





Freshwater sport fishing: characterization of operations in the middle Negro River, Amazonas, Brazil

Chiara Lubich^{1*} , Flávia Siqueira-Souza^{1,2} , Carlos Freitas^{1,2} 

1.Universidade Federal do Amazonas , Programa de Pós-Graduação em Ciência Animal e Recursos Pesqueiros – Manaus (AM), Brazil.

2.Universidade Federal do Amazonas , Departamento de Ciências Pesqueiras – Manaus (AM), Brazil.

*Corresponding author: lubichchiara@gmail.com

ABSTRACT

The present study aimed to characterize the sport fishing that occurs in the middle Negro River region. The data collection was carried out with the application of semi-structured questionnaires to sport fishing operators and sport fishers. Data were analyzed using descriptive statistics. A total of 142 questionnaires was applied. The results obtained from the questionnaires indicated that most of the operators are male (97.62%), whose ages ranging from 24 to 57 years old (44.09 ± 10.14 years old). The average duration of the season was six months, during which the companies operate in five different types of fishing tourism. The boat-hotel is the most adopted form of accommodation by operators, as well as being the oldest. Transport for the fishing trips is carried out in a greater quantity with semi-flat-nosed boats equipped with a 30-hp engine. Fishing operations are carried out depending on the type of operation, and trips last for seven days, with six fishing days. Twenty-two rivers were identified as being used for catch of *Cichla temensis* as the target species, and the main channel, the Aracá, Demeni and Cuiuni Rivers, was the most used.

Keywords: *Cichla temensis*, Amateur fishing, Fishing resources, Peacock bass, Fishing tourism.

Pesca esportiva de água doce: caracterização das operações no médio Rio Negro, Amazonas, Brasil

RESUMO

O presente estudo propôs caracterizar a pesca esportiva que é praticada na região do médio Rio Negro, Amazonas, Brasil. Os dados foram coletados por meio de questionários semiestruturados, sendo aplicado o total de 142 entre os operadores de pesca esportiva e pescadores esportivos. Os dados foram analisados posteriormente com uso de estatística descritiva. Os resultados obtidos por intermédio dos questionários revelaram que a maioria dos operadores é do sexo masculino (97,62%), com idades variando de 24 a 57 anos ($44,09 \pm 10,14$ anos). O tempo médio de duração de uma temporada de pescaria foi de seis meses. As empresas que atuam na atividade de pesca ofertam cinco modalidades distintas de turismo, sendo a modalidade de barco-hotel a mais aderida pelos operadores e também a mais antiga. A locomoção nas pescarias é realizada em maior quantidade por botes semichatas, equipadas com motor de 30 hp. As operações de pesca são realizadas em sua maioria por sete dias, sendo seis de pesca. Vinte e dois rios foram identificados como utilizados para a captura de *Cichla temensis* como espécie-alvo, sendo o canal principal, os rios Aracá, Demeni e Cuiuni, o mais utilizado.

Palavras-chave: *Cichla temensis*, Pesca amadora, Recursos pesqueiros, Tucunaré, Turismo de pesca.

Received: May 25, 2022 | **Approved:** March 8, 2023

INTRODUCTION

At a global level, sport fishing is an activity that has been growing and gaining more and more fans, with an estimated 220 million anglers who spend up to 190 billion dollars per year, of which, in developed countries, 7% of this amount is destined only for the purchase of equipment. In developing countries the figure is 10% (World Bank, 2012). This equipment, such as rods, multifilament lines and various artificial baits, is used to capture a huge amount and diversity of fish in continental and marine aquatic environments (Cooke and Cowx, 2004, 2006; World Bank, 2012; Arlinghaus et al., 2015). In general, in some countries, this activity has high economic importance when compared to commercial fishing and contributed about US\$ 70 billion to global gross world product (GDP) in 2012 (World Bank, 2012). In Brazil, this activity generates US\$ 629,419,200 per year (ANEPE, 2017).

Fishing is one of the artisanal activities that represents the largest source of employment and income generation in the Amazon region, and the types of fishing vary with the diverse spatial and seasonal scenarios that the region provides (McGrath et al., 2004). In the Amazon basin, six fishing modalities coexist, and four occur simultaneously in the Negro River basin, namely subsistence, commercial, ornamental, and sports (Freitas and Rivas, 2006; Sobreiro and Freitas, 2008; Inomata and Freitas, 2015). Among these modalities, sport fishing is the only one carried out for the purpose of tourism, leisure and/or sport, and is practiced predominantly in the form of catch and release (Brasil, 2009; Amazonas, 2011, 2018), which consists of capturing, photographing, measuring, and returning the fish to the environment.

In the middle Rio Negro region of the state of Amazonas, more precisely in the municipalities of Barcelos and Santa Isabel do Rio Negro, the main sport fishing destinations are located (Freitas and Rivas, 2006). According to Barroco and Freitas (2014), sport fishers mainly explore the Aracá, Demeni, Cuiuni, Caurés, Jurubaxi, Padauari and Unini Rivers due to their specimens of peacock bass (*Cichla temensis* Humboldt 1821), which have sizes of greater than 62 cm and are known as “trophies” (Holley et al., 2008; Lubich et al., 2021).

Species belonging to the genus *Cichla* are popularly known by different names, *pavón* (Peru, Venezuela, and Colombia), *samapi* (Bolivia), peacock bass (in English) and *tucunaré* (in Brazil) (Hoeinghaus et al., 2003; Kullander, 2003; Santos et al., 2006). Peacock bass includes 16 described species (Kullander and Ferreira, 2006; Sabaj et al., 2020), of which five are the most popular: *Cichla intermedia*,

Cichla monoculus, *Cichla ocellaris*, *Cichla orinocensis*, and *C. temensis* (Kullander and Ferreira, 2006). This last species is distinguished from the others by reaching greater lengths (Jepsen et al., 1999; Hoeinghaus et al., 2003; Holley et al., 2008; Campos et al., 2015), growing at a faster pace than their congeners (Jepsen et al., 1999; Holley et al., 2008). In general, species of the genus reach medium to large sizes (Santos et al., 2006; Soares et al., 2007; Campos et al., 2015; Lubich et al., 2021) and are of great economic importance for commercial and sport fishing that occurs in the Rio Negro region (Inomata and Freitas, 2015; Lubich et al., 2021). Winemiller et al. (1997) highlighted that peacock bass is the most widespread and abundant predatory fish in clear and black water systems of the Amazon and Orinoco basins.

