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One Trip, Too Many Threats: Evidence of Interactions with Fisheries Threating River Dolphins in Central Amazon

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ONE TRIP, TOO MANY THREATS: EVIDENCE OF INTERACTIONS WITH FISHERIES THREATING RIVER DOLPHINS IN CENTRAL AMAZON

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INTRODUCTION

Both Amazonian dolphin species in central Amazonia – the boto *Inia geoffrensis* and the tucuxi *Sotalia fluviatilis* – are threatened with extinction (EN; IUCN, 2021). Despite the numerous anthropic changes in the Amazon basin, negative interactions with fishing activities are considered the main threat to the conservation of these species (da Silva et al., 2018a; 2020; CMP, 2020).

Negative interactions between fisheries and Amazonian dolphins can be separated into three types: (i) bycatch, when animals are accidentally killed in fishing practices, normally entangled in fishing nets; (ii) intentional mortality due to the perception of competition with dolphins, as they prey on fishing gear and fish; and (iii) direct capture to be used as bait for piracatinga fishing. While *S. fluviatilis* is primarily threatened by bycatch, *I. geoffrensis* is severely impacted by all the three types of interaction; the piracatinga fishing, currently prohibited in Brazil, is considered the most urgent threat to the species (Trujillo et al., 2010; da Silva et al., 2018b; Trujillo et al., 2020; Brum et al., 2021).

In this context, since 2021, a partnership has been established between the National Institute of Amazonian Research (INPA) and the Sea Shepherd to carry out population estimates, in order to provide information on the population trend of these dolphins in the Central Amazon in the face of the threats suffered. This long-term monitoring is of extremely importance to understand the impact of, for example, the piracatinga fishing moratorium on dolphins populations for a better management and protection of the dolphins. Six surveys are scheduled until March 2024, two of which have already been carried out.

In this report, we intend to: (i) present the fishing areas monitored along the surveys and the rates of nets and dolphins found; (ii) report evidence of continued piracatinga fishing in the region; and (iii) report the finding of dead animals and evidence of interactions with fisheries.

METHODS

Study area

The study area comprises three rivers in the Central Amazon, state of Amazonas: a long stretch of the Solimões River, between the municipalities of Iranduba (03º17'06"S/60º11'09"W) and Uarini (02º59'24"S/65º06'28"W); the lower Purus River, around the municipalities of Beruri (03º53'54"S/61º22'23"W) and Anori (03º46'22"S/61º38'39"W); and the lower Japurá River, municipality of Maraã (01º51'21"S/65º34'51"W). We defined four focal areas: (i) Manacapuru, which comprises the area of the Solimões River between the cities of Iranduba and Manacapuru (03º17'59"S/60º37'14"W), monitored since 2018 (Brum and da Silva, 2021); (ii) Purus, which comprises the area from the mouth of the Purus River to the first third portion of the Piagaçu-Purus Sustainable Development Reserve (RDSPP); (iii) Badajós, which comprises the area of the Solimões River, between the cities of Codajás (03º50'13"S/62º03'25"W) and Coari (04º05'06"S/63º08'27"W), and the Badajós River tributary; and (iv) Mamirauá, which comprises areas of the Solimões and Japurá Rivers, between the cities of Tefé (03º21'14"S/64º42'39"W), Alvarães (03º13'15"S/64º48'15"W), Uarini and Maraã, around the focal area of the Mamirauá Sustainable Development Reserve (RDSM) and the Paranã do Cubuá, where the Projeto Boto monitors since 1994 the populations of the boto and the tucuxi (da Silva et al., 2011; 2018b).

The Solimões and Purus Rivers are 'white water' rivers, characterized by high dissolved sediment in the water and consequent high productivity. The region has an important area of 'várzea', a highly productive floodplain area that comprises land, lakes, and channels totally related with the river pulse (Sioli, 1984), and are the preferred habitat for botos (Martin et al., 2004). These two rivers are also highly explored for fishing activities.

