

Conflicts with fisheries and intentional killing of freshwater dolphins (Cetacea: Odontoceti) in the Western Brazilian Amazon

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Abstract We report three cases of conflicts with fishing activities of freshwater dolphins *Inia geoffrensis* and *Sotalia fluviatilis* in the Western Brazilian Amazon. The animals presented several cuts produced by perforating and cutting objects, especially on the dorsum, sides and flukes. The wounds were probably caused by harpoons and machetes, gear commonly used by local inhabitants for fishing and agricultural practices in the Amazon. The carcasses had not been subsequently used in any way, which suggests that the animals were not killed for consumption. Conflicts with fishermen and persistent cultural taboos may have led to the deaths. These records are an indication of a growing situation of conflict with fishing activities that should be taken into consideration in the conservation policy planning of aquatic mammals in the Amazon.

Keywords Amazonian dolphins · Brazilian Amazonia · Conflicts with fishermen · Direct killing

Abbreviations

AM Amazonas state
ASDR Amanã Sustainable Development Reserve
GIS Geographic information system
IDSIM Mamirauá Sustainable Development Institute

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Ig	<i>Inia geoffrensis</i>
Sf	<i>Sotalia fluviatilis</i>
TL	Total length

Introduction

Conflicts between aquatic mammals and humans in pursuit of common sources of food have increased in recent years (Plagányi and Butterworth 2002). The demand for fish and shellfish has more than doubled in the past 30 years as a result of increasing of the world's population mainly in developing countries (Earle 1996; Swartz and Pauly 2008), which is giving rise to negative interactions among fisheries and cetaceans. If fisheries may cause a depletion of food resources for aquatic mammals, cetaceans and sea lions are often accused by fishermen of consuming large amounts of fish, reducing the extent of food available to people. This concern has generated conflicts in some parts of the world, where animals are seen as unwanted competitors (Earle 1996; Northridge 2002).

Nowadays, the so-called 'resource competition' between men, cetaceans and sea lions is probably more significant to their conservation than direct exploitation. This fact has stimulated some policies of culling populations to increase the resource base available to fishermen, by reducing aquatic mammal predation on fish stocks (Crespo and Hall 2001; Yodzis 2001; Fertl 2002). This removal or density reduction of top-predators would leave a greater fraction of net production for human consumption, resulting in a historical and widespread call for culling cetaceans and sea lions to enhance fisheries (Earle 1996; Mulvaney 1996; DeMaster et al. 2001; Yodzis 2001).

Conflicts between aquatic mammals and fisheries can be ecological, when there is predation of commercially important fish stocks, or operational, when they result in physical encounters with fishing gear. Operational interactions involve gear damage provoked by incidental entanglement, disturbances on fishing operations caused by the presence of aquatic mammals and also depredation (Fertl 2002; Kaschner and Pauly 2005). Depredation is a question of great concern, as cetaceans and sea lions can cause direct damage by stealing fish from the net, damaging and spoiling fish and also reducing the catch rate (Earle 1996; Lauriano et al. 2009). As a consequence, fishermen may take retaliatory measures against animals such as deliberate catches, vessel chases, gunshots, use of explosives and even killing with a variety of objects and methods (Fertl 2002).

In both operational and ecological conflicts, there is a tendency of fishermen to adopt dolphin culling by lethal or non-lethal methods. While non-lethal methods involve removal and relocation of individuals, lethal methods are based on killing of targeted individuals or of a large number of animals with the objective of reducing interactions with human activities (Lavigne 2003). Little evidence suggest that lethal culling will provide an effective solution to dolphin-human conflicts for fisheries resources. Unfortunately, the complexity of ecological interactions among aquatic mammal populations, the relevant fish stocks and fisheries are often ignored or not properly documented (Earle 1996; Fertl 2002; Balata and Mariani 2009). Even though direct competition for prey between aquatic mammals and fisheries appears to be very limited, culling practice is illegally widespread throughout the world (Crespo and Hall 2001; Fertl 2002; Plagányi and Butterworth 2002; Lavigne 2003).

The Amazon basin harbors two endemic species of cetaceans, the tucuxi, *Sotalia fluviatilis*, and the boto, *Inia geoffrensis*, sympatric in the greater part of their area of distribution (Best and da Silva 1989). Although both species use channels, lakes and rivers,

the boto can additionally use flooded forests and even rivers with small falls (Best and da Silva 1989; Borobia et al. 1991).

