



Analysis of the Industrial Fishing of Piramutaba Catfish, *Brachyplatystoma vaillantii* (Valenciennes 1840), in two Estuarine Areas of the Brazilian Amazon

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Abstract: In the North Region of Brazil, the fishery of the piramutaba catfish, *Brachyplatystoma vaillantii* (Valenciennes 1840), is notable due to its high volume of capture, by the job opportunities and revenue this activity generates, and by the conflicts between artisanal and industrial fleet vessels in the exploration of this resources. In order to minimize such conflicts, the extinct Brazilian governmental fisheries agency (SUDEPE) in 1983 announced the Regulation n° 9, which forbade industrial vessels to operate in latitudes less than 00°05'N and longitudes less than 48°00'W. The aim of this study was to analyze the industrial captures of piramutaba in both areas where fishing was allowed and forbidden by Regulation n° 9, from 2002 to 2008. These data showed that 31.58% of the trawlings were performed in forbidden areas. The most frequent size class in both areas was between 35 and 40 cm LF. In all areas and seasons around 99% of the individuals have still not reached the size of their first sexual maturation (L50). This study reveals that the industrial fleet is not respecting the legal limitations, a fact which may compromise the sustainable use of piramutaba stocks.

Keywords: bycatch, amazon estuary, *Brachyplatystoma vaillantii*, capture size, capture zone

Resumo. Análise da pesca industrial da piramutaba, *Brachyplatystoma vaillantii* (Valenciennes 1840) em duas áreas estuarinas da amazônia brasileira. Na região norte do Brasil a pesca da piramutaba, *Brachyplatystoma vaillantii* (Valenciennes 1840) se destaca pelo elevado volume de captura, geração de emprego e renda, e pelos conflitos de exploração entre as frotas artesanal e industrial. Para reduzir tais conflitos, a extinta Superintendência do Desenvolvimento da Pesca (SUDEPE) publicou em 1983 a Portaria n° 9, proibindo a frota industrial de atuar em latitude inferior a 00°05'N e longitude inferior a 48°00'W. No entanto, a frota industrial desrespeita esta legislação e realiza arrasto de fundo nas áreas de exclusão estabelecidas. Assim, o presente estudo teve como objetivo analisar as capturas industriais de piramutaba nas áreas de pesca permitidas e proibidas, a partir da mencionada portaria, entre 2002 e 2008. Os resultados mostram que 31,58% dos arrastos foram realizados em áreas proibidas. A classe de comprimento de captura mais frequente foi de 35 a 40 cm LF nas duas áreas. Em todas as áreas e períodos, cerca de 99% dos indivíduos encontraram-se abaixo do

tamanho de primeira maturação sexual (L50). O estudo revela que a frota industrial não está respeitando os limites impostos pela legislação, fato que pode comprometer o uso sustentável do estoque da piramutaba na Amazônia.

Palavras-chave: fauna acompanhante, estuário amazônico, *Brachyplatystoma vaillantii*, tamanho de captura, área de captura

Introduction

Brazil is one of the major suppliers of fish in the world, and its annual fish production in 2007 was 1,072.226 tonnes (t), being the state of Pará the second largest-producer in the country. In this state, the piramutaba catfish *Brachyplatystoma vaillantii* (Valenciennes, 1840), captured exclusively in the estuarine zone, corresponded to 19,689 t, representing 15% of all species landed (IBAMA, 2007).

Initial studies on piramutaba fisheries realized by Dias Neto and Damasceno (1985), Dias Neto and Mesquita (1988) have already been alerted by the problem of overfishing, determining that the best option to stock recovery was to capture with a limited fleet of 44 boats fishing in doublet and with mesh tunnel bags of 125 mm.

About stock recovery, Barbieri and Hartz (1995) state that the main parameter used to plan the exploration and conservation of a fishery resource is L_{50} value (size at first maturity) which indicates that at least 50% of the population is in stage of sexual maturity being ready to reproduce. Data of Pirker (2001) revealed that *B. vaillantii* reaches its L_{50} with 55 cm LF.

According to Fabr e and Barthem (2005) the Amazon estuary, main capture area of the species, is an important feed and growth zone, therefore the shoals are composed of young individuals and large fish production in this region may affect spawning and survival of the piramutaba population.

