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SEASONAL AND SPATIAL DYNAMIC OF SMALL SCALE FISHERIES IN CENTRAL AMAZONIA

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Abstract: Amazonia is considered to host some of the more productive freshwater fisheries of the world, and these are of key importance to the local population. Accordingly, fishing activity needs to be studied to evaluate its dynamics, so that long-term sustainability of the resource can be assured the fishing. The objective of the current study, therefore, was to analyze seasonal and spatial variation in the production of fish landed in the city of Manacapuru, in Central Amazonia. The landing data was collected daily from January to December 2012 at the main port of landing in Manacapuru, Amazonas, Brazil. Results indicate that lakes were most frequently visited by fishermen, but that rivers had higher catch values. In total, 39 species of fish were landed, with jaraqui escama grossa (*Semaprochilodus taenirus*) and jaraqui escama fina (*Semaprochilodus insignis*) being the species most exploited by fishermen. Landing had a seasonal character, with higher values in the rising and high water periods. Significant differences were observed between the different seasonal periods, with peak-flood period having the highest catch per unit effort (CPUE) values. Principal Component Analysis (PCA) revealed that fishing gear varied according to the fishing environment and exploited species.

Keywords: Catch per unit effort, Fishing environment, Fishing gear, Landing

Resumo: A pesca na Amazônia desempenha um papel fundamental para a população, sendo considerada umas das pescarias de água doce mais produtivas do mundo. Devido a sua extensa importância para a região amazônica, a atividade pesqueira necessita de estudos para avaliar sua dinâmica. O objetivo deste estudo foi analisar sazonalmente e

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espacialmente a pesca desembarcada no município de Manacapuru, na Amazônia Central. Os dados de desembarque foram obtidos a partir da aplicação de questionários estruturados aos pescadores, sendo coletados entre janeiro a dezembro de 2012. Os resultados indicaram que os lagos foram os ambientes mais visitados pelos pescadores, no entanto, os rios apresentaram maiores valores de captura. Foram desembarcadas um total de 39 espécies de peixes, sendo o jaraqui escama grossa (*Semaprochilodus taenirus*) e o jaraqui escama fina (*Semaprochilodus insignis*) as espécies mais exploradas pelos pescadores. As capturas de peixe apresentaram um caráter sazonal com valores mais altos no período de enchente e cheia. Os testes de Mann-Whitney e Kruskal-Wallis foram empregados para testar as hipóteses de que existem diferenças espaciais e sazonais na captura por unidade de esforço (CPUE). Diferenças significativas ($p<0,05$) foram observadas entre os diferentes períodos sazonais, sendo o período de cheia, com os maiores valores de captura por unidade de esforço (CPUE). A análise de componentes principais (PCA) revelou que os apetrechos de pesca variaram de acordo com o ambiente onde ocorreu a pesca e as espécies exploradas.

Palavras-chave: Captura por unidade de esforço, Ambiente de pesca, Apetrechos de pesca, Desembarque

INTRODUCTION

Small-scale fishing (SSF) is an important source of income and food security for many populations of tropical and subtropical countries (Béné et al. 2009; Welcomme et al. 2010; FAO 2014; Lynch et al 2016). Small-scale fisheries are estimated to employ around 90% of the world's fishermen and contribute approximately half of all world fish (86.6 million tonnes in 2012) (FAO 2014; Chuenpagdee et al., 2018). In developing countries SSF is a major source of protein for many families, however it is poorly quantified and receives little attention from managers regarding large-scale fisheries (LSF) (UNDP 2005; Chuenpagdee and Pauly 2006; Zeller et al., 2007; Carvalho et al., 2011; Zeller et al., 2015).

In the Amazon basin, fisheries have been an important activity since pre-colonial times (Batista et al. 2004; Barthem and Goulding 2007; Isaac *et al*. 2008). Although some industrial fisheries also occur in the region (Bayley, 1989; Hallwass et al. 2016), most fishing is done by small-scale, artisanal fishermen, ie it has low financial investment and simple technology (Hawkins and Roberts 2004; Baptist Hallwass et al., 2013). Studies have estimated that the fishing potential of the Amazon is between 207,000 and 902,000 t / year (Bayley and Petrere 1989; Mérona 1995). In addition, fishermen tend to exploit a high diversity of species and use different types of fishing gear (Freitas and Rivas 2006)

The SSF in Amazon involve about 330,000 fishermen (Ministério da Agricultura

Pecuária e Abastecimento [MAPA], 2016), as well as produce annual revenue of some R$ 389 million (Almeida et al. 2010) with an estimated production of nearly 140,000 t (Ministério da Pesca e Aquicultura [MPA], 2010). Its importance is shown by the large quantities of fish landed in the main urban centers of the region (Barthem and Fabré 2003; Lopes et al. 2016), which reflect both the high levels of fish consumption by the population varying from 369g to 805g per day per capita in some places (Isaac e Almeida 2011; Garcez *et al*. 2009; Isaac *et al*. 2015; Garcez *et al*. 2017).