Following the recent increase in fishing activities in the Brazilian Amazon region, negative interactions between dolphins and fisheries are on the rise (da Silva and Best 1996). This occurs by accidental entanglement in fishing gear (da Silva and Best 1996; Beltrán-Pedrerros 1998) and by direct conflict with fishermen, who consider the dolphins as direct competitors for some species of fish (da Silva and Best 1996). Similar conflicts have also been recorded in the Colombian and Peruvian Amazon (Leatherwood and Reeves 1997; Trujillo and Diazgranados 2002).

In this article we report three cases of stabbing and mutilation as possible cause of death of dolphins due to the direct conflict with local inhabitants. Cases were recorded in two nearby areas of Western Amazonia: a protected area of direct use (Amanã Sustainable Development Reserve—ASDR) and a non-protected area (Tefé Lake), both in the state of Amazonas (AM).

Methods

Dolphin carcasses found in 2005 were obtained through systematic and opportunistic monitoring and reports by inhabitants of the ASDR, located on the mid Japurá river, as well as reports by fishermen and boatmen on the Tefé Lake (Fig. 1).

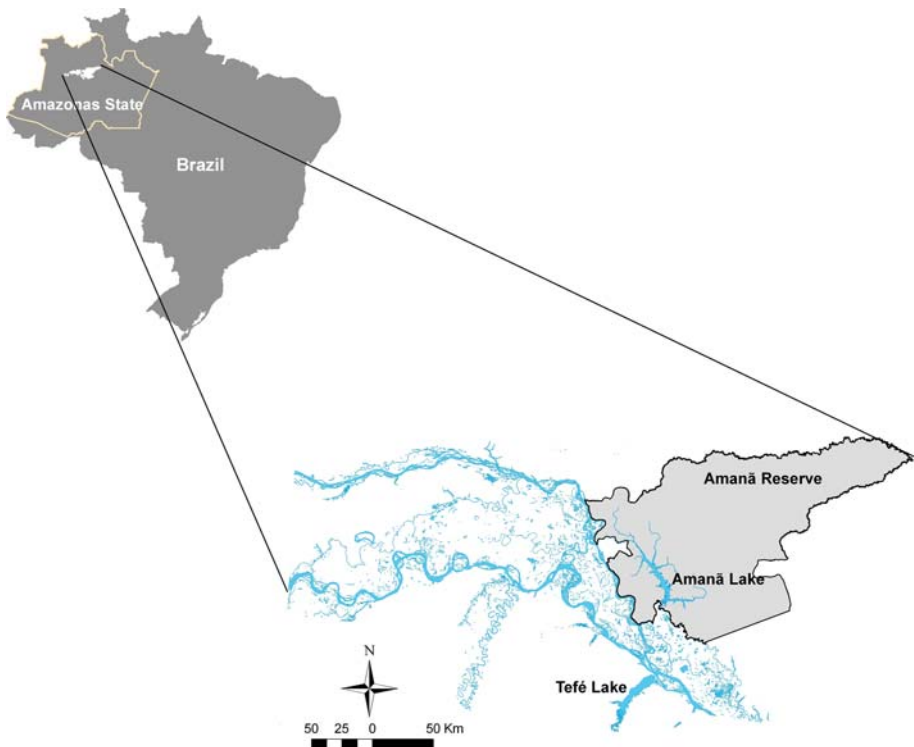


Fig. 1 Location of the study area: Tefé Lake and Amanã sustainable development reserve

Data on origin and sex were obtained whenever possible. Sex was determined by examination of the external morphology of the genital region and analysis of the reproductive tract during necropsy; under advanced decomposition, sex was not determined.

The intentional nature of the mortality was diagnosed through the marks and lesions observed on the carcasses, especially the wounds caused by perforating and cutting objects. Biometry followed Norris (1961). All materials collected were stored on the scientific collection of Mamirauá Sustainable Development Institute (IDSM).

Results

During the systematic and opportunistic monitoring efforts conducted in 2005, 12 carcasses of *S. fluviatilis* and 6 of *I. geoffrensis* were found in the focal area of the ASDR (represented by Amanã Lake) and surroundings of Tefé Lake. Due to the lesions observed, three (17%) of the 18 recovered specimens were believed to have been intentionally attacked and killed.

