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Review Article

Sport fishing in Brazil: the current state

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ABSTRACT

Sport fishing has ecological, economic, and social importance, but there are few studies that characterize it according to the sustainability tripod. Due to this gap, we present a systematic review of the literature to evaluate the current situation of sport fishing in Brazil. The papers on the subject were systematically evaluated based on quantitative criteria. Additionally, in order to create a list of the species of interest of sport fishers, the survey of 22 papers was carried out regarding the species caught. A total of 70 complete papers published between 1994 and 2021 were included in the study. Since the 1990s, publications have increased quantitatively, with most studies coming from the South-Eastern region of Brazil (39.19%). The papers published discussed, in the majority, the sport fishing carried out in marine environment (55.38%), and the focus was "fishing and fishers" (30%). Evaluating the sustainability tripod, most of the papers provided only information regarding the ecological aspect (58.57%). About 330 species of marine and freshwater fish of interest to sport fishers were dealt with in the studies. This information reflects the current state of knowledge about Brazilian sport fishing, and it can serve as a basis for the management of the activity and the target species used by fishers. Additionally, the present review can serve as an aid for future research on this topic.

Keywords: Fishery management; Recreational fishing; Fishery resources; Sustainability.

A pesca esportiva no Brasil: o estado atual

RESUMO

A pesca esportiva apresenta importância ecológica, econômica e social, mas são poucos os estudos que a caracterizam segundo o tripé da sustentabilidade. Por causa dessa lacuna, apresentamos uma revisão sistemática da literatura para avaliar a atual situação da pesca esportiva no Brasil. Os artigos foram avaliados sistematicamente com base em critérios quantitativos. Por fim, com o objetivo de criar uma lista com as espécies de interesse dos pescadores esportivos, foi realizado o levantamento das espécies capturadas em 22 artigos científicos. Foram incluídos no estudo 70 artigos completos, publicados no período de 1994 a 2021. Na década de 1990, as publicações incrementaram quantitativamente, sendo a grande maioria estudos oriundos da Região Sudeste do Brasil (39,19%). Os artigos publicados em sua maioria abordam a pesca esportiva realizada em ambiente marinho (55,38%), e o foco principal foi "a pesca e os pescadores" (30%). Avaliando o tripé de sustentabilidade, a maioria dos artigos trazia apenas informações sobre o aspecto ecológico (58,57%). Cerca de 330 espécies de peixes marinhos e de água doce de interesse dos pescadores esportivos foram levantadas nos estudos. Essas informações refletem o estado atual de conhecimento sobre a pesca esportiva brasileira e podem servir como base para gestão da atividade e das espécies-alvo utilizadas pelos pescadores. De outra forma, a presente revisão pode servir de auxílio para as futuras pesquisas realizadas na temática.

Palavras-chave: Gestão pesqueira; Pesca recreativa; Recursos pesqueiros; Sustentabilidade.

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INTRODUCTION

Sport fishing is a term used, in general, to define the capture of fish for fun, where the individual does not use the fishery resources to meet their basic nutritional needs and the animals caught are usually neither sold nor traded in the export, domestic or black market (Pitcher and Hollingworth, 2002; FAO, 2012).

Although this universal definition exists, in Brazil, this practice is called amateur fishing, which is divided into recreational and sport fishing, as established in Brazilian federal legislation (No. 11.959/2009 and No. 4/2009). The main difference between these two forms is in the catch quota of fish for recreational fishing. In sport fishing it is mandatory to practice catch and release, and keeping fish after catching them is prohibited (ICMBIO, 2009). In the present study, the terminology used to refer to the fishing activity that aims to catch fish as a recreational activity will be *sport fishing*.

Sport fishing is one of the most popular tourism and leisure activities in the world and it is widely practiced in many countries (Cowx, 2002; Cooke and Cowx, 2004; FAO, 2012), such as the United States (Muoneke and Childress, 1994; Siepker et al., 2007), Australia (McLeay et al., 2002; Broadhurst et al., 2005), Canada (Brownscombe et al., 2014), European countries (Aas et al., 2002; Lloret et al., 2008; Veiga et al., 2011; Tunca et al., 2016; Pita et al., 2018; Martínez-Escauriaza et al., 2020), and Brazil (Catella, 2004; Fabri, 2005; Holley et al., 2008; Peixer and Petrere Júnior, 2009; Sobreiro et al., 2010; Barcellini et al., 2013; Barrella et al., 2016a; 2016b; Alves-Junior et al., 2020). This activity is also recognized as being of ecological importance (because it has an impact on the environment and food chains, as well as promoting environmental awareness), economic (because the market is worth billions of US$) and social (because it is a traditional and cultural activity, which is passed on between generations) (Pitcher and Hollingworth, 2002; Cooke and Cowx, 2004; FAO, 2012; Fenichel et al., 2013).

These three aspects together make up the sustainability tripod that is internationally known as the triple bottom line (TBL) and, by using the ecological or environmental, economic and social lines, it provides a framework to measure the performance of the activity and its success (Elkington, 1997). Considered a benign activity, sport fishing has importance within the lines of the tripod (Pitcher and Hollingworth, 2002). However, there are few studies that characterize it according to the criteria proposed by the TBL (Arlinghaus and Cooke, 2009).

Due to this gap, we present a systematic review of the literature to evaluate the current situation of sport fishing in Brazil and discuss the following questions:

- What is the temporal trend of publications on sport fishing in Brazil?
- How many papers are published per geographical region?
- What types of environment were studied?
- What are the main focuses of study in the publications?
- Which aspects of sport fishing have been studied the most in relation to sustainability (ecological, economic and social)?
- What species are of interest to sport fishers?

MATERIALS AND METHODS

Search system

Considering the time interval from 1945 (limit on search platforms) to June 2021, a systematic keyword-based review was carried out using four databases: Google Scholar (scholar.google.com.br), journals from Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) (www-periodicos-capes-gov-br), Scopus (scopus.com), and Web of Science (apps-webofknowledge). In the Google Scholar and Periódicos CAPES platforms, five search terms were used in Portuguese since it is a platform that searches for papers published in Portuguese (Fig. 1), while in the Scopus and Web of Science platforms, in order to locate papers published in English, the same terms were searched in English, totaling 10 search terms (Fig. 1).

Selection criteria

The searches carried out on the platforms resulted in 648 publications, originating from papers, end of course papers (monographs, dissertations, and theses), book chapters and summaries of work presented at scientific events (Fig. 1). Following this, a refinement in the search was carried out on the basis of a time interval, language and type of document, which resulted in 191 complete papers (457 papers were removed) (Fig. 1). The remaining papers were exported to a digital spreadsheet (Microsoft Excel 2019) for organization and final refinement. At this stage, duplicated papers were excluded, and the selection and permanence of the paper for further analysis were carried out based on the reading of the title and abstract. Finally, 121 papers were excluded, leaving 70 complete papers for analysis (Fig. 1).

Collection of information

The papers were systematically evaluated based on quantitative criteria (Table 1) in order to summarize, evaluate and present the current situation of sport fishing in Brazil. Some papers contained information from two or more Brazilian states, so the data presented in some analyses may not necessarily represent the number of complete papers incorporated in the study.

