

**PARASITES OF *SOTALIA GUIANENSIS* IN
THE SOUTH AND SOUTHEASTERN COASTS OF BRAZIL**

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Abstract

Molecular studies have recently concluded that marine and riverine *Sotalia* are different species. The conservation status of both species is unknown and the identification of stocks by different simultaneous methods, including the study of parasites as biological tags is a research priority. The aim of this work was to present a preliminary description of the parasite community of *Sotalia guianensis*. From May/1997 to October/2000 we studied 49 *Sotalia guianensis* incidentally caught in fishing nets or stranded in São Paulo (SP) (ca. 25°00'S, 47°56'W) and Paraná (PR) States (ca. 25°30'S, 48°23'W). Biometry and necropsy were carried out in all specimens. The dolphins total length average was 166.88cm (± 25.63cm). A total of 17 lungs, 35 stomachs and 30 intestines were analyzed. Contents were washed through a sieve (mesh =150µm) and examined on a stereoscopic microscope to collect the parasites, which were fixed, stained and identified based on specialized bibliography. The nematode *Halocercus brasiliensis* was found in 88.2% (15/17) of all lungs examined and its prevalence was 100% (2/2) and 86.7% (13/15) in SP and PR States, respectively. Although none gastric parasites were found in a specimen from SP, they were found in 23.5% (8/34) of animals from PR. In PR, the trematode *Braunina cordiformis* infected six stomachs (17.6%; 6/34, mean intensity of 45.4 parasites) and the nematode *Anisakis* sp. was found in four ones (23.5%, 4/34, mean intensity of 6.7 parasites). Acanthocephalans were also found in the stomach of six animals (1.6%, 6/34, mean intensity of 1.6 parasites). In three of these cases, the acanthocephalans were identified as *Bolbossoma* sp. and were considered rare due to their low prevalence (8.6%, 3/35). Only the trematode *Hadwenius tursionis* was found in the intestines (73,3%, 22/30, mean intensity of 5.3 parasites). Considering the geographical areas, this intestinal parasite infected 100% of the dolphins from SP (2/2, mean intensity of 4.5 parasites) whereas in PR its prevalence was 71.4% (20/28, mean intensity 5.4 parasites). These preliminary results have added information for the species knowledge and may encourage research in other areas being useful in stock differentiation for conservation purposes.

Key words: Cetacea. Parasitology. By-catch. Stranding. *Sotalia guianensis*

Introduction

Sotalia is a genus of Neotropical dolphin with large distribution in the Atlantic coast and in the Amazon Basin, occurring from Honduras (15°58'N) to Santa Catarina State in Brazil (27°35'S) (da Silva and Best, 1996). The current taxonomic status of *Sotalia* species is uncertain. The genus once comprised five species, but in the twentieth century they were grouped into two (riverine *Sotalia fluviatilis* and marine *Sotalia guianensis*) that later were further lumped into a single species (*S. fluviatilis*), with marine and riverine ecotypes. Recently, studies on mitochondrial DNA control region and cytochrome b sequence data, according to various species definition methods, concluded that marine and riverine *Sotalia* are different species. And based on priority criteria, recommended the revalidation of *Sotalia guianensis* (Van Bénédén 1864) for the marine animals, while riverine dolphins should retain the species name *Sotalia fluviatilis* (Gervais 1853), thus becoming the first exclusively riverine delphinid. The study also pointed that the populations of *S. guianensis* show a strong subdivision along the Brazilian coast, with at least three evolutionarily significant units: north, northeastern and south/southeastern (Cunha et al., 2005).

Sotalia is probably the second most incidentally captured dolphin in fishing activities in Brazil and considered data deficient by the Brazilian Action Plan for Aquatic Mammals (Di Benedetto et al, 1998; IBAMA 2001; Monteiro-Neto et al, 2000; Siciliano, 1994). One of the priorities for this species is to identify its stocks by different simultaneous methods, including the study of parasites as biological tags (IBAMA 2001).

Parasites studies in cetaceans have progressed in recent years, particularly due to its use as a biological tool to elucidate stock identity and social structure. On the Brazilian coast, these studies are still scarce and parasites communities for many cetaceans are unknown, with little exception to *Pontoporia blainvillei* in which parasite studies have been highly recommended and efforts concentrated (Marigo et al., 2002; Andrade, 1996; Aznar et al., 1995). Da Silva and Best (1994) mention few parasites known to occur in *Sotalia* including the nematodes *Halocercus brasiliensis*, *Anisakis typica* and *Anisakis alexandri* and the trematodes *Amphimeris lancea* (in the riverine form) and *Nasitrema attenuata*. Very few new reports have been made for this coastal species and will be discussed here.