In the 2018 and 2019 season, the search for trophies of peacock bass in the Negro River basin involved approximately 8,400 fishers, of whom 80% were Brazilians and 20% foreigners, primarily Americans (AmazonasTur, 2020). According to the estimates of AmazonasTur (2020), considering the average package price of US\$ 1,699.70 for a week of fishing in the region, the biannual revenue was US\$ 14,277,520.32.

Despite involving a wide production chain, due to the consumption of goods and services necessary to carry out the activity, which result in a great economic contribution (MPA, 2010), there is a scarcity of studies on several aspects involving this activity. However, there are reports of a decrease in fishery yields and in the sizes of peacock bass (*C. temensis*) caught as a result of the high rates of fish exploitation in the middle Negro River region (Holley et al., 2008; Lubich et al., 2021).

In general, there is no consolidated information on the number of companies operating in the regions where sport fishing takes place, the length of the sport fishing season, modalities of sport fishing companies and the mapping of the areas where fishing is carried out, among other information. In view of the above, this study aimed to fill these gaps by characterizing the sport fishing that occurs in the middle Negro River region, including the municipalities of Barcelos and Santa Isabel do Rio Negro, to provide information that can subsidize management actions and sustainable development plans.

MATERIALS AND METHODS

Study area

Sport fishing occurs in the channel of the Negro River and its tributaries, mainly in the central region of the Rio Negro Basin (Fig. 1). The city of Barcelos (Amazonas) is used by sport

fishing connoisseurs as a starting point for the capture of large specimens of peacock bass (*Cichla* sp.) and has been considered the international capital of freshwater sport fishing, since in this region the current world records for weight and length of peacock bass (*C. temensis* Humboldt 1821), in 2010 and 2015, and butterfly peacock bass (*C. orinocensis* Humboldt 1821) in 2010 and 2019, were captured. All record catches were approved by the International Game Fish Association (IFGA, 2022), a non-profit organization that recognizes fisheries and catch records by fish species and size, as well as by category of fishing equipment.

Data collection

The data were collected in the municipality of Barcelos, where most of the sport fishing operators are concentrated, using the snowball sampling method (Biernacki and Waldorf, 1981). The technique was used because there were companies not affiliated with the Barcelona Tour Operators Association, the main association of sport fishing operators, making it

difficult to find and approach these companies. The semi-structured questionnaires were applied to sport fishers in the period from 7 to 12 November 2018, and to sport fishing operators in the period from 26 July to 3 August 2019, under the authorization of the Research Ethics Committee of the Universidade Federal do Amazonas (approval No. 99609318.7.0000.0006).

A total of 42 questionnaires was applied to the sport fishing operators and contained questions that sought to characterize this type of entrepreneur and the fishing operations carried out. The questions sought information on gender and age of the fishing operator, year operations started, months of operation during the season, type/mode of operation, types of boats used, engine power, maximum number of sport fishers attended per fishing trip and places/ivers where fisheries occur (Suppl. Mat.).

In order to find out if the sport fishers had any preference among peacock bass species in the region, 100 questionnaires

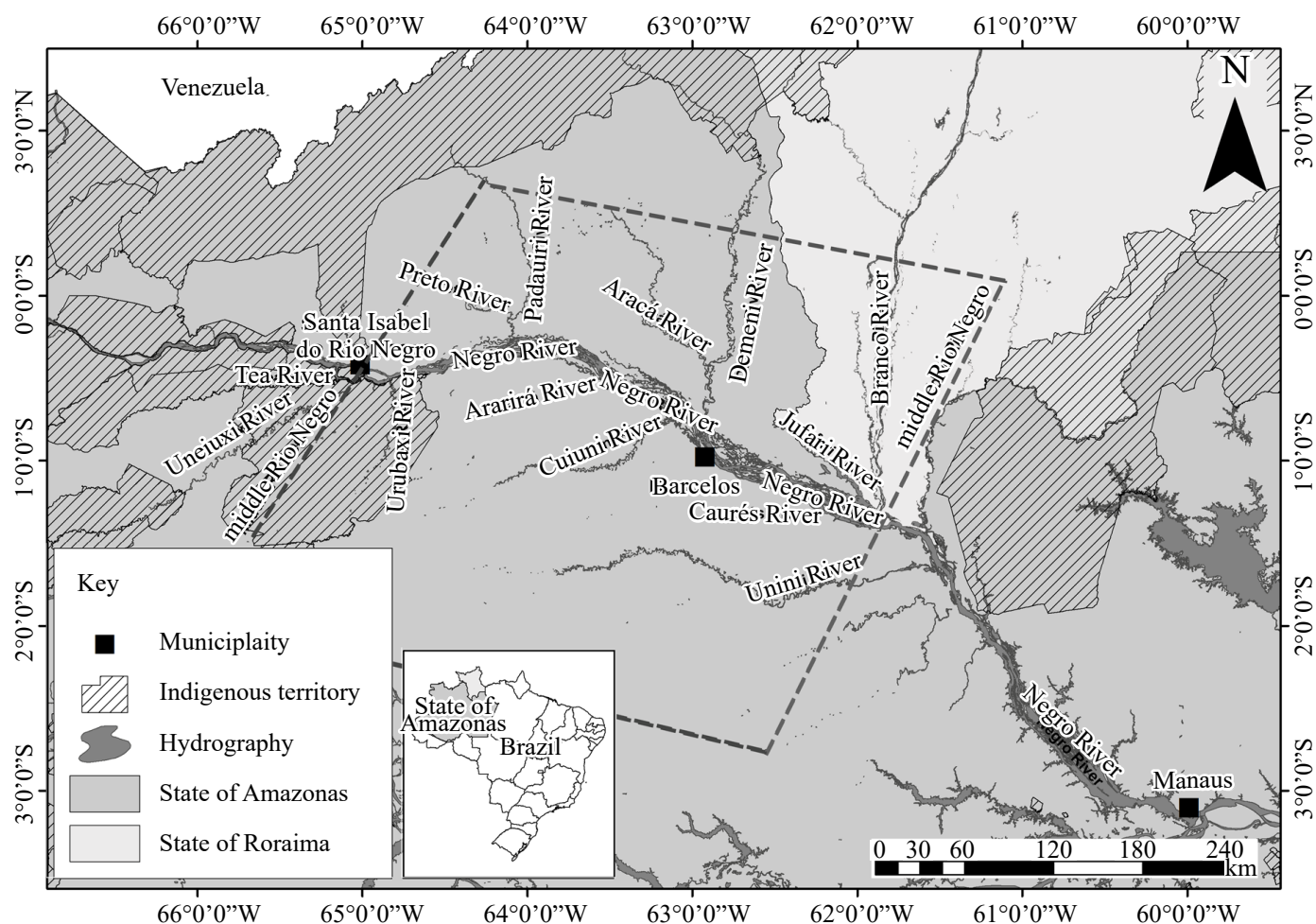


Figure 1. Map of the operations of sport fishing companies in the middle Rio Negro, delimited by dashed lines. (Latrubesse and Franzinelli, 2005; Montero and Latrubesse, 2013).