Fisheries in the Amazon occur in a variety of environments, including rivers, lakes, floodplains, and streams. However, patterns of exploitation within these environments tend to vary along basin. In the middle River Solimões, the fishing fleet mainly exploits the main river channel, while on the lower Amazon river fisheries tend to occur in lakes during high water and in the river channel in the low water season (Cerdeira et al. 2000; Viana, 2004; Isaac et al. 2004; Pinaya et al. 2016). The choice of environments for fishing activity is strongly influenced by the hydrological cycle, since the water level varies widely throughout the year, a phenomenon known as the flood pulse (Junk *et al*., 1989). Such river dynamics determined both the life and behavior of the fish species, and the kind of fishing strategies deployed by the fishermen (Isaac et al. 2016) and, consequently, the results extent and composition of the catch by commercial fisheries (Merona et al 1993; Freitas and Rivas 2006; Castello et al., 2015; Garcez et al., 2017).

Due to their key economic and social importance, fisheries need to be managed effectively so that resource use is stable and sustainable (Selig *et al*., 2016; Inomata *et al*. 2018). Information about their features, structure and dynamics beyond of analyses fisheries-based data are fundamental to the management of these resources, as they allow monitoring of temporal and spatial stock variation of exploited species, thus facilitating resource management decision making (Defeo and Castilla, 2005; Chuenpagdee *et al*., 2006; Salas *et al*., 2007; FAO, 2016; Grüss *et al*. 2017).

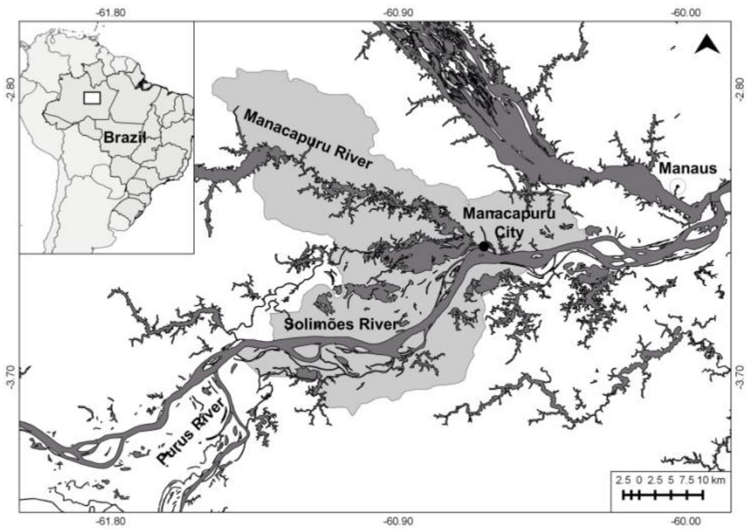
To contribute to this lack of knowledge, this paper aims to study the spatial-temporal variability in CPUE (Catch per Unit Effort) of the main fisheries resources in the Central Amazon. Our working hypotheses are: i) Spatial variation in fishing environments has an influence on fishing yields (CPUE) and: (ii) Seasonal variation in water level has an influence on fishing yields (CPUE).

MATERIAL AND METHODS

Study area

The present study was conducted in the Central Amazon region of Manacapuru municipality. The municipality is the fourth largest city in the state with a territorial extension of 7,330.074 km (IBGE, 2016) and is located 84 kilometers from Manaus. Manacapuru has the second largest fishing fleet in the state of Amazonas, with an infrastructure for the disposal of production, including refrigeration and floating fishing terminals (Batista 2012) (Figure 1).

Figure 1: Location of study area



The ecosystem of this region is classified as floodplain, these areas are periodically flooded by increased water levels caused by increased rainfall, and receive a large supply of sediment and nutrients from the Andes (Sioli 1968; Junk et al., 1989). The flood pulse in these areas causes an elevation of 10 to 12 meters on average water level amplitude, with a maximum water level in May-June and a minimum in October-November (Bittencourt and Amadio, 2007). Fishing occurs in a variety of habitats such as rivers, streams, lakes, herbaceous fields and flooded forests (Hess et al. 2003).

