



PIRARUCU LENGTH STRUCTURE (*Arapaima Gigas*) CAPTURED IN AREAS MANAGED IN THE MIDDLE RIO SOLIMÕES / AMAZONAS - BRAZIL

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ABSTRACT :

*The management of pirarucu (*Arapaima Gigas*) has been carried out by the traditional communities of Amazonas, especially the municipality of Fonte Boa since 2002. This activity consists of annual and joint work among communities and institutions of Technical Assistance, where the community organization, counting, monitoring and surveillance of lakes are part of this process. The minimum size for the capture of Pirarucu was established under the rules of the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA) in 150 cm, which is released for areas that have a fishing agreement and Conservation Units. The present work consists of a descriptive analysis on the Pirarucu Length Structure (*Arapaima Gigas*) managed in the middle Solimões River / Amazonas - Brazil. The objective was to analyze the morphological aspects related to size (Total Length), gender and gonadal stage females caught during fishing. For data collection, the fishery monitoring charts were used in the Database of the Institute of Sustainable Development of Fonte Boa / AM. Data from 33,395 specimens collected during the period from 2013 to 2016 were analyzed. Of these, 17,038 were females and 16,357 males, being in the year 2016 and 2014 to larger number of females captured, totaling 5,458 species, and in the years of 2013 and 2015 they presented higher numbers of males caught 7.710. In relation to the total length are being captured in greater quantity species with measures between 161cm to 170 cm. Only in 2016 was it possible to find a specimen with 291cm of total length, female in the gonadal stage III. Regarding the gonadal stage, it was possible to notice that there is an index of 1.669 that is found in the gonadal stage I (without ova) and presenting the Total Length - CT between 150cm and 160cm. With this same measure we found 111 species in the IV gonadal stage (mature oocytes). In this way we can verify that a greater number of species are being captured that have not yet reached their stage of maturation.*

KEYWORDS : fishing, management, gonadal stage.

INTRODUCTION

The Pirarucu (*Arapaima Gigas*) is one of the largest species in the Amazon Basin, being a fish that inhabits mainly floodplain lakes and flooded forests (Castello 2008). It has mandatory air breathing and can reach 200kg of body mass and 3m in length (Castello 2004). It has a high growth rate and reproduces relatively early (Arantes et al., 2010). The indication of overfishing of some species and the conflicts generated by disputes over fishing territories led the government to base the management of the fishery resources in the Amazon in measures that restrict the capture of commercial species (Barthem, 2006 apud Cerdeira, 2009).

In order to control and reduce the impacts caused by predatory fishing, measures were established that related to restrictions of the closure (Ordinance IBAMA 48/2007); the determinations contained in the

IBAMA Order no. 43/2004 for fishing in inland waters; and legalized fisheries agreements in floodplain areas. The IBAMA Ordinance no. 08/1996, art. 5th determines the minimum catch size at 55 cm for Tambaqui; 150 cm for the Pirarucu; and 80 cm for Surubim. For species like Jaraqui (*Semaprochilodus* spp), Matrinchã (*Brycon* spp), Curimatã (*Prochilodus* nigricans), Pacu (*Mylossoma* spp) and Aracu (*Schizodon* spp) and *Leporinus* spp, the main measure adopted is the prohibition of commercial catch at the time of the reproductive period, known as closed (CAMARGO, 2010).

Pirarucu grows up to 88 cm in length in its first year of life, 123 cm in the second year, 154 cm in the third year, 174 in the fourth year, and in areas where there is no fishery or in which the minimum catch size is respected. 188 in its fifth year of life (ARANTES et al., 2010).

In the Solimões River, the female of the pirarucu reaches sexual maturity from 157 cm of total length and at the age of three years (Arantes et al., 2010). In the Tocantins River, the first maturation of pirarucu is reached in the range of 145-154 cm and 115-124 cm of female and male CT, respectively (Godinho et al., 2005). However, Arantes et al. (2010) showed that the selectivity of the harpoon and mahogany fishing tended to decrease the growth rate of the pirarucu population, due to the removal of the larger individuals that grew faster among those from the same cohort.