were applied, in which the interviewees were asked to score the different species in order of preference (*C. temensis* Humboldt 1821, *C. orinocensis* Humboldt 1821, *C. monoculus* Agassiz 1831, and *Cichla nigromaculata* Jardine & Schomburgk 1843), with the value 1 for the most preferred and the value 4 for the least preferred, as well as citing two characteristics that make it their target species (Suppl. Mat.).

Data analysis

All information obtained was stored in digital spreadsheets and analyzed using descriptive statistics (numerical frequency and relative frequency) (Zar, 2010). The map containing the fishing sites mentioned in the questionnaires (identified with the help of geographical coordinates) was generated by the Google Earth Pro Software (version 7.3). Later, the points were saved in the KML extension for use in the Q-GIS software (QGIS Development Team, 2019), and the files converted and saved in shapefile format.

The number of times the location was cited in the questionnaire was added using the file in the dbf extension. The kernel density technique (which calculates the specific intensity of the event, i.e., the identification of hot spots for the occurrence of these events within an area) was also used. An area with a radius of 5 km was proposed to avoid over positioning and to determine the correct identification of the fishing grounds, which was done with the Esri National Geography database, available in the Q-GIS Quick Map Service plugin.

The operations identified as “jungle lodge” and “guesthouse” were grouped under the denomination of “guesthouses”.

RESULTS

According to the reports of 98% of respondents, sport fishing has already almost three decades of activity in the region, occurring since 1993 in the middle Negro River region. The variation in the time of operation of the companies in the location is around two years (for the most recent ones, i.e., less than a year) and 22 years (for the oldest ones, i.e., more than 10 years), with an average value of 5.73 ± 4.38 years of operation. Almost all the owners are male ($N = 41$) – only one operator is female. However, as informed by the female owner, the administration of the enterprise is carried out by her spouse. The surveyed entrepreneurs were aged between 24 and 57 years old (44.09 ± 10.14 years old).

Seasonal fishing operations last an average of six months. The majority started in September and ended in February

(33.33%), followed by operations starting in September and ending in March (28.57%). In general, there are companies with short operations (November to February (4.76%), and others with longer ones, occurring from July to March (2.38%). However, most operations last between five and eight months (92.86%).

When asked about the type of enterprise, it was noted that the operations can be identified in five operating formats:

- **Camp:** When customers plan the entire trip, from their hometown to the final destination where the fishing will take place, including hiring of the fishing guide. In this format, customers can stay overnight by camping on islands, sleeping in tents or in hammocks, under tarps/outdoors. However, another option for overnight stays can be in hotels located in the nearest municipality, to enjoy more comfort, and then return to the fishing the next day. This overnight option is known among operators as a “day trip”. The other four operations have in common the contracting of services provided by the companies responsible for the sales of fishing packages, and these companies are responsible for the entire organization of the itinerary. All-inclusive services, such as a welcome buffet, breakfast, lunch, appetizers and drinks, air-conditioned environments, fuel for motorized boats, fishing guides and other services, such as a laundry service and catering. The clients are only responsible for choosing the date of their trip, as well as informing the number of people in the party and, when they already know the region well, informing the river they prefer to fish in. The journey to the cities of Barcelos or Santa Isabel do Rio Negro is also customers’ responsibility, as well as their return trip to the city/country where they reside (but there are cases in which companies assist in this process, such as with the hiring of the plane);
- **Boat-hotel:** Customers board medium to large boats, usually made of wood, and covered in glassfiber and painted, though they can also be made from naval aluminum. Once the guests are on board, the boat sails to the destination where the fisheries will take place, or it is anchored in strategic places so the fishers can visit one or more nearby rivers. The fishery is aided by the use of aluminum boats and monitoring by the fishing guide. At the end of the fishing day, customers return to the boat-hotel, where they will remain on board until the end of the trip, which has an average duration of seven days;

- Floating hotel: The transfer of customers is made by seaplane from Manaus to the river where the floating hotel is static. The hotel structure is aluminum and is fixed in a part of the river where the fishing is carried out. The travel between the fishing spots is carried out in aluminum boats together with the fishing guide;
- Guesthouse: In this modality, there are two types of companies, ones based in the middle of the forest, and others in the municipality of Barcelos. The first type of company carries out the transfer of customers to the premises of the hotel, usually done by boat/speedboat. The hotel structure is rustic, being usually wooden, but it is comfortable and guests have direct contact with nature. The second type of company is located in the municipality of Barcelos, and it is not necessary to transfer customers by river. Its construction is of masonry and offers comfort and the possibility of indirect contact with nature, since it is located in the municipality. In addition to sport fishing, guests can enjoy facilities such as massage rooms, satellite wi-fi internet, and a games area, among other leisure options;
- Jungle lodges: The company carries out the transfer of customers to the premises of the hotel, usually in speedboats. The hotel structure is in masonry, refined and has greater comfort, and the possibility to enjoy nature, since it is located in the middle of the forest. In addition to sport fishing, guests can enjoy other leisure options such as recreation/games areas, a bar, a swimming pool, and trails, etc.

Out of the five modalities found in the region, most companies operate “boat-hotels” (N = 32), followed by “camps” (N = 6) (Fig. 2), with the first being the oldest modality, at over 20 years of existence. The other modalities have existed for 5 to 10 years (Fig. 2). Analyzing this information chronologically, the boat-hotel was the first modality adopted (> 20 years), and, over the years, new modalities have emerged, approximately 10 years

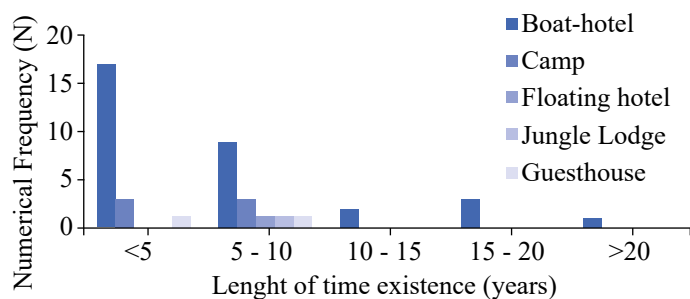


Figure 2. Age and quantity of the types of operations adopted to carry out sport fishing in the middle Negro River region, Amazonas, Brazil.

ago (Fig. 2). However, according to the respondents, the “jungle lodge” was the first development that offered fishing tourism in the region, and it began in 1993.