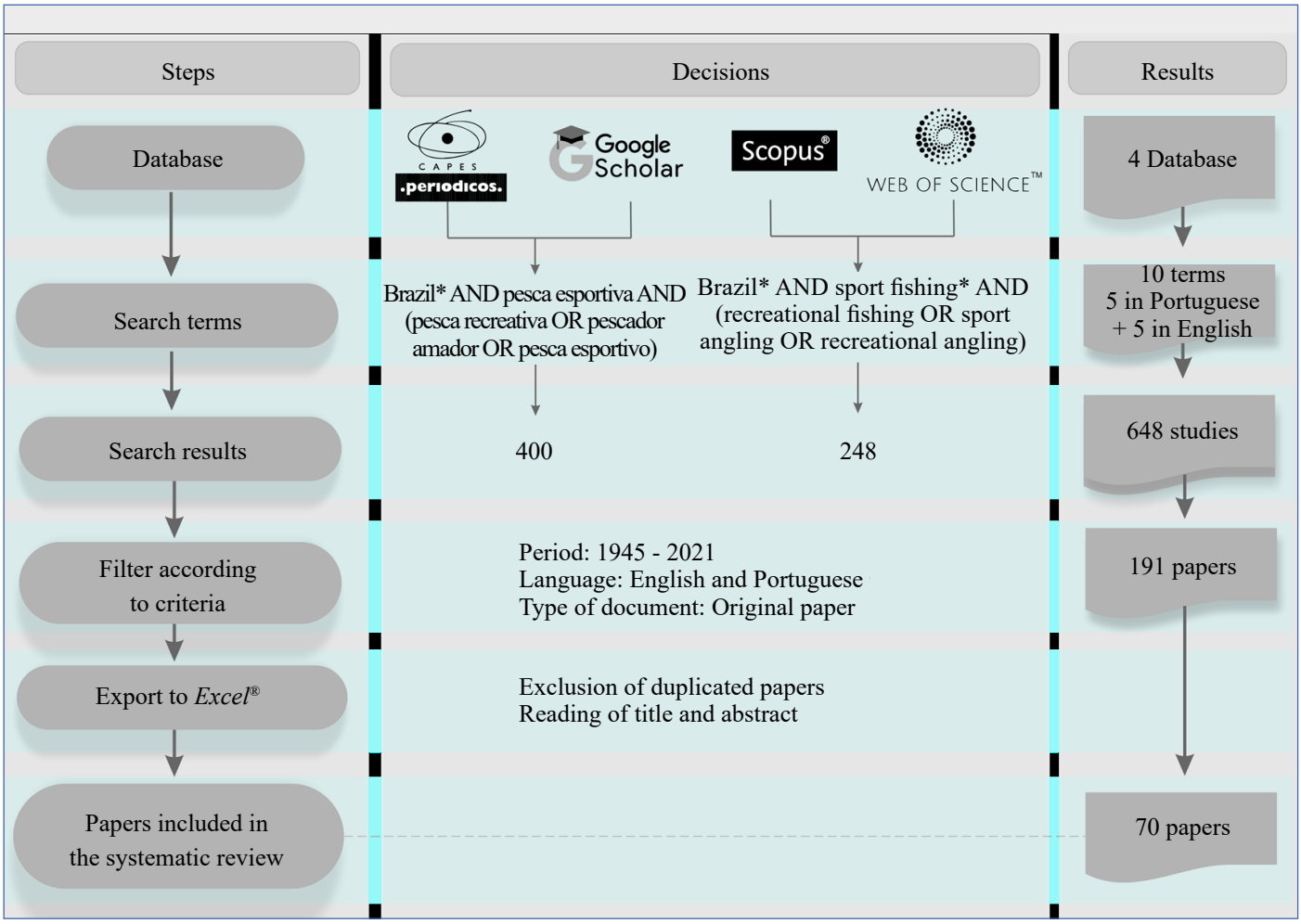

Figure 1. Flow chart with stages, decisions, and results of the systematic search of publications on sport fishing in Brazil, in the period from 1945 to 2021. Boolean operators used: AND, OR and asterisk.

In order to obtain information on the aspects that comprise the sustainability of an activity, i.e., the ecological, economic and social aspects, each paper was organized into six categories (Table 2).

A survey of all the species caught by sport fishers was carried out with the aim of creating a list of the species of interest for sport fishing aficionados. Using the FishBase database (www.fishbase.se), information on the maximum length, environment of origin, and trophic level of each species was included, as well as the taxonomic classification, which was conducted according to Van der Laan et al. (2021).

The species were grouped into three categories in relation to the environment of origin:

- Freshwater: freshwater species that migrate only in fresh water (potamodromous);
- Marine: marine species that migrate only in salt water (oceanodromous);
- Freshwater-marine: species that use both environments during their life cycle (diadromous, anadromous, catadromous, and amphidromous).

The trophic level, obtained from the FishBase website, was used to group the species into three trophic categories: carnivorous/piscivorous, herbivorous, and omnivorous (Pauly and Palomares, 2000).

Data analysis

Based on the quantitative criteria, the data extracted were evaluated using descriptive statistics (mean and standard deviation), absolute frequency (N) and relative frequency (%) (Zar, 2010).

RESULTS

A total of 70 complete papers were included in the study, which addressed the sport fishing activity in Brazil, and had

Table 1. Categories established for the evaluation of papers about Brazilian sport fishing published between 1945 and 2021.

Category	Description
Publications	
Temporal distribution of publications on Brazilian sport fishing	Number of publications per year
Number of publications according to Brazilian geographic region	Location of the study described in the title and verified in the Material and Methods section
Study environment	
Marine	Estuary, bay, beach, coastal lake, and reef
Freshwater	Lake, "fish and pay" nursery, reservoir, and river
Focus of the paper	
Eye injuries	Accidents occurring during sport fishing
Fish stocks	Assessment of the fishing stock using sport fishing data
Introduction of new species	Species introduced for sport fishing
Fishing	Fishing techniques
Fishers	Social and ecological (socio-ecological) aspects involving sport fishers, such as demographic aspects, species caught and fishing areas
Fishing and fishers	Fishing techniques and social and ecological (socio-ecological) aspects of sport fishers
Catch and release	Mortality after catch and release
Economic potential	Assessment of the economic value of sport fishing
Live bait production	Production of foraging species for sale as live bait
Water quality	Assessment of water quality where sport fishing is carried out
Sustainability of the activity	Assessment of the sustainability of sport fishing, considering the ecological, economic, and social aspects of the activity

Table 2. Category established for grouping papers about Brazilian sport fishing published between 1994 and 2021.

N	Category	Description
1	Ecological	Information about the environment and the species caught
2	Economic	Information about the economic value of sport fishing
3	Social	Information about demographic and social aspects of sport fishers, as well as social issues within the activity of sport fishing, such as accidents in the practice of the activity
4	Socio-ecological	Social and ecological aspects
5	Socio-economic	Social and economic aspects
6	Ecological, economic and social	Ecological, economic, and social aspects

publication dates from 1994 to 2021 (Suplementary data 1). In general, the number of publications has been increasing since the first paper published in 1994, with the years 2016 (N = 8) and 2020 (N = 12) presenting the largest quantities of publications (Fig. 2).

The first paper found during the systematic review, published in 1983 in the *Boletim de Ciência do Mar* journal (Suplementary data 1), predates the earliest date of the papers incorporated in the study. However, it was not incorporated into the study, since online access to it was unavailable. Thus, the first paper considered in the study was the one published in 1994.