Sampling data

Fishing data were collected from between January to December 2012 through daily interviews, joint to the fishermen and fish boats owners the fish landing moment at the main fish landing port. For each fishing trip, the following information was collected: number of fishermen per trip, number of days spent fishing, catch in weight for each species, fishing environment (floodplain lake or river channel), fishing gear used. Captured fish were identified using the key proposed by Ferreira et al. (1998). Respective daily river water level data measured at Manacapuru (Fig. 1) was conceded from (Agência Nacional de Águas [ANA], 2015).

Data analysis

To calculate catch per unit of effort (CPUE), the equation proposed by Petrere *et al*. (2010) was used, dividing the total catch (in kg) by the fishing effort (number of fishers × days spent fishing). Catch per unit effort (CPUE) were calculated by fishery and fishing environment and organized as monthly data in order to create a balanced sample design (Isaac et al., 2016). To identify the Solimões River hydrological periods, we following the procedure described on Bittencourt and Amadio (2007).

We used a Mann Whitney U-test test to the hypothesis that there is differences catch per unit effort values between the fishing environments, and the Kruskal-Wallis non-parametric test to assay for differences between periods in the hydrological cycle (Siegel 1975, Zar, 1999), both tests had significance levels of 5% ($p<0.05$). Posteriorly to the application of statistical tests, we applied a D Dunn discriminatory test (Siegel 1975) to assay which the analyzed hydrological periods were statistically different.

Subsequently, we evaluated the relationship between the fishing environment, fishing gear and species captured with principal components analysis (PCA). Catch data were log converted to reduce the differences in fishing gear catchability rates. All analyzes were made using R software (R Development Core Team 2019).

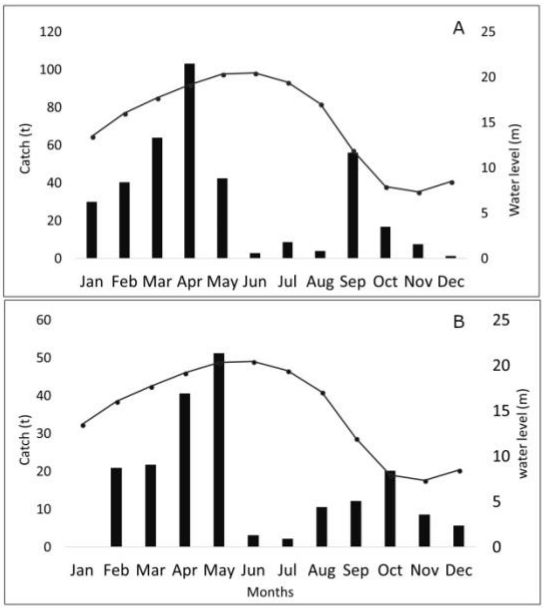
RESULTS

Responses from fishermen at the fish-landing port produced a total of 1021 questionnaires. These covered data on an estimated 546 t (monthly average of 44.8 t ± 43.6 t) of fish landed at Manacapuru over the course of one year.

Fishing was reported as occurring in thirty-six lakes and three different rivers. The lakes were the environments most visited by the fishermen (69% of the fisheries), especially the lakes Piranha (32%), Grande (26.2%), Beruri (7.7%) and Jacaré 7%). Rivers contributed to 31% of fishing activity, this being divided between three rivers: Manacapuru (54%), Purus (43%) and Solimões (3%).