Sotalia fluviatilis

IDSM Sf 2005-03: male, TL 152 cm

Found dead at “Jauari Point”, mid portion of the Amanã Lake (ASDR), in August 2005. The animal had signs of aggression by two types of perforating and cutting objects (Fig. 2). A 10 × 10 cm dorso-lateral wound in the thoracic region, probably inflicted by a harpoon, and multiple strikes by a cutting object on the sides of the body. On the right side, four cuts, three in the scapular region and the fourth and largest located below and caudal to the eye. Upon necropsy it was verified that one of the cuts reached the scapula, resulting in a fracture of its central portion. On the left side, three similar cuts, also in the scapular region.

IDSM Sf 2005-08: unidentified sex, TL 150 cm

Found dead floating at the entrance of Amanã Lake in October 2005. Presented strikes by perforating and cutting objects of different sizes in three regions of the body; in the occipital region of the skull, an extensive and deep oblique cut greater than 30 cm in length (Fig. 3). After preparation of the material, it was verified that the strike caused sectioning of the supra-occipital bone and the release of the cephalic mass. On the right side, close to the dorsal fin, the carcass showed a small, approximately 4-cm-long, transversal cut. The caudal peduncle presented three close and transversal strikes caused by a cutting object. The deepest cuts reached the caudal vertebrae, as well as associated ligaments and innervations.

Inia geoffrensis

IDSM Ig 2005-05: female, TL 173 cm

Found dead floating on Tefé Lake, near the harbor, in October 2005. Presented over 15 strikes of perforating and cutting objects throughout the body, mainly in the dorsal area

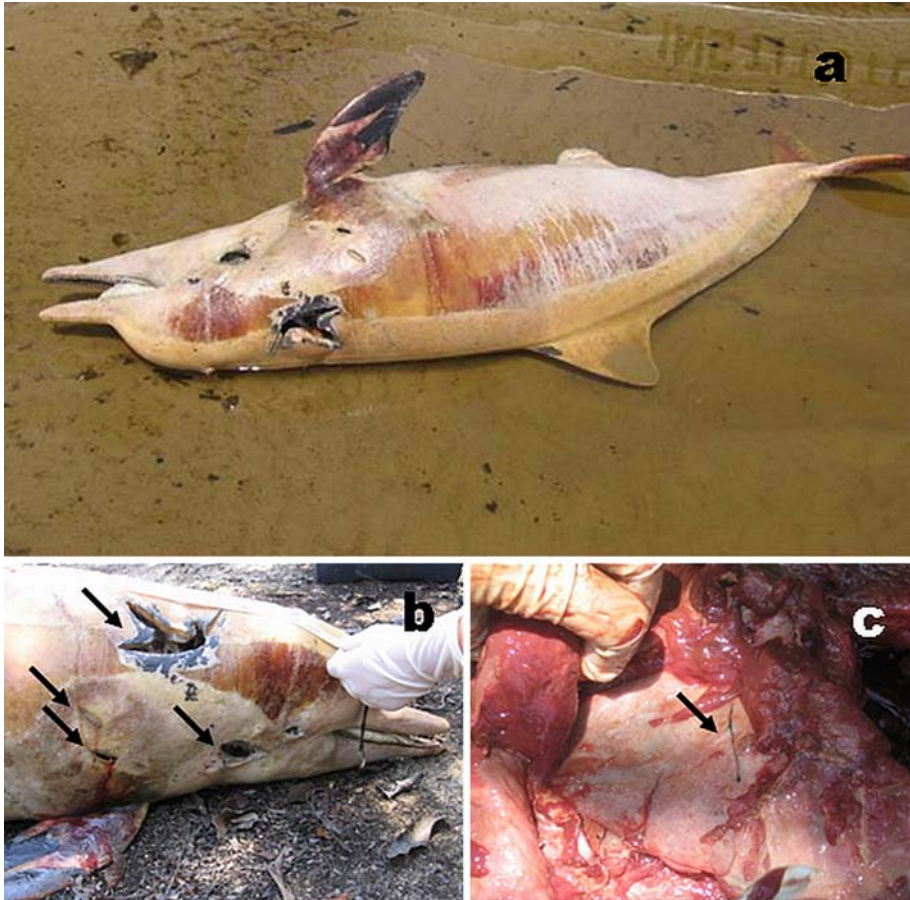


Fig. 2 **a** General view of wounds in *Sotalia fluviatilis* (IDSM Sf 2005-03). **b** Lesions in the scapular region and extensive wound in the thoracic region on the right side. **c** Fission in the central region of the right scapula caused by one of the strikes

(Fig. 4). Multiple strikes of different sizes on the sides, with larger cuts in the thoracic region and on the sides of the body close to the dorsal fin. Through some cuts in the ventral region, protrusion of the intestines could be observed. Presented a V-shaped mutilation in the medial area of the flukes, almost causing the severance of the portion close to the caudal cleft. Necropsy revealed that the specimen was a pregnant female, carrying a fetus of approximately 25 cm in length.