Since the 1990s, several studies have been developed in different Brazilian geographical regions (Figs. 3a and 3b). Our results indicate that most of the papers published come from the South-Eastern region (39.19%, Fig. 3a), while the Mid-Western region presented the lowest amount (9.46%, Fig. 3a).

At the state level, São Paulo (32%) is the state with the highest concentration of published papers, followed

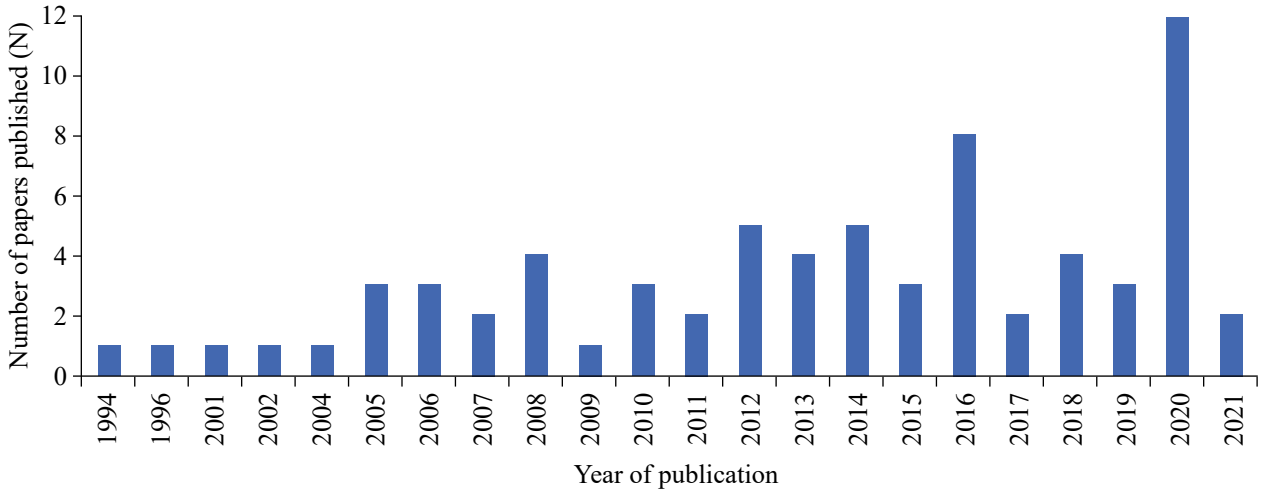

Figure 2. Temporal pattern of publications of papers on sport fishing in Brazil, considering 22 years of data.

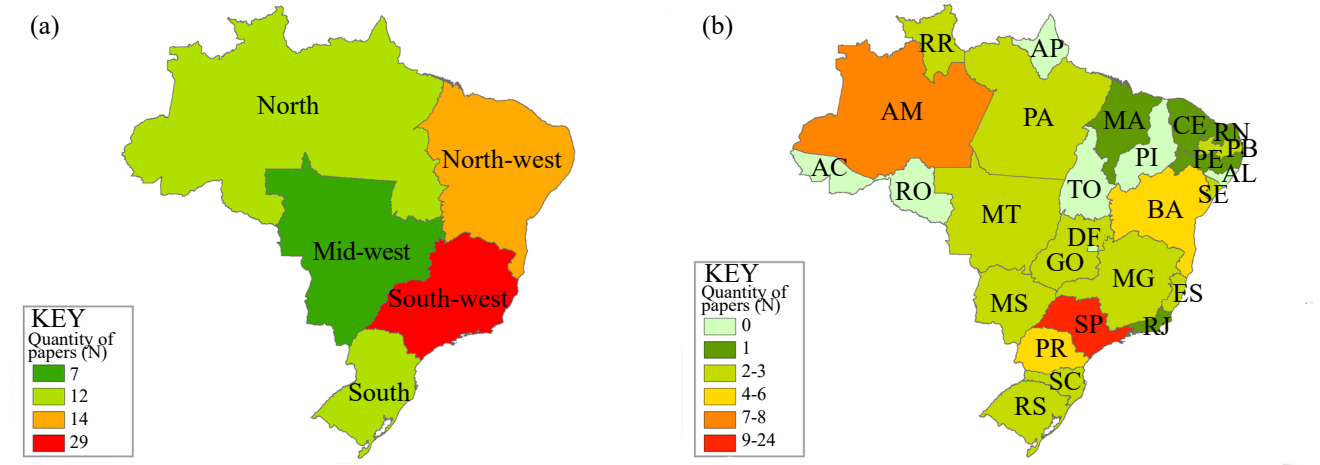

Figure 3. Number of papers published about Brazilian sport fishing, considering: (a) geographic regions and (b) Brazilian states. There is no information regarding review papers that deal with sport fishing at a countrywide level (number of review papers = 6).

by Amazonas (10.67%), Paraná (8%) and Bahia (6.67%) (Fig. 3b). There were no published papers on studies evaluating sport fishing in seven Brazilian states, nominally: Acre, Alagoas, Amapá, Distrito Federal, Piauí, Rondônia, and Tocantins (Fig. 3b).

Just over half of the papers published analyzed sport fishing in the marine environment (55.38%), with emphasis on the estuary region (41.67%) and the coastal region (33.33%) (Fig. 4a). However, in freshwater environment most of the papers conducted studies on sport fishing in rivers (68.97%) and in "fish and pay" nurseries (17.24%); these are places where fishers pay to catch fish that are being raised in nurseries located on private property (Fig. 4b).

The focus of the papers was "fishing and fishers" (30%), followed by "fishing stock" (28.57%) (Fig. 5). When evaluating them according to the sustainability tripod (ecological, economic, and social), most of the papers were focused on the ecological aspect of the activity (58.57%), followed by the socioeconomic (18.57%) and social (8.57%) aspects (Fig. 6). Only two papers jointly addressed two aspects of the sustainability of sport fishing, both of which were literature review papers (2.86%; Fig. 6).

In all environments evaluated, 330 species of fish of interest to sport fishers were found. Among them, 286 species were identified at the lowest taxonomic level, and belong to 30 orders and 80 families (Suplementary data 2). The remaining species (44) were identified only at the genus level. The results show that most species are of marine origin (49%), followed by those of freshwater origin (43.7%), and 7.3% inhabit freshwater-marine environments (Table 3).

The species of the families Carangidae (14.3%), Sciaenidae (11.4%), Serranidae (7.9%), and Scombridae (7.9%) arouse greater interest in sport fishers who performed the activity in marine environments. In freshwater environments, representatives of the families Cichlidae (20.8%), Pimelodidae (15.2%) Serrasalmidae (12.8%), and Anostomidae were the main targets (12%) (Suplementary data 2).

