyatremus luteus	Sauara	Torroto grunt	5	0.3	18.1−27.8
Anisotremus surinamensis	Pirambú	Black margate	2	0.1	19.1−19.9
Pomadasys corvinaeformis	Coroca branca	Roughneck grunt	2	0.1	15.0−19.5
Sciaenidae					
Menticirrhus littoralis	**Tremitara**	**Gulf kingcroaker**	**142**	**8.2**	**13.2−33.0**
Cynoscion leiarchus	Pescada branca	Smooth weakfish	1	<0.1	37.7
Tetraodontidae					
Sphoeroides testudineus	Baiacu	Checkered puffer	20	1.2	14.8−24.0
Colomesus psittacus	Baiacu pé de meia/ arara	Banded puffer	3	0.2	25.5−35.5
Lagocephalus laevigatus	Baiacu xaréu	Smooth puffer	2	0.1	40.0−48.0
Lagocephalus lagocephalus	Baiacu xaréu	Oceanic puffer	1	<0.1	41.0

to be continued...

continuation Table 2...

Carcharhinidae					
Carcharhinus sp.	Cação	Shark	1	<0.1	64.0
Centropomidae					
Centropomus parallelus	Robalo peva	Fat snook	4	0.2	23.3−26.5
Dasyatidae					
Hypanus guttatus	Arraia	Longnose stingray	18	1.0	46.0−265.0
Elopidae					
Elops saurus	Ubarana	Ladyfish	3	0.2	28.3−44.0
Engraulidae					
Lycengraulis grossidens	Sardinha arenga	Atlantic sabretooth	2	0.1	17.7−19.8
Gerreidae					
Eucinostomus melanopterus	Carapicum	Flagfin mojarra	7	0.4	13.0−17.0
Lobotidae					
Lobotes surinamensis	Gereba	Tripletail	1	<0.1	70.0
Polynemidae					
Polydactylus virginicus	**Barbudo**	**Barbu**	**96**	**5.6**	**13.9−27.5**
Rhinobatidae					
Pseudobatos percellens	Cação viola	Chola guitarfish	2	0.1	49.0−56.5
TOTAL	—	—	1725	100	—

* Source: FishBase (FROESE and PAULY, 2016)

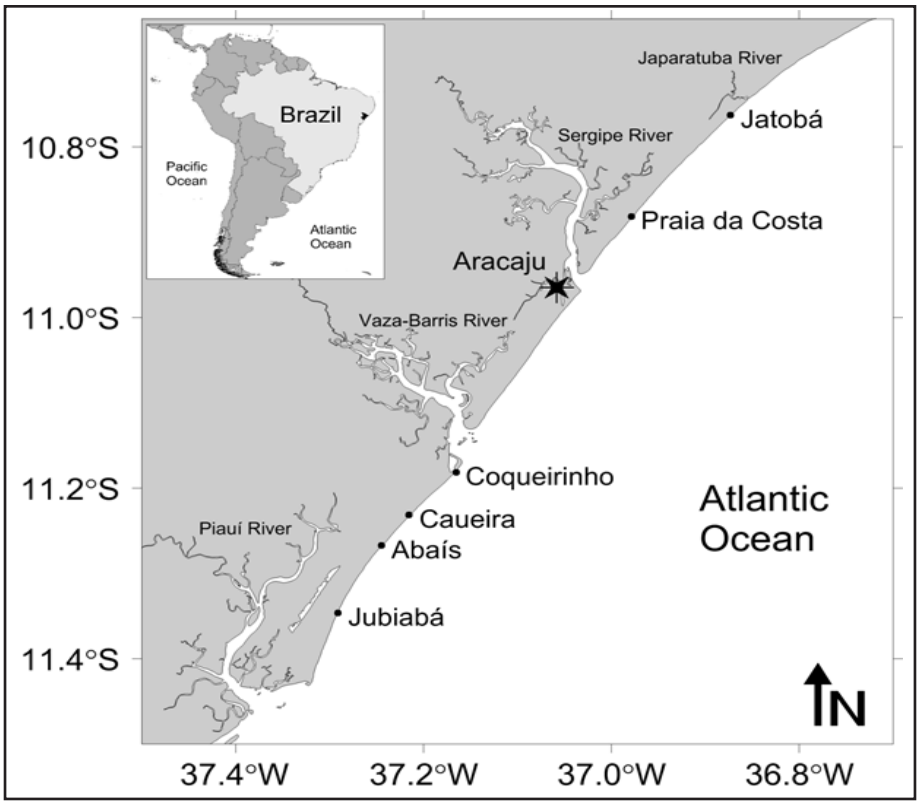

Figure 1 . Map of the study area along the coast of Sergipe, showing all beaches where the nine rounds of the XXI *Campeonato Sergipano de Pesca da ASPA-BV* took place and the main rivers of the region.