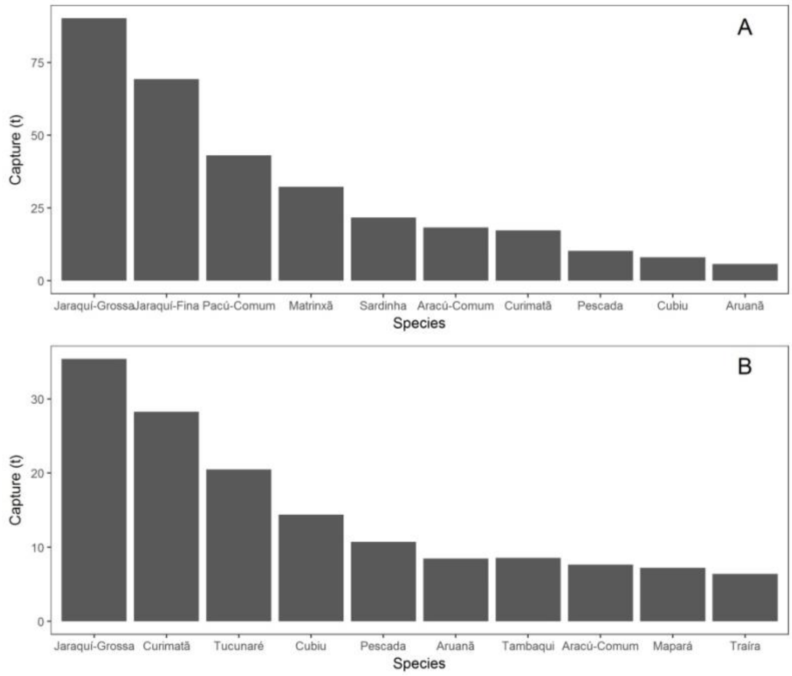
A total of 349 t of fish were captured in riverine environments and 197 t in lake environments. Among the rivers, the highest yields came from the Manacapuru (~ 188 t), followed by the Purus river (~ 150 t) and Solimões river (~ 10 t). For the lakes, Jacaré had the largest catch volume (~ 39 t), followed by Piranha (~ 24 t), Sacambu (~ 23 t) and Beruri (~ 21 t). The amount of fish landed from river based fisheries ranged from ~ 2 t for the month of August to ~ 103 t in April, while in the lakes the catch ranged from ~ 51 tons in May to ~ 2217 t in July. In terms of total catch for the two environments, production from rivers was notably higher during the high water period, but for lakes peaked in the periods of water level decline and lowest water levels (Figure 2 A B).

Figure 2. A - Monthly variation in main species landed at the municipality of Manacapuru during the year 2012 in environment river. B - Monthly variation in main species landed at the municipality of Manacapuru during the year 2012 in environment lake.



During the study period, 39 species or species-groups were landed (Table 2). From river environments, the jaraqui escama grossa (Semaprochilodus insignis) and the jaraqui escama fina (Semaprochilodus taenirus) accounted for 25.8% and 19.8% of fish production respectively. This was followed by pacus (Mylossoma spp.: 12.3%), matrinxã (Brycon amazonicus: 9.2%) and sardinhas (Triportheus spp.: 6.2%) (Figure 3A). From lakes, the predominant species were jaraqui escama grossa (17.9%), curimatã (Prochilodus nigricans: 14.3%), tucunaré (Cichla spp.: 10.3%) and cubiu (Anodus elongatus: 7.3%) (Figure 3B).

Figure 3. A - Main species of fish caught in rivers, Jan-Dec 2012; B - Main species of fish caught in lakes, Jan-Dec. 2012.



For total fish landing, 10 species accounted for approximately 85% of the fishery production. High-water captures were dominated by Characiform species such as jaraqui escama-grossa and jaraqui escama-fina, followed by pacus, curimatã and matrinxã (Table 1). During the period when waters were receding, and at the beginning of the low-water period, another peak in landed fish volume occurred, although of lower intensity. During this, the commonest species were aracu-comum (*Schizodon fasciatus*), cubiu (*Anodus elongatus*), curimatã and pescada (*Plagioscion* spp.).

Catch per unit of effort (CPUE)

There was a high variability in the mean catch per unit of effort values, and in some cases the values of the standard deviations are greater than the means. Thus, we used the median values to represent the CPUE and its spatial and seasonal variation.

There was no difference in CPUE between the analyzed rivers and lakes (Mann-Whitney U-test, $U = 107480$, $p > 0.05$). Based on median fishing yield values, the calculated CPUE for the rivers was 13.8 kg/fisher/day, while in the lakes it was 12.7 kg/fisher/day. For CPUE seasonal variation, median values for rivers ranged from 3.3

kg/fisherman/day in February to 95.2 kg/fisherman/day in November. In lakes values ranged from 6.3kg/fisherman/day in February, to 16 kg/fisherman/day in May.

A Kruskal-Wallis test confirmed differences in CPUE values during the hydrological cycle (Kruskal-Wallis H = 22.743, gl = 3, p <0.05), a result that supports our hypothesis that fish yields would vary with the hydrological cycle. The Dunn test confirmed that high-water periods had higher CPUE values than other period of the hydrological cycle (Table 2).

Table 2: Mean and median values for the hydrological periods.