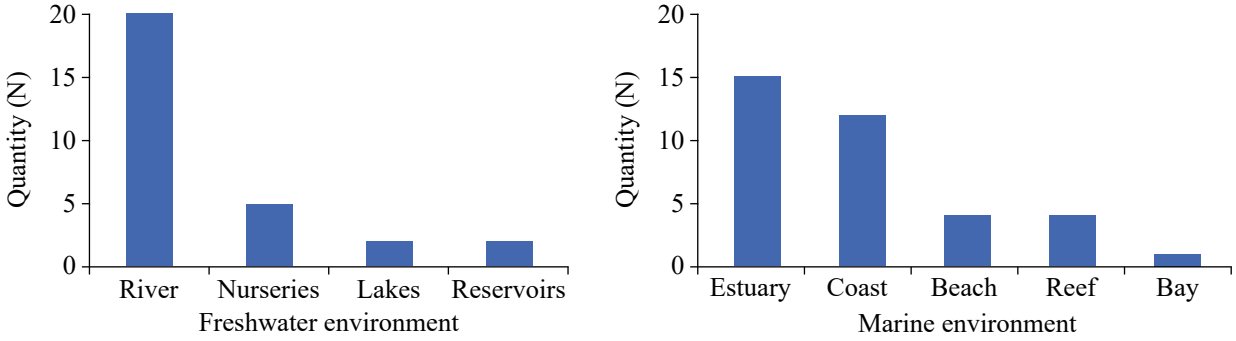

Figure 4. Environments evaluated in papers published between 1994 and 2021 about Brazilian sport fishing. This quantity does not contain information regarding review papers (review papers = 6).

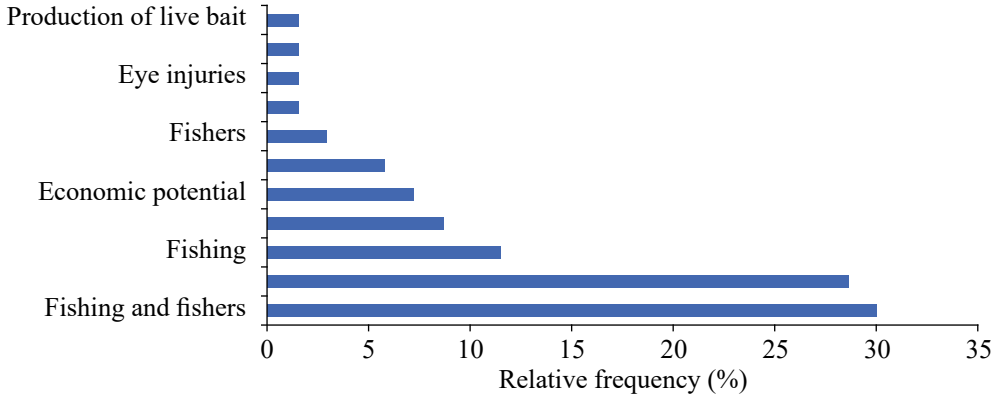

Figure 5. Focal theme of papers published between 1994 and 2021 about Brazilian sport fishing.

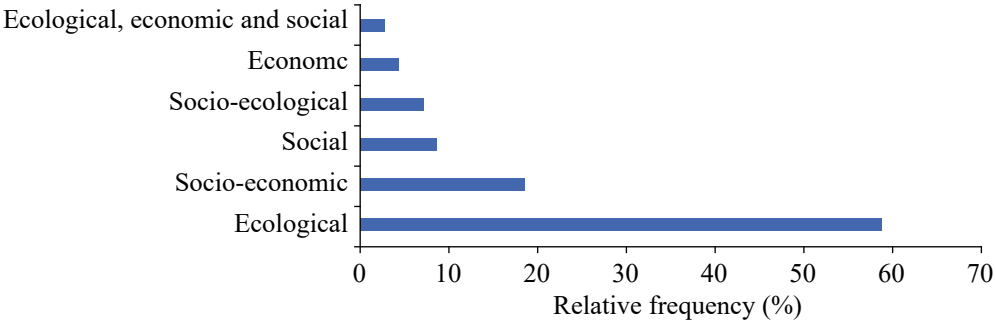

Figure 6. Main aspects of the sustainability of Brazilian sport fishing addressed in papers published between 1994 and 2021.

Table 3. Quantities of the species of interest of Brazilian sport fishing according to environment and trophic category.

Environment	N	Trophic category		
		Carnivore/piscivore (n)	Herbivore (n)	Omnivore (n)
Freshwater	125	41	42	39
Marine	140	63	9	65
Freshwater/marine	21	10	2	9
Total	286	114	53	113

N: number of species.

Regarding the trophic level, the target species of sport fishing were mainly carnivorous/piscivorous (40.7%), and omnivorous (40.4%), followed by herbivorous (18.9%). When evaluated according to the environment of origin, the sport fishing species of marine origins were mainly omnivores (47.4%), followed by carnivores/piscivores (46%), and herbivores (6.6%). In freshwater, the species were mostly herbivorous (34.4%), carnivorous/piscivorous (33.6%), and omnivorous (32%) (Table 3).

DISCUSSION

The number of publications on sport fishing in Brazil since 1994 has increased since the first decade of publication, considering 1945 as the first year of the survey. This increase may be related to the attention that the activity has received, especially after the emergence of conflicts with other users, since different actors use the same resources, whether spatial or fishing (Sobreiro and Freitas, 2008; Sobreiro et al., 2010). Moreover, the growth of activity and its economic importance in different environments and Brazilian states (Albano and Vasconcelos, 2013) are also perceived, since the activity involves an extensive production chain, which includes the air travel, travel agencies, fishing tourism companies, clothing and gear, among others.

Although the studies on sport fishing are centralized in the South-Eastern and North-Eastern regions, they were also conducted in other regions of Brazil (Fig. 3a). This centralization may be related to the ease of access to the locations as it is classed as urban fishery, i.e., one carried out near cities and urban centers (Albano and Vasconcelos, 2013). These places are safe and have infrastructure for carrying out the activity, which is considered a great cost benefit since fishers can access the places by land and return to their homes on the same day, spending only a few hours fishing (Silva et al., 2016; Alves-Junior et al., 2020). In the municipality of Santos, São Paulo state, most of the fishers who use the fishers' deck (fishing spot known among users) reside in the municipality itself (50%), or within the limits of the state of São Paulo (50%), a situation that facilitates travel by land via automobile, bicycle, motorcycle or bus (Barrella et al., 2016a). However, fisheries are usually also carried out in beach environments (Freire et al., 2014; 2017) and from fishing platforms (Barrella et al., 2016a; Alves-Junior et al., 2020).

On the other hand, in a freshwater environment, the activity is mainly carried out on rivers, such as the central region of the Negro River basin, municipality of Barcelos, Amazonas state, (Barroco and Freitas, 2014; Lubich et al., 2021; 2023) which is in the style of tourist sport fishing due to the distance of the region from large urban centers (Albano and Vasconcelos, 2013). These fisheries are carried out on boats (Lubich, C; Siqueira-Souza, F.; Freitas, C., 2023) and the dynamics are more complex. Fishers typically buy packages for a period of seven days (Lubich, C; Siqueira-Souza, F.; Freitas, C., 2023), which cost around US$ 3,000 during the main fishing season (Freitas and Rivas, 2006). According to Shrestha et al. (2002), the practice of tourist sport fishing has a higher value than urban sport fishing, since many costs include flights and travel to the fishing area, as well as the fishing package, which has full accommodation, fishing guides and fisheries logistics.

