NATURAL HISTORY OF DOLPHINS OF THE GENUS *SOTALIA*

FERNANDO CESAR WEBER ROSAS

Instituto Nacional de Pesquisas da Amazônia (INPA). Lab. Mamíferos Aquáticos. Caixa Postal 478, Manaus, AM, 69011-970. Brazil. E-mail: frosas@inpa.gov.br

Abstract

General biology, including food habits, predation, reproduction, age estimation, health and the main threats faced by the dolphins of the genus *Sotalia*, are reviewed according to current scientific knowledge. At least 23 teleost fish families and 3 cephalopod families are included in the diet of the estuarine dolphin (*S. guianensis*), while up to 11 fish families were identified in the stomachs of the tucuxi (*S. fluviatilis*). Both dolphins usually prey on fish schools and use similar fishing strategies. However, due to the completely different ecosystems that they use, prey species consumed by these dolphins are also different. The maximum age of incidentally caught estuarine dolphins was 30 years, leading one to believe that if they were not caught by the nets, the longevity of this species could be around 30-35 years. The maximum age estimated in the tucuxi was 43 years, which could be considered the longevity of this dolphin. Sexual maturity in the estuarine dolphin was estimated to occur at 170-180cm in males, and 160-169cm in females, while onset maturity in the tucuxi occurs at around 140cm in males and 132-137cm in females. Ovulation apparently occurs only in the left ovary of the tucuxi, while both ovaries of the estuarine dolphins are functional. The proportion of testes mass in relation to total body mass in adult males can reach up to 5% in the tucuxi, and 3.3% in the estuarine dolphin, suggesting a promiscuous mating system with sperm competition in both species. Although seasonal birth peaks can occur in estuarine dolphins, they seem to reproduce throughout the year. However, the tucuxi presents a defined birth seasonality, with most females giving birth during the low-water period in the Amazon. Due to intense incidental catches and the coastal environmental pollution faced by the estuarine dolphin, I recommend considering this species as "vulnerable" in the IUCN Red Data Book. On the other hand, due to the lack of quantitative data of the tucuxi as concerns its contamination and incidental catches throughout the Amazon basin, I suggest keeping this species as "data deficient", as it is now classified by IUCN.

Introduction

A tridimensional morphometric analysis recently performed on *Sotalia* skulls from the coastal and Amazonian regions revealed significant differences between them, separating the so-called marine and riverine ecotypes into two different species (Monteiro-Filho *et al*., 2002). This was also supported by Cunha *et al*. (2005), who used the mitochondrial DNA control region and cytochrome *b* sequence showing that marine and riverine ecotypes form very divergent monophyletic groups.

Both species of the genus *Sotalia* were described in the 19th century and despite having been regularly observed, very little was known about their biology until 25-30 years ago. Continuous and long-term studies on the freshwater species started in 1979 at INPA (Manaus, AM) (Magnusson *et al*., 1980; da Silva, 1983; Best and da Silva, 1984). Long-term studies on the estuarine dolphin (*S. guianensis*) are also very recent. Apart from sporadic records and very few studies on parasites and morphology (Lins de Almeida, 1933; de Carvalho, 1961; 1963), the first

studies on the biology and ecology of the species only started in the 80's (Borobia, 1984; Geise, 1984).

The main purpose of this document is to briefly describe the general biology and ecology of both species of the genus *Sotalia* with emphasis on age estimation, food habits, reproduction, health and predation, comparing the biology of these two species, pointing out some main threats faced by these dolphins and suggesting their conservation status.

General characteristics - Dolphins of the genus *Sotalia* are dark gray on their dorsal region. There are two lateral flashes of even lighter gray that run dorso-ventrally, one behind the flippers and one about mid-way down the body. Ventral coloration can vary from pink to very light gray (da Silva and Best, 1994; 1996). However, despite being similar in their color, the estuarine dolphin can reach up to 210cm of total length (Flores, 2002) and 121kg (Rosas and Monteiro-Filho, 2002), while the maximum total length and weight recorded for the tucuxi are152cm and 53kg, respectively (da Silva and Best, 1994).

Age estimation - Among the different techniques used to estimate age in *Sotalia* spp., the thin-section method originally described by Hohn *et al*. (1989) for bottlenose dolphins, presents better reading acuity in estuarine dolphins (Ramos *et al*., in press). According to Rosas *et al*. (2003), the mean distance from the neonatal line to the end of the first GLG is around 622µm. The authors mention that there is one accessory layer (sometimes two) between the neonatal line and the first GLG. The always-present accessory layer is located at a mean distance of 420µm from the neonatal layer and it is attributed to weaning in this species (Rosas *et al*., 2003). Although no age differences were observed between estuarine dolphins' teeth orientated in the buccal-lingual and antero-posterior planes, Rosas *et al*. (2003) recommend the buccal-lingual plane to obtain easier on-center or close-to-center sections. The same authors also recommend using teeth from the median region of the tooth row for age estimation in order to obtain reliable results.