The aim of this work is to present a preliminary description of the parasite community of specimens of *S. guianensis* from Paraná and São Paulo States. These results add information for the species knowledge and may encourage research in other areas that can be useful in stock differentiation for conservation purposes.

Materials and Methods

From May/1997 to October/2000 we analyzed 49 *Sotalia guianensis* that were incidentally captured in fishing nets or stranded in beaches located in Cananéia, São Paulo State (ca. 25°00'S, 47°56'W) and Paraná State (ca. 25°30'S, 48°23'W).

The total length and gender of each specimen were recorded. Age class segregation was made by total body length data. Rosas and Monteiro-Filho (2002) analyzed gonads and determined the ages of almost all *S. guianensis* examined in this paper. The authors estimated that sexual maturity of the estuarine dolphin from those areas is attained when males and females are 170-175cm and 164-169cm long, respectively, and that the age of attainment of sexual maturity was 7 years for males and between 6 and 7 years for females.

Whenever possible, a complete necroscopic examination was performed, emphasizing the parasitological and histopathological sampling. Fragments of 1-2 cm³ from the main organs were

fixed in formalin for histological studies. During the necropsies, all the organs were examined looking for parasites, but special attention was given to the lungs, stomachs and intestinal segments. In some cases lungs, stomachs and intestines were frozen for posterior evaluation.

Lungs were opened with scissors inside a plastic tray and all the contents were washed in a sieve (mesh =150µm) to collect parasites. All macroscopic parasites seen during the analysis of food remains in the stomachs were collected. The intestine was entirely examined after measuring the total length and being divided in three equal parts for separated analysis. The intestinal contents were washed in a sieve (mesh = 150µm) and examined on a stereoscopic microscope (10x) to collect the parasites. All parasites were fixed and stained according to Amato et al. (1991), Dailey (1978) and Gardiner (2000).

Results and discussion

From 1997 to 2000 a total of 49 *Sotalia guianensis* stranded or accidentally captured were analyzed and divided by state of origin. The average total length for *S. guianensis* was 166.88cm (\pm 25.63cm) indicating that most animals were almost mature or mature (Figure 1). Animals from São Paulo State (n=3) measured 185.66cm in average (\pm 17.89cm) and 165.51cm (\pm 26cm) from Paraná (n=45). A total of 17 lungs, 35 stomachs and 30 intestines from *S. guianensis* were analyzed.

Lungs

Using macroscopic analyses, lung parasites of the species *Halocercus brasiliensis* (Nematoda, Pseudaliidae, Metastrongyloidea) were identified in 88.2% (15/17) of the cetaceans. Due to the fragility of the lung parasites and difficulty in separating them to have the accurate number counted, we established levels of infection based on the average number of parasites observed.

- Level +: from 1 to 25 parasites (Low)
- Level ++: from 26 to 50 parasites (Medium)
- Level +++ and ++++: from 51 to 75 parasites or more (High)

S. guianensis presented prevalence of 100% (2/2) of the nematode parasite *H. brasiliensis* in the lungs of animals from São Paulo and 86.7% (13/15) from animals from Paraná (Table 1).

The 17 lungs of *S. guianensis* analyzed presented different levels of infection, two animals with no parasites (11.7%, 2/17), six animals with low level (35.3%, 6/17), three with medium level (17.6%, 3/17) and six with high level (35.3%, 6/17) (Figure 2).

Halocercus are often found within the bronchi and bronchioli, frequently with their posterior ends embedded in the pulmonary parenchyma (Howard et al., 1983; Measures, 2001; Rosas et al, 2002). In our work, lungs were frozen and parasites were found free in the bronchial tree, some with their extremities partially fixed to the bronchioli, which had a high incidence of infection.

Studying the causes of death of some of our sampled animals and others, Ruoppolo (2003) found that parasitic pneumonia due to *Halocercus brasiliensis* was the primary cause of death of 20% (2/5) of the *Sotalia guianensis* studied. Although moderate to severe pulmonary lesions related to the presence of parasites was observed in all cases (100% - 5/5), indicating lung parasitism to be an important debilitating condition for the species. Gross lesions observed during necropsy included finding nematode parasites within the bronchial tree, moderate to severe pulmonary congestion and frothy fluid within the airways. Other findings related included lobar multifocal abscedation and fibrinous ascitis. Fibrinous pleuropneumonia was a common finding,

observed throughout the cases. Main microscopic findings included moderate to severe chronic interstitial and lobular pneumonias and broncopneumonia. Fibrinopurulent pneumonia was also diagnosed. Polimorphonuclear infiltrates, predominantly eosinophilic were a common finding. Lung consolidation areas and lymphadenitis were also determined. A young individual (<1 year) from Paraná died of complications due to the presence of lung parasites, indicating that prenatal infection could have occurred.