Periods[1]	**Mean (SD)**	**Median**
Rising [a]	28.09 (55.3)	11.3
Flood [b]	38.04 (59.5)	16.6
Receding [a]	31.57 (72.4)	10.75
Drought [a]	18.6 (25)	12.75

[1] The periods indicated by the same letter do not differ significantly from each other by the Dunn test (p <0.05).

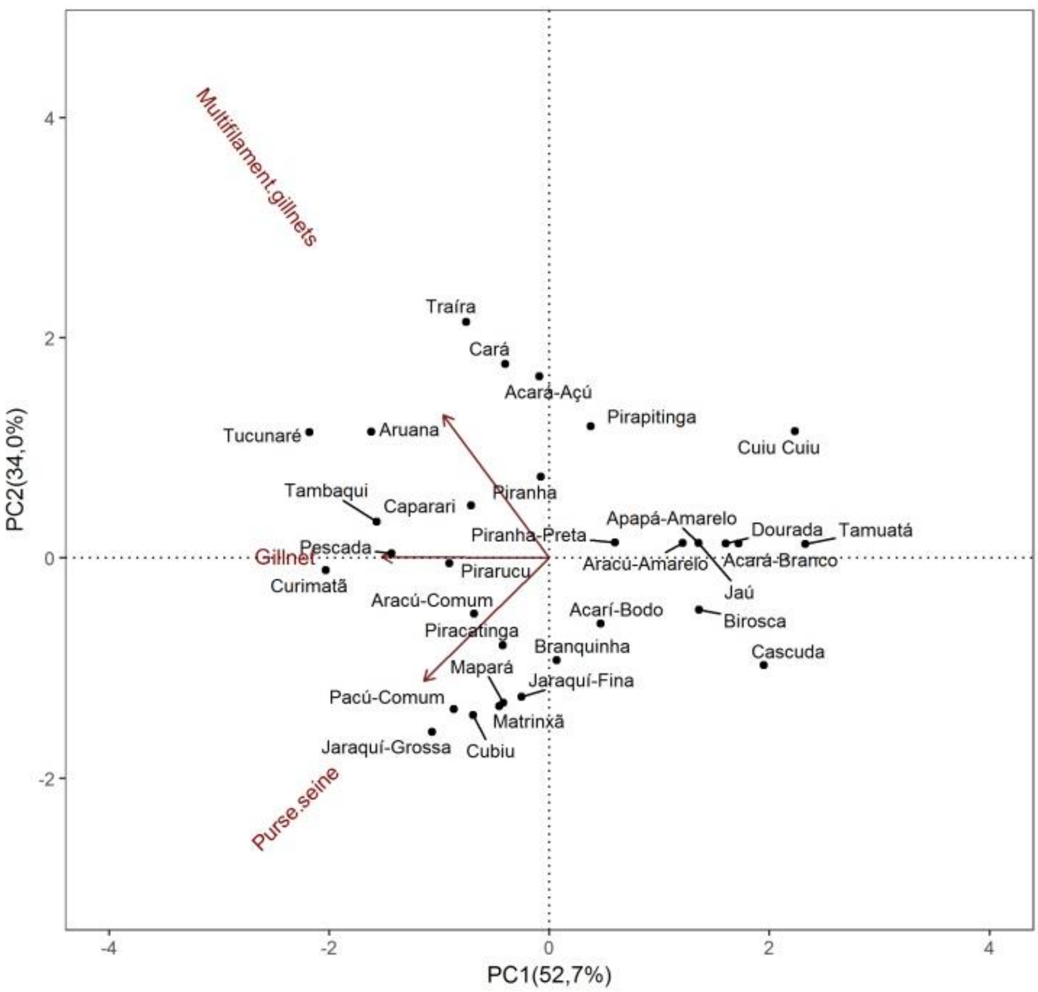
Fishing gear per environment and species

During the study period, four forms of fishing gear were identified for the river-based fisheries (gillnet, hook and line, multifilament gillnet and purse seine) and three for fisheries based on lakes (multifilament gillnet, gillnet and purse seine).

For lake-based fisheries, the PCA produced two main components that together explained 86.7% of the expected variability. The main component (PC1) accounted for 52.7% of the total variability, and was negatively correlated with gillnet and the purse seine use. The species most associated with this component were tambaqui (*Colossoma macropomum*), pirarucu (*Arapaima gigas*), curimatã.