The maximum age estimated in estuarine dolphins incidentally caught in fishing nets was 30 years (Rosas *et al*., 2003; Di Beneditto and Ramos, 2004). Considering that some animals could live longer if the nets had not caught them, Rosas *et al*. (2003) suggest that longevity in this species could be around 30-35 years. On the other hand, the maximum number of GLGs counted in female and male tucuxi teeth was 43 and 26, respectively (da Silva, 1994). According to this author, the large variability in body lengths for different age groups makes the age prediction of individuals based on their body length unreliable.

Feeding habits – According to Oliveira *et al*. (in press), a total of 53 fish species consisting of 23 families were identified in the stomachs of *S. guianensis* from the Brazilian coast. Food habits of estuarine dolphins from the Rio de Janeiro (Di Beneditto, 2000) and Paraná (Oliveira, 2003) coasts revealed that teleosts were present in 92% and cephalopods in 63% of the stomachs analyzed. These results suggest that despite the distance between the two study areas, the species maintain the same proportions of prey items in their diet. According to Oliveira (2003), *S. guianensis* on the Paraná coast seems to have more of a specialized diet than an opportunistic one. The maximum length of fish eaten by the estuarine dolphins was a 115cm long *Trichiurus lepturus*. However, the mean size of fish eaten by this dolphin is around 13-16cm (Oliveira *et al*., in press). In the Amazon, da Silva (1983) identified 28 fish species from 11 families in the stomachs of *S. fluviatilis*. Comparing the food habits of *S. fluviatilis* and *Inia geoffrensis* in the Amazon, da Silva (1986) suggests that the tucuxi is more specialized in its diet than *I. geoffrensis*. According to da Silva (1983), the minimum and maximum body lengths of fish eaten by the

tucuxi were 4.7cm and 37cm, respectively. The feeding behavior described by da Silva (1986) for the tucuxi in the central Amazon is similar to that observed by Monteiro-Filho (1995) for the estuarine dolphin. According to these authors, both species usually prey on fish schools (seldom on solitary fish) and use similar fishing strategies. However, due to the completely different ecosystems used by *S. guianensis* and *S. fluviatilis*, prey species consumed by these dolphins are also completely different.

The nutritional composition of milk from a 11-year-old *S. guianensis* female, which was incidentally caught in a fishing net together with its 5-month-old calf is presented in Table 1.

Reproduction – Body length at sexual maturity in *S. guianensis* was estimated to be between 170-180cm in males, and 160-169cm in females (Ramos *et al*., 2000; Rosas and Monteiro-Filho, 2002). Sexual maturity in *S. fluviatilis* is reached around 140cm in males and between 132-137cm in females (Best and da Silva, 1984). Seasonality in testicular activity was not detected in the estuarine dolphin (Rosas and Monteiro-Filho, 2002), while Best and da Silva (1984) mention that adult male tucuxi have seasonally active testes. Adult males of the genus *Sotalia* have large testes, which can reach up to 3.3% of the total body weight in *S. guianensis* (Rosas and Monteiro-Filho, 2002) and 5% in active adult males of *S. fluviatilis* (Best and da Silva, 1984). According to Best and da Silva (1984), the tucuxi has a polyandrous mating system with sperm competition, while Rosas and Monteiro-Filho (2002) mention a promiscuous mating system in the estuarine dolphin, also with sperm competition. However, considering that polyandry is a very rare mating system among mammals, Rosas and Monteiro-Filho (2002) suggest that a promiscuous system with sperm competition may be more likely for both species of the genus *Sotalia*.

Length at birth of estuarine dolphins was estimated to be between 92 and 106cm and the gestation period can last about one year (Ramos *et al*., 2000; Rosas and Monteiro-Filho, 2002). On the other hand, Best and da Silva (1984) reported length at birth in *S. fluviatilis* to be around 71-83cm and a gestation period of about 10 months. Lactation period was estimated to be between 8.7 to 9.4 months in the estuarine dolphin (Ramos, 1997; Rosas and Monteiro-Filho, 2002) and around 7 months in the tucuxi (Best and da Silva, 1984). As indicated by ovarian scars, ovulation in *S. fluviatilis* occurs exclusively in the left ovary (Best and da Silva, 1984), while both ovaries are functional in *S. guianensis* (Rosas and Monteiro-Filho, 2002). Reproductive senescence was observed by Rosas and Monteiro-Filho (2002) in ovaries of female *S. guianensis* older than 25 years. No information is available concerning senescence in the tucuxi.

The peak of births of estuarine dolphins from the Rio de Janeiro coast occurs in the fall (Di Beneditto, 2000), while Rosas and Monteiro-Filho (2002) did not record any defined seasonality in the births of this species on the Paraná coast. On the other hand, according to Best and da Silva (1984), births of *S. fluviatilis* are very seasonal and occur during the low-water period in the Amazon.

