BOLETIM DO INSTITUTO DE PESCA
ISSN 1678-2305 online version
Scientific Article

FISHING PRACTICES AND ETHNOICHTHYOLOGICAL KNOWLEDGE IN THE FISHING COMMUNITY OF MIGUEL ALVES, PIAUÍ, BRAZIL

Kelly Polyana Pereira SANTOS[1]
Irlaine Rodrigues VIEIRA[1]
Nelson Leal ALENCAR[2]
Romildo Ribeiro SOARES [2]
Roseli Farias Melo de BARROS[1,2]

[1]Universidade Federal do Piauí – UFPI, Programa de Pós-graduação em Desenvolvimento e Meio Ambiente, Núcleo de Referência em Ciências Ambientais do Trópico Ecotonal do Nordeste - TROPEN, Campus Ministro Petrônio Portella, Av. Universitária, 1310, Bairro Ininga, CEP 64049-550, Teresina, PI, Brazil. E-mail: kellypolyana@hotmail.com (corresponding autor).

[2]Universidade Federal do Piauí – UFPI, Departamento de Biologia, Laboratório de Etnobiologia e Ecologia Vegetal – LEEV, Campus Ministro Petrônio Portela, Av. Universitária, 1310, Bairro Ininga, CEP 64049-550, Teresina, PI, Brazil.

Received: July 17, 2017
Approved: September 06, 2017

ABSTRACT

Fishing communities acquire a wealth of knowledge through their activities and interactions with the aquatic environment. This study characterized the ethnoichthyological knowledge, fishing tackle and fishing practices of a traditional fishing community in Miguel Alves, Piauí. Data was collected through semi-structured interviews, ichthyological specimen collection, direct observations and photographic records. Gender and age groups were compared in terms of Shannon-Wiener Diversity Index of citations and correlation between age, time in the trade and citation abundance was tested using Pearson's correlation coefficient. A total of 42 species were identified in six orders and 20 families with Pimelodidae, Cichlidae and Serrasalmidae being the most representative. The traíra (*Hoplias malabaricus*), barred sorubim (*Pseudoplatystoma fasciatum*) and the piranha (*Pygocentrus nattereri*) were the most frequently mentioned species. Gill nets, fish-hooks and cast nets were the most frequently used types of fishing tackle. Men and women had similar Shannon-Wiener Index values, while significant differences were found between youths and other age groups (adults and elderly). Age and time in the trade were weakly correlated with the number of cited fish species. This study shows that local knowledge was mainly acquired through traditional fishing activities.

Key words: traditional knowledge; ethnozoology; fishing tackle; fish.

ATIVIDADE PESQUEIRA E CONHECIMENTO ETNOICTIOLÓGICO NA COMUNIDADE DE PESCADORES ARTESANAIS DE MIGUEL ALVES/PI, BRASIL

RESUMO

Por intermédio da pesca, os pescadores exploram o ambiente aquático e estabelecem interações com o ambiente. Objetivou-se caracterizar a atividade pesqueira na comunidade de pescadores artesanais de Miguel Alves/PI, quanto aos apetrechos de pesca utilizados e a identificação do conhecimento etnoictiológico. Foram realizadas entrevistas semiestruturadas, observação direta e registro fotográfico. Procederam-se análises quantitativas dos dados por meio do Índice de Diversidade de Shannon-Wiener e coeficiente de Pearson. Realizaram-se coleta e identificação do material zoológico. Foram apontadas 42 espécies, distribuídas em seis ordens e 20 famílias, sendo as mais representativas: Pimelodidae, Cichlidae e Serrasalmidae. Entre as espécies mais citadas destacam-se: traíra (*Hoplias* aff. *malabaricus,* Bloch, 1794), surubim (*Pseudoplatystoma fasciatum,* Linnaeus, 1766) e piranha (*Pygocentrus nattereri,* Kner, 1858*)*. Os apetrechos mais utilizados foram: engancho/rede, seguido de anzol e tarrafa. O Shannon-Wiener demonstrou que a diversidade de citações entre gêneros alcançou valores semelhantes entre homens e mulheres. Por meio do Coeficiente de Pearson, constatou-se que embora a idade e o tempo no ofício da pesca tenham influenciado no número de peixes citados por cada classe, esta influência foi muito discreta tendo como base os valores numéricos trabalhados. O saber local é adquirido por intermédio de atividades relacionadas com a pesca artesanal.

Palavras-chave: conhecimento tradicional; etnozoologia; apetrechos pesqueiros; pescado.

INTRODUCTION

Fishing is a major traditional economic activity in Brazil. According to estimates of the former Ministry of Fisheries and Aquaculture (BRASIL, 2014), one in every two hundred Brazilians is a traditional fishermen, a total of about one million people. This activity is highly significant in social, economic, cultural and historical terms for riverine communities, since fishing is an important source of employment, income and

food in these communities (DIEGUES and ARRUDA, 2001; LIMA and VELASCO, 2012; BRASIL, 2014).

Traditional fishing differs from industrial fishing in regards to the techniques, target habitats and catch quantity. Traditional fishermen can be found along the coast, in rivers and lakes. They usually work as individuals or in kinship groups, using simple fishing tackle and selling most of their produce in markets.

Through their activities and interactions with aquatic environments, traditional fishermen build-up comprehensive stores of knowledge (NOVAES and CARVALHO, 2011, 2013; RAMIRES *et al.,* 2012; SANTOS *et al*., 2014; NOVAES *et al*., 2015). This makes them ideal study populations for ethnobiological studies, specifically ethnoichthyological studies, which allows us to develop a deeper understanding of fish species. In these studies the following variables are of particular interest: catch composition, income, fishery productivity and types of fishing tackle (CLAUZET *et al*., 2007; VASCONCELLOS *et al*., 2011).

Traditional fishermen knowledge on these natural resources can contribute to the conservation of these resources (SILVANO, 1997). Understanding how fishing communities are organised and how knowledge is distributed in them is important to implement proper fishery management measures and to promote economic development in of these communities (WALTER, 2000).

In this study we aim to identify what knowledge fishermen possess on local ichthyofauna and fishing techniques and how this knowledge is distributed in terms of gender, age and experience. The fishing community under study is located in the municipality Miguel Alves, Piauí which is understood to have extensive knowledge on the subject matter.

METHODS

Study area and populations

Miguel Alves (Figure 1) is a Brazilian municipality in the state of Piauí – PI. Population is estimated to be 32 289 in 2016. The municipality covers an area of 1 393.708 km^2 and is bordered by Porto, PI and the State of Maranhão to the north; União, Lagoa Alegre and Cabeceiras do Piauí, PI to the south; Nossa Senhora dos Remédios and Barras, PI to the east and Maranhão to the west; the municipality is 112 km away from the state capital Teresina (IBGE, 2016).