Although these studies warn and provide guidance about the need for a sustainable fishery for *B. vaillantii*, only two management actions were enforced in the northern region of the country. At first, the extinct Superintend ncia para o Desenvolvimento da Pesca - SUDEPE, published the Regulation n  9 on March 9th, 1983, which aimed only to reduce conflicts between artisanal and industrial fisheries in the estuarine zone by banning the industrial fleet in acting in latitude less than 00 05'N and longitude less than 48 00'W (BRASIL, 1983). Subsequently in 1984, studies of the Japan International Cooperation Agency (JICA), Museu Paraense Em lio Goeldi (MPEG) and Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renov veis (IBAMA), confirmed

the presence of hatchery fish in the estuary and the need to adopt the closed season between the months from September to November each year, which originated the Normative Instruction (IN) IBAMA n  6 of June 7th, 2004.

Given the social and economic importance of the piramutaba's stock for present and future generations and the major impacts of this activity the present study aims to analyze the industrial catch of piramutaba in the allowed and forbidden areas, according to the Regulation n  9/1983, thus aiming to contribute to the generation of information to assist in the sustainable management of the piramutaba in the amazon.

Material and methods

The information on production and diversity about the bycatch of the industrial fishery of piramutaba were obtained from the project "Biology and Fisheries of Piramutaba" of the Centro Nacional de Pesquisa e Conserva o da Biodiversidade Marinha do (CEPNOR) with the monitoring of 15,107 trawl net fishing in the period 2002-2008 in monthly shipments with an average duration of 15 days in boats of the industrial piramutaba fleet operating at the mouth of the Amazon River in front of the Maraj  Island, between the Maguari Cape (00 15'N and 48 25'W) and the North Cape (01 42'S and 49 55'W) at an approximate distance of 80 miles from the coast at depths ranging from 7 to 20 m with bottom trawl nets outboard in a vessel.

Industrial vessels have iron hull and average length of 22 m, engines with an average power of 375 HP, storage capacity from 35 to 60 t, around 28 days at sea, being manned by 5-6 fishermen. Fishing nets are made of polypropylene yarn of 30/45, length 70 to 80 m, opening of 50 to 60 m and height of 6 m.

During the fishing trip were analyzed two daily trawls, one in the daytime and another at night. The distribution of trawling in the study area was made according to the preferences of captains of the vessels without any interference from the board sampler.

After trawling the entire production was launched on deck, the piramutaba was classified by the crew in recovered individuals, that meet the market requirements in relation to size and state of

conservation and rejected those which are at odds with market standards.

The sampler onboard performed randomly furcal length (LF) biometric of 200 individuals considered as availed and 200 individuals considered rejected by noting the measures in an appropriate worksheet, besides the biometric information the sampler onboard also recorded the following data for each trawling: trawling identification, date, start and end time, area of fishing (fishing ground), initial and final latitude and longitude.

In the laboratory, the data were digitalized into spreadsheets considering the month of sampling and season, area of occurrence and the regional hydrological cycle (dry and rainy) proposal by Oliveira *et al.* (2007), which defines: 1) flood, as the rainy season occurring from December to May with greater accumulation of sediments in the estuary; and 2) ebb, as the rainy season interruption, which occurs between June and November, with a consequent increase of salinity. After entering the data, they were organized by field of study: allowed and forbidden, according to Regulation n° 9/1983.

To statistical analysis was considered the Piramutaba average length by trawl and was applied Analysis of Variance Test (ANOVA) or Welch Test for unequal variances.

Results

Data analysis reveals that 31.58% of trawling were carried out in forbidden area and 68.42% in the permitted area. (Fig. 1), and a total of 113,648

sampled individuals, 80,204 (70.57%), were caught in that permitted area and 33,444 (29.43%) in the considered prohibited area (Table I).

In the permitted area, the approved individuals presented average length of 39.98 cm, in the flood season, and 37.45 cm in the dry season. In prohibited area during the flood the average length was 37.94 cm and in the dry season 36.90 cm (Table II). The graph of the interaction (Figure 2) shows the trend of lengths between seasons and areas. In the two areas, the average length is greater in flood than in the dry, however, decreases more sharply in the permitted area, revealing highly significant differences in lengths between seasons ($p < 0,0001$), between áreas ($p < 0,0001$) and between the season and area ($p < 0,0001$).