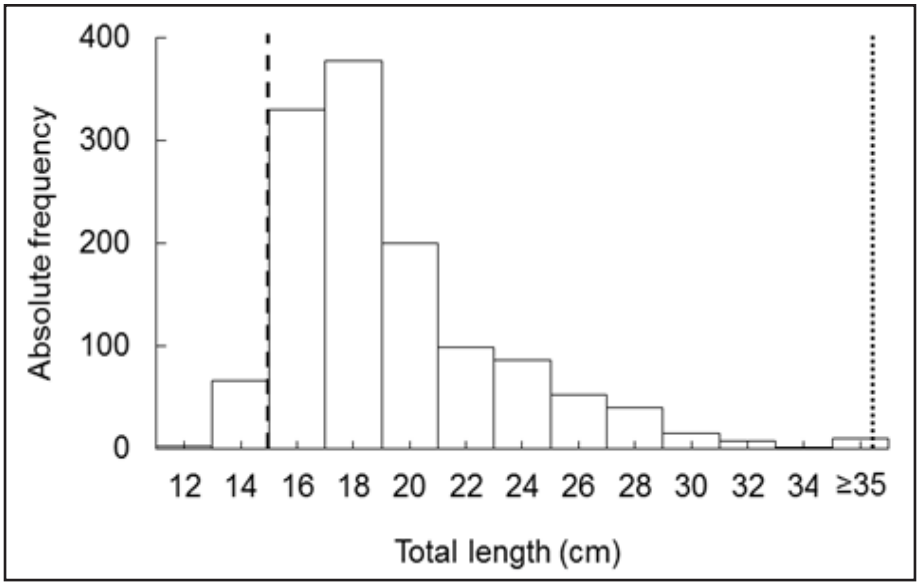

Figure 2 . Frequency distribution of total length for *Sciades proops* caught during the XXI *Campeonato Sergipano de Pesca da ASPA-BV* in 2014 off coastal waters of the state of Sergipe. The vertical dashed line represents the minimum catch size defined in the rules of the championship (for all species; TL_{min}) and the dotted vertical line indicates the size at first maturity (36.6 cm; AZEVEDO *et al.,* 2010).

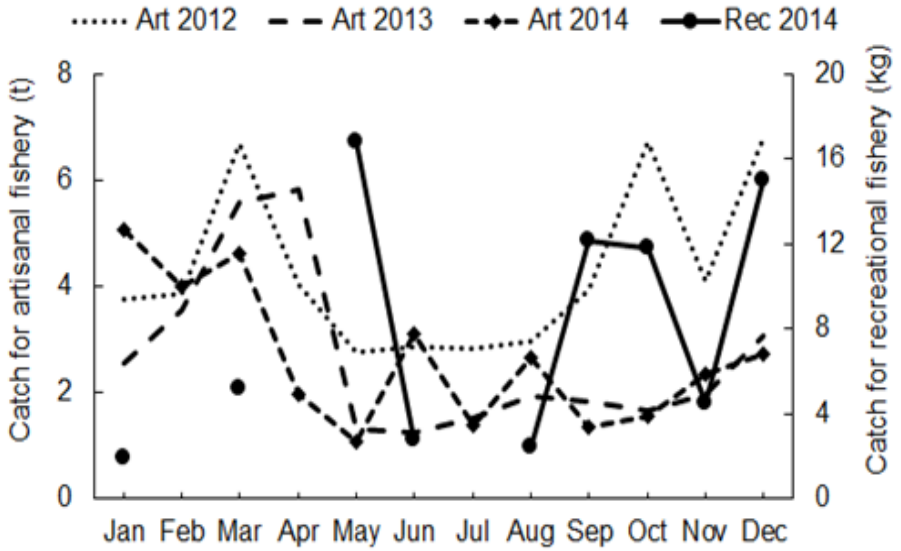

Figure 3 . Monthly artisanal catches (Art) for *Sciades proops* off the state of Sergipe in 2012-2014 (THOMÉ-SOUZA *et al.*, 2014a, b; ARAÚJO *et al.*, 2016) and recreational catches (Rec) for 2014. Note that there was no recreational fishing event in February, April, and July 2014.