The Parnaíba River is the main river in the municipality; it is a perennial river and can be navigated by small-sized vessels. The largest streams are Tamanduá, Arara, Ameixa, Riachão das Piranhas e Riachão de Fora. The main lakes are: Riachão, Salina,

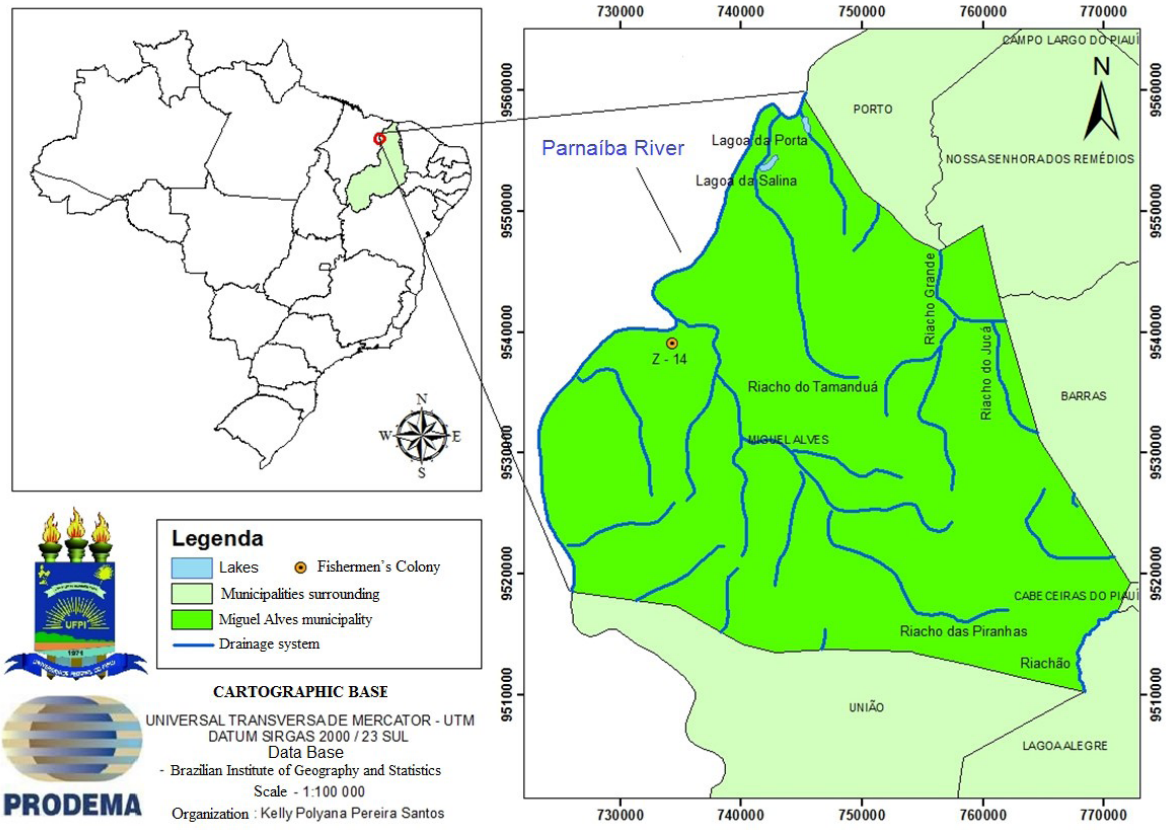

Figure 1. Location of the Miguel Alves municipality – PI, Brazil and the Z-14 Fishermen's Colony.

Almas, Curtumes, Caraíbas, Conceição e Lagoa Porta. The area has a Hot Tropical Semiarid climate (IBGE, 2016).

The study was carried between January 2016 and January 2017, in the fishing community whose inhabitants are affiliated with the Z-14 Colony, founded on the 25th of April 1986, which is part of the Fishermen's Federation of the State of Piauí. This colony has 440 members, 366 are from the Miguel Alves municipality and the remaining members are distributed among the neighbouring municipalities of Buriti, Duque Bacelar and Coelho Neto located in in the State Maranhão.

Fishing is the main source of income for inhabitants of this community, although secondary activities do supplement family incomes. Fishing in the region is not only an economic activity but also a cultural activity with immeasurable value.

Data collection

The study proposal was submitted to the Research Ethics Committee of the Federal University of Piauí and approved by Decision n° 2.007.351. Interviews were carried after interviewees consented by signing two copies of the Informed Consent Form, one for the interviewee and one for the researcher.

A probabilistic sample with 5% sample error was collected (BARBETTA, 2006), making up a total of 183 fishermen and fisherwomen. Individuals were classified by gender and by ages group (as used by IBGE, 2016): youth (18 to 24 years old), adults (25 to 59) and elderly (above 60).

Semi-structured interviews were used to collect quantitative and qualitative data, using a standard form with closed-ended and open-ended questions (BERNARD, 1988). Data was collected on the types of fish (ethnospecies), fishing tackle and fishing activity. To supplement this data fish species and fishing tackle were photographed and casual conversations were recorded in audio field journals.

Interviews and audio field journals were transcribed for quantitative and qualitative analysis. These transcriptions are quoted using a code for each interviewee ("E" followed by interview number and age of interviewee). These transcriptions were archived at the *Núcleo de Referência em Ciências Ambientais do Trópico Ecotonal do Nordeste* (TROPEN) of the Federal University of Piauí (UFPI).

Zoological specimens were donated by traditional fishermen for identification and further analysis. Specimens were treated using standard field methods as defined by AURICCHIO and SALOMÃO (2002). Fish were identified by consulting specialized bibliography and by comparison with specimens deposited in the *Antônio João Dumbra* Zoological Laboratory (LZUFPI) of the Federal University of Piauí. The specimens collected on this study were incorporated to this same collection. Binomial nomenclature follows that found on FishBase (FROESE and PAULY, 2017).

Data analysis

Data was compiled in Excel and graphs and tables were generated with Bioestat 5.0 software. Citation diversity was calculated for each gender and age group using Shannon-Wiener Diversity Index (H´) (MAGURRAN, 1988), based on the number of cited species in each group. These values were compared using the Hutcheson t-test (ZAR, 1999) as implemented in the Past software (HAMMER *et al*., 2001), assuming the null hypothesis was that there was no difference in citation diversity between groups. Correlation between age and time in the trade (experience) on the one hand and number of citations for each individual was calculated using Pearson's correlation coefficient.

RESULTS

Demographic structure

Fishermen in Miguel Alves are distributed among ages groups in the following manner: youth (8%), adults (82%) and elderly (10%). In terms of gender, 59.6% are male and 40.4% female.

Ethnoichthyological knowledge

Interviewees cited 42 species among 6 orders and 20 families (Table 1) when asked about existing species in the Parnaíba River. The most well represented families were: Pimelodidae (7 spp.), Cichlidae (4 spp.), Serrasalmidae (4 spp.). The most cited species were the traíra [wolf fish], *Hoplias malabaricus* (125 citations), the surubim [barred catfish] *Pseudoplatystoma fasciatum* (123 citations) and the piranha, *Pygocentrus nattereri* (119 citations).

Regarding citation diversity between genders, similar values were observed for men (H'= 3.611) and women (H'= 3.587), with no significant difference being found between the two groups ($t=1.625$; $df=1685.7$; $p=0.1043$).

Regarding citation diversity among youth (H'=3.34), adults (H'=3.61) and elderly (H'=3.59), youth showed significantly lower values then adults ($t=6.637$; $df=123.23$; $p=9.05\times10^{-10}$) and elderly ($t=4.4831$; $df=201.48$; $p=1.23\times10^{-5}$) and adults showed significantly higher values then the elderly ($t=2.4468$; $df=300.71$; $p=0.0149$).