The main component (PC2) represented 34.0% of the total variability, being positively correlated with the multifilament gillnet. The species highly correlated with (PC2) were pacu, jaraqui escama grossa, jaraqui escama fina and matrinxã (Figure 4).

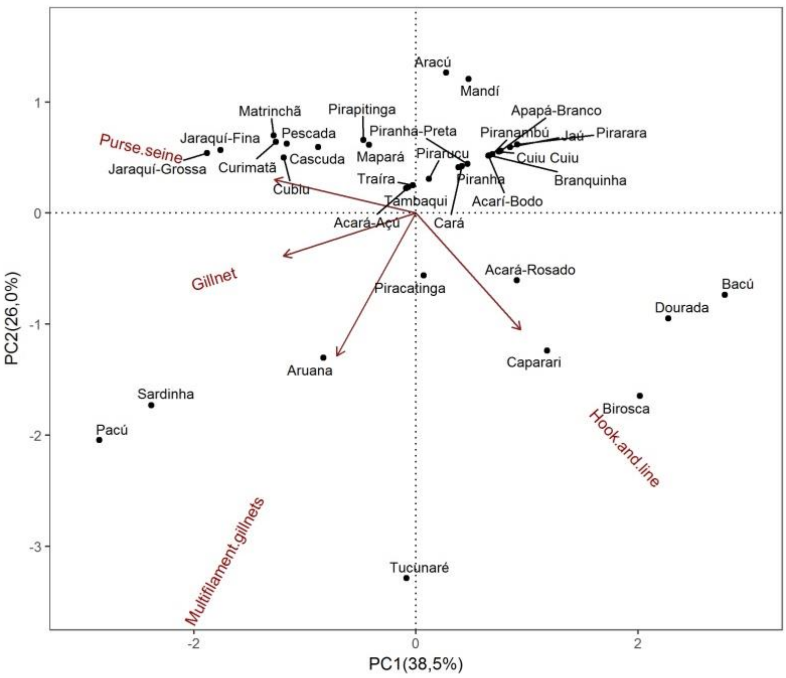
Figure 4: Principal Component Analysis (PCA), based on the type of gear used in the lake environment.



For river fisheries data, the two main components PC1 and PC2 of the Principal Component Analysis (PCA) explained 59.3% of the expected variability for these gear types. The main component (PC1) represented 38.5% of the total variability, being positively correlated with hook and line use; while the main component (PC2) explained 26.0% of the total variability and was positively correlated with purse seine use.

Data showed a group, mostly catfish, such as dourada (*Brachyplatystoma rousseauxii*), bacú (*Lithodoras dorsalis*), caparari (*Pseudoplatystoma tigrinum*) associated with hook and line capture. Another group formed by jaraqui escama grossa, jaraqui escama fina, curimatã, matrinxã and sardinhas, were commonly caught with a purse seine (Figure 5).

Figure 5. Principal Component Analysis (PCA), based on the type of gear used in the river environment.



DISCUSSION

Spatial and seasonal analysis of fisheries can generate data to support measures for effective management, as they may indicate the periods and environments that are more productive and/or more attractive for the development of fishing activity, which can then be more effectively monitored.

Our results differ from most of the results found in other regions of the Amazon (Cerdeira *et al*. 2000; Isaac *et al*. 2004), where fisheries were found to focus on the river environment. We hypothesize that fisher preference for lakes is related to the physiographic characteristics of the environment, which contains a large number of lakes (Melack 1984).

Although the fishermen showed a preference for lake environments, rivers, especially the Manacapuru and Purus yielded greater volumes of the landed fish. That the Manacapuru, is both the most productive river and that most visited by the fishermen, is likely due to its proximity to Manacapuru itself. This makes fishing there less expensive, since it facilitates production flow and reduces the costs of ice and fuel. Fisher preference for rivers closer to commercial centres was also found by Cardoso and Freitas (2006) for fisheries on the Manicoré River.

For the Purus River, its position as one of the most exploited rivers in the region has been reported by several authors, as has the increasing contribution of its fish-stocks to landings at the port of Manaus (Batista 1998; Soares and Junk 2000). However, we believe that the Purus River has well-preserved stocks, as it continues to be one of the main targets of the fishing fleets of Central Amazonia (Freitas and Rivas 2006). The low contribution of the Solimões River to the fish landing is likely associated with the fact that the main target on this river species are large catfish, destined for refrigerators and fish warehouses.