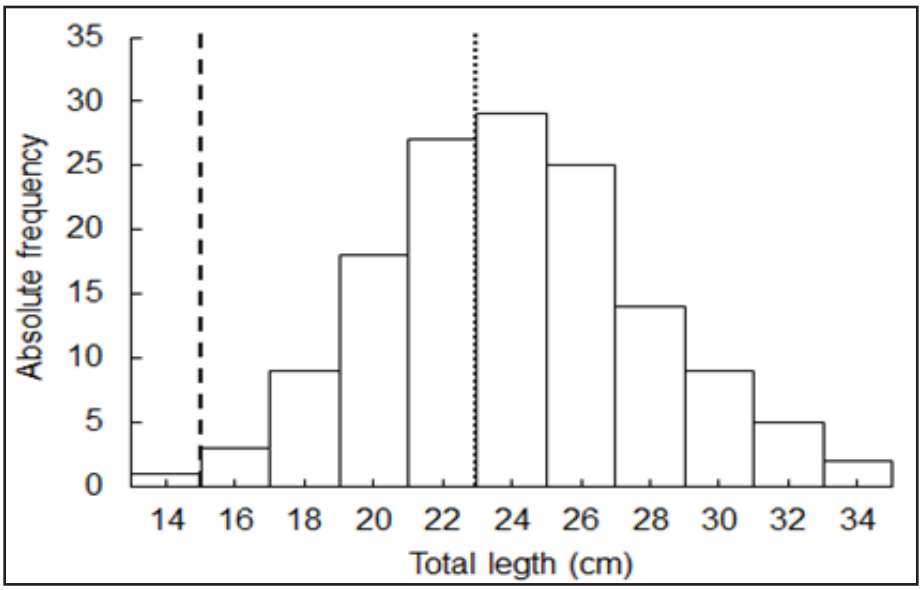

Figure 4 . Frequency distribution of total length for *Menticirrhus littoralis* caught during the XXI *Campeonato Sergipano de Pesca da ASPA-BV* in 2014 off coastal waters of the state of Sergipe. The vertical dashed line represents the minimum catch size defined in the rules of the championship (for all species; TL_{min}) and the dotted vertical line indicates the size at first maturity (BRAUN and FONTOURA, 2004).

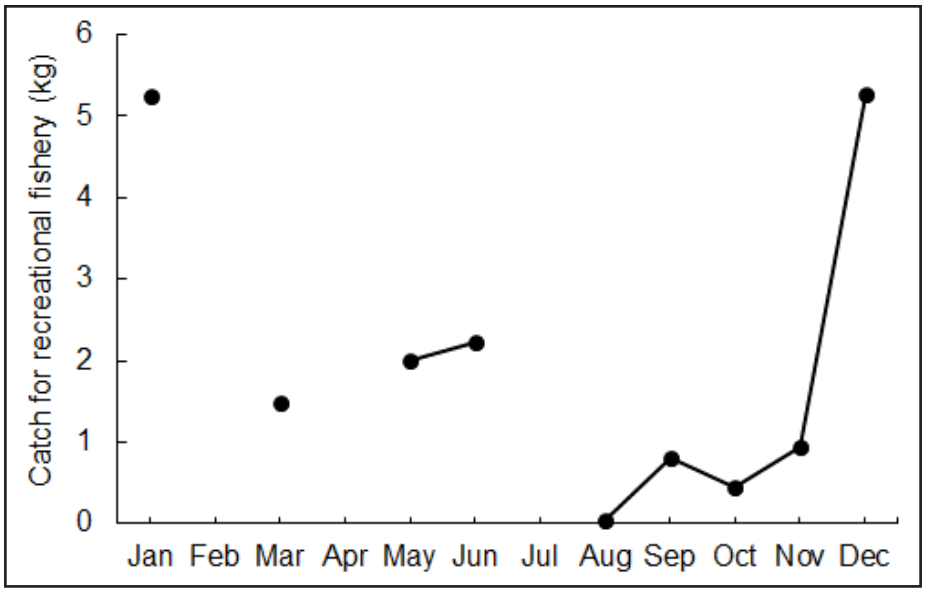

Figure 5 . Monthly recreational catches for *Menticirrhus littoralis* off the state of Sergipe in 2014. Note that there was no recreational fishing event in February, April, and July 2014.