A weak positive relationship was found between number of species cited and age ($r=0.305$; $p<0.0001$; Figure 2) as well as between number of species cited and time in the trade ($r=0.345$; $p<0.0001$; Figure 3).

Fishing practices and tackle

Fishing is carried out in the Parnaíba River and in lakes near the community, both individually and in kin groups at different times of the day (Figure 4).

Interviewees declared they knew about the breeding season (November 15th to March 16th) and respected the fishing restrictions during this season. During this season most fishing is prohibited

Table 1. Ichthyofauna cited by the fishermen of Miguel Alves, Piauí in 2017.

Ordem/ Family	Ethnospecies	Scientific name	Number of citations
Characiformes			
Serrasalmidae	Pacu	*Myleus asterias* (Müller & Troschel, 1844)	19
	Pirambeba	*Serrasalmus rhombeus* (Linnaeus, 1766)	39
	Piranha	*Pygocentrus nattereri* Kner, 1858	119
	Tambaqui	*Colossomama cropomum* (Cuvier, 1816)	49
Characidae	Corcunda	*Roeboides sazimai* Lucena, 2007	33
	Piabinha	*Astyanax* aff. *Bimaculatus* (Linnaeus, 1758)	23
Anostomidae	Piau-de-vara	*Schizodon dissimilis* (Garman, 1890)	27
	Piau-cabeça-gorda	*Leporinus piau* Fowler, 1941	44
	Piau-de-coco	*Leporinus friderici* (Bloch, 1794)	104
Prochilodontidae	Curimatá/ Sambuda	*Prochilodus lacustris* Steindachner, 1907	96
Triportheidae	Sardinha	*Triportheus signatus* (Garman, 1890)	66
Curimatidae	Branquinha-do-oião	*Curimata macrops* Eigenmann & Eigenmann, 1889	44
	Branquinha-do- oin	*Psectrogaster rhomboide* Eigenmann & Eigenmann, 1889	90
Chilodontidae	Escama-dura	*Caenotropus labyrinthicus* (Kner, 1858)	49
Erythrinidae	Traíra	*Hoplias* aff. *malabaricus* (Bloch, 1794)	125
	Yú	*Hoplerythrinus unitaeniatus* (Spix & Agassiz,1829)	68
Hemiodontidae	Frecheiro/voador	*Hemiodus parnaguae* Eigenmann and Henn, 1916	73
Siluriformes			
Auchenipteridae	Fidalgo/Boca- mole	*Ageneiosus* sp Valenciennes, 1836	34
	Matrinchan	*Ageneiosus inermis* (Linnaeus, 1766)	71
	Cumbá	*Trachelyopterus galeatus* (Linnaeus, 1766)	23
Loricariidae	Bodó	*Hypostomus plecostomus* (Linnaeus, 1758)	44
	Carí	*Loricaria parnahybae* (Steindachnner, 1907)	35
	Cachimbo	*Rineloricaria* sp (Bleeker, 1862)	57
Pimelodidae	Mandi-dourado	*Synodontis clarias* (Linnaeus, 1758)	74
	Bico- de-pato	*Sorubim lima* (Bloch & Schneider, 1801)	78
	Piratinga	*Brachyplatystoma filamentosum (*Lichtenstein, 1819)	33
	Pintado	*Pseudoplatystoma corruscans (*Spix & Agassiz, 1829)	20
	Mandubé	*Hemisorubim platyrhynchos* (Valenciennes, 1840)	53
	Surubim	*Pseudoplatystoma fasciatum (*Linnaeus, 1766)	123
	Branquin	*Brachyplatystoma vaillantii (*Valenciennes, 1840)	79
Doradidae	Grangiola	*Platydoras brachylecis* Pioski, Garavelo, Arce & Sabaj, 2000	36
	Mandi-cabeça- de-cavalo	*Hassar affinis* (Steindachner, 1881)	27
Heptapteridae	Mandi- mole/pomba- de- padre	*Pimelodella parnahybae* Fowler, 1941	83
Clupeiformes			
Pristigasteridae	Arenga	*Pellona flavipinnis* (Valenciennes, 1837)	90
Myliobatiformes			
Potamotrygonidae	Arraia	*Potamotrygon signata* Garman, 1913	43
Beloniformes			
Belonidae	Bico- de- agulha	*Pseudotylosurus microps* (Günther, 1866)	05

Table 1. Continued...

Ordem/ Family	Ethnospecies	Scientific name	Number of citations
Perciformes			
Cichlidae	Tilápia	*Coptodon rendalli* (Boulenger, 1897)	45
	Tucunaré	*Cichla monoculus* Spix & Agassiz, 1831	60
	Cará- praiano	*Astronotus ocellatus* (Agassiz, 1931)	82
	Cará- barrão	*Geophagus brasiliensis* (Quoy & Gaimard, 1824)	46
Scianidae	Corvina	*Plagioscion squamosissimus* (Heckel, 1840)	56
Gymnotidae	Sarapó-do- bico-fino	*Gymnotus gr. carapo* Linnaeus, 1758	70

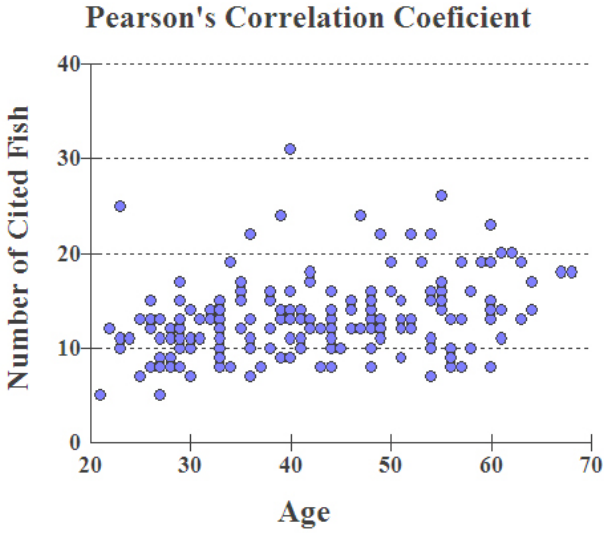

Figure 2. Correlation between the number of cited species and the age of traditional fishermen.

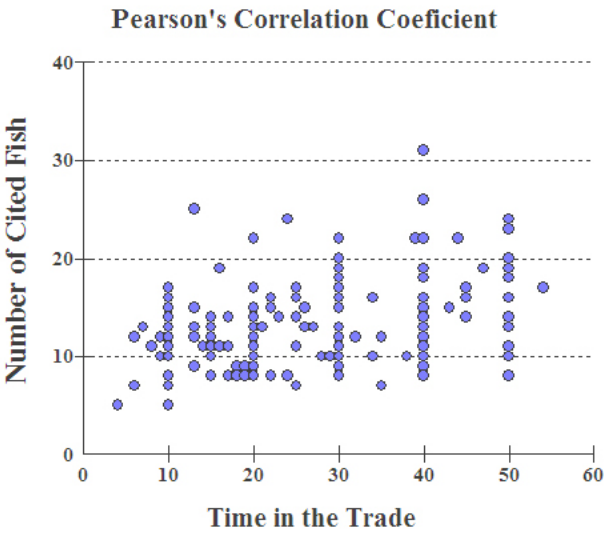

Figure 3. Correlation between number of cited species and the time in trade of traditional fishermen.