There were sampled 80,204 individuals in the permitted area and 33,444 in the prohibited area and in both areas approximately 50% the specimens were rejected by the fishermen. A highly significant statistical difference between the average lengths by trawl of approved and rejected piramutabas occurred in different seasons and áreas ($p < 0,0001$) (Table III).

Considering the length classes of the sampled specimens (Table IV) occurred significant difference between the flood and dry seasons in the permitted area ($p < 0,0001$) and the prohibited area ($p < 0,0001$). The most common class of length of the two areas was 35 to 40 cm (Figure 3), including the approved individuals. In this case the piramutaba population are young considering the size at first maturity of 55 cm determined by Pirker (2001).

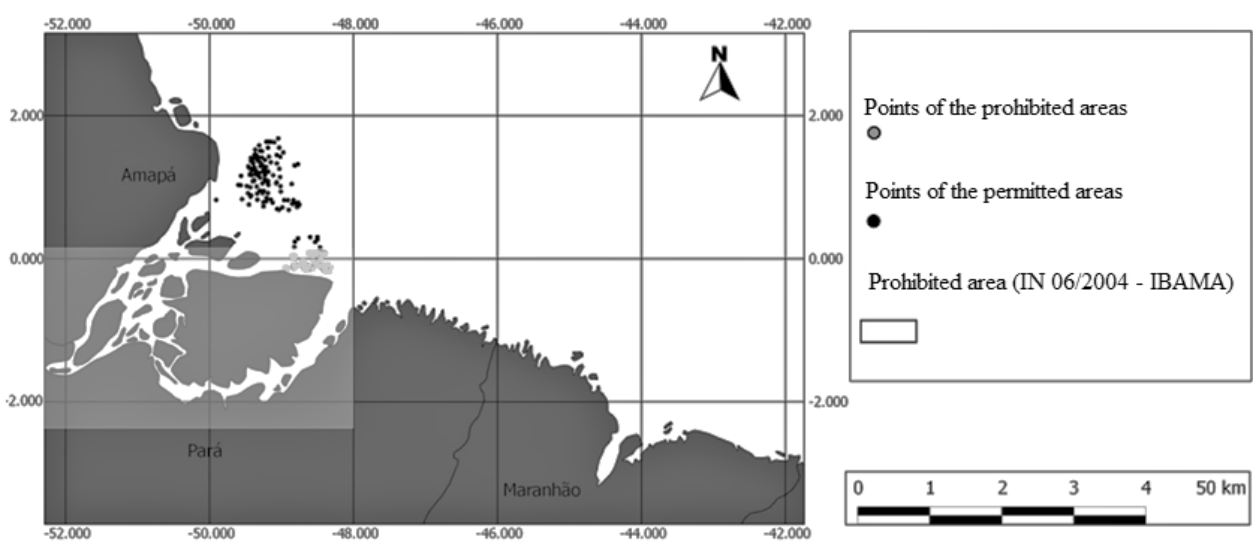


Figure 1. Permitted and Prohibited area of capture of the *Brachyplatystoma vaillantii* in the Amazon River mouth in the period 2002-2008.

Table I. Number of trawling (Na) and number of individuals sampled (Ni) in the permitted and prohibited areas during the period 2002-2008.

Area	Bottom Trawls		Individuals Sampled	
	Na	%	Ni	%
Permitted	10,336	68.42	80,204	70.57
Prohibited	4,771	31.58	33,444	29.43
Total	15,107	100.00	113,648	100.00

Discussion

Our data shows that the industrial fleet operates outside the limits imposed by Regulation SUDEPE n° 9/1983. These results agree with the studies of Sousa *et al.* (2007) and Zagaglia *et al.* (2009) studying the spatial-temporal dynamics of industrial fishing of piramutaba in the Amazon continental shelf using satellite data, showing fishing

activities of industrial fleet into the prohibited estuarine zone.