Data collection

The survey is boat-based, designed primarily to estimate the abundance of both species of dolphins (details of the survey design could be found at Brum and da Silva, 2021), and was conducted between 02 to 22 October 2021. Here we report the fishing activities data and anecdotal encounters with dolphin carcasses.

Data on fishing activities are collected concomitant with dolphin data, and information on densities of nets will be produced in other opportunity. The observers are highly experienced in Amazonian dolphin counts and identification of fishing activities. A map with the overlap of prevalence of fishing nets (the most damaging gear to dolphins) and dolphin's presence based on the frequency of observations was produced. It is important to highlight the survey is not designed to collect data on fishing activities that occur more frequently during early morning and evening.

In order to find evidence of interactions with fishing activities the encountered carcasses were necropsied by experienced researchers. The position of the carcasses were georeferenced, its species was identified, as well as its sex, and biometric measurements were taken. Biological samples were collected and sent to INPA for future genetic analysis.

RESULTS AND DISCUSSION

Dolphins and Fisheries

The results on the encounter rates of dolphins and the presence of fishing nets are presented in the Table 1. This monitoring is ongoing, aiming to estimate the abundance and trends of these species in the study area.

Table 1: Effort, encounter rates and total number of nets found, in each focal area of the study area

FOCAL AREA	Km	BOTO/km	TUCUXI/km	NETS/km	NETS
Manacapuru	119.2	0.2	2	0.2	27
Purus	309.9	1.7	3.5	0.05	16
Badajós	176.9	1.9	4.6	0.04	7
Mamirauá	421.6	1	1.9	0.06	23
Solimões out	151.4	0.6	1	0.2	34

We can see places with more fishing nets are strongly correlated with lower rates of encounters with botos (R^2=-0.81) (figure 1). For the tucuxi, this correlation cannot be observed (R^2=-0.57).

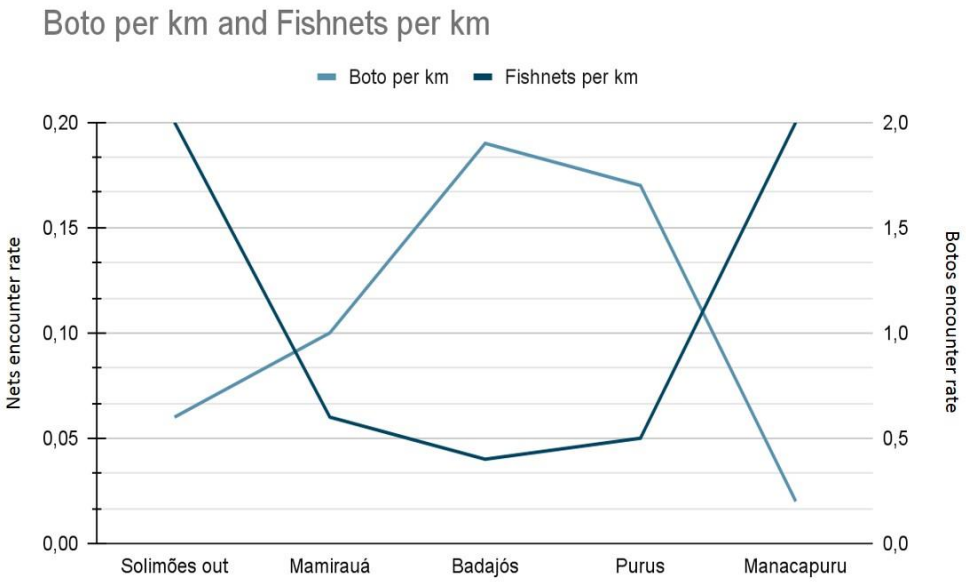

Figure 1: Curves of botos per km and fishnets per km in each area covered, showing the inverse relation

Because fisheries interactions are major threats for both species of the dolphins, and particular to the tucuxi, we hypothesize a correlation with both species, which was not

observed. It is possible this result is more related to the conflicts between fishers and botos. To fishers, the tucuxi is related to positive or neutral interactions, and even considered pleasant; while with the boto the conflicts are constant. Botos are perceived as competitors, and are intentionally killed due this persecution (Brum, 2011; Brum et al., 2021). In Manacapuru region, informants said botos are intentional killed to avoid damage to the nets or fish in a fishing area.