Over the last twelve years, participatory management of pirarucu has been replicated in several regions of the state of Amazonas and even in other states such as Acre and Pará, as well as in other Pan-Amazon countries such as Peru, Colombia and Guyana. Despite the different confirmations that the management presents in its expansion, it continues based on the same principle, the system of counts of pirarucus. This is because such a method makes it possible to estimate the stocks of the species relatively quickly and at a low cost, compared to other fish stock estimation methodologies of ichthyofauna (CASTELLO, 2007, VIANA et al.

Community management of fisheries comprises the management actions taken at the local level by the users / community members themselves (CAMARGO, 2010). As such, the Municipality of Fonte Boa implemented the Pirarucu Community Management actions in 2002, and in 2004 alone the first Pirarucu fishery was found in the Middle Rio Solimões. At the beginning of the first year of implementation of the project it was possible to see a subsequent increase in the population of the species. The present work sought to describe information about the age group of pirarucu managed in the areas of the Middle Rio Solimões, in the municipality of Fonte Boa / AM, length, sex and gonadal stage, and how the management activities are constructing for the increase of fish stocks in the region .

MATERIALS AND METHODS

Study area

The municipality of Fonte is located in the Amazon region. According to estimates by the Brazilian Institute of Geography and Statistics (IBGE) in 2016, its population was 20 199 inhabitants, it has an area of 12,110,907 square kilometers. In this way the municipality is divided into 13 sectors: Solimões de Baixo, Solimões de Cima I, Solimões de Cima II, Solimões do Meio, SetorGuedes, SertorMacopani, Panoã de Baixo Sector, Maiana Sector, Campina Sector, SertorArumanduba, PanoãSector , Sector Auati - Paraná, Sector Mineruá and Sector Aranapu, all grouping communities that are located in the same channel of the river, or near one of the others. Currently 86 communities are involved in Pirarucu community management activities.

Data collect

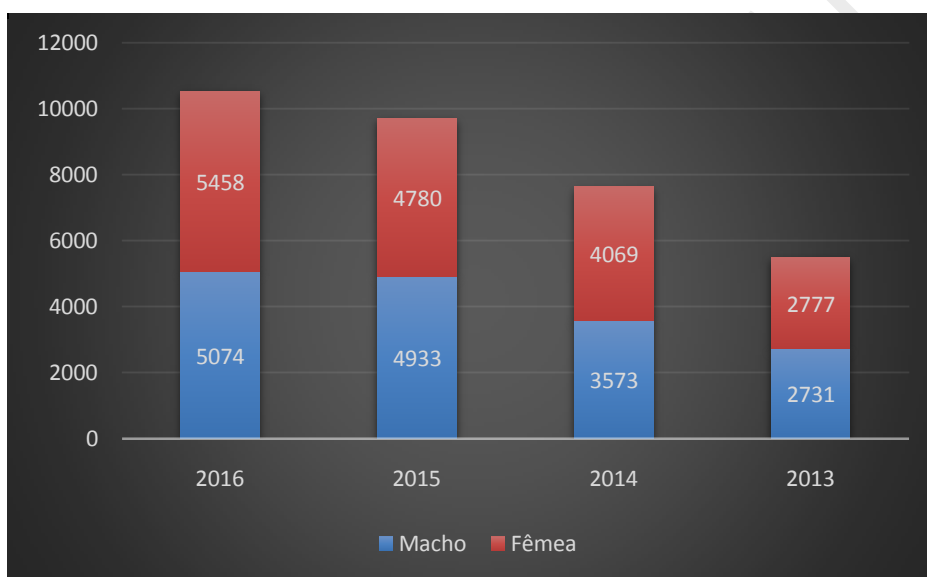
The research is based on the quantitative form, starting from the analysis of the Database of the Institute of Sustainable Development of Fonte Boa - IDSFB, where it is fed annually through the fish monitoring worksheets filled out by the community with the following information: number of seals, length, state of gonads, weight, sex, all of this information being passed to the program in Excel format. We have as criterion for analyzing the results the qualitative standard in literature review and bibliographies of

collections and scientific articles on the subject . We may also consider the descriptive and exploratory basis of the data as the nature of the research.