The shorter length of the specimens during drought can be explained by the resumption of the reproductive cycle, since from the end of the rainy season and beginning of the dry, the piramutaba in the reproductive age migrates into the estuary, sup the Amazon towards the river channel for breeding. In this period the search for larger individuals for areas with lower salinity (below 00°05N) and further preparation for their reproductive cycle may explain why during the dry season the average size is smaller in permitted area than in the prohibited (Winemiller, 1989; Barthem, 1990; Ribeiro and Petrere, 1990; Vieira *et al.*, 1999). Those data agree with the Barthem (2004) who shows higher productivity of the artisanal fleet into the prohibited area beyond the closed season (IN IBAMA n° 6/2004) which prohibits the operation of any industrial fleet from September to November.

Table II. Minimum, maximum and average capture furcal lengths (cm) of fishermen approved *Brachyplatystoma vaillantii* by area (prohibited and permitted) and season (dry and rainy) in the period 2002-2008.

Season	Area							
	Permitted				Prohibited			
	Min.	Max.	Ave	Total Individuals	Min.	Max.	Ave	Total Individuals
Flood	17.90	77.80	39.98	94,478	19.00	50.00	37.94	40,076
Dry	18.60	81.80	37.45	50,136	14.60	49.00	36.90	19,850

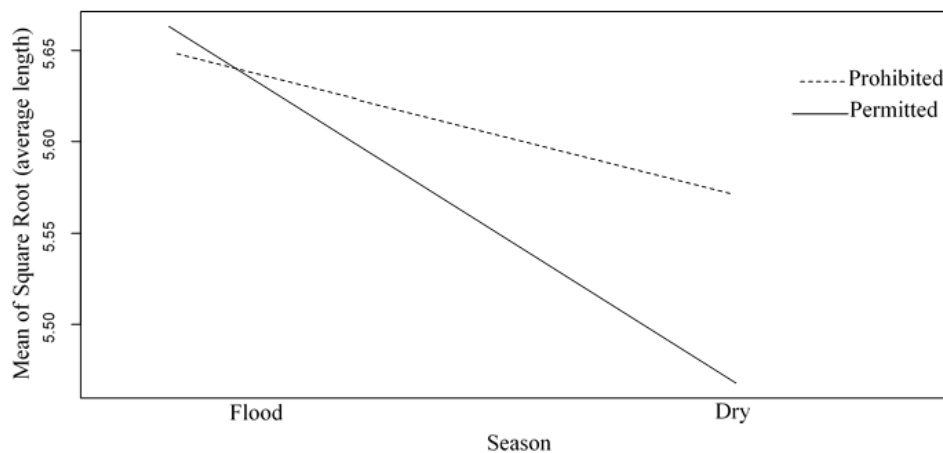
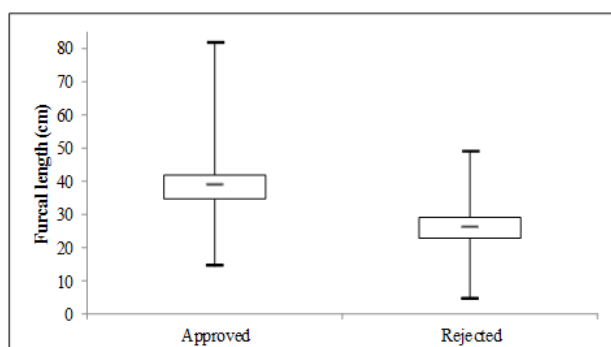


Figure 2. Interaction between the average furcal lengths of *Brachyplatystoma vaillantii* captured in the permitted and prohibited areas, in relation to season (flood ad dry).

Table III. Average furcal length (cm) of *Brachyplatystoma vaillantii* approved and rejected by the fishermen by season and fishing area.

Classification	Area and Season				Total of Individuals
	Permitted		Prohibited		
	Flood	Dry	Flood	Dry	
Approved	39.98	37.45	37.94	36.90	56,823
Rejected	26.65	25.22	26.09	25.60	147,726
Average	33.31	31.34	32.02	31.25	
Total of Individuals	94,487	50,136	40,076	19,850	204,549

With the beginning of the rainy season and increased food availability, the piramutabas born in the Amazon River and tributaries migrate to the Amazon estuary, where the encounter favorable conditions for the growth of larvae and juveniles until reaching an average age of two years (Sánchez Botero and Araújo Lima, 2001; Fabr e and Barthem, 2005; Santos and Santos, 2005; Leite *et al.*, 2006).