Discussion

Cases of aggression and intentional killing of aquatic mammals are not uncommon in the Brazilian territory. Simões-Lopes and Ximenez (1990) reported two cases of human aggression toward *Sotalia guianensis* in the Baía Norte of Santa Catarina Island, where knife cuts and strikes were also the probable cause of death. Pinnipeds (seals and sea lions)

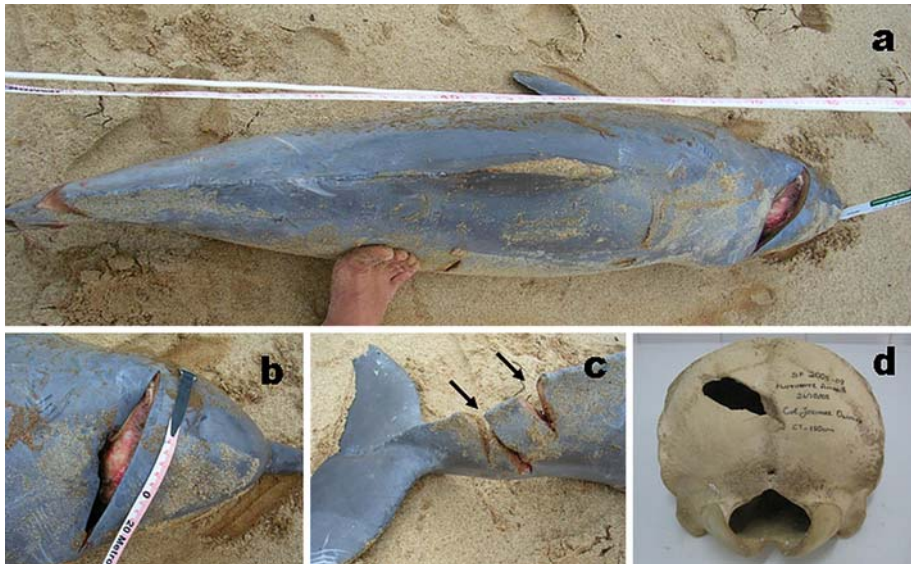


Fig. 3 **a** General view of wounds in *Sotalia fluviatilis* (IDSM Sf 2005-08). **b** Deep oblique cut in the occipital region of the skull, approximately 30 cm long. **c** Strikes to the caudal peduncle. **d** Sectioning of the supra-occipital region caused by strike seen in (**b**)



Fig. 4 **a** Wounds along the body of *Inia geoffrensis* (IDSM Ig 2005-05). **b** Cuts and mutilation on the flukes. **c** Transversal oblique cuts in the anterior and posterior insertions of the dorsal fin

in the southern region of Brazil are often shot at, victims of the conflict with fishermen (Rosas 1989; Drehmer et al. 1998). Such retaliatory measure is usually related to competition for prey or damage to fishing gear.

Leatherwood and Reeves (1997) reported that in the Peruvian Amazon there is little evidence of dolphin killing in a deliberate way or even commercialization of their products, and they attributed it to the many local superstitions and taboos. By-catch in fishing gear, motivated by a recent proliferation of drift nets, and some evidence of poisoning by commercial fishermen, seem to be the main conservation threats to Amazonian dolphins in Peru (Reeves et al. 1999). On the other hand, in Colombia and Brazil, reproductive organs,

eyes and teeth are objects of commerce (da Silva and Best 1996; Trujillo and Diazgranados 2002; Alves and Rosa 2008). Part of these products are derived from incidental catches in fishing gear, but da Silva and Best (1996) confirmed the intentional death by harpoon of at least four tucuxis and one boto, which represented 7.5% of their sample ($n = 67$). Trujillo and Diazgranados (2002) reported one death by harpooning in the Colombian Amazon, in a ten-year monitoring period. In both cases, there were apparently no signs of competition between the cetaceans and fishermen, possibly explained by the fact that dolphins tend to use smaller prey, but reasoning in this case may be different. In our case study, 17% of the sample ($n = 18$) presented signs of intentional aggression.