As for total annual volume of fish landed (559 t), our results were lower than those found in nearby Coari (1014 t) (Corrêa *et al*. 2012). However, the value was higher than values for annual landing from Manicoré (256 t) (Cardoso and Freitas 2008), Tefé (148 t) (Ferraz and Figueiredo 2010), and from the Madeira (460 t) (Doria *et al*. 2012) and Juruá (60 t) rivers (Alcantara *et al*. 2015). The higher value for landed fish in comparison to other municipalities within Amazonas state may be explained by the proximity of Manacapuru to the capital Manaus, which consequently expands the consumer market. This feature also highlights the importance of Manacapuru municipality as a fisheries landing center in the state of Amazonas, where 50% of the state population reside in the capital (IBGE 2018).

The study shows that fishing activity in the Amazon focusses strongly on several species, since 39 species were captured. This value appears to be a near-standard in Solimões-Amazonas; Gonçalves and Batista (2008) reported 35 species for Manacapuru, while Petrere (1978) found 31 species commonly landed in Manaus and Fabré and Alonso (1998) noted 33 species in Tabatinga. Notably, the three municipalities of greatest fishing importance in the Solimões-Amazonas channel (Batista, 2010). Fernandes *et al*. (2009) argue that the multispecies character of the Amazon fisheries may be related to the fact that fishermen use different fishing gear.

Despite the diversity of species caught in the present study, 10 species were responsible for more than 85% of the total landings by weight, something already expected, as this form of resource use profile has already been reported by several authors in the Amazon (Merona and Bittencourt 1988; Barthem and Fabré 2004; Gonçalves and Batista 2008; Hallwass and Silvano 2016).

Characiformes dominate the most landed species, characteristic found on the Madeira River (Doria et al. 2012) and in Coari (Corrêa et al. 2012). The frequency of occurrence of species of this order (Batista 2012) can be explained from the cultural point of view, given the consumer's preference for fish with scales; from the environmental point of view, the abundance of these species and the formation of shoals; and from an economic point of view, as a result, they are more captured and have greater commercial value (Batista and Petrere 2003; Gonçalves and Batista 2008).

Fishing yields (CPUE) were greater in the months of April and May, a period that corresponds to the rising and flooding period. Among the species that contributed to this increase were curimatã, matrinxã, pacú and jaraqui escama grossa. These species are all Characiformes, and carry out river-lake migrations during the rising-flood period (Ribeiro and Petrere 1990; Halls and Welcomme 2004), forming large concentrations of individuals which are then targeted by fishermen due to the ease of capture. An increase in fishing yields during rising-flood periods has been reported for Characiformes by other authors (Falabella 1994; Batista 2004; Doria and Lima 2008; Doria *et al*. 2012), since during the flood there is an increase in the biomass of most fish species due to the entry of allochthonous food items the aquatic system (Goulding 1980; Mérona 1993).

It is reported that, during the high water period, fishermen tend to use mesh up to 500 meters due to the expansion of the aquatic environment, which consequently increases the fishing yield (CPUE), since the equipment becomes larger. fishing power (Fabré and Alonso 1998). However, we do not have information about the size of the equipment, which makes it impossible to affirm this fact.

It was observed that fishermen use the same equipment to catch several species and more than one type of gear may be used for the same species a characteristic also reported by Souza et al. (2015). In general, fishing gear is used according to the time of year and species to be exploited (Freitas et al. 2002), which characterizes a specialization in the Amazon fisheries, characteristic also observed in our data. This feature was evident in our results, species of the order Siluriformes, such as dorada (*Brachyplatystoma rousseauxii*), bacú (*Lithodoras dorsalis*), caparari (*Pseudoplatystoma tigrinum*), cuiu-cuiu (*Oxydoras niger*), Jaú (*Zungaro zungaro*) and pirarara (*Phractocephalus hemioliopterus*) were very important in catches taken in rivers and lakes. This result was also found by Souza *et al*. (2015) for fisheries in the Central Amazon.

It was more common for fishing in lacustrine environments to use gear such as gillnet and multifilament gillnets, since lakes have little or no current (Barthem and Fabré 2004). In both rivers and lakes, fishermen commonly used nets to catch schooling fish such as jaraqui, and matrinxã, this has been widely observed in Amazon fisheries (Barthem 2003).