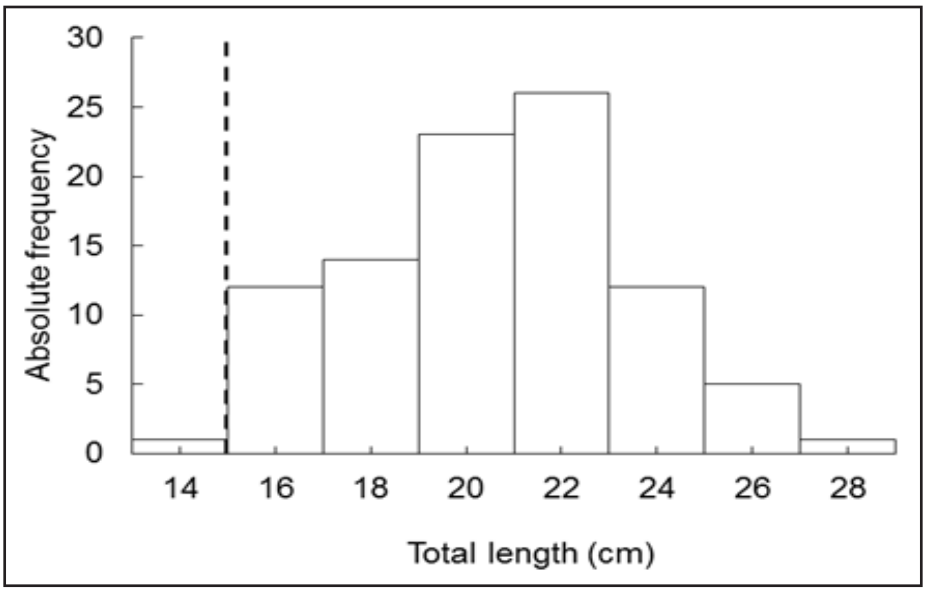

Figure 6 . Frequency distribution of total length for *Polydactylus virginicus* caught during the XXI *Campeonato Sergipano de Pesca da ASPA-BV* in 2014 off coastal waters of the state of Sergipe. The vertical dashed line represents the minimum catch size defined in the rules of the championship (for all species; TL_{min}).