**Figure 3.** Average furcal lengths (cm) of catches of *Brachyplatystoma vaillantii* utilized and rejected after homogenization of variances (Welch's Test).

According to Muniz and Chaves (2008), Pina and Chaves (2009) the high frequency of juveniles is characteristic of shallow shelf in Brazil; however, the variation in the average size of the individuals is influenced by fishing pressure in the population (Policansky, 1993; Trippel, 1995). The low capture of mature individuals in the two areas does not necessarily indicate their absence since some groups of mature fish that live in shoals can avoid trawl nets (Yoklavich *et al.*, 1991).

The first study on L_{50} for the piramutaba was realized by Barthem and Goulding (1997) who

stated that the species reaches its first maturity at 40 cm. Our data reveal that approximately 79% of the specimens captured in the permitted and forbidden area are below this length. However, the latest study conducted by Pirker (2001), reveals that L_{50} for this species is 55 cm, therefore more than 98% of the specimens sampled in all seasons and areas are below the length at first maturity. This difference in estimated L_{50} , by Barthem and Goulding (1997) and Pirker (2001), can reflect a change in life cycle of species because overexploitation, what supports Alonso & Pirker (2005) that suggests a state of growing overfishing of piramutaba.

According to Batista *et al* (2005), the artisanal fleet in the coast of Par a also captures piramutaba with an average size of 42.70 cm LF (juveniles). These results demonstrate that both the industrial and artisanal fleet are not respecting the size limits of the capture of the piramutaba in order to be able replace the stock. Furtado-Junior *et al.* (2007) shows that the use of bottom trawl nets with mesh tunnel bags of 100 mm generates a capture of individuals with size less than 42 cm, below the sexual maturation obtained by Pirker.

Besides the industrial fishing for piramutaba to be occurring in disagreement with the law, the peak of productivity of artisanal fisheries in the dry season when the species migrates to reproduce, may be contributing to the collapse of stock. Thus, further studies on the impact of artisanal fleets on the species it is recommended in order to, if necessary establish specific regulations for this fleet. Therefore, it is important to point out that besides regulations, better control system by the environmental agencies is also necessary.

Table IV. Distribution of furcal length classes of *Brachyplatystoma vaillantii* captured in the dry and flood season and permitted and prohibited fishing area.

Class (cm)	Status	Areas				Total	Grand Total
		Permitted		Prohibited			
		Flood	Dry	Flood	Dry		
5 -10	Approved	0	0	0	0	0	39
	Rejected	16	13	7	3	39	
10 -15	Approved	2	3	0	4	9	655
	Rejected	270	290	71	15	646	
15 - 20	Approved	20	14	3	7	44	5243
	Rejected	2626	1647	644	282	5199	
20 -25	Approved	243	19	19	20	301	15717
	Rejected	7662	3679	2383	1692	15416	
25 -30	Approved	1142	627	236	256	2261	25115
	Rejected	12019	3395	4518	2922	22854	
30 -35	Approved	5285	3766	1923	1942	12916	21435
	Rejected	4689	871	1771	1188	8519	
35 -40	Approved	12028	3736	5425	3434	24623	26632
	Rejected	1538	23	305	143	2009	
40 -45	Approved	7507	1614	2585	1216	12922	13004
	Rejected	61	4	0	17	82	
45 -50	Approved	2974	449	534	314	4271	4283
	Rejected	9	3	0	0	12	
50 -55	Approved	816	84	40	7	947	949
	Rejected	1	1	0	0	2	
55 -60	Approved	247	44	50	1	342	342
	Rejected	0	0	0	0	0	
60 -65	Approved	92	26	13	0	131	131
	Rejected	0	0	0	0	0	
65 -70	Approved	5	0	3	0	8	8
	Rejected	0	0	0	0	0	
70 -75	Approved	2	0	1	0	3	3
	Rejected	0	0	0	0	0	
75 -80	Approved	1	0	0	0	1	1
	Rejected	0	0	0	0	0	
80 -85	Approved	0	0	0	1	1	1
	Rejected	0	0	0	0	0	
Total Approved		30364	10382	10832	7202	58780	113558
Total Rejected		28891	9926	9699	6262	4778	

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