The perception that aquatic mammals compete with humans for food resources is relatively widespread among traditional communities. In Sierra Leone, manatees are considered ‘pests’ in the rice plantations and fishing activities, where they damage fishing gear (Reeves et al. 1988). However, culled animals are completely consumed in contrast to what was observed with Amazon dolphins in this study, where the bodies were not used for any purpose.

In the Colombian Amazon, cases of aggression to dolphins by fishermen have been recorded, especially using arrows and harpoons directed at fins and nearby regions, with the aim of maiming the animals (Trujillo and Diazgranados 2002). The same authors mentioned that, on some occasions, animals accidentally caught in fishing nets are wounded by knife strikes (stabbing) and then released. Such practices may be adopted by fishermen in Brazil as well, but the absence of net marks on the three specimens reported in this study does not allow us to declare that the animals were accidentally caught prior to suffering stabbing and mutilation. Reports of negative attitudes against cetaceans without apparent motivation are common in the region, especially towards the boto, considered by the local inhabitants as bad-tempered and capable of inflicting damage to the fishing activity.

According to Bearzi et al. (2004), direct killing of small cetaceans also has been recorded in the Adriatic Sea since historical times. Most of this deliberate killing involved measures to reduce conflicts with fisheries and were stimulated and rewarded by some governments, and also celebrated by popular press through culling campaigns. Retaliation by fishermen for damage to the fishing gear and to avoid competition for fishes are considered to be the main causes of this type of mortality on the Mediterranean, although there are indications of culling for bait and human consumption on a small scale.

A newly-established hunt for botos to be used as bait for ‘*Piracatinga*’ (*Calophysus macropterus*), a scavenging catfish, appears to be an important threat to conservation of Amazonian dolphins. Although direct evidence of hunt is scarce and difficult to judge, estimates of decline in dolphin populations and interviews with local villagers demonstrate that this practice is possibly widespread in the Brazilian Amazon (da Silva and Martin 2007; Serrano et al. 2007; IWC 2007). Based on fish-landing data on the town of Tefé, Serrano et al. (2007) estimated that 600 botos are taken annually as bait for catfish, but these authors could not recover any dolphin carcass possibly linked to bait use.

Apparently, the lesions that may have resulted in death of the three specimens reported in this case study are not related to meat consumption, commerce of organs, or the use of meat as fishing bait, contradicting what was observed in other studies (Beltrán-Pedrerós 1998; Trujillo and Diazgranados 2002; Serrano et al. 2007; Alves and Rosa 2008; Estupiñán et al. 2003). Based on interviews with local villagers and boat operators, at least in two cases (dolphins IDSM Sf 2005-08 and IDSM Ig 2005-05) animals were seen swimming near fishing nets and possibly were killed to avoid feeding from the catches or damage to fishing gear.

According to Crespo and Hall (2001), most catches and negative interactions with fishing gear occur because some aquatic mammals have learned to take advantage of the fishing operations to obtain an easy meal, either by feeding from the catch or from the discards. In his paper on interactions between marine mammals and fisheries, Read (2008) identified ‘depredation’ (removal or damage of fish caught in fishing gear, causing a reduction on price) as a source of conflicts with fishing activities. In addition, fishermen may take retaliatory attitudes towards the animals due to real or perceived monetary losses, which is giving rise to an important conservation issue. We have no direct evidence that on the third case (dolphin IDSM Sf 2005-03) the death of the animal was linked to negative interactions with fishing activity, but the presence of a harpoon wound on its back reinforces the hypothesis that this lesion was inflicted while it was alive. It is less plausible that a dead animal entangled in a fishing net would suffer a harpoon wound; it seems it was intentionally harpooned before dying.

Another evidence that these cases are unrelated to use of meat as fishing bait is that carcasses were recovered whole while floating on Tefé and Amanã lakes. Despite of lesions due to harpooning or stabbing, there were no signs of sectioning of body parts or removal of meat, blubber or organs that could be used for some purpose. Most of the wounds reached the occipital region of the skull and the thoracic and ventral regions of the body, which carry vital organs. It may be evidence that some wounds were probably intentionally provoked.

This leads us to believe that the perception of freshwater dolphins as competitors to humans for fishing resources, and myths and cultural taboos associated with magical aspects—undesired pregnancy of women, enchantment, etc. (Slater 1994; Alves and Rosa 2008), especially related to the boto—may still persist among local inhabitants of the Amazon and might explain these deaths. Although this is a case study, these records of intentional mortality clearly point to an impact whose magnitude is still unknown in the conservation of Amazonian freshwater dolphins.

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