Health – Hematological values described by van Foreest (1980) for the estuarine dolphin are presented in Table 2. Some diseases, such as lobomycosis (de Vries and Laarman, 1974) and toxoplasmosis (Bandoli and Oliveira, 1977), were reported in estuarine dolphins. Greenwood and Taylor (1979) reported septicaemia in *S. guianensis* caused by *Proteus morgani*, *Clostridium perfringers*, *Yersinia enterocolitica*, *Staphylococcus aureus* and *Streptococcus fecalis* and a possible case of botulism. Bossenecker (1978) mentions hepatic degeneration, lung problems and severe vascular thrombosis in estuarine dolphins caught on the Caribbean coast of Colombia. Ramos *et al*. (2001) reported chronic bone lesions in estuarine dolphins from the Rio de Janeiro coast, and Ruoppolo (2003) mentions parasitic pneumonia as one of the causes of mortality of this

species from the São Paulo and Paraná coasts. Osteomyelitis was reported by Furtado and Simões-Lopes (1999) in *S. guianensis* from Santa Catarina coast.

As far as is known, apart from osteomyelitis (Fettuccia *et al*., 2005) no other specific disease has been reported for the tucuxi. Spotte (1967) mentions that a *S. fluviatilis* caught near Manaus (AM) by members of the Aquarium of Niagara Falls (USA) died, presumably from shock, and adds that this species is very sensitive to handling and subject to fatality from shock. Trujillo *et al*. (1987) reported a tucuxi with a tripartite tail in the Colombian Amazon, but did not identify the cause of the deformity.

Predation & Conservation Status – According to da Silva and Best (1994), the bull shark (*Carcharhinus leucas*), which is fairly common in the Amazon river, is a potential predator of tucuxi. This and many other shark species could also be possible predators for the estuarine dolphin throughout its distribution. According to Castello and Pinedo (1986), a female killer whale (*Orcinus orca*) that stranded alive on the Rio de Janeiro coast regurgitated, before dying, body parts of an unidentified dolphin, which were probably the remains of *Sotalia* sp. However, man, acting directly or indirectly, is the main predator of *Sotalia* sp. According to Geise and Borobia (1987) and van Waerebeek (1990), estuarine dolphins are eventually killed to use their meat as fish bait or for human consumption, and body parts of the tucuxi are frequently used for love charms throughout the Amazon basin (da Silva and Best, 1986). A genetic forensic analysis of dolphin eyes sold in Amazonian markets as love charms and alleged to be from pink dolphins (*Inia geoffrensis*) revealed that they are in fact from dolphins of the genus *Sotalia* (Gravena *et al*., 2005). As an indirect predation, incidental mortality of *Sotalia* sp. in fishing nets is the most important cause of death (Siciliano, 1994; da Silva and Best, 1996; Di Beneditto *et al*., 1998; Rosas, 2000).

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Fettuccia, D.C.; da Silva, V.M.F. and Simões-Lopes, P.C. (2005) Presença de costelas cervicais em golfinhos do gênero *Sotalia* e outras variações morfológicas. Page 86 *in* Abstracts III Congresso Brasileiro de Mastozoologia, Aracruz, 12-16 de outubro, Espírito Santo, Brasil.

Gravena, W.; Hrbek, T.; da Silva, V.M.F. and Farias, I.P. (2005) *O que os olhos não vêem, o coração sente? Um análise da genética forense à procura do boto-vermelho (Inia geoffrensis)*. Page 103 *in* Abstracts 51º Congresso Brasileiro de Genética. Águas de Lindóia, 7-10 setembro. São Paulo, Brasil.

Habitat degradation and loss due to antropic actions are other threats caused by man to these dolphins. According to Kunito *et al*. (2004), hepatic concentration of copper and zinc in the estuarine dolphins from the Paraná coast were comparable to those recorded in marine mammals from the northern hemisphere. Similarly, wide ranges of organochlorine residues (DDT and PCB) were observed in the blubber of estuarine dolphins, suggesting that the high industrialization on the Brazilian coast is probably the main source of pollution (Kajiwara *et al*., 2004). Despite no information being available concerning contaminants in *S. fluviatilis*, the development of the Amazon basin is proceeding rapidly, leading to degradation and loss of habitat essential for the tucuxi.

On the basis of the main threats faced by the estuarine dolphin, I recommend this species to be considered as "vulnerable" in the IUCN Red Data Book. On the other hand, due to the lack of quantitative data about contamination and incidental catches of the tucuxi throughout the Amazon basin, I suggest keeping this species as "data deficient", as it is now classified by IUCN.

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Table 1. Nutritional composition of milk of *Sotalia guianensis* from Paraná coast (Rosas and Monteiro-Filho, 2002).

		mg/100g						
Protein g/100g	**Fat g/100g**	**Na**	**K**	**Ca**	**Mg**	**Fe**	**Zn**	**P**
9.46	17.12	148.27	129.15	48.84	8.09	<0.5*	1.03	98.0

* Value lower than the resolution of the method.

Table 2. Hematological values of *Sotalia guianensis* (van Foreest, 1980).

	Ht (%)	**Hb (g/dL)**	**RBC (x10^{6}cells/µL)**	**MCV (fl)**	**MCH (pg)**	**MCHC (g/dL)**	**WBC (cell/µL)**
Mean	40.5	13.4	4.27	94	31	33	9163
Range	38-43	12.9-14.5	3.7-5.0	86-101	29-34	33.7-33.9	5700-14100