In the figure 2 we present the map with the frequency of dolphins encounters and fishing places, including the location of the piracatinga fishing activity recorded in this survey (figure 3). The survey hours (between 8a.m. to 5p.m) are not the most frequent hours when the fishing nets are set in the water, which occurs normally very early morning and late afternoon (Brum and da Silva, 2021). As such, the numbers of fishing nets observed are underestimated, but the representation in our sample is an indication of the places with a higher likelihood of frequency of nets, and so, risk to the dolphins.

We observed fisheries activities are concentrated in the main channel of the Solimões River, particular in the lower part, overlapping mainly with tucuxis. The drift nets, called 'arrastão' in the region (described in Brum and da Silva, 2021), are prevalent in this area. This kind of net was identified as one of the most problematic regarding entanglement of tucuxis in the medium Solimões River area (Brum, 2011), and the mortality from entanglement in those nets could be related to the high number of tucuxi carcasses found.

Piracatinga fishing

Piracatinga fishing has been prohibited in Brazil since 2015 (Brazilian Normative Instruction no 6 of 17 July 2014; and Normative Instruction no 17 of 10 June 2020), and in Colombia since 2017 (Colombian Resolution no 01710 of 23 August 2017). But the ban on fishing of piracatinga in Brazil was implemented without the necessary enforcement and the practice has remained practically unchecked and widespread (Brum et al., 2021). Manacapuru has a history of piracatinga fishery since before the ban, with records of illegal fishing (Brum et al., 2015; da Silva et al., 2018c; Brum and da Silva, 2021).

Piracatinga fishing is considered the main threat to the conservation of the botos (da Silva et al., 2018a). Although the intentional use of *I. geoffrensis* as bait is a relatively easier issue to address, because the main market in Colombia is officially closed made all exports of this species illegal in the Brazilian border, and the Freezing plants that process these fishes are easy to monitor, it continues to occur. Improvements in law enforcement together with a renewal of the moratorium in Brazil could effectively curb this threat (Brum et al., 2021). Since the other great sources of dolphins mortality as the entanglement in nets and the conflicts with fishers are complex tasks of conservation and difficult to address in the vast area of the Amazon River basin, the renewal of the Brazilian moratorium, which will finish in July 2022, is imperative.