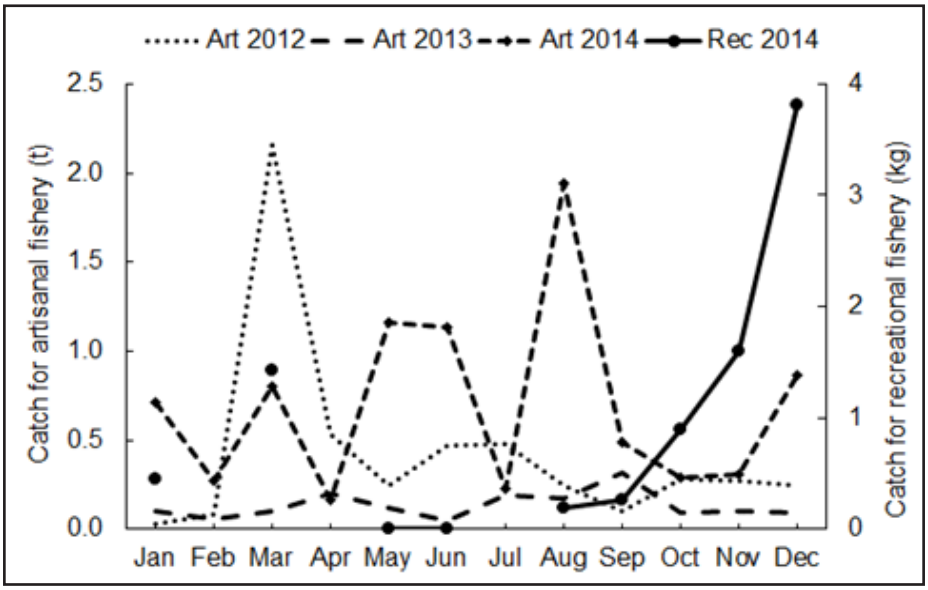

Figure 7. Monthly commercial catches for *Polydactylus virginicus* off the state of Sergipe in 2012-2014 (THOMÉ-SOUZA *et al.*, 2014a, b; ARAÚJO *et al.*, 2016) and recreational catches for 2014. Note that there was no recreational fishing event in February, April, and July 2014.

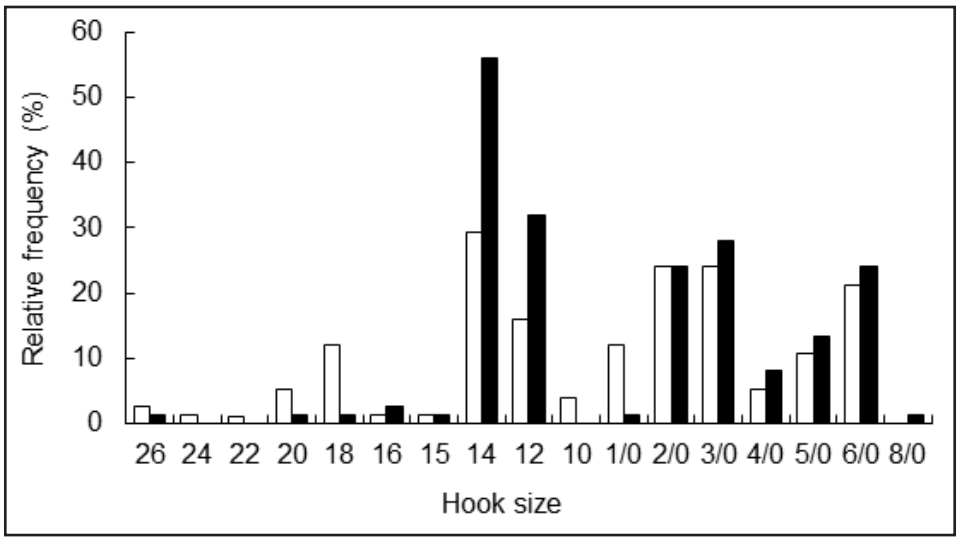

Figure 8 . Standard number referring to the size of hooks used by anglers of ASPA-BV in championships (□) and in daily fishing activities (■) in Sergipe.

Table 3 . Species targeted and/or caught by 75 of the anglers affiliated to the *Associação Sergipana de Pesca Amadora Bons Ventos (ASPA-BV)* in the state of Sergipe. Eleven species were targeted and effectively caught and nine species were not targeted but ended up being caught.

	Targeted and caught	**Only targeted**	**Only caught**	**TOTAL**
Diapterus spp.	73	0	2	75
Centropomus spp.	52	0	23	75
Caranx hippos/C. latus	30	1	44	75
Scomberomorus cavala/S. brasiliensis	30	1	11	42
Conodon nobilis	25	0	50	75
Thunnus spp.	24	17	1	42
Rays	16	0	59	75
Sphyraena spp.	4	1	46	51
Sharks	3	0	71	74
Coryphaena hippurus	2	12	21	35
Billfishes	1	22	0	23
Groupers	0	1	72	73
Catfishes	0	0	75	75
Menticirrhus spp.	0	0	75	75
Polydactylus spp.	0	0	75	75
Pufferfishes	0	0	75	75
Genyatremus luteus	0	0	75	75
Elops saurus/Albula spp.	0	0	75	75
Trachinotus goodei	0	0	75	75
Eucinostomus spp.	0	0	75	75
Snappers	0	0	75	75

DISCUSSION

Ichthyofauna

In 2014, the rules defined by the Organizing Committee of the *XXI Campeonato Sergipano de Pesca* set a minimum catch length of 15 cm (TL). However, considering this size, most of the specimens of *S. proops* and *P. virginicus* are immature, as well as a high proportion of *M. littoralis*. This rule have been changed throughout time (20 cm in 2008, 15 cm in 2011, 20 cm in 2012, and no minimum size set in 2013; see FREIRE *et al*., 2014). Considering that all these species have commercial importance (THOMÉ-SOUZA *et al*., 2014b), it is recommended that the minimum size is changed back to 20 cm and be kept for a number of years to properly access its effect. Some consider that recreational fisheries do not have an impact on fish stocks but this is now known not to be true (COLEMAN *et al*., 2004; MOTTA *et al*., 2016). The volume caught by recreational fishers in marine waters off Sergipe is certainly lower than by shrimp trawlers but respecting the maturity size should be a rule for all sectors using the same resource.