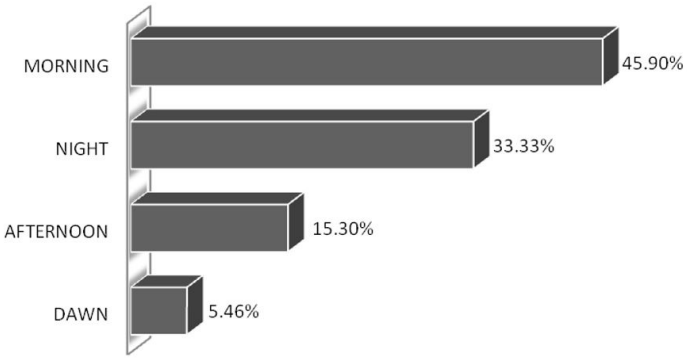

Figure 4. Preferred times of the day for fishing.

with the exception of angling which is restricted to a daily quantity of 4kg. Offenders can be fined and lose their "*seguro-defeso*" [traditional fishermen's unemployment benefits].

> *Over here we respect the piracema [breeeding season] otherwise we won't have fish for the rest of the year. Interviewee 25 (46 years of age).*

> *My dear, we can even lose our our [fishermen's] license if we don't respect the piracema [breeding season]. Interviewee 92 (58 years of age).*

Among interviewed fishermen, 100% received were granted unemployment benefits due to fishing prohibition during the breeding season (*seguro-defeso* as established under Federal Law 10,779 of November 2003).

When asked about the month when fish are most available, answers were the following: May, 22.2%; June, 62.7%; July, 22.2%. These are the months following the breeding season.

As for fishing tackle, fishermen described 8 types of gear which are used to catch different species (Table 2).

The types of fishing tackle that were used most often in the community were gill nets (74.32% of citations), fish-hooks (66.67%) and throw nets (37.70%) (Figure 5).

Table 2. Fishing gear and target fish species in the fishing community.

Classification	Type	Fishing tackle	Description	Target species
Active	Gill fishing	Engancho/ Rede de espera	Rectangular shaped net. Catches fish of different sizes in the spaces between the knots. The larger space between knots, the higher the selectivity of the net.	Branquinha Branquin Arenga
	Net	Tarrafa	Conical shaped net, with lead weights distributed along the edge of the net. Used mainly to catch lare fish. When cast in the river it sinks due to weights and is then pulled by the fishermen, snatching the fish in the mesh.	Piratinga Matrinchan Cachimbo
Passive	Line Fishing	Anzol	An instrument made out of bamboo (*Bambusa* sp.) or iron rod, nylon lines and a small iron hook were a bait is placed. It is used to catch a few small-sized carnivorous fish.	Piranha Traíra Mandi
	Trapping	Quixó/ Currú	Conical instrument, with an inverted funnel shape, with an opening in the top and bottom extremities. The instrument is placed in shallow water in the stream bed. Catch is removed from the top opening. It is used to catch small fish that live close to the river banks.	Traíra Mandi Piabinha Arraia
	Trapping	Jiqui/ Curral	Made out of wood and plastic and shaped like a cube. A bait is placed in the inside that attracts and traps fish.	Mandi Piranha Sardinha
	Trapping	Landoá	Conical shaped instrument, with three strings attached to the edge of the circumference that join a main rope which has a piece of styrofoam attached to extremity. Used to catch small fish that accumulate in dry streams.	Sardinha Piau-de-vara
	Trapping	Groseira	Instrument with several lines with hooks placed along a central line; used to catch big fish.	Bico-de-pato Cachimbo Surubim
	Trapping	Peneira	Circular instrument. It is fine sieve made out of interweaved dried bamboos (*Bambusa* sp.), through which water passes. This instrument can be used to fish close to river banks and catch is of small-size.	Branquinha Piranha

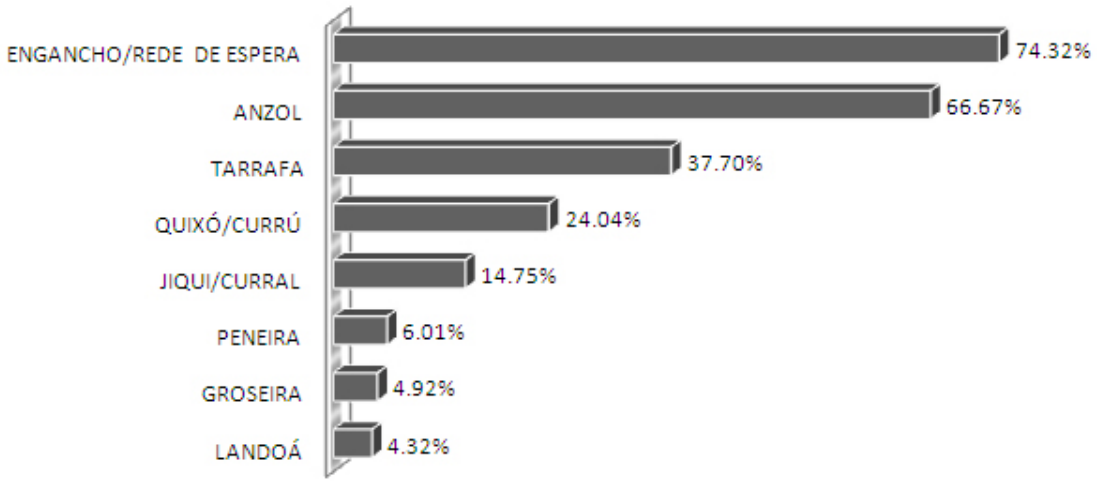

Figure 5. Fishing tackle used by traditional fishing community.

DISCUSSION

Demographic structure

The large number of adults involved in fishing as a professional activity in the community can in part be explained by that lack of educational opportunities that would allow them to pursue different professions. According to IBGE (2016) the municipality has three state schools with high school education and therefore further education has to be sought out in neighbouring regions, which is not an option for most individuals due to lack of financial means.

Social benefits, specifically old-age pension, which traditional fishermen are entitled to, can also explain the large proportions of individuals from older generations involved in this activity, with most paying particular attention to the minimum contribution time need to be entitled to old-age pension.

In contrast the low percentage of youth most likely is explained by the low income associated with the activity; this a crucial factor as it influences the transmission of fishing knowledge from the older to the younger generations. The reduced number of youth entering the profession is an observation consistent with previous studies (VASCONCELOS *et al.,* 2003; BORCEM *et al*., 2011; BASILIO and GARCEZ, 2014; ZACARDI *et al*., 2014; INONATA and FREITAS, 2015, PINTO *et al*., 2015, SILVA-GONÇALVES and D'INCÃO, 2016).

MASSENA *et al*. (2014) noted that most traditional fishermen in Ilhéus, Bahia are "old" fishermen, with the majority being over 40 years of age (64%). ZACARDI, 2015 reported that the majority traditional fishermen in Ferreira Gomes, Amapá were adults, with an average age of 47 and range between 18 and 76 years, the most frequent age being between 20 and 40 years. In this last study the small proportion of youths was explained by the fact that most sought employment in other professions which were consider to be more advantageous then traditional fishing.