Among all the modalities, the boat-hotels are the only ones with a support vessel, which serves as accommodation for the guides during the fishing week, as well as to store the fuel that will be used and the garbage produced during the week’s fishing. On the main boat, there are only the customers and crew members who work on it, such as the manager, the cook, a chambermaid, a caterer, the captain, a caretaker (takes care of the cleaning and maintenance of the boat) and a mechanic.

For fishing, the most often-used aluminum boats are those of the semi-flat-nosed type (N = 30), followed by the bass boat (N = 11) and boats with a v nose (N = 1); all are equipped with a motor of varying power. When evaluated by operation modality, it is observed that semi-flat-nosed boats equipped with a 30-hp power engine are more often used in campgrounds and boat-hotels (Fig. 3). All the interviewees mentioned the use of an electric motor when fishing, since they minimize noise, thus increasing the possibility of catching peacock bass (*Cichla* spp.).

The fishing operations of the interviewed companies are carried out with a minimum of four and a maximum of 44 sport fishers (13.51 ± 7.14), depending on the modality of the operation. The camps work with the least number of clients (between four and eight clients), while the boat-hotels present the greatest amplitude in the variation of the number of customers, since they operate with a maximum of six to 20 customers. Jungle lodges, on the other hand, are an enterprise that can receive the largest number of customers (Fig. 4). The duration of the fishing trips was predominantly seven days (95%), of which six are fishing days.

We identified 22 rivers exploited by sport fishing in the middle Rio Negro region. The main channel of the Negro River was mentioned by all interviewees (N = 42), followed by the Aracá (N = 35), Demeni (N = 31), Cuiuni (N = 30), and Preto (N = 20) rivers. The most cited rivers are those closest to the municipality of Barcelos (Fig. 5).

As for the sport anglers, all of them confirmed their preference for catching *C. temensis*, known as peacock bass or speckled pavon, followed by *C. orinocensis*, which was in second place, *C. monoculus* in third place, and *C. nigromaculata* in the last place. The two characteristics that make *C. temensis* the main sport fishing preference, according to the interviewees, are size and strength.

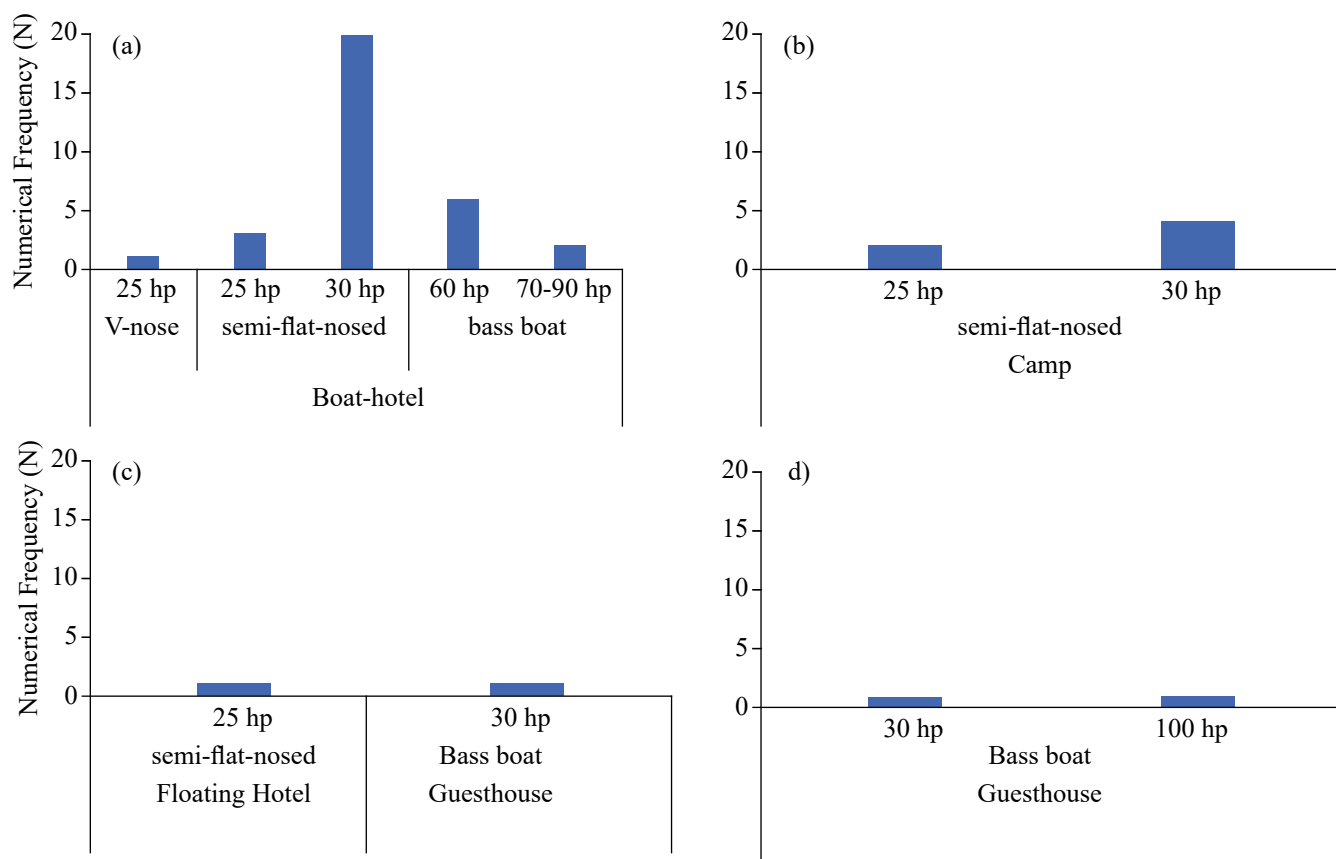


Figure 3. Types of boats and engine power used by different types of sport fishing operations, (A) boat-hotel, (B) camp, (C) floating hotel and guesthouse, (D) jungle lodge, in the middle Negro River region, Amazonas, Brazil.