Regarding the focus of the papers, the results presented "fishing and fishers" as the main topic of research in Brazil. These papers, in general, mainly provide information on the characteristics of sport fishing, such as fishing sites, species caught, length of species caught and fishing licenses, as well as socio-economic aspects of fishers, such as gender, occupation, equipment and baits used. Data regarding the fishers is also mentioned, such as the observation that the majority are male (90%), ranging in age from 7 to 88 years (43.66 ± 27.28) (Pereira et al., 2008; Peixer and Petrere Júnior, 2009; Barcellini et al., 2013; Tsuruda et al., 2013; Freire et al., 2014; Barrella et al., 2016a; Barrella et al., 2016b; Silva et al., 2016; Freire et al.,

2017; Felizola-Freire et al., 2018; Alves-Junior et al.; Lubich et. al., 2023), and have a monthly income that exceeds US$ 352 (Schork et al., 2010; Freire et al., 2012; Abreu et al., 2015).

The theme "sustainability" was the subject of analysis in several areas of research that involve the relationship of people and the environment (Elkington, 1997). Most of the papers on sport fishing in Brazil are aimed at presenting the ecological aspects of the activity, though leave out the evaluation of the cultural, social, and economic impacts that it exerts. The only two studies found addressed the three aspects together, and discussed the absence of management and incentives for the activity. These pointed to problems such as lack of training courses for tour guides, lack of a development plan of the activity, lack of supervision, and absence of environmental education initiatives involving sport fishers (Albano and Vasconcelos, 2013; Vitório and Vianna, 2016).

Aris et al. (2017) carried out an evaluation of economic, social and management aspects of marine recreational fishing in Indonesia and concluded that the activity presented a high score in the sustainability index, but with less evidence for the environmental/ecological aspect. In Brazil, yet there are no published studies that jointly evaluate the aspects of the sustainability tripod (economic, ecological, and social), or provide an indication of the real situation of the activity. However, sport fishing appears to be sustainably economical, as, according to Shrestha et al. (2002), the value of sport fishing for the Brazilian Pantanal alone fluctuates between US$ 35-56 million annually.

Among the papers with an ecological focus, one of the most discussed topics is the evaluation of fish stocks, mainly in reef areas, as well as the effect of species introduction, either as a target species for sport fishing or for use as bait. Assessments of stocks of reef species that are exploited in sport fishing have received attention, since species such as groupers, snappers and parrot fish can be considered vulnerable due to their biological characteristics (large body size, late maturation and seasonal reproduction, shoal formation and absence of fear of humans) (Samia et al., 2019). As a consequence, some stocks have shown signs of overexploitation (Oliveira Freitas et al., 2011; Moura et al., 2013; Giglio et al., 2020).

Another factor of great importance associated with the ecological aspect of sport fishing is the introduction of species. In Brazil, species introductions are the result of formal stocking programs that are supported by the State and due to the perceived lack of adequate native species, but may be due to cultural imperialism or illegal stocking with the aim of encouraging sport fishing in certain locations (Vitule, 2009; Vitule et al., 2009). Several species, such as *Salminus brasiliensis* (Cuvier 1816) (Vitule et al., 2014), *Micropterus salmoides* (Lacepède 1802), *Erythrinus erythrinus* (Bloch & Schneider 1801), *Hoplerythrinus unitaeniatus* (Spix & Agassiz 1829) (Britton and Orsi, 2012), *Pygocentrus nattereri* (Kner 1858), *Astronotus ocellatus* (Agassiz 1831), *Clarias gariepinus* (Burchell 1822), *Oreochromis niloticus* (Linnaeus 1758), *Hoplosternum littorale* (Hancock 1828), *Colossoma macropomum* (Cuvier 1816) (Latini et al., 2004), and the species of the genus *Cichla* (Latini et al., 2004; Pelicice and Agostinho, 2009; Britton and Orsi, 2012; Ferraz et al., 2019) have been reported in basins other than those of their origin. The introductions of these species can quickly result in a significant decline in the diversity of native fish species and, therefore, are a potential threat to local biodiversity (Pelicice and Agostinho, 2009; Vitule, 2009; Vitule et al., 2009; Britton and Orsi, 2012).

Another problem reported in the literature is the use of fish eggs as bait. Machado et al. (2020) cite that, in the South-Eastern region of Brazil, sport fishing of *Genidens barbus* (Lacepède 1803) is carried out with eggs of the same species as natural bait. The adoption of this practice can intensify the pressure of fishing on their populations, and the use of other species as bait can also cause indirect introduction to the environment and affect the way of life of fish.

Many species are the target of sport fishing. Zeinad and Prado (2012) list 114 species of freshwater fish, and Anon (2015) cites that approximately 60 species of marine fish are of interest to fishers. Our results show the existence of 286 species that are of interest to sport fishers, and 44 more species that have been identified only at the genus level. Sport fishing involves the catching of fish of different classes, including chondrichthyans (sharks and rays) and actinopterygians (fish with radiated fins). Although there are laws that prohibit the capture, transport, storage, management, processing, and marketing of species classified in categories such as critically endangered (CR), endangered (EN) and vulnerable (VU), and those constantly included in the official National List of Endangered Species of Fauna-Fish and Aquatic Invertebrates (MMA No. 445/2014, MMA No. 98/2015, and MMA No. 163/2015), some of these species, such as *Megalops atlanticus* (Valenciennes 1847) (VU), *Brycon insignis* (Steindachner 1877) (EN), *Brycon orbignyanus* (Valenciennes 1850) (EN), *Genidens barbus* (Lacepède 1803) (EM), *Sciades parkeri* (Traill 1832) (VU), *Scarus trispinosus* (Valenciennes 1840) (EM), *Thunnus thynnus* (Linnaeus 1758) (CR), and *Makaira nigricans* (Lacepède 1802) (EN), have been cited in the papers as being caught and/or making up part of the landings of sport fishers.

In general, as a result of this review, the absence of papers with the main objective of evaluating the sustainability of sport fishing and which consider the tripod (ecological or environmental, economic and social) is evident. The only two studies found that addressed the subject during the systematic review were review papers. Considering that the study was conducted in a universe of 22 years of scientific publication on the subject, it is recommended that new studies should take into account the sustainability tripod, since this information can be useful for activity management. This is mainly due to the fact that the use of resources is shared by different users who have different objectives, as it is the case of commercial and sport fishing, which in some regions share the same fishing sites and same species with different objectives for the fish caught, culminating in greater pressure of use on the resource.

The information presented here reflects the current state of studies and knowledge about Brazilian sport fishing, and can serve as a basis for the management of the vulnerable species that are used by fishers and the activity, as well as an inspiration for future research that may be carried out in relation to this theme.

CONFLICT OF INTERESTS

Nothing to declare.

AUTHORS' CONTRIBUTIONS

Conceptualization: Lubich, C; Siqueira-Souza, F; Freitas, C; **Data curation:** Lubich, C; **Formal analysis:** Lubich, C; **Investigation:** Lubich, C; **Project administration:** Lubich, C; **Supervision:** Siqueira-Souza, F; **Writing – original draft:** Lubich, C Siqueira-Souza, F.; **Writing – review & editing:** Freitas, C.