Most youths are also given an incentive to study by parents, while being kept away from fishing activities. ALMEIDA *et al*. (2014) observed that most youths in the municipality of João Pessoa, Paraíba showed a decreased interest in fishing due to both economic and ecological factors, such as the limited amount of catch available due to limitations on fishing periods and environmental degradation.

With regard to gender, there is high level of involvement of women in fishing activities, both directly (fishing with their husbands) and indirectly (by preparing fish and crafting tackle). Fisherwomen are thus not only involved in housekeeping but also in generating income for families. GARCEZ and SÁNCHEZ-BOTERO (2005) found that in Rio Grande do Sul non-professionalized women play several different roles in fishing activities, such as preparing catch before sale; This is commonly observed in many other traditional fishing communities in Brazil: Amazonas (SILVA *et al*., 2014), Paraná (PÉREZ and GOMÉZ, 2014) Pernambuco (SANTOS, 2016), Rio Grande do Norte (MAIA and NETO, 2012; KNOX and FIRME, 2016); Rio Grande do Sul (ROSÁRIO, 2010), Piauí (SOUSA, 2010; AMORIM, 2010; NASCIMENTO, 2014; SANTOS *et al*., 2015). It is interesting to note that until the mid 80s fishing was an exclusively male activity (MOTTA-MAUÉS, 1993).

Fishing practices and tackle

Most fishermen in the community (45.90%) considered the best time for fishing to be during the day, not only for safety reasons but also due to the larger quantity and wider variety of catch available. Traditional fishermen in União, Piauí preferred night-time (41,33%) to avoid the health risks associated with sun exposure (SANTOS *et al*., 2015). Further south in Tramandaí, Rio Grande do Sul, traditional fishermen prefer to start fishing between 6-7 pm, with fishing outing/trip lasting on average 6.6 hours (SILVA-GONÇALVES and D'INCAO, 2016).

PINHEIRO and JOYEUX (2007) observed that fishing times depend on the type of catch, while BARBOZA and PEZZUTI (2011) observed that fishing times are influenced by a combination of factors such as the tide, the time of the day and the behaviour in school structuring. NASCIMENTO (2014) in a study at Barrinha, Piauí, found that the morning was the best period for fishing (n=29; 55.77%) and that the activity period was influenced by the phase of the moon (crescent or waning). Thus periods considered best for fishing are influenced by several factors and seem to be chosen differently from community to community (and even from individual to individual).

Fishermen in the community understood what the breeding season (*piracema*) was and its significance. During this period schools of fish swim against the current to reach river springs for spawning and were fingerlings have the best chance to survive. During this time of the year the large quantity of adult fish swimming up river are easy prey and a single net can catch an entire school. The breeding period usually occurs between November and February, but can vary between river basins and can have different lengths for each fish species (FREITAS *et al*., 2010).

Gill-nets are the type of fishing tackle most commonly used in the community. These allow a large quantity and diversity of fish to be caught on one occasion, since the size of the mesh can have holes of varying in size, between 3 and 12 cm. Mesh size varies according to target species (HARAYASHIKI *et al*., 2011), which influences gill net catch selectivity, that is defined as the relationship between the size of mesh and the size of the fish; mesh size can be adjusted to avoid catching smaller fish (SPARRE and VENEMA, 1997; ALVES *et al*., 2012).

Fishing, especially gill-netting, is carried out in partnerships since it requires more than one fishermen to attach the net in opposites sides of the river. Gill nets are set-up at the end of the day and removed at dawn in the following day

The types of fishing tackle and use proportions observed in this fishing community are similar to those reported in previous studies. SANTOS *et al*. (2015) found that in União, Piauí different types of tackle is used to catch different types of fish; gill nets (91.33%), fishing rods (60.67%) and throw nets (42.67%) were the types of tackle most used; these instruments were crafted by 13.3% of the fishermen in the colony. AMORIM (2010) found that in the Poti River estuary, nets are the most common type of tackle in use (91%), specifically gill nets (54%) and throw nets (37%).

The preferential use of gill nets has been observed in riverine communities in several Brazilian studies (COSTA NETO and MARQUES, 2001; FREITAS NETTO, *et al*., 2002; CHAVES

and ROBERT, 2003; PINHEIRO and JOYEUX, 2007; COTRIM, 2008; BURDA and SCHIAVETTI, 2008; DAVID *et al*., 2016; FLEXA *et al*., 2016; SANTOS *et al*., 2016). This preference has several explanations, such as lower environmental impact and the ability to capture large quantities and diversity of fish.

Gill nets and throw nets are frequently used by traditional fishermen in North-east Brazil, choices that are influenced by environmental and cultural conditions (MUEHE and GARCEZ, 2005).

In our study community, women frequently use fishing rods, since it doesn't require much physical effort and can be crafted easily by the women; this has been observed in several studies on traditional fishing in Brazil (LESSA *et al*., 1998; VASKE-JUNIOR *et al*., 2008; SAZIMA *et al*., 2013; DOMINGUEZ *et al*., 2016).

Fishing tackle is an important knowledge component for fishermen. Other studies on traditional fishing studies have described catch composition and fishing tackle (NOVAES and CARVALHO (2011) in São Paulo; RAMIRES *et al.* (2012) in São Paulo; NOVAES and CARVALHO (2013) in Paraná; SANTOS *et al*. (2014) in Pernambuco; NOVAES *et al*. (2015), in Rio Grande do Norte).

Fishermen in Miguel Alves use different types of fishing tackle over their life-time depending on catch availability and fishing intent.

Ethnoichthyological knowledge

Regarding the citation diversity (H') a similar value was observed among men and women. This similarity is explained by the fact that men and women participate and cooperate in fishing activities and thus acquire and share similar experiences and knowledge. These results corroborate findings from previous studies: SOUSA (2010) studied ethnozoological knowledge of two communities in the Environmental Protection Area of the Parnaíba Delta, North-east Brazil and found that there were no significant differences in citation diversity between men and women in both Barra Grande (men H'=3.86; women H'=3.43) and Morro da Mariana (men H'=3.72; women H'=3.63); MEIRELES (2012) observed similar results in another fishing community (Canárias) of the Environmental Protection Area of the Parnaíba Delta, with no significant differences being found between men (H'(e)=3,38) and women (H'=3.21).

This is not always the case however; in Barrinha, on the coast of Piauí, NASCIMENTO (2014) found that men had a higher citation diversity index (H'=3.37892). These differences between studies can possibly be explained by gender differences in levels of engagement with fishing activities.

Ethnoichtyological knowledge is unevenly distributed among age's groups. Adults and elderly are the most knowledgeable groups. For adults this is due to their strong professional engagement with the activity and due to the knowledge transfer from older generations. Among the elderly, these high values are explained by accumulation of knowledge over a lifetime. FONSECA-KRUEL and PEIXOTO (2004) observed in the Arraial do Cabo Extractive Reserve, Rio de Janeiro, that traditional knowledge is concentrated in the elderly. Similar results have also been found by FIGUEIREDO *et al.* (1997), ROSSATO *et al*. (1999), MERÉTIKA *et al*. (2010) and SOUSA *et al*. (2012). Lower values of citation diversity among the youth are consistent with the observation of lower engagement in fishing activities.