RESULTS AND DISCUSSIONS

The pirarucu's managed fishery takes place from August to November according to the watershed. The analysis of the fish monitoring worksheets in the years 2013 to 2016 are subject to variations in the number of communities involved in the fishery, as well as the quota released by IBAMA, which is based on the fish counts of the lakes and their mapping. During the period from 2013 to 2016, 33,395 were caught, making a total of 1,395,395 kg of pirarucu Eviscerated Whole (IE). Graph 01 presents data related to the number of annual quotas and the value of captured distributed between male and female.

Based on the annual catch efficiency, we can verify that in the years of 2013, 2014 and 2016, there was a higher rate of capture in female specimens, where in the year of 2015 the male catch index was higher, however the increase of inventories over the years.



Graph 1: Age distribution between males and females caught between 2013 and 2016 and catch index.

According to Lopez &Queiroz (2009) young animals are considered those below the minimum catch size, which was legally established at 1.5 m. Adult animals are larger than the minimum catch size, regulated by the official Brazilian environment agency (IBAMA). Thus, the standard measure established as a rule can be observed that the size of species captured in the municipality of Fonte Boa are in a Total Length - CT between 150 and 291 described as indicated in Table 01. The analysis of age structures allowed us to infer population parameters such as growth, mortality and expected maximum length, and whether more males or females were captured during this period. The importance of knowing these catch structures can give us important information about the ecosystem of the lakes or about the type of fishing that develops there (CROSSA & OVIEDO, 2011).

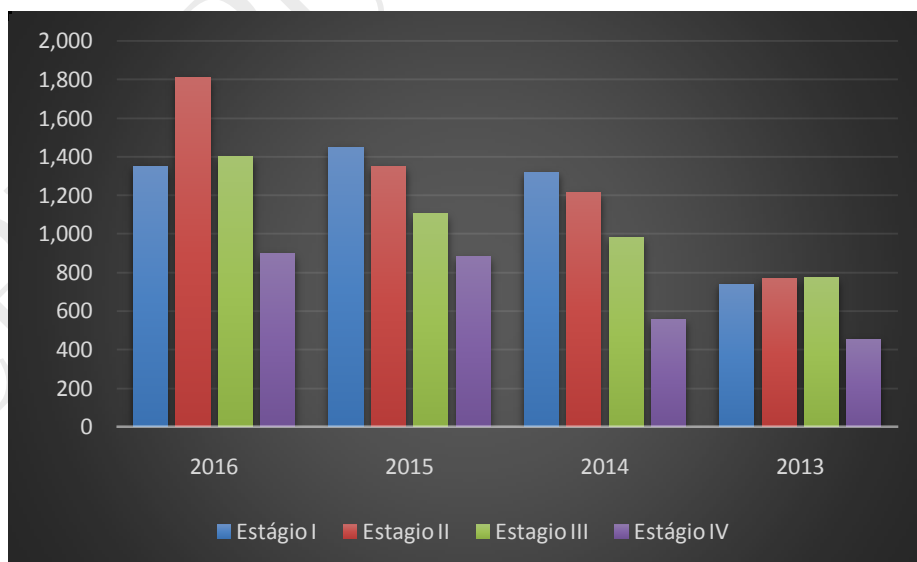
In order to establish the quota authorized by IBAMA, a method of counting using traditional fishermen's knowledge in distinguishing young and adult animals is necessary. This method can be visualized through the "floatation" of the fish, because it needs to rise to the surface to breathe in a 20 minute interval. The released quotas may correspond to a maximum of 30% of the total adult fish counted in each sector of the lakes authorized to be practiced. Over the last twelve years, participatory management of pirarucu has been replicated in several regions of the state of Amazonas and even in other states such as Acre and Pará, as well as in other Pan-Amazon countries such as Peru, Colombia and Guyana. Despite the different

confirmations that the management presents in its expansion, it continues based on the same principle, the system of counts of Pirarucus.

CT (cm)	2013	2014	2015	2016	Total
150 à 160	1.083	1.455	1.584	1.793	5.915
161 à 170	1.064	1.587	1.832	2.104	6.587
171 à 180	1.095	1.471	1.680	1.855	6.101
181 à 190	1.010	1.197	1.740	1.635	5.582
191 à 200	632	937	1.422	1.356	4.347
201 à 210	325	631	785	1.011	2.752
211 à 220	159	199	414	514	1.286
221 à 230	113	110	180	191	594
231 à 240	18	41	61	51	171
241 à 250	7	9	14	11	41
251 à 260	2	4	1	4	11
261 à 270	0	1	0	3	4
271 à 280	0	0	0	2	2
281 à 290	0	0	0	1	1
291	0	0	0	1	1

Table 1: Size structure (Total length - CM) of Pirarucus captured in the period from 2013 to 2016.