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SUPPLEMENTARY DATA

1 - List of papers included in the systematic review conducted in April 2021, on sport fishing in Brazil. https://institutodepesca.org/index.php/bip/article/view/1745/1573

2 - List of species of interest for sport fishing, which were cited in papers published between 1994 and 2021 and incorporated in the systematic review. https://institutodepesca.org/index.php/bip/article/view/1745/1574

REFERENCES

Aas, Y.; Thailing, C.E.; Ditton, R.B. 2002. Controversy Over Catch-and-Release Recreational Fishing in Europe. In: Pitcher, T.J.; Hollingworth, C.E. (Eds.), *Recreational Fisheries: Ecological, Economic and Social Evaluation* (pp. 95–106). Blackwell. https://doi.org/10.1002/9780470995402.ch7

Albano, C.J.; Vasconcelos, E.C. 2013. Análise de casos de pesca esportiva no Brasil e propostas de gestão ambiental para o setor. *Revista Brasileira de Ciências Ambientais*, 28: 77-89.

Alves-Junior, U.J.M.; Rotundo, M.M.; Petrere-Junior, M.; Barrellla, W.; Ramires, M. 2020. A atividade pesqueira na Plataforma Marítima de Pesca Amadora de Mongaguá (Brasil), Sudoeste do atlântico. *Research, Society and Development*, 9(9), e937998020. https://doi.org/10.33448/rsd-v9i9.8020

Anon. 2015. Biblía do pescador. In: *O anuário brasileiro de estudo da pesca esportiva* (p. 400). Um.

Aris, M.; Fahrudin, A.; Riani, E.; Muttaqin, E. 2017. Sustainability analysis of the Marine Recreational Park Management based on local customary law in Weh Island, Aceh Provice, Indonesia. *International Journal of Science and Research*, 6(2), 721-726. Available at: https://pdfs.semanticscholar.org/5777/92a774013cb6fabc7ff5d2c58e3b72eacc26.pdf. Accessed on: Jul. 15, 2021.

Arlinghaus, R.; Cooke, S.J. 2009. Recreational Fisheries: Socioeconomic Importance, Conservation Issues and Management Challenges. In: Dickson, A.; Hutton, J.; William, M.A. (Eds.), *Recreational Hunting, Conservation and Rural Livelihoods* (pp. 39-58). Wiley-Blackwell. https://doi.org/10.1002/9781444303179.ch3

Barcellini, V.C.; Motta, F.S.; Martins, A.M.; Moro, P.S. 2013. Recreational anglers and fishing guides from an estuarine protected area in southeastern Brazil: Socioeconomic characteristics and views on fisheries management. *Ocean & Coastal Management*, 76: 23-29. https://doi.org/10.1016/j.ocecoaman.2013.02.012

Barrella, W.; Cachola, N.; Ramires, M.; Rotundo, M.M. 2016a. Aspectos biológicos e socioeconômicos da pesca esportiva no" Deck do Pescador" de Santos (SP, Brasil). Brazilian *Journal of Aquatic Science and Technology*, 20(1): 61-68. https://doi.org/10.14210/bjast.v20n1.5301

Barrella, W.; Ramires, M.; Rotundo, M.M.; Petrere, M.; Clauzet, M.; Giordano, F. 2016b. Biological and socio-economic aspects of recreational fisheries and their implications for the management of coastal urban areas of south-eastern Brazil. *Fisheries Management and Ecology*, 23(3-4): 303-314. https://doi.org/10.1111/fme.12173

Barroco, L.S.A.; Freitas, C. E. C. 2014. A pesca esportiva na Amazônia: implicações para a sustentabilidade dos estoques pesqueiros e da atividade. Scientia Amazonia, 3(2):93-99. Available at: http://scientia-amazonia.org/wp-content/uploads/2016/06/v3-n2-93-99-2014.pdf. Accessed on: July 03, 2023.

Brasil. 2009. Lei nº 11.959, de 29 de junho de 2009. Dispõe sobre a Política Nacional de Desenvolvimento Sustentável da Aquicultura e da Pesca, regula as atividades pesqueiras. *Diário Oficial da União*, Seção 1(122): 1.

Britton, J.R.; Orsi, M.L. 2012. Non-native fish in aquaculture and sport fishing in Brazil: economic benefits versus risks to fish diversity in the upper River Paraná Basin. *Reviews in Fish Biology and Fisheries*, 22(3): 555-565. https://doi.org/10.1007/s11160-012-9254-x

Broadhurst, M.K.; Gray, C.A.; Reid, D.D.; Wooden, M.E.L.; Young, D.J.; Haddy, J.A.; Damiano, C. 2005. Mortality of key fish species released by recreational anglers in an Australian estuary. *Journal of Experimental Marine Biology and Ecology*, 321(2): 171-179. https://doi.org/10.1016/j.jembe.2005.02.001

Brownscombe, J.W.; Bower, S.D.; Bowden, W.; Nowell, L.; Midwood, J.D.; Johnson, N.; Cooke, S.J. 2014. Canadian Recreational Fisheries: 35 Years of Social, Biological, and Economic Dynamics from a National Survey. *Fisheries*, 39(6): 251-260. https://doi.org/10.1080/03632415.2014.915811

Catella, A.C. 2004. *Reflexões sobre a pesca esportiva no Pantanal Sul:* crise e perspectivas. Embrapa Pantanal. Available at: https://www.infoteca.cnptia.embrapa.br/infoteca/bitstream/doc/812672/1/ADM046.pdf. Accessed on: July 15, 2021.

Cooke, S.J.; Cowx, I.G. 2004. The Role of Recreational Fishing in Global Fish Crises. *BioScience*, 54(9), 857-859. https://doi.org/10.1641/0006-3568(2004)054[0857:TRORFI]2.0.CO;2

Cowx, I.G. 2002. Recreational Fishing. In: Hart, P.J.B.; Reynolds, J.D. (Eds.), *Handbook of Fish Biology and Fisheries* (Vol. 2, pp. 367-390). Blackwell Science. https://doi.org/10.1002/9780470693919.ch17

Elkington, J. 1997. *Cannibals with forks: The Triple Bottom Line of 21st Century Business, Conscientious Commerce*. New Society Publishers.

Fabri, J.B. 2005. Pesca. In: Costa, L.P. (Ed.), *Atlas do Esporte no Brasil* (pp. 393-396). Conselho Federal de Educação Física. Available at: https://listasconfef.org.br/arquivos/atlas/atlas.pdf Accessed on: July 15, 2021.

Felizola-Freire, K.M.; Sumaila, U.R.; Pauly, D.; Adelino, G. 2018. The offshore recreational fisheries of northeastern Brazil. *Latin American Journal of Aquatic Research*, 46(4): 765-778. https://doi.org/10.3856/vol46-issue4-fulltext-14

Fenichel, E.P.; Abbott, J.K.; Huang, B. 2013. Modelling angler behaviour as a part of the management system: synthesizing a multi-disciplinary literature. *Fish and Fisheries*, 14(2): 137-157. https://doi.org/10.1111/j.1467-2979.2012.00456.x

Ferraz, J.D.; Casimiro, A.C.R.; Pereira, A.D.; Garcia, D.A.Z.; Jarduli, L.R.; Magnoni, A.P.V.; Orsi, M.L. 2019. Incentivo à pesca esportiva de Tucunaré *Cichla* Bloch & Schneider, 1801 no Lago Igapó, Londrina, Paraná: ameaça a comunidade aquática nativa e aos habitantes da cidade? *Boletim da Sociedade Brasileira de Ictiologia*, 128, 19-25.