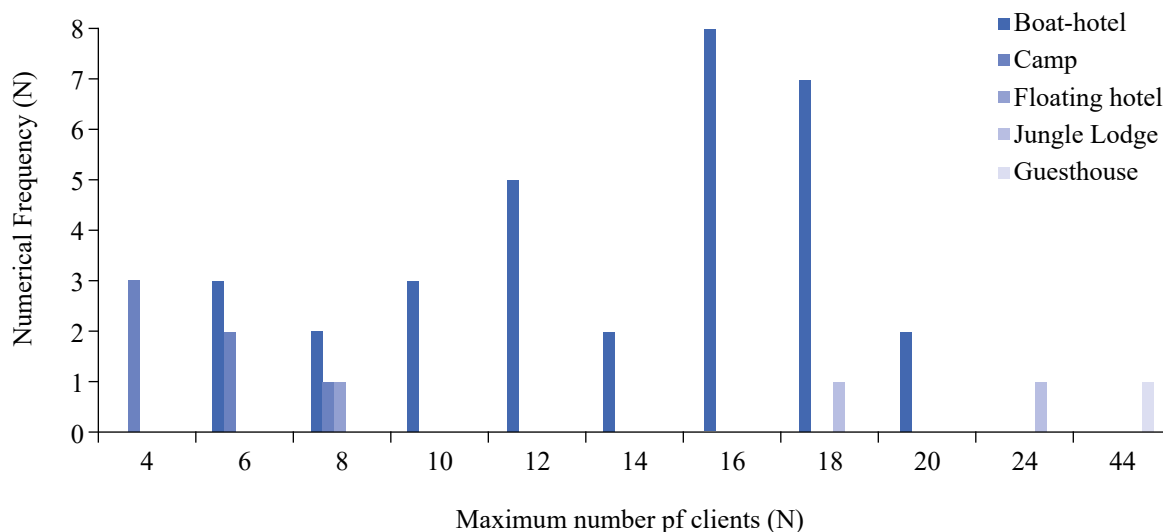


Figure 4. Numerical frequency of the maximum number of clients that sports fishing operations can receive in the middle Rio Negro, Amazonas, Brazil.

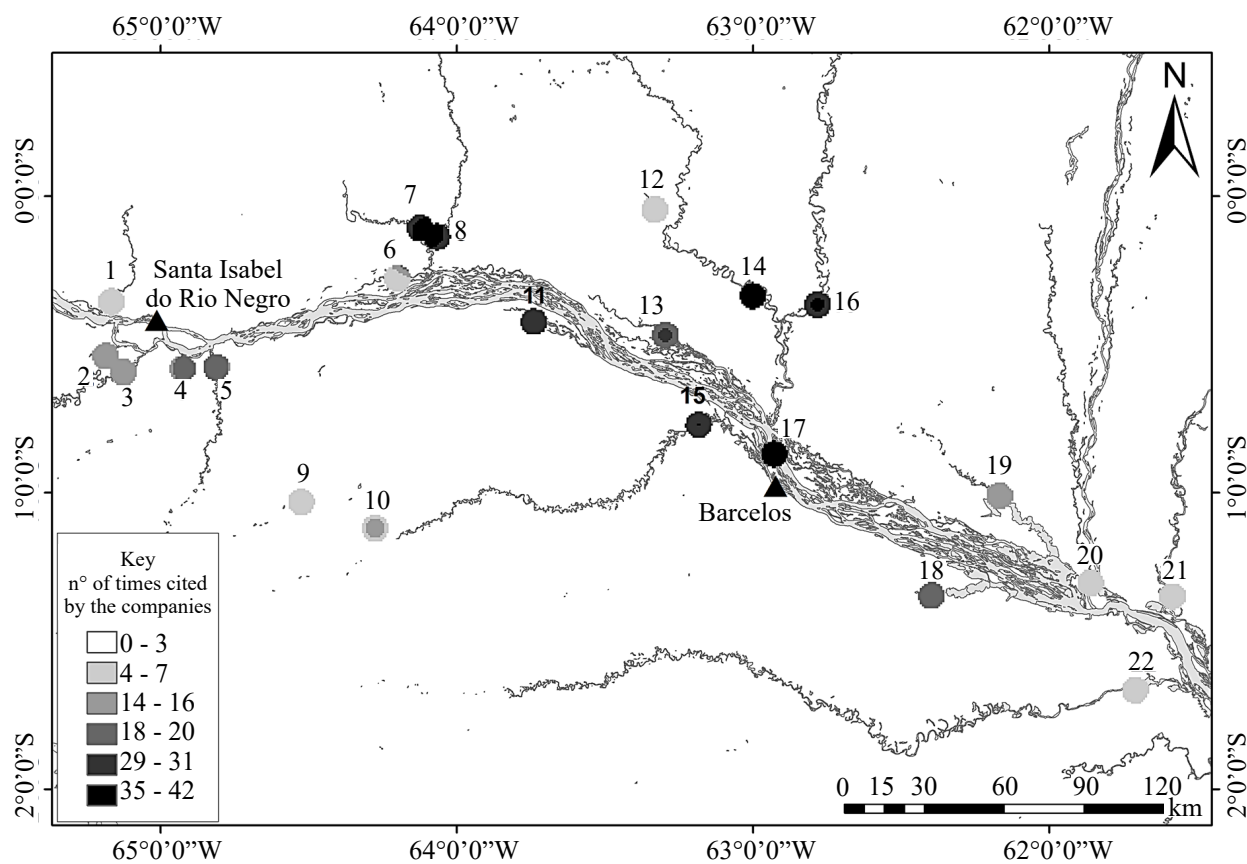


Figure 5. Fishing sites used by sport fishing companies in the middle Negro River region according to the number of times each river was cited by the interviewed entrepreneurs: (1) Marauaiá; (2) Teia; (3) Uneiuxi; (4) Aiuanã; (5) Urubaxi; (6) Atauí; (7) Preto; (8) Padauri; (9) Cuiunizinho; (10) Alegria; (11) Arirarrá; (12) Curuduri; (13) Itú; (14) Aracá; (15) Cuiuni; (16) Demeni; (17) Negro River channel; (18) Caurés; (19) Jufariz; (20) Branco; (21) Jauaperi; (22) Unini.