Vazoller (1996) describes the importance of the control measure of minimum size related to fishing biology. According to him, according to it establishes discrimination and the identification of gonadal development, which is carried out by means of a virtual classification and its classification in the classes of gonadal development (VAZZOLER, 1996). The value for the minimum catch size, therefore, is due to the size value at the first reproductive event, in which at least 50% of the animals are in reproductive activity (FONTELES FILHO, 1989; SHINOZAKI-MENDES et al., 2007) . Based on the highest Total Length of each year, we can see that the Pirarucu growth estimate of the Middle Rio Solimões is 10 cm per year.



Graph 2: Gonadal stage of females captured from 2013 to 2014

According to the survey carried out, we can see that there is a high rate of capture of immature animals and that can generate a risk of population reduction. In figure 2 we can verify the 4 gonadal stages

of female animals, distinguished from the characteristics described by Lopes and Helder (2009) described as follows: stage I (immature), stage II (initial maturation), stage III (advanced maturation) , stage IV (mature), stage V (spawned) and stage VI (at rest) were not collected in the Fonte Boa region.

CONCLUSIONS

When analyzing the data collected in this survey sample, we can not use the comparative efficiency method in the annual catch, nor as a measure of the level of population growth. In this context of the research we take into account the difference of the catch values in relation to the released quota, based on the increase of the participation of communities adhering to the Pirarucu Management Program, lakes count and catch efficiency in which there is an annual variation .

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ESTRUTURA DE COMPRIMENTO DO PIRARUCU (*Arapaima Gigas*) CAPTURADOS EM ÁREAS MANEJADAS NO MÉDIO RIO SOLIMÕES / AMAZONAS - BRASIL**RESUMO**

O manejo do pirarucu (*Arapaima Gigas*) vem sendo realizado pelas comunidades tradicionais do Amazonas, em especial as do município de Fonte Boa desde o ano de 2002. Nesta atividade consiste em um trabalho anual e em conjunto entre comunidades e instituições de Assistência Técnica, onde a organização comunitária, contagem, monitoramento e vigilância dos lagos fazem parte deste processo. O tamanho mínimo para captura do Pirarucu foi estabelecido segundo as regras do Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA) em 150 cm, sendo esta ação liberada para áreas que possuem acordo de pesca e Unidades de Conservação. O presente trabalho consiste em uma análise descritiva sobre a Estrutura de Comprimento do Pirarucu (*Arapaima Gigas*) manejado no médio Rio Solimões / Amazonas - Brasil e teve como objetivo analisar os aspectos morfológicos relacionados ao tamanho (Comprimento Total), sexo e estágio gonadal referente as fêmeas capturadas durante a pesca. Para coleta de dados foram utilizados as planilhas de monitoramento da pesca disponíveis no Banco de Dados do Instituto de Desenvolvimento Sustentável de Fonte Boa/AM. Foram analisadas informações de 33.395 exemplares capturados no período de 2013 à 2016. Destes, 17.038 eram fêmeas e 16.357 machos, sendo no ano de 2016 e 2014 apresentou um maior número de fêmeas capturadas totalizando 5.458 espécies e nos anos de 2013 e 2015 apresentaram maior número de machos capturados 7.710. Em relação ao comprimento total estão sendo capturados em maior quantidade espécies com medidas entre 161cm à 170 cm. Somente no ano de 2016 foi possível encontrar um exemplar com 291cm de comprimento total, fêmea no estágio gonadal III. Quanto ao estágio gonadal foi possível perceber que há um índice de 1.669 que se encontram no estágio gonadal I (sem presença de ova) e apresentando o tamanho do Comprimento Total - CT entre 150cm a 160cm. Com esta mesma medida encontramos 111 espécies no estágio gonadal IV (ovócitos maduros). Desta forma podemos constatar que estão sendo capturadas um maior número de espécies que ainda não atingiram seu estágio de maturação.

Palavras Chave: pesca, manejo, estagio gonadal.