In relation to *Menticirrhus*, two species are reported in Brazilian waters: M. americanus and *M. littoralis* (CARVALHO-FILHO, 1999). According to RODRIGUES and VIEIRA (2010), *M. americanus* is more abundant in estuarine waters and *M. littoralis* in coastal waters. Considering that only *M. littoralis* was found in this study, commercial catches for this species should be better investigated, as currently all catches reported as "papa-terra" are attributed to *M. americanus* and, unusually, to some species of *Stellifer* (THOMÉ-SOUZA *et al*., 2014b). A higher number of females of *M. littoralis* was caught in the samples analyzed here and this may be associated to the migration of females to shallow waters to spawn (BRAUN and FONTOURA, 2004). Indeed, most of the females sampled in this study were mature. Besides, there was a high proportion of immature individuals. This occurs because *Menticirrhus* spp. spawn in coastal areas and juveniles are found in the surfzone (TEIXEIRA *et al*., 1992). The high abundance of *M. littoralis* was also found in samples obtained from the *Campeonato Interno do Clube de Pesca de Ilhéus - CLUPESIL* (10.3%) in 2007-2008 (PINTO-NASCIMENTO, 2008) and by ALVES (2011) during the championships promoted by *Pâmpano Esporte Clube* in waters off the state of Rio Grande do Norte. Studies conducted in sandy beaches in southeastern-southern Brazil also reported high abundance for this species in coastal waters (ZAHORCSAK *et al*., 2000; GODEFROID *et al*., 2003; GOMES *et al*., 2003; FÉLIX et al., 2007).

Polydactylus virginicus occurs from the United States to southern Brazil (CERVIGÓN, 1993). Its preferred habitat is sandy and muddy bottom in coastal areas, estuaries and mangroves, as well as the surfzone. The occurrence of this species in the surfzone was reported in this study, where most of the catches are taken. Similarly, PINTO-NASCIMENTO (2008) and ALVES (2011) reported high abundance of *P. virginicus* in championships promoted in the states of Bahia and Rio Grande do Norte, respectively. Several authors have mentioned that *Polydactylus* spp. are usually found in surfzone, but in lower abundance (GODEFROID *et al*., 2003; GOMES *et al*., 2003; VASCONCELOS *et al*., 2007). This may be associated with a difference in fishing gear used in these studies and our study. Sequential hermafroditism is observed in *P. virginicus*, with females changing into males (SANTOS *et al*., 1987). There is not much information on the reproduction of this species, which is necessary to better understand this aspect in order to better manage local stocks.

Sandy beaches, such as the ones found in the coast of Sergipe, are considered feeding areas, with a high proportion of juveniles, as found in this study. The high turbidity and turbulence help to prevent predation and provide a high abundance of feeding resources, which are also important for the reproduction of various fish species (LASIAK, 1986). Most of the species found in this study are non-residents and their high abundance is seasonally associated with feeding and reproduction (BROWN and MCLACHLAN, 1990; FÉLIX *et al*., 2007). *Menticirrhus littoralis,* however, is considered resident (LIMA and VIEIRA, 2009). There was no correspondence between months with highest catches for recreational and commercial fisheries (THOMÉ-SOUZA *et al*., 2014a, b; ARAÚJO *et al*., 2016), but this may be associated with the difference in fishing area for these sectors, with recreational fishers fishing in the surfzone, closer to the shore and shrimp trawlers towards deeper waters, and the feeding and reproductive migration of these species.