Food and Agriculture Organization (FAO). 2012. Recreational Fisheries: FAO technical guidelines for responsible fisheries. In: Arlinghaus, R.; Cooke, S.J.; Johnson, B.M. (Eds.), *Fisheries Management*. FAO. Available at: http://www.fao.org/3/i2708e/i2708e00.pdf. Accessed on: July 15, 2021.

Freire, K.M.F.; Camila, M.; Melins, R.; Luz, C.A. 2014. Competitive marine fishery in the State of Sergipe. *Actapesca*, 2(1): 59-72. https://doi.org/10.2312/ActaFish.2014.2.1.59-72

Freire, K.M.F.; Luz, R.M.C.A.; Santos, A.C.G.; Oliveira, C.S. 2017. Analysis of the onshore competitive recreational fishery in Sergipe. *Boletim do Instituto de Pesca*, 43(4): 487-501. https://doi.org/10.20950/1678-2305.2017v43n4p487

Freire, K.M.F.; Machado, M.L.; Crepaldi, D. 2012. Overview of Inland Recreational Fisheries in Brazil. *Fisheries*, 37(11): 484-494. https://doi.org/10.1080/03632415.2012.731867

Freitas, C.E.C.; Rivas, A.A.F. 2006. A pesca e os recursos pesqueiros na amazônia ocidental. *Ciência e Cultura*, 58(3): 30-32.

Giglio, V.J.; Suhett, A.C.; Zapelini, C.S.; Ramiro, A.S.; Quimbayo, J.P. 2020. Assessing captures of recreational spearfishing in Abrolhos reefs, Brazil, through social media. *Regional Studies in Marine Science*, 34: 100995. https://doi.org/10.1016/j.rsma.2019.100995

Holley, M.H.; Maceina, M.J.; Thomé-Souza, M.; Forsberg, B.R. 2008. Analysis of the trophy sport fishery for the speckled peacock bass in the Rio Negro River, Brazil. *Fisheries Management and Ecology*, 15(2): 93-98. https://doi.org/10.1111/j.1365-2400.2007.00587.x

Instituto Chico Mendes de Conservação da Biodiversidade (ICMBIO). 2009. *Portaria IBAMA Nº 4, de 19 de Março de 2009*. Estabelece normas gerais para o exercício da pesca amadora em todo território nacional, inclusive competições e cadastros de entidades da pesca amadora junto ao IBAMA. Available at: https://www.icmbio.gov.br/cepsul/images/stories/legislacao/Portaria/2009/p_ibama_04_2009_normasparapescaamadora_revoga_p_30_2003_51_2003.pdf. Accessed on: Jul. 20, 2021.

Latini, A.O.; Lima-Junior, D.P.; Giacomini, H.C.; Latini, R.O.; Resende, D.C.; Espírito-Santo, H.M.V.; Barros, D.F.; Pereira, T.L. 2004. *Alien fishes in lakes of the Doce river basin (Brazil): Range, new occurrences and conservation of native communities*. Lundiana.

Lloret, J.; Zaragoza, N.; Caballero, D.; Riera, V. 2008. Biological and socioeconomic implications of recreational boat fishing for the management of fishery resources in the marine reserve of Cap de Creus (NW Mediterranean). *Fisheries Research*, 91(2-3): 252-259. https://doi.org/10.1016/j.fishres.2007.12.002

Lubich, C.; Campos, C.; Freitas, C.; Siqueira-Souza, F. 2021. Effects of Fishing on the Population of Speckled Pavon Cichla temensis in the Middle Negro River (Amazonas State, Brazil): A Decrease in the Size of the Trophy Fish? *Transactions of the American Fisheries Society*,150(6): 667-678. https://doi.org/10.1002/tafs.10329

Lubich, C; Siqueira-Souza, F.; Freitas, C. 2023. Freshwater sport fishing: characterization of operations in the middle Negro River, Amazonas, Brazil. *Boletim do Instituto de Pesca*,49, e715.https://doi.org/10.20950/1678-2305/bip.2023.49.e738

Machado, R.; Gentil, E.; Rodrigues-Filho, J.L. 2020. When an advantageous reproductive trait turns bad: Eggs of the threatened fish *Genidens barbus* as a natural bait in recreational fisheries. *Journal of Fish Biology*, 97(3): 914-918. https://doi.org/10.1111/jfb.14420

Martínez-Escauriaza, R.; Hermida, M.; Villasante, S.; Gouveia, L.; Gouveia, N.; Pita, P. 2020. Importance of recreational shore angling in the archipelago of Madeira, Portugal (northeast Atlantic). *Scientia Marina*, 84(4): 331-341. https://doi.org/10.3989/scimar.05046.30A

McLeay, L.J.; Jones, G.K.; Ward, T.M. 2002. National strategy for the survival of released line-caught fish: a review of research and fishery information. Fisheries Research and Development Corporation Project 2001/01 Report, South Australian Research and Development Institute. Available at: https://researchonline.jcu.edu.au/27999/1/27999_Brown_etal_2008.pdf. Accessed on: July 15, 2021.

Ministério do Meio Ambiente (MMA). 2014. *Portaria MMA n° 445, de 17 de dezembro de 2014*. Reconhece como espécies de peixes e invertebrados aquáticos da fauna brasileira ameaçadas de extinção aquelas constantes da Lista Nacional Oficial de Espécies da Fauna Ameaçadas de Extinção-Peixes e Invertebrados Aquáticos. MMA. Available at: https://www.icmbio.gov.br/cepsul/images/stories/legislacao/Portaria/2014/p_mma_445_2014_lista_peixes_amea%C3%A7ados_extin%C3%A7%C3%A3o.pdf. Accessed on: Jul. 15, 2021.

Ministério do Meio Ambiente (MMA). 2015a. *Portaria MMA nº 89, de 28 de abril de 2015*. A Portaria nº 445, de 17 dezembro de 2014, publicada no Diário Oficial da União de 18 de dezembro 2014, Seção 1, página 126, passa vigorar com a seguinte redação. MMA. Available at: https://www.icmbio.gov.br/cepsul/images/stories/legislacao/Portaria/2015/p_mma_98_2015_altr_p_445_2014.pdf. Accessed on: Jul. 15, 2021.

Ministério do Meio Ambiente (MMA). 2015b. *Portaria MMA nº 163, de 8 de junho de 2015*. A Portaria nº 445, de 17 dezembro de 2014, publicada no Diário Oficial da União de 18 de dezembro 2014, Seção 1, página 126, passa vigorar com a seguinte redação. Available at: https://www.icmbio.gov.br/cepsul/images/stories/legislacao/Portaria/2015/p_mma_163_2015_altr_art_p_445_2014.pdf. Accessed on: Jul. 15, 2021.