DISCUSSION

The sport fishing that occurs in the middle Negro River has been going on for 29 years. According to some respondents, some companies are no longer in business, due to problems such as bankruptcy or legal problems. This is the case with one jungle hotel, which was pointed out by the interviewees as the first development to operate in the region and which currently belongs to another owner. In general, sport fishing on the middle Rio Negro is carried out in five modalities, the main one being the hotel boat. The displacement to the fishing sites takes place mostly using aluminum boats of the semi-flat-nosed type, and with a 30-hp engine, during seven days of fishing.

In the study, 42 companies were observed operating in the region. However, in the period from 12 to 19 July 2019, during a planning action carried out by the Amazonas State Tourism Company (AmazonasTur), 40 companies providing services

for fishing tourism in this region were detected (AmazonasTur, 2019), which reflects a 5% increase in the number of companies when comparing the data obtained in the study and those from Amazonastur. Despite the short time taken for the survey, this increase can probably be associated with the start of the season in the last quarter of that year.

This growth perspective gains strength when added to the data obtained on the age of companies, which reveal the insertion of new companies in this market, some with only two years of operation. The growth of this activity has been reported before, on a global (FAO, 2017), national (Barroco and Freitas, 2014; Schober, 2015), and regional (AmazonasTur, 2020) scale, and has also resulted in the growth of other sectors, such as tourism, navigation, specialized equipment, hospitality, restaurants, among others (Franquesa et al., 2004; Schork et al., 2010).

The owners of the companies are mostly men, with the average age of 44 years old, coinciding with the age of male

sport fishers, which is around 40 to 50 years (Basaglia and Vieira, 2005; Tsuruda et al., 2013; Moraes and Seidl, 2019). The same pattern was observed in other Brazilian states, such as Mato Grosso do Sul (Moraes and Seidl, 2019), Rio Grande do Sul (Basaglia and Vieira, 2005), São Paulo (Tsuruda et al., 2013), and in other countries, such as Turkey (Unal et al., 2010), and Mozambique (Pereira et al., 2003).

The displacement of fishers to the middle Negro River region is associated with the low level of the river (Freitas and Rivas, 2006; Albano and Vasconcelos, 2013), which causes the greater ease of catching fish due to the reduction of water volume in waterbodies. Although sport fishing in the Amazon region occurs per season, in the marine environment, this activity occurs throughout the year (Pereira et al., 2003; Basaglia and Vieira, 2005; Unal et al., 2010), because it is mostly carried out in a land-base way (without the aid of a vessel to carry out the fishery). Despite there being indications that the season lasts about six months (Freitas and Rivas, 2006; AmazonasTur, 2020), our results indicate that the duration of the season may vary from company to company, and this is possibly due to each one's different capacity to explore the environments available in the region.

As well as the duration of the season, the types of fishing modality vary from one location to another. According to Freire et al. (2016) and Moraes and Seidl (2019), in the Pantanal of the state of Mato Grosso, more than half of the fishers who fish there use boat-hotels. Freire et al. (2016) also mention that in other states in the north of Brazil, such as Pará, Roraima, Amapá, Rondônia, Acre and Tocantins, most of the operations are based on boat-hotels, but hotels and jungle lodges are also used. In general, we believe that in the northern region of Brazil, most companies operate using boat-hotels due to greater mobility, since they have the possibility of moving from one river to another during the same fishing operation if the site is not productive, while also providing comfort for the sports fishers who hire the service. This modality apparently proved to be the most consolidated and adopted in the middle Negro River region.

Even though it is common to use boat-hotels in these inland water regions, in marine sports fishing, when carried out on boats, the vessels are differentiated due to the different characteristics of the environment, such as wind and wave strength. In the marine environment, sport fishing is usually carried out on the shore, and the charter boat is in second place in the statistics for Turkey (Unal et al., 2010) and Spain (Pita et al., 2018), for example. In our study, all fishers reported needing a vessel to carry out the fishery, be it small, medium, or large, because, unlike the

land-based fishing carried out on the coasts and beaches of large cities, the places in the middle Negro River in general do not have communities close by, thus making the fishery dangerous without a support vessel. In addition, they often travel long distances to get to the river of interest and carry out their fishing.

Regarding the number of fishers, the companies work with a variable number, which is related to the different types of enterprises that operate in the region. The camps serve the smallest number of customers, perhaps due to the type of structure, as they do not offer as much convenience as the other operations, and are hired by sports fishers who are also lovers of outdoor adventure. In contrast, the jungle lodge presents a structure that can meet the desires of greater amounts of fishers, due to the size of the hotel structure, greater convenience, and ability to offer in addition to fishing tourism, options for recreation, leisure and sport.

In the middle Negro River region, groups of six to 15 fishers are formed (Freire et al., 2016), which are numbers lower than those found in the present study, and which may be associated with the current improvement in the structure of companies (allowing family trips), and with the offer of other services and/or expanding their capacity to serve a greater number of customers. With the greater number of clients, this would lead to an increase in turnover. Another factor that may have influenced the greater number of clients is the insertion of new companies with new modalities, in order to meet fishers with different profiles. Regarding fisheries, these are carried out on board boats, mostly using aluminum boats of the semi-flat-nosed type, and with a 30-hp engine, which provides greater mobility between habitats and other benefits for fishers, in addition to being lighter to load and their removal from the water can be manual.

In general, the contracting of the trips is for seven days of fishing (Freitas and Rivas, 2006) since, in the same season, fishers can acquire more than one trip to travel and fish in other municipalities of the Amazonas state, such as Autazes and Nova Olinda (information from the interviewees) or even to other states of Brazil such as Rondônia and Paraná (Albano and Vasconcelos, 2013), thus making the most of the entire fishing season in different locations.

In the region of the middle Negro River, fishers use 22 rivers to carry out fishing tourism, and the closest to the host municipalities are the most used because they provide less fuel expenditure. However, this choice causes an increase in the intensity of the fisheries in these places, as in the case of the Aracá, Demeni and Cuiuni rivers, located near Barcelos. In other cases, rivers such as the Cuiunzinho and Curuduri,

although more distant, continue to be used in fisheries, which is very positive for fishing in the region, since less exploited places can contribute to the capture of larger specimens (Lubich et al., 2021).