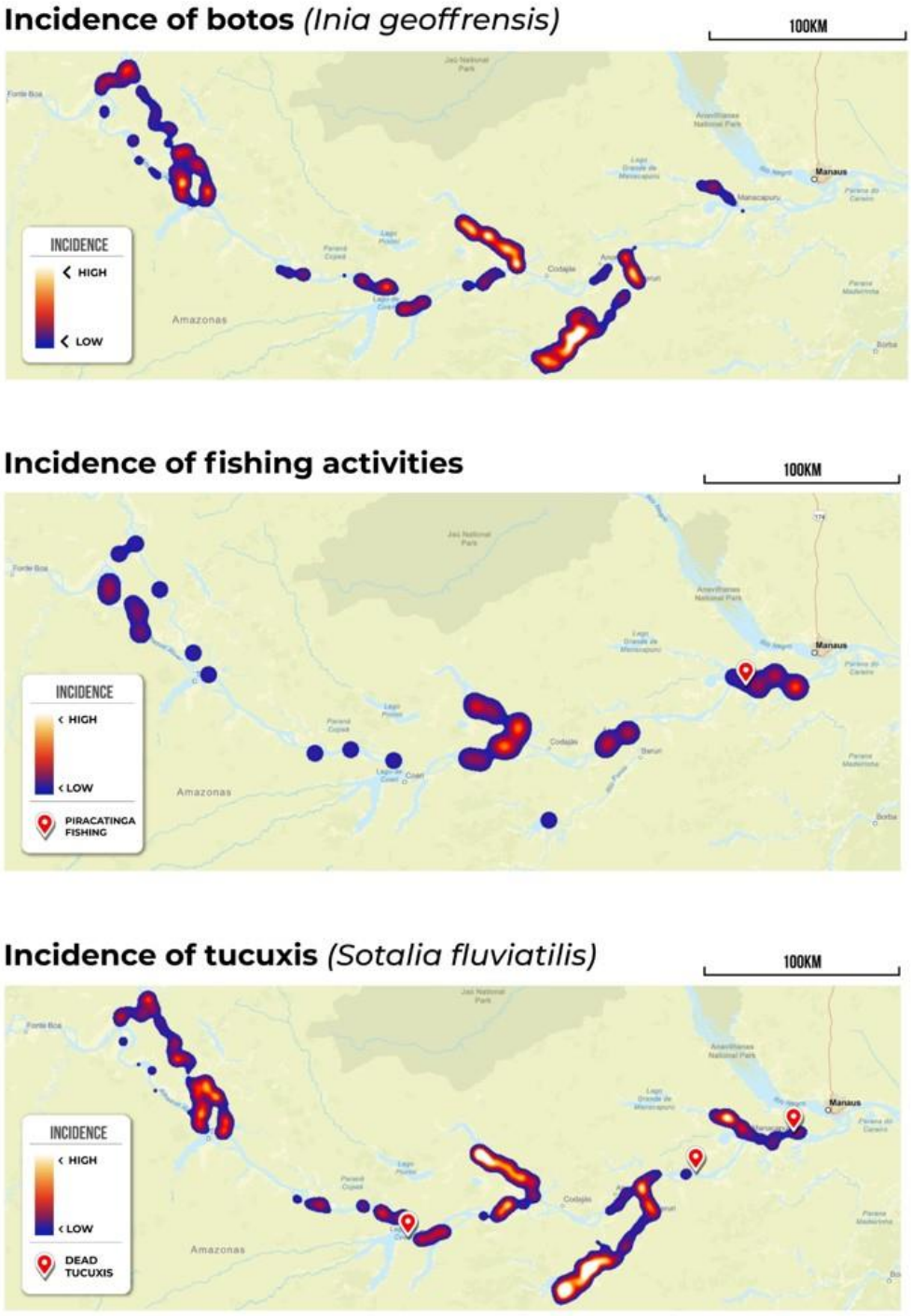

Figure 2: Overlap maps showing the frequency of botos, tucuxis and fishing nets in the study area. In the fishing activities maps, we highlighted the piracatinga fishing found. In the tucuxi incidence map, we highlighted where the carcasses were found