Moura, R.L.; Secchin, N.A.; Amado-Filho, G.M.; Francini-Filho, R.B.; Freitas, M.O.; Minte-Vera, C.V.; Teixeira, J.B.; Thompson, F.L.; Dutra, G.F.; Sumida, P.Y.G.; Guth, A.Z.; Lopes, R.M.; Bastos, A.C. 2013. Spatial patterns of benthic megahabitats and conservation planning in the Abrolhos Bank. *Continental Shelf Research*, 70, 109-117. https://doi.org/10.1016/j.csr.2013.04.036

Muoneke, M.I.; Childress, W.M. 1994. Hooking mortality: A review for recreational fisheries. *Reviews in Fisheries Science*, 2(2): 123-156. https://doi.org/10.1080/10641269409388555

Oliveira Freitas, M.; Leão de Moura, R.; Bastos Francini-Filho, R.; Viviana Minte-Vera, C. 2011. Spawning patterns of commercially important reef fish (Lutjanidae and Serranidae) in the tropical western South Atlantic. *Scientia Marina*, 75(1): 135-146. https://doi.org/10.3989/scimar.2011.75n1135

Pauly, D.; Palomares, M.L. 2000. Approaches for dealing with three sources of bias when studying the fishing down marine food web phenomenon. *Fishing Down the Mediterranean Food Webs*, 12: 61-66.

Peixer, J.; Petrere Júnior, M. 2009. Sport fishing in Cachoeira de Emas in Mogi-Guaçu River, State of São Paulo, Brazil. *Brazilian Journal of Biology*, 69(4): 1081-1090. https://doi.org/10.1590/S1519-69842009000500011

Pelicice, F.M.; Agostinho, A.A. 2009. Fish fauna destruction after the introduction of a non-native predator (*Cichla kelberi*) in a Neotropical reservoir. *Biological Invasions*, 11(8): 1789-1801. https://doi.org/10.1007/s10530-008-9358-3

Pereira, J.; Petrere-Jr., M.; Ribeiro-Filho, R. 2008. Angling sport fishing in Lobo-Broa reservoir (Itirapina, SP, Brazil). *Brazilian Journal of Biology*, 68(4): 721-731. https://doi.org/10.1590/S1519-69842008000400006

Pita, P.; Hyder, K.; Gomes, P.; Pita, C.; Rangel, M.; Veiga, P.; Vingada, J.; Villasante, S. 2018. Economic, social and ecological attributes of marine recreational fisheries in Galicia, Spain. *Fisheries Research*, 208: 58-69. https://doi.org/10.1016/j.fishres.2018.07.014

Pitcher, T.J.; Hollingworth, C.E. (Eds.). 2002. *Recreational Fisheries: Ecological, Economic and Social Evaluation*. Blackwell. https://doi.org/10.1002/9780470995402

Samia, D.S.M.; Bessa, E.; Blumstein, D.T.; Nunes, J.A.C.C.; Azzurro, E.; Morroni, L.; Sbragaglia, V.; Januchowski-Hartley, F.A.; Geffroy, B. 2019. A meta-analysis of fish behavioural reaction to underwater human presence. *Fish and Fisheries*, 20(5): 817-829. https://doi.org/10.1111/faf.12378

Schork, G.; Mottola, L.S.M.; Hostim-Silva, M. 2010. Diagnóstico da pesca amadora embarcada na região de São Francisco do Sul (SC). *Revista CEPSUL - Biodiversidade e Conservação Marinha*, 1(1): 8-17. https://doi.org/10.37002/revistacepsul.vol1.2958-17

Shrestha, R.K.; Seidl, A.F.; Moraes, A.S. 2002. Value of recreational fishing in the Brazilian Pantanal: a travel cost analysis using count data models. *Ecological Economics*, 42(1-2): 289-299. https://doi.org/10.1016/S0921-8009(02)00106-4

Siepker, M.J.; Ostrand, K.G.; Cooke, S.J.; Philipp, D.P.; Wahl, D.H. 2007. A review of the effects of catch-and-release angling on black bass, *Micropterus* spp.: implications for conservation and management of populations. *Fisheries Management and Ecology*, 14(2): 91-101. https://doi.org/10.1111/j.1365-2400.2007.00529.x

Silva, L.F.; Souza, T.R.S.; Molitzas, R.; Barrella, W.; Ramires, M. 2016. Aspectos socioeconômicos e etnoecológicos da Pesca Esportiva praticada na Vila Barra do Una, Peruíbe/SP. *Unisanta BioScience*, 5(1): 1-14.

Sobreiro, T.; Carvalho Freitas, C.E.; Prado, K.L.; Nascimento, F.A.; Vicentini, R.; Moraes, A.M. 2010. An evaluation of fishery co-management experience in an Amazonian black-water river (Unini River, Amazon, Brazil). *Environment, Development and Sustainability*, 12(6): 1013-1024. https://doi.org/10.1007/s10668-010-9238-8

Sobreiro, T.; Freitas, C. 2008. Conflitos e territorialidade no uso de recursos pesqueiros do médio Rio Negro. *IV Encontro Nacional da Anppas*, 2016, pp. 2-16.

Tsuruda, J.M.; Nascimento, R.B.; Barrela, W.; Ramires, M.; Rotundo, M.M. 2013. Fishing and socio-economic profile of sportive anglers of Galhetas Tip, Asturias Beach-Guarujá (SP). *Unisanta BioScience*, 2(1): 22-34. Available at: https://periodicos.unisanta.br/index.php/bio/article/view/126. Accessed on: July 15, 2021.

Tunca, S.; Ünal, V.; Miran, B.; Güçlüsoy, H.; Gordoa, A. 2016. Biosocioeconomic analysis of marine recreational fisheries: A comparative case study from the Eastern Mediterranean, Turkey. *Fisheries Research*, 174, 270-279. https://doi.org/10.1016/j.fishres.2015.10.025

Van der Laan, R.; Fricke, R.; Eschmeyer, W.N. 2021. *Eschmeyer's Catalog of Fishes: Classification*. Electronic Version. Available at: http://www.calacademy.org/scientists/catalog-of-fishes-classification/. Accessed on: Jul. 29, 2021.

Veiga, P.; Gonçalves, J.M.S.; Erzini, K. 2011. Short-term hooking mortality of three marine fish species (Sparidae) caught by recreational angling in the south Portugal. *Fisheries Research*, 108(1): 58-64. https://doi.org/10.1016/j.fishres.2010.11.021

Vitório, L.D.S.; Vianna, S.L.G. 2016. Turismo de base comunitária: análise quanto às interferências do turismo de pesca no baixo Rio Branco, Roraima, Brasil. *Caderno Virtual de Turismo*, 16(2), 126-149. https://doi.org/10.18472/cvt.16n2.2016.1164

Vitule, J. 2009. Introdução de peixes em ecossistemas continentais brasileiros: revisão, comentários e sugestões de ações contra o inimigo quase invisível. *Neotropical Biology and Conservation*, 4(2): 111-122. https://doi.org/10.4013/nbc.2009.42.07

Vitule, J.; Bornatowski, H.; Freire, C.; Abilhoa, V. 2014. Extralimital introductions of *Salminus brasiliensis* (Cuvier, 1816) (Teleostei, Characidae) for sport fishing purposes: a growing challenge for the conservation of biodiversity in neotropical aquatic ecosystems. *BioInvasions Records*, 3(4): 291-296. https://doi.org/10.3391/bir.2014.3.4.11

Vitule, J.R.S.; Freire, C.A.; Simberloff, D. 2009. Introduction of non-native freshwater fish can certainly be bad. *Fish and Fisheries*, 10(1):98-108.https://doi.org/10.1111/j.1467-2979.2008.00312.x

Zar, J.H. 2010. *Biostatistical analysis (5th ed.)*. Pearson Prentice Hall.

Zeinad, A.K.; Prado, R.A. 2012. *Peixes fluviais do Brasil*. Pescaventura.