In fact, the choice between more distant rivers is related to the objective of capturing the large specimens of the main species of the region, the peacock bass (*C. temensis*), since the species exhibits outstanding characteristics such as its size and strength. These have already pointed out in other studies as being characteristics that make it a target of sport fishers (Freitas and Rivas, 2006; Holley et al., 2008; Albano and Vasconcelos, 2013). The size and strength of the species provide fishers with greater “fight” time (time interval between the moment the fish is hooked and its landing), thus resulting in great sport. The size of *C. temensis* deserves attention because it is recognized as the species of the genus *Cichla* that reaches the largest size—it is able to reach up to 90 cm and weigh up to 13.19 kg (IGFA, 2022).

CONCLUSION

The rise of sport fishing in the middle Negro River has promoted the emergence of new modalities of operations, such as camping and guesthouses, thus offering more options for people with different profiles. However, the traditional modality, known as boat-hotels, remains the most adhered to by new entrepreneurs in this region, for presenting the advantages of greater mobility and comfort for sports fishers who hire the service. The data presented here can be used to manage and organize this activity in the region since, for the creation of public policies, governments need data that characterize the profile of the direct and indirect participants, as well as the object of use for the realization and success of the activity.

CONFLICT OF INTERESTS

Nothing to declare.

DATA AVAILABILITY STATEMENT

All dataset were generated or analyzed in the current study.

FUNDING

Conselho Nacional de Desenvolvimento Científico e Tecnológico
Grant No: 131933/2018-3.

Fundação de Amparo à Pesquisa do Estado do Amazonas
Grant: POSGRAD 2020/2021 - Resolution 006/2020

Coordenação de Aperfeiçoamento de Pessoal de Nível Superior
Grant No: 131933/2018-3.

AUTHORS' CONTRIBUTION

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

ACKNOWLEDGMENTS

We thank the recreational fishing entrepreneurs in the municipality of Barcelos (Amazonas, Brazil) for participating in the research and for sharing their knowledge. In particular, we appreciate C. Lubich's mother, Edite Bonfim, for helping with data collection.

REFERENCES

- 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* (Online), (28): 77-89.
- Amazonas. 2011. Decreto nº 31.151, de 6 de abril de 2011. Disciplina a pesca em área da Bacia do Rio Negro, compreendendo o trecho situado entre a divisa do Estado do Amazonas com a Colômbia, até a foz do Rio Branco. *Diário Oficial do Estado, Amazonas*, n. 32.047, p. 1. Available at: diario.imprensaoficial.am.gov.br/portal/visualizacoes/pdf/13954#/p:1/e:13954?find=Decreto. Accessed on: Feb. 18, 2022.
- Amazonas. 2018. Decreto nº 39.125, de 14 de junho de 2018. Regulamenta a pesca amadora no Estado do Amazonas. *Diário Oficial do Estado, Amazonas*, n. 33.782, p. 6. Available at: <http://www.ipaam.am.gov.br/wp-content/uploads/2019/07/Decreto-n%C2%BA-39.125-de-14-de-Junho-de-2018.pdf>. Accessed on: Feb. 18, 2022.
- AmazonasTur. 2019. Barcelos: Amazonastur realiza ação de orientação em empreendimento ligados ao turismo. Available at: <https://www.amazonastur.am.gov.br/barcelos-amazonastur-realiza-acao-de-orientacao-em-empreendimentos-ligados-ao-turismo/>. Accessed on: Feb. 19, 2022.

- AmazonasTur. 2020. Levantamentos sobre a Pesca Esportiva na Calha do Rio Negro. Available at: http://www.amazonastur.am.gov.br/wp-content/uploads/2020/08/Levantamentos-sobre-a-Pesca-Esportiva-na-Calha-do-Rio-Negro_2019.pdf. Accessed on: Feb. 19, 2022.
- Arlinghaus, R.; Tillner, R.; Bork, M. 2015. Explaining participation rates in recreational fishing across industrialised countries. *Fisheries Management and Ecology*, 22(1): 45-55. <https://doi.org/10.1111/fme.12075>
- Associação Nacional de Ecologia e Pesca Esportiva (ANEPE). Notícias. 2017. Available at: <http://www.anepe.org.br/index.php/pages/noticias-anepe?start=10>. Accessed on: Feb. 19, 2022.
- Barroco, L.S.; Freitas, C.E.C. 2014. A pesca esportiva na Amazônia: implicações para a sustentabilidade dos estoques pesqueiros e da atividade. *Revista Scientia Amazonia*, 3(2): 93-99.
- Basaglia, T.P.; Vieira, J.P. 2005. A pesca amadora recreativa de caniço na praia do cassino, RS: necessidade de informações ecológicas aliada à espécie alvo. *Brazilian Journal of Aquatic Science and Technology*, 9(1): 25-29. Available at: <https://periodicos.univali.br/index.php/bjast/article/view/571>). Accessed on: Apr. 10, 2023.
- Biernacki, P.; Waldorf, D. 1981. Snowball sampling: Problems and techniques of chain referral sampling. *Sociological Methods & Research*, 10(2): 141-163. <https://doi.org/10.1177/004912418101000205>
- 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, Brasília, n. 122, Seção 1, p. 1.
- Campos, C.P.; Amadio, S.A.; Freitas, C.E.C. 2015. Growth of the *Cichla temensis* Humboldt, 1821 (Perciformes: Cichlidae) from the middle Rio Negro, Amazonas, Brazil. *Neotropical Ichthyology*, 13(2): 1-8. <https://doi.org/10.1590/1982-0224-20140090>
- 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](https://doi.org/10.1641/0006-3568(2004)054[0857:TRORFI]2.0.CO;2)
- Cooke, S.J.; Cowx, I.G. 2006. Contrasting recreational and commercial fishing: searching for common issues to promote unified conservation of fisheries resources and aquatic environments. *Biological Conservation*, 128(1): 93-108. <https://doi.org/10.1016/j.biocon.2005.09.019>
- Food and Agriculture Organization of the United Nations (FAO). 2017. Globefish Highlights: a quarterly update on world seafood markets. FAO.
- Franquesa, R.; Gordo, A.; Mina, T.; Nuss, S.; Borrego, J.R. 2004. A pesca recreativa no quadro mediterrâneo da Europa Central e Ocidental. GEM-UB. Universidade de Barcelona, 15.
- Freire, K.M.F.; Tubino, R.A.; Monteiro-Neto, C.; Andrade-Tubino, M.F.; Belruss, C.G.; Tomás, A.R.G.; Crepaldi, D.V. 2016. Brazilian recreational fisheries: current status, challenges and future direction. *Fisheries Management and Ecology*, 23(3-4): 276-290. <https://doi.org/10.1111/fme.12171>
- 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.
- Hoeninghaus, D.J.; Layman, C.A.; Arrington, D.A.; Winemiller, K.O. 2003. Movement of *Cichla* species (Cichlidae) in a Venezuelan floodplain river. *Neotropical Ichthyology*, 1(2): 121-126. <https://doi.org/10.1590/S1679-62252003000200006>
- 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>
- Inomata, S.O.; Freitas, C.E.C. 2015. Fish landings in Barcelos, in the middle Negro River region, Amazonas. *WIT Transactions on Ecology and the Environment*, 192: 67-76. <https://doi.org/10.2495/ECO150071>
- International Game Fish Association (IGFA). 2022. IFGA Fish Database. Florida (USA). Available at: <http://igfa.org/fish/fishdatabase.aspx>. Accessed on: Feb. 19, 2022.
- Jepsen, D.B.; Winemiller, K.O.; Taphorn, D.C.; Rodriguez, O.D. 1999. Age structure and growth of peacock cichlids from rivers and reservoirs of Venezuela. *Journal of Fish Biology*, 55(2): 433-450. <https://doi.org/10.1111/j.1095-8649.1999.tb00689.x>
- Kullander, S.O. 2003. Family cichlidae. In: Reis, R.E.; Kullander, S.O.; Ferraris, C.J. (org.). Check list of the freshwater fishes of South and Central America. Porto Alegre: Edipucrs, p. 605-654.
- Kullander, S.O.; Ferreira, E.J.G. 2006. A review of the South American cichlid genus *Cichla*, with descriptions of nine new species (Teleostei: Cichlidae). *Ichthyological Exploration of Freshwaters*, 17(93): 289-398.
- Latrubesse, E.M.; Franzinelli, E. 2005. The late Quaternary evolution of the Negro River, Amazon, Brazil: implications for island and floodplain formation in large anabranching tropical systems. *Geomorphology*, 70(3-4), 372-397. <https://doi.org/10.1016/j.geomorph.2005.02.014>
- 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>