CONCLUSION

The municipality of Manacapuru is an important fishing landing pole in the Central Amazon. The capture per unit of effort - CPUE did not vary between environments and aquatic environments, however, between hydrological periods, the period of high waters presented higher values of CPUE compared to other periods. Fishing in this region is multispecific as in most Amazonian fisheries. The order of the Characiformes is the order of fish most landed during the fishing landing, especially the coarse-scale jaraquis. The use of fishing gear, environment and species has shown a spatial pattern. New variables must be entered such as size of fishing tackle, vessel size, amount of ice, number of connections between lakes and rivers, depth of lakes, suspended sediment load. Fisheries monitoring generates data and allows the formulation of public policies. Therefore, new programs aimed at collecting and processing long-term data on fishery statistics in the Central Amazon should be fostered.

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Table 1: Types of fish and total fish landings (in kg) per environment (Lake and River) at the Panairzinha harbor in Manacapuru municipality (Amazon-Brazil).

Taxon	Commum name	Fish landing (kg)		
		Lake	River	Total
Osteoglossiformes				
Osteoglosidae				
Arapaima gigas (Schinz, 1822)	Pirarucu	3250	1509	4759
Osteoglossum bicirrhosum (Cuvier, 1829)	Aruanã branca	8451	5767	14218
Clupeiformes				
Pristigasteridae				
Pellona castelnaeana Valenciennes, 1847	Apapá amarelo	168	0	168
Pellona flavipinnis (Valenciennes, 1837)	Apapá branco	0	60	60
Siluriformes				
Loricariidae				
Liposarcus pardalis (Castelnau, 1855)				
Hypostomus plecostumus (Linnaeus, 1758)	Acarí-Bodo	538	105	643
Callichthyidae				
Callichthys callichthys (Linnaeus, 1758)	Tamuatá	5	0	5
Doraridae				
Lithodoras dorsalis (Valenciennes, 1840)	Bacú	0	118	118
Oxydoras niger (Valenciennes, 1821)	Cuiu cuiu	54	65	119
Pimelodidae				
Brachyplatystoma rousseauxii (Castelnau, 1855)	Dourada	72	134	206
Calophysus macropterus (Lichtenstein, 1819)	Piracatinga, Birosca	5851	2951	8802
Hypophthalmu ssp.	Mapará	7238	791	8029
Phractocephalus hemiliopterus (Bloch & Schneider, 1801)	Pirarara	0	28	28
Pimelodus blochii Valenciennes, 1840	Mandí	0	4100	4100
Pinirampus pirinampus (Spix & Agassiz, 1829)	Piranambú	0	87	87
Pseudoplatystoma spp.	Caparari, Sorubim	1390	2101	3491
Zungaro zungaro (Humboldt, 1821)	Jaú	167	39	206
Characiformes				
Anastomidae				
Leporinus fasciatus (Bloch 1794)	Aracú amarelo	280	0	280
Schizodon fasciatus Spix & Agassiz, 1829	Aracú comum	7645	18310	25955

Characidae				
Brycon amazonicus (Spix e Agassiz, 1829)	Matrinxã	8562	32335	40897
Triportheu ssp .	Sardinha	0	21712	21712
Curimatidae				
Curimata inornata Vari , 1989	Branquinha	1300	100	1400
Psectrogaster sp.	Cascuda	712	3250	3962
Erythrinidae				
Hoplias malabaricus (Bloch, 1794)	Traíra	6412	3194	9606
Hemiodontidae				
Hemiodus immaculatus Kner, 1858	Cubiu	14402	8100	22502
Prochilodontidae				
Prochilodus nigricans Spix & Agassiz, 1829	Curimatã	28263	17343	45606
Semaprochilodus insignis (Jardine, 1841)	Jaraqui escama grossa	35410	90190	125600
Semaprochilodus taeniurus (Valenciennes , 1821)	Jaraqui escama fina	5240	69297	74537
Serrasalmidae				
Colossoma macropomum Cuvier, 1818	Tambaqui	8550	4259	12809
Myleus spp.	Pacú	14025	43050	57075
Piractus brachypomus Cuvier, 1818	Pirapitinga	616	999	1615
Serrasalmus rhombeus (Linnaeus, 1766)	Piranha preta	2338	267	2605
Serrasalmus ssp.	Piaranha	525	400	925
Perciformes				
Cichlidae				
Astronotus crassipinnis (Hackel, 1840)	Acará-açu, Cará	4606	4293	8899
Cichla spp.	Tucunaré	20505	4213	24718
Chaetobranchopsis orbicularis (Steindachner, 1875)	Acará branco	48	0	48
Caquetaia spectabilis (Steindachner, 1875)	Acará rosado	0	35	35
Plagioscion spp.	Pescada	10729	10345	21074