Profile of the recreational fishers

Most of the anglers surveyed here were middle aged (32-48 years old). Similar pattern was also found by PINTO-NASCIMENTO (2008) in the state of Bahia (36-54), by CHIAPPANI (2006) in the state of Espírito Santo (41-50), and by BASAGLIA and

VIEIRA (2005) in the state of Rio Grande do Sul (40-45), all coastal anglers. Even though some teenagers were found in this study, there is a perception that children are not interested in recreational fisheries and this may decrease the importance of this activity in the future. CLUPESIL (Bahia) has adopted different rules for children in an attempt to keep them fishing in their fishing events, where they are allowed to fish specimens weighing less than 200 g (Kátia M.F. Freire, personal observation). This may be adopted in the state of Sergipe, where children could be granted the right to fish specimens below size limit. Another incentive for children is to have an event for themselves, which is already done in Sergipe (FREIRE *et al*., 2014) and Rio Grande do Norte (ALVES, 2011).

Most of the anglers learned how to fish with friends or father, but they currently prefer go fishing with their friends. Similar trend was observed by PINTO-NASCIMENTO (2008) for Ilhéus. This may represent a general change in modern society in relation to family ties. Ultimately, this may also imply a lower number of children fishing with their fathers in the future.

The predominant monthly income for ASPA-BV anglers of 6-10 minimum wages was similar to the one observed by CHIAPPANI (2006) in Vitória, state of Espírito Santo. However, it could range from two to more than 20 minimum wages, indicating that coastal recreational fishery is a much more democratic fishing activity than oceanic fisheries. Even more so in Ilhéus (Bahia), where the most common monthly income was 2-5 minimum wages (PINTO-NASCIMENTO, 2008) and in Rio Grande (Rio Grande do Sul; 3-5 minimum wages), as reported by BASAGLIA and VIEIRA (2005).

Most of ASPA-BV anglers practice coastal fishing and have the habit of consuming their catch as well as of donating. Some fishes are also released. During the championships, there is a problem with releasing some small specimens, such as catfishes, as they may hurt some of the anglers who go deeper to cast their rod. Some discussion about this issue should be promoted among anglers and clubs that define minimum size. Besides, many specimens smaller than the minimum size are brought to the weighing table,which could be avoided by providing each angler with a fish ruler in the beginning of each event.

ASPA-BV anglers usually prefer to fish during periods of full and new moon. The influence of the moon in catch rates is not completely solved because many factors act jointly and to disentangle their effects is challenging. However, there seems to be a consensus that the effect is different for each species, which could be directly associated with their feeding habits (see, e.g., LOWRY *et al*., 2007). Future studies could be designed to assess the effect on catch rates for the main species caught in coastal waters off Sergipe.

Segundo CHAVES and FREIRE (2012), many anglers are not aware of the impacts of their activity on fishes after being released (catch-and-release). One of the problems raised by experts is the permanence of the hook inside the fish after the fishing line is cut (in cases where hooking takes place deep inside the fish, known as deep hooking). Nickel hooks, which are the most widely used by the surveyed anglers, have a higher oxidation rate and can be more easily egested, but this may result in further injuries and higher mortality (MCGRATH *et al*., 2011). On the other hand, a very high proportion of anglers use hooks made of stainless steel (64%), which have a lower oxidation rate and thus a longer lifespan, with the potential of continuously catching fishes, known as ghost fishing (see, e.g., CHAVES and ROBERT, 2009). The impact of these different types of hooks on local species has not yet been assessed.

CONCLUSIONS

Even though three species dominate the catches by anglers in onshore competitive events in Sergipe, the number of species caught is high. Some of these species are not targeted but end up being caught. Many specimens of the three main species caught were immature, therefore it is recommended that the minimum catch size is increased back to 20 cm, and the effect of this change should be assessed in the future. This proposition should be accompanied by the simple habit of providing fish rulers to anglers in order to allow for the release of small fishes right after being caught, increasing their chance of survival.

As observed in other Brazilian states and in other countries, ASPA-BV anglers are mainly middle-aged men. The reduced number of young anglers in Sergipe is worrisome, as it may represent a decreasing trend in interest towards such an outdoor activity. Measurements to increase the participation of children in these events could be introduced, including different rules in relation to the adults. This study may inspire scientists to conduct similar studies in other states along the coastline of Brazil, as have been also done in the states of Bahia and Rio Grande do Norte, in order to be able to cover the entire country. Thus, a better understanding of Brazilian recreational fisheries and

a proper management of local fish resources would be possible.

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