Age and time in the trade of fishermen were weakly correlated with the number of cited fish species, which is in agreement with studies by SANTOS *et al*. (2015) of traditional fishing communities in União, Piauí, in which the correlation between age and number of cited species was moderately correlated (r=-0.62), but insignificant.

CONCLUSIONS

In the study community at Miguel Alves, fishing is an activity carried out by both men and women, with fisherwomen playing several roles, both as income earners and housekeepers.

Local ecological knowledge, especially on fish, is acquired through fishing activities, such as by capturing and handling catch for consumption and sale. This knowledge is an important resource, which can aid in the conservation and sustainable use of local ichtyofauna.

The great diversity of fishing tackle used to capture target species and the high number species cited are proof that these traditional fishermen have comprehensive ethnoicthyological knowledge. Gender and age group are important characteristics in fishing communities and should be considered in public policy that aims to improve livelihoods in these fishing communities.

REFERENCES

ALMEIDA, D.M.; SILVA-OLIVEIRA, E.C.; ALVES, R.R.N. 2014 Ethnoichthyology of fishermen community from the praia da Penha, in João Pessoa City, Paraíba, Brazil. *Brazilian Journal of Biological Sciences*, *1*(2): 39-49. **http://dx.doi.org/10.21472/bjbs.010202**.

ALVES, P.M.F.; ARFELLI, C.A.; TOMÁS, A.R.G. 2012 Selectivity of bottom gillnet of southeastern Brazil. *Boletim do Instituto de Pesca*, *38*(4): 275-284.

AMORIM, A.N. 2010 *Etnobiologia da comunidade de pescadores artesanais urbanos do bairro Poti Velho, Teresina/PI, Brasil*. Teresina. 122f. (Dissertação de Mestrado. Programa de Pós-graduação em Desenvolvimento e Meio Ambiente, UFPI). Available from: <http://www.leg.ufpi.br/subsiteFiles/mestambiente/arquivos/files/Disserta%C3%A7%C3%A3o%20AMORIM,%20A_N_%202010%20-%20impress%C3%A3o.pdf>. Access on: 20 oct. 2016.

AURICCHIO, P.; SALOMÃO, M.G. 2002 *Técnicas de coleta e preparação de vertebrados para fins científicos e didáticos*. Rio de Janeiro: Papel Virtual. 348p.

BARBETTA, P.A. 2006 *Estatística aplicada às Ciências Sociais*. 6ª ed. Florianópolis: Ed. da UFSC. p. 315.

BARBOZA, R.S.L.; PEZZUTI, J.C.B. 2011 Etnoictiologia dos pescadores artesanais da Resex Marinha Caeté - Taperaçu, Pará: aspectos relacionados com etologia, usos de hábitat e migração de peixes da família Sciaenidae. *Sitientibus*, *11*(2): 133-141. **http://dx.doi.org/10.13102/scb104**.

BASILIO, T.H.; GARCEZ, D.S. 2014 A pesca artesanal no Estuário do Rio uru, Ceará, Brasil: saber local e implicações para o Manejo. *Actapesca*, *2*(1): 42-58.

BERNARD, H.R. 1988 *Research methods in cultural anthropology*. Newbury Park: Sage. 520p.

BORCEM, E.R.; FURTADO-JÚNIOR, I.; ALMEIDA, I.C.; PALHETA, M.K.S.; PINTO, I.A.A. 2011 Atividade pesqueira no município de Marapanim-Pará, Brasil. *Revista de Ciências Agrárias*, *54*(3): 189-201.

BRASIL. Lei Federal nº 10.779, de 25 de Novembro de 2003. Dispõe sobre a concessão do benefício de seguro desemprego, durante o período de defeso, ao pescador profissional que exerce a atividade pesqueira de forma artesanal. Diário Oficial da União, Brasília, 2003. Available from: <http://www.planalto.gov.br/Ccivil_03/leis/2003/L10.779.htm>. Access on: 25 july 2017.

BRASIL. MINISTÉRIO DA PESCA E AGRICULTURA 2014 *Produção pesqueira e aquícola*. Brasília: MPA. Available from: <http://www.mpa.gov.br/index.php/pesca/artesanal>. Access on: 5 nov. 2016.

BURDA, C.L.; SCHIAVETTI, A. 2008 Análise ecológica da pesca artesanal em quatro comunidades pesqueiras da costa de Itacaré, Bahia, Brasil: subsídios para a gestão territorial. *Revista Gestão Costeira Integrada*, *8*(2): 149-168. **http://dx.doi.org/10.5894/rgci136**.

CHAVES, P.T.; ROBERT, M.C. 2003 Embarcações, artes e procedimentos da pesca artesanal no litoral sul do estado do Paraná, Brasil. *Atlantica*, *25*(1): 53-59.

CLAUZET, M.; RAMIRES, M.; BEGOSSI, A. 2007 Etnoictiologia dos pescadores artesanais da praia de Guaibim, Valença (BA), Brasil. *Neotropical Biologyand Conservation*, *2*(3): 136-154.

COSTA-NETO, E.M.; MARQUES, J.G.W. 2001 Atividades de pesca desenvolvidas por pescadores da comunidade de Siribinha, município de Conde, Bahia: Uma abordagem etnoecológica. *Sitientibus*, *1*(1): 71-78.

COTRIM, D.S. 2008 *Agroecologia, sustentabilidade e os pescadores artesanais*: O caso de Tramandaí (RS). Porto Alegre. 197f. (Dissertação de Mestrado em Desenvolvimento Rural. UFRGS). Available from: <http://www.lume.ufrgs.br/handle/10183/14270>. Access on: 20 jan. 2017.

DAVID, G.S.; CAMPANHA, P.M.G.C.; MARUYAMA, L.S.; CARVALHO, E.D. 2016 Artes de pesca artesanal nos reservatórios de Barra Bonita e Bariri: monitoramento pesqueiro na bacia do médio rio Tietê. *Boletim do Instituto de Pesca*, *42*(1): 29-49. **http://dx.doi.org/10.20950/1678.2305.2016v42n1p29**.

DIEGUES, A.C.; ARRUDA, R.S.V. (Org.) 2001 *Saberes tradicionais e biodiversidade no Brasil,* Brasília: Ministério do Meio Ambiente, Biodiversidade. v.4. 211p.

DOMINGUEZ, P.S.; ZEINEDDINE, G.C.; ROTUNDO, M.M.; BARRELLA, W.; RAMIRES, M. 2016 A pesca artesanal no arquipélago de Fernando de Noronha (PE). *Boletim do Instituto de Pesca*, *42*(1): 241-251. **http://dx.doi.org/10.20950/1678-2305.2016v42n1p246**.

FIGUEIREDO, G.M.; LEITAO-FILHO, H.F.; BEGOSSI, A. 1997 Ethnobotany of Atlantic Forest Coastal Communities: II. Diversity of Plant Uses at Sepetiba Bay (SE Brazil). *Human Ecology*, *25*(2): 353-360. **http://dx.doi.org/10.1023/A:1021934408466**.