- McGrath, D.G.; Cardoso, A.; Sá, E.P. 2004. Community fisheries and co-management on the lower Amazon floodplain of Brazil. In: The Second International Symposium on the Management of Large Rivers for Fisheries. Proceedings. v. 2, p. 207-221.
- Ministerio da Pesca e Aquicultura (MPA). 2010. I Encontro Nacional da Pesca Amadora: Construindo a política da pesca amadora. Brasília: MPA. Available at: <https://pt.slideshare.net/zezinhocoimbra/1-encontro-amador-de-pesca>. Accessed on: Feb. 17, 2019.
- Montero, J.C.; Latrubesse, E.M. 2013. The igapó of the Negro River in central Amazonia: Linking late-successional inundation forest with fluvial geomorphology. *Journal of South American Earth Sciences*, 46, 137– 149. <https://doi.org/10.1016/j.jsames.2013.05.009>
- Moraes, A.S.; Seidl, A.F. 2019. Visitas de pescadores esportivos ao Pantanal Sul (Brasil). *Revista de Economia e Sociologia Rural*, 36(3): 99-116.
- Pereira, M.A.; Abrantes, K.G.; Videira, E.J. 2003. Características, participação e atitudes dos pescadores recreativos de margem da Cidade de Maputo, técnicas usadas e suas capturas. *Boletim de Divulgação do Instituto de Investigação Pesqueira*, 39: 1-25.
- Pita, P.; Hyder, K.; Gomes, P.; Pita, C.; Rangel, M.; Veiga, P.; 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>
- QGIS Development Team. 2019. QGIS Geographic Information System. QGIS Association. Available at: <https://www.qgis.org>. Accessed on: Feb. 19, 2022.
- Sabaj, M. H.; López-Fernández, H.; Willis, S. C.; Hemraj, D. D.; Taphorn, D. C.; Winemiller, K. O. 2020. *Cichla cataractae* (Cichliformes: Cichlidae), new species of peacock bass from the Essequibo Basin, Guyana and Venezuela. *Proceedings of the Academy of Natural Sciences of Philadelphia*, 167(1), 69-86. <https://doi.org/10.1635/053.167.0106>
- Santos, G.M.; Ferreira, E.J.G.; Zuanon, J.A.S. 2006. Peixes Comerciais de Manaus. Manaus: IBAMA/AM, ProVárzea, 144 p.
- Schober, J. 2015. Impactos da pesca recreativa sob a perspectiva da pesquisa científica. *Ciência e Cultura*, 67(1): 10-11. <https://doi.org/10.21800/2317-66602015000100005>
- Schork, G.; Mottola, L.S.M.; Hostim-Silva, M. 2010. Diagnóstico da pesca amadora embarcada na região de São Francisco do Sul (SC). *Revista Biodiversidade e Conservação Marinha*, 1(1): 8-17. <https://doi.org/10.37002/revistacepsul.vol1.2958-17>
- Soares, M.G.M.; Costa, E.L.; Siqueira-Souza, F.K.; Anjos, H.D.B.; Yamamoto, K.C.; Freitas, C.E.C. 2007. Peixes de lagos do Médio Rio Solimões. 2. ed. Manaus: Instituto PIATAM, 160 p.
- Sobreiro, T.; Freitas, C.E. 2008. Conflitos e territorialidade no uso de recursos pesqueiros do Médio Rio Negro. In: Encontro Nacional da ANPPAS, 4., 2008, Brasília. Anais... v. 1. p. 78-91.
- Tsuruda, J.M.; Nascimento, R.B.; Barrella, 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.
- Unal, V.; Acarli, D.; Gordo, A. 2010. Characteristics of marine recreational fishing in the anakkale Strait (Turkey). *Mediterranean Marine Science*, 11(2): 315-330. <https://doi.org/10.12681/mms.79>
- Winemiller, K.O.; Taphorn, D.C.; Barbarino-Duque, A. 1997. Ecology of *Cichla* (Cichlidae) in two Blackwater rivers of Southern Venezuela. *Copeia*, (4): 690-696. <https://doi.org/10.2307/1447287>
- World Bank. 2012. Hidden harvest: the global contribution of capture fisheries. Washington, D.C.: International Bank for Reconstruction and Development, 71 p.
- Zar, J.H. 2010. Biostatistical analysis. 5. ed. Upper Saddle River: Prentice Hall.