Some other studies have already shown signs of prenatal infection of the genus *Halocercus* (Balbuena et al., 1994; Conlogue et al., 1985; Dailey et al., 1991; Jepson et al., 2000; Moser and Rhinehart, 1993; Parsons et al., 1999; Parsons et al., 2001) as we observed here.

Odontocete parasites from the family Pseudaliidae (Metastrongyloidea) are particularly interesting because of its restricted parasite-host specificity, notable abundance in the infected host, and apparent high infection incidence (Dougherty, 1943). In this survey the pulmonary nematode *H. brasiliensis* was identified in high quantities and frequency in *S. guianensis*. Costa (2002) also reports the occurrence of pulmonary lesions associated to non identified parasites in *S. guianensis* stranded in Ceará state. *H. brasiliensis* has also been reported in *Stenella coeruleoalba* (Rosas et al., 2002) but was absent in *P. blainvillei* in areas where the species are sympatric corroborating with the idea of some narrow relationship between the parasites and the host species. It is possible that the greater the phylogenetic distance between hosts, the less probable that a parasite of one host will possess compatible antigens with the other. Therefore, even though abundant in the environment, *Halocercus* are not compatible with *P. blainvillei* (Balbuena e Raga, 1993; Marigo et al., 2002).

Stomachs

No parasites were found in the only stomach of *S. guianensis* from São Paulo. Gastric parasites were found in 23.5% (8/34) of animals from Paraná (Table 1). The trematode *Braunina cordiformis* was found in six animals (17.6%; 6/34), with mean intensity of 45.4 parasites per animal. *B. cordiformis* was recorded in Brazil parasitizing *S. guianensis*, *T. truncatus* and *S. bredanensis* from Rio de Janeiro and São Paulo (Marigo et al., 2001; Santos et al., 1996). *B. cordiformis* was also found in cetaceans from Argentina and Peru with high prevalence and the infection level seems to diminish with the total length of the animal suggesting progressive immunization (Beron-Vera et al., 2001; Dans et al., 1999; Van Waerebeek et al., 1993).

The nematode *Anisakis* sp was found in four stomachs (prevalence 23.5%, 4/34), with mean intensity of 6.7 parasites per animal. Anisakid nematodes are widely spread and present at high prevalence in the marine environment, including South America (Andrade et al., 1998; Cattan et al., 1976; Dailey, 2001; Santos et al., 1996). In this study, parasites were generally found free in the main stomach, though because the organ was frozen before, parasites may have been loosened from the mucosa.

Acanthocephalans were found in six animals from Paraná (prevalence of 1.6%, 6/34), with mean intensity of 1.6 parasites per animal. In three of these cases, the acanthocephalans were identified as *Bolbossoma* sp. and were considered rare with prevalence below 10% (8.6%, 3/35). This genus was registered in stomachs and intestines of *P. blainvillei* from Rio Grande do Sul (Andrade, 1996) and in the intestines of other species in Brazil (Andrade et al., 2001; Rosas et al., 2002).

Intestines

From 30 *S. guianensis* intestines the total length average was 9.71 cm (\pm 1.98 cm, n= 29). The *S. guianensis* presented only one parasite species, the trematode *Hadwenius tursionis*,

identified in 73.3% (22/30) of the animals, with mean intensity of 5.3 parasites. The prevalence observed in two animals from São Paulo was 100%, with mean intensity of 4.5 parasites per host. Animals from Paraná showed prevalence of 71.4% (20/28), with mean intensity of 5.4 parasites (Table 1).

The parasites distribution did not present a regular distribution. There was no significant difference in number of intestinal parasites between males and females for *S. guianensis* (Mann-Whitney, $p=0,604$; Figure 3).

As in this study, the intestine has been previously described as the main habitat for the genus *Hadwenius* (Dans et al., 1999). The genus is part of the component parasite community of *Lagenorhynchus obscurus* from Argentina were interestingly were found mostly in the stomach with prevalence of 52.17% and mean intensity of 42.6 parasites (± 51.0) (Dans et al., 1999). Was also found in the stomach and intestines of *P. blainvillei* from Rio Grande do Sul (Andrade, 1996). Inside the intestines, parasites were generally found distributed in the anterior portion of the organ, as was specially described for *P. blainvillei*, where this may be indicating one parasite concentration with reproductive purpose, particularly interesting for a very long intestine like franciscana's (Aznar et al., 1997). *H. tursionis* has been identified in other cetacean species (Andrade et al., 1999; Torres et al., 1992), including *S. guianensis* from other regions of Brazil (Andrade and Pereira, 1998).

The absence of significant differences between the total length of the animals and the number of parasites occurring may be due to sample characteristics, with samples representing mostly mature *S. guianensis*. In both groups there was an absence of animals in the extremes of the age classes and differences in age structure are known to influence helminth communities in mammals (Dans et al., 1999). And older host tend to harbor more diverse infracommunities which might be a result from a relationship between age and body size (Balbuena e Raga, 1993).