FLEXA, C.E.; SILVA, K.C.A.; CINTRA, I.H.A. 2016 pescadores artesanais à jusante da usina hidrelétrica de Tucuruí, Amazônia, Brasil. *Boletim do Instituto de Pesca*, *42*(1): 221-235. **http://dx.doi.org/10.20950/1678-2305.2016v42n1p221**.

FONSECA-KRUEL, V.S.; PEIXOTO, A.L. 2004 Etnobotânica na Reserva Extrativista Marinha de Arraial do Cabo, RJ, Brasil. *Acta Botanica Brasílica*, *18*(1): 177-190. **http://dx.doi.org/10.1590/S0102-33062004000100015**.

FREITAS NETTO, R.; NUNES, A.G.A.; ALBINO, J. 2002 A pesca realizada na comunidade de pescadores artesanais de Santa Cruz/ES – Brasil. *Boletim do Instituto de Pesca*, *28*(1): 93-100.

FREITAS, R.R.; REIS, V.L.; APEL, M. 2010 Governança de Recursos Pesqueiros na Bacia do Rio Acre com Ênfase na Tríplice Fronteira (Brasil, Peru e Bolívia). In: ENCONTRO NACIONAL DA ASSOCIAÇÃO NACIONAL DE PESQUISA E PÓS-GRADUAÇÃO EM AMBIENTE E SOCIEDADE, Florianópolis, 2010. *Anais*... Florianópolis: ANPPAS.

FROESE, R.; PAULY, D., editors. 2017 *FishBase.* Versão 06/2017. [online] URL: <www.fishbase.org>.

GARCEZ, D.S.; SÁNCHEZ-BOTERO, J.I. 2005 Comunidades de pescadores artesanais no estado do Rio Grande do Sul, Brasil. *Atlantica*, *27*(1): 17-29.

HAMMER, Ø.; HARPER, D.A.T.; RYAN, P.D. 2001 *PAST*: Paleontological statistical software package for education and data analysis. *Palaeontologia Electronica*, *4*(1): 1-9.

HARAYASHIKI, C.A.Y.; FURLAN, F.M.; VIEIRA, J.P. 2011 Perfil sócio-econômico dos pescadores da Ponte dos Franceses, Rio Grande, RS, Brasil. *Boletim do Instituto de Pesca*, *37*(1): 93-101.

IBGE – Instituto Brasileiro de Geografia e Estatística 2016 [online] URL: <http://cidades.ibge.gov.br/xtras/perfil.php?lang=&codmun=220620&search=piaui|miguel-alves>.

INONATA, S.O.; FREITAS, C.E.C. 2015 Caracterização da frota pesqueira de Coari, Médio Rio Solimões (Amazonas-Brasil). *Revista Agrogeoambiental*, *3*(1): 65-70.

KNOX, W.; FIRME, R. M. 2016 Mulheres na atividade pesqueira no Espírito Santo. *Revista Gênero*, *16*(2): 219-235.

LESSA, R.; SALES, L.; COIMBRA, M.R.; GUEDES, D.; VASKE-JUNIOR., T. 1998 Análise dos desembarques da pesca de Fernando de Noronha (Brasil). *Arquivo de Ciências do Mar, 31*(1): 47-56.

LIMA, B.B.; VELASCO, G. 2012 Estudo piloto sobre o Autoconsumo de pescado entre pescadores artesanais do estuário da Lagoa dos Patos, RS, Brasil. *Boletim do Instituto de Pesca*, *38*(4): 357-367.

MAGURRAN, A.E. 1988 *Ecological diversity and its measurement.* New Jersey: Princeton University Press. 179p.

MAIA, I.S.; OLIVEIRA NETO, J.T. 2012 Estudo de viabilidade econômica e gestão democrática de empreendimentos populares: o caso das marisqueiras do semiárido potiguar. *Vivência: Revista de Antropologia*, *40*(6): 7-79.

MASSENA, F.S.; RAMOS, F.L.; MIROTTI, P.I.; TREVIZAN, S.D.P.; WIBELINGER, L.M. 2014 Etnoictiologia dos Pescadores artesanais da Vila Cachoeira. Ilhéus/BA. *Revista Brasileira de Engenharia de Pesca*, *7*(1): 33-44.

MEIRELES, V.J.S. 2012 *Etnobotânica e etnozoologia da comunidade pesqueira Canárias, reserva extrativista marinha do Delta do Parnaíba, Nordeste do Brasil.* Teresina, 160f. (Dissertação de Mestrado. Programa de Pós-graduação em Desenvolvimento e Meio Ambiente, UFPI). Available from: <http://leg.ufpi.br/subsiteFiles/mestambiente/arquivos/files/Disserta%C3%A7%C3%A3o%20Victor%20de%20Jesus%20Silva%20Meireles.pdf>. Access on: 20 jan. 2017.

MERÉTIKA, A.H.C.; PERONI, N.; HANAZAKI, N. 2010 Local knowledge of medicinal plants in three artisanal fishing communities (Itapoá, Southern Brazil), according to gender, age, and urbanization. *Acta Botanica Brasílica*, *24*(2): 386-394. **http://dx.doi.org/10.1590/S0102-33062010000200009**.

MOTTA-MAUÉS, M.A. 1993 *Trabalhadeiras e camaradas: relações de gênero, simbolismo e ritualizacão numacomunidade amazônica*, Belém: Editora Universitária/UFPA.

MUEHE, D.; GARCEZ, D.S.A. 2005 Plataforma Continental Brasileira e sua relação com a Zona Costeira e a Pesca. *Revista Mercator*, *4*(8): 69-88.

NASCIMENTO, M.G.P. 2014 *Etnobotânica e Etnozoologia em Comunidades Pesqueiras de Parnaíba e Cajueiro da Praia, Piauí.* Teresina. 155f. (Dissertação de Mestrado. Programa de Pós-graduação em Desenvolvimento e Meio Ambiente, UFPI). Available from: <https://www.sigaa.ufpi.br/sigaa/public/programa/noticias_desc.jsf?lc=pt_BR&id=340&noticia=64762142>. Access on: 23 mar. 2017.

NOVAES, J.L.C.; CARVALHO, E.D. 2013 Analysis of artisanal fisheries in two reservoirs of the upper Paraná River basin (Southeastern Brazil). *Neotropical Ichthyology*, *11*(2): 403-412. **http://dx.doi.org/10.1590/S1679-62252013005000002**.

NOVAES, J.L.C.; FREIRE, A.E.; AMORIM, R.A.; COSTA, R.S. 2015 Diagnóstico da pesca artesanal em um reservatório do semiárido brasileiro. *Boletim do Instituto de Pesca*, *41*(1): 31-42.

NOVAES, J.L.C.A.; CARVALHO, E.D.B. 2011 Artisanal fisheries in a Brazilian hypereutrophic reservoir: Barra Bonita Reservoir, Middle Tietê River. *Brazilian Journal of Biology = Revista Brasileira de Biologia*, *71*(4): 821-832. **http://dx.doi.org/10.1590/S1519-69842011000500003**.

PÉREZ, M.S.; GÓMEZ, J.R.M. 2014 Políticas de desenvolvimento da pesca e aquicultura: conflitos e resistências nos territórios dos pescadores e pescadoras artesanais da vila do Superagüi, Paraná, Brasil. *Sociedade & Natureza*, *26*(1): 37-47. **http://dx.doi.org/10.1590/1982-451320140103**.