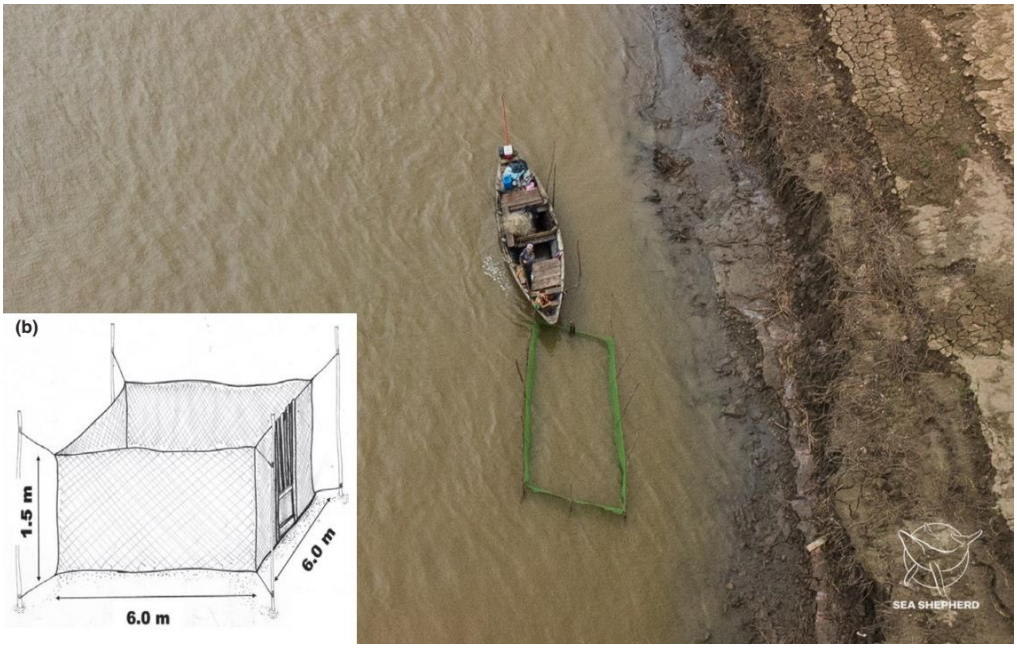

Figure 3: The 'nylon cage' gear, used in the piracatinga fishing, observed in Manacapuru area. In the detail, the scheme of this gear from Brum et al., 2015.

Carcasses encountered

Surprisingly, we found three carcasses of dolphins during the survey. Animal carcasses are difficult to find in the Amazon region, because there are many scavenging animals in the water and land. Over the last years, due the use of dolphins, botos in particular, as bait in the piracatinga fishing, we hypothesize that it is even more difficult to find carcasses, because the dead dolphins could be retrieved from the water and used for this fishing activity.

All carcasses found in the survey were of *S. fluviatilis*. The first one was an adult male (fig. 4), found at slight decomposition state (state 3, according Geraci and Lounsbury, 2005). The necropsy revealed stomach contents and fresh feces in the intestine, indicating the animal was apparently not ill before death. However, we found marks of nets around the neck of the animal and also a harpooned wound, indicating evidence of fisheries interactions.

The second individual was a male calf (fig. 5), in stage 3 of decomposition. This individual had only hatched its front teeth. The stomach was empty, but it was not clear if this animal was still milk-feeding. A harpoon wound was also found, but no visible net entanglement marks. Harpoons are traditional fishing gears in Amazon, commonly used for fishing arapaima. Dolphins could be incidentally harpooned when the fishers could be looking for other animals, or even intentional harpooned.

Figure 4: Adult male tucuxi necropsy; first carcass found

Figure 5: Harpoon wound on the second tucuxi carcass found, a calfl

The third individual was an adult male, in advance decomposition (stage 4). We found stomach content and feces in the intestine. The skin of the animal was already peeling off, making difficult to find evidences of fisheries interactions, as marks of nets.

CONCLUSIONS

In just one survey trip of 21 days and 110 hours of observation, we reported the encounter with three carcasses and several fishing activities harmful to the dolphins, confirming fisheries interaction with dolphins in Central Amazon are present and widespread, yet still unquantified.

The boto and the tucuxi are endangered species, highly threatened by fishing activities. Despite this, there is still a lack of information on population abundance and trends to understand the impact of fishing interactions with these species, and even more so, there is a lack of a risk map comparison between fisheries interaction to and these species. In this context, the following research expeditions already planned to happen, with four more expeditions planned until March 2024, will be a fundamental tool to fill up this gap in the Central Amazon.

Even considering the lack of more robust data regarding fisheries interactions with the boto and the tucuxi one conclusion is very clear: the mortality in piracatinga fishing must be curbed if we intend to conserve the dolphins in Amazon, as the interactions with fishing nets are also a huge problem and threat to the species, but one which is much more difficult to address in the short-term, with only long-term and more complex solutions on the horizon.

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