S. guianensis is threatened by incidental captures cetacean in Brazil and some animals can escape from fishing gear but those non-lethal encounters may cause serious health problems to small cetaceans and reduce their lifetime (Ramos et al, 2001). Other anthropogenic activities such as environmental contaminants can also compromise their immune system (Kajiwara et al, 2003; Yogui et al, 2003).

The larger number of lesions related to lungworms seen here is a serious condition for *S. guianensis* as aquatic animals that depend on the lung capacity while the gastrointestinal lesion were not significative. Pulmonary lesions can affect their health and ability to dive, subsequently affecting their feeding, growth and survival (Measures, 2001). Lungworms are considered one of the main causes of death in cetaceans populations due to their direct effects as parasitic and bacterial pneumonias and its cardiovascular complications and also because of hypersensitivity reactions to the parasite (Jepson et al., 2000).

The information referring to anatomopathological findings, even in incidentally captured animals, therefore supposedly health, should look for determining the real meaning of the pathological process and the sanity state of the populations. Including the impact of parasites where many intrinsic and extrinsic factors may be related. We should also look for the understanding of the effects of the parasite host relation in the survival of the populations and not only the individuals. These preliminary results have added information for the species knowledge and may encourage research in other areas being also useful in stock differentiation for conservation purposes.

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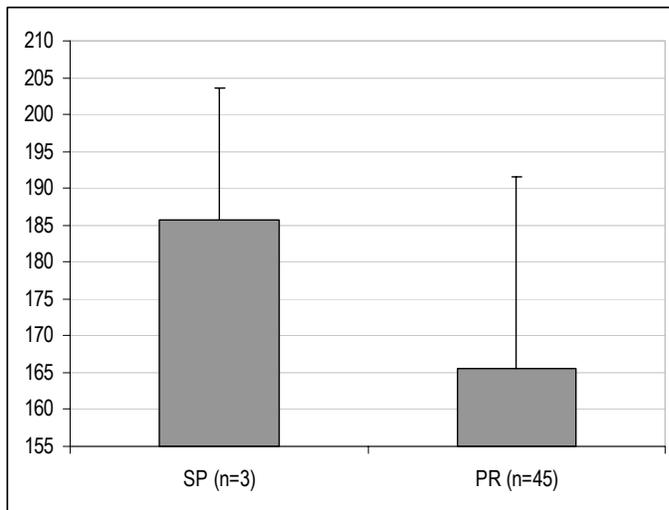


Figure 1: Average and standard deviation of total body length of *Sotalia guianensis* distributed by state of origin. São Paulo and Paraná, 1997-2002.

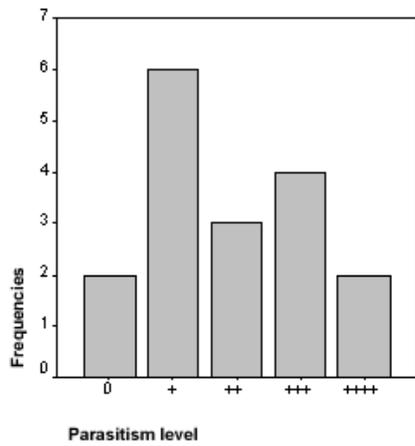


Figure 2: Distribution of parasitism levels of *H. brasiliensis* in *S. guianensis*, by frequency of animals parasitized. São Paulo and Paraná, 1997-2002.

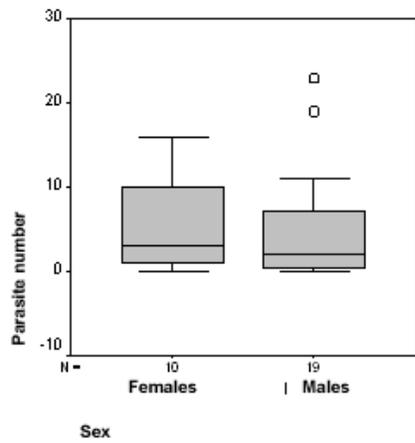


Figure 3: Number of intestinal parasites in males and females of *Sotalia guianensis* respectively (the symbols outside the “box plot” represent the aberrant values). São Paulo and Paraná, 1997-2002.

Table 1: Prevalence and mean intensity distribution for parasites of *Sotalia guianensis* by analyzed organ and location/State. São Paulo and Paraná, 1997-2002.

		<i>Sotalia guianensis</i>	
Organs		São Paulo State	Paraná State
Lung	Prevalence	(2/2) 100%	(13/15) 86.7%
Stomach	Prevalence	(0/1) 0	(8/34) 23.5%
Intestine	Prevalence	(2/2) 100%	(20/28) 71.4%
Intestine	Mean intensity	4.5	5.4