PINHEIRO, H.T.; JOYEUX, J.-C. 2007 Pescarias multi-específicas na região da foz do rio doce, ES, Brasil: características, problemas e opções para um futuro sustentável. *Brazilian Jornal Aquatic Science and Technology*, *11*(2): 15-23. **http://dx.doi.org/10.14210/bjast.v11n2.p15-23**.

PINTO, M.F.; MOURÃO, J.S.; ALVES, R.R.N. 2015 Use of ichthyofauna by artisanal fishermen at two protected areas along the coast of Northeast Brazil. *Journal of Ethnobiology and Ethnomedicine*, 11: 20. PMid:25888941.

RAMIRES, M.; CLAUZET, M.; ROTUNDO. M.M.; BEGOSSI, A. 2012 A pesca e os pescadores artesanais de Ilhabela (SP), Brasil. *Boletim do Instituto de Pesca*, *38*(3): 231-246.

ROSÁRIO J.J. 2010 Cultura, educação e sustentabilidade: práticas da vida da mulher trabalhadora da Maré. *Revista Espaço Livre, 5*(10): 5-17.

ROSSATO, S.C.; LEITÃO-FILHO, H.G.F.; BEGOSSI, A. 1999 Ethnobotany of caiçaras of the Atlantic Forest coast (Brazil). *Economic Botany*, *53*(4): 377-385. **http://dx.doi.org/10.1007/BF02866716**.

SANTOS, A.C.L.; BITTENCOURT, C.F.; FILHO, R.J.P.A.; OLIVEIRA, P.G.V. 2014 Caracterização da pesca e perfil socioeconômico do pescador que atua sobre as Pontes do Recife, PE. *Boletim do Instituto de Pesca*, *40*(2): 291-298.

SANTOS, K.P.P.; SOARES, R.R.; BARROS, R.F.M. 2015 Atividade pesqueira e construção de embarcações na colônia de Pescadores Z-18 do Município de União/PI, Brasil. *Holos*, *31*(6): 90-106. **http://dx.doi.org/10.15628/holos.2015.3205**.

SANTOS, L.O.; CATTANI, A.P.; SPACH, H.L. 2016 Ictiofauna acompanhante da pesca de arrasto para embarcações acima de 45 hp no litoral do Pa*raná, Brasil. Boletim do Instituto de Pesca*, *42*(4): 816-830. **http://dx.doi.org/10.20950/1678-2305.2016v42n4p816**.

SANTOS, T.J.P. 2016 Mulher e pesca artesanal: uma análise da participação das pescadoras de Belo Jardim – PE para o desenvolvimento local na colônia z-28. *Revista Ouricuri*, *6*(1): 14-26.

SAZIMA, I.; KRAJEWSKI, J.P.; BONALDO, R.; SAZIMA, C. 2013 *A vida dos peixes em Fernando de Noronha.* Campinas: Terra da Gente. 275p.

SILVA, M.B.; SILVA, K.C.A.; HERRMANN, M.; ARAÚJO, M.V.L.F.; CINTRA, H.A. 2014 Mulheres pescadoras de Camarão- da- Amazônia a Jusante da Usina Hidrelétrica de Tucuruí, Amazônia, Brasil. *Revista Brasileira de Engenharia de Pesca*, *7*(2): 15-33.

SILVA-GONÇALVES, R.S.; D'INCAO, F. 2016 Perfil socioeconômico e laboral dos pescadores artesanais de camarão-rosa no complexo Estuarino de Tramandaí *(RS), Brasil. Boletim do Instituto de Pesca*, *42*(2): 387-401. **http://dx.doi.org/10.20950/1678-2305.2016v42n1p387**.

SILVANO, R.A.M. 1997 *Ecologia de três comunidades de pescadores do rio Piracicaba (SP).* Campinas. 147f. (Dissertação de Mestrado em Ecologia. Instituto de Biologia, UNICAMP). Available from: <http://www.bibliotecadigital.unicamp.br/document/?code=000116579>. Access on: 20 nov. 2016.

SOUSA, R.S. 2010 *Etnobotânica e Etnozoologia de Comunidades Pesqueiras da Área de Proteção Ambiental (APA) do Delta do Parnaiba, Nordeste do Brasil.* Teresina. 176f. (Dissertação Mestrado. Programa de Pós-graduação em Desenvolvimento e Meio Ambiente, UFPI). Available from: <http://www.leg.ufpi.br/subsiteFiles/mestambiente/arquivos/files/Dissert_Rosemary_Silva_Sousa.pdf.pdf>. Access on: 10 jan. 2017.

SOUSA, R.S.; HANAZAKI, N; LOPES, J.B.; BARROS, R.F.M. 2012 Are gender and age important in understanding the distribution of local botanical knowledge in fishing Communities of the Parnaíba Delta Environmental Protection Area? *Ethnobotany Research & Applications,* 10: 551-556.

SPARRE, P.; VENEMA, S.C. 1997 Introdução à avaliação de mananciais de peixes tropicais. Rome: FAO. 404p. (FAO Documento Técnico sobre as pescas).

VASCONCELLOS, M.; DIEGUES, A.C.; KALIKOSKI, D.C. 2011 Coastal fisheries of Brazil. In: SALAS, S.; CHUENPAGDEE, R.; CHARLES, A.; SEIJO, J.C. Coastal fisheries of Latin America and the Caribbean. Rome: FAO. p. 73-116. (FAO Fisheries and Aquaculture Technical Paper, 544).

VASCONCELOS, E.M.S.; OLIVEIRA, J.E.L.; MATOS, J.A.; JÚNIOR, W.; TAVARES, M.M. 2003 Perfil socioeconômico dos produtores da pesca artesanal marítima do estado do Rio Grande do Norte. *Boletim Técnico Cientifico*, *11*(1): 277-292.

VASKE-JUNIOR, T.; LESSA, R.P.T.; RIBEIRO, A.B.C.; NÓBREGA, M.F.; PEREIRA, A.A.; ANDRADE, C.D.P. 2008 A pesca comercial de peixes pelágicos no Arquipélago de São Pedro e São Paulo, Brasil. *Tropical Oceanography*, *36*(1-2): 47-54.

WALTER, T. 2000 *Ecologia da pesca artesanal no lago Paranoá – Brasília – DF.* São Carlos. 227f. (Dissertação de Mestrado. USP). Available from: <http://www.bv.fapesp.br/pt/bolsas/103572/ecologia-da-pesca-artesanal-no-lago- paranoa-brasilia-df/>. Access on: 23 mar 2017.

ZACARDI, D.M. 2015 Aspectos sociais e técnicos da atividade pesqueira realizada no Rio Tracajatuba, Amapá, Brasil. *Acta of Fisheries and Aquatic Resources*, *3*(2): 31-48.

ZACARDI, D.M.; PONTE, S.C.S.; SILVA, A.J.S. 2014 Caracterização da pesca e perfil dos pescadores artesanais de uma comunidade às margens do rio Tapajós, Pará. *Amazônia, Ciência e Desenvolvimento*, *10*(19): 129-148.

ZAR, J.H. 1999 *Biostatistical analysis*. New Jersey: Prentice Hall. 663p.