

NOTA CIENTÍFICA

INGESTION OF PLASTIC DEBRIS BY ESTUARINE DOLPHIN, *Sotalia guianensis*, OFF NORTHEASTERN BRAZIL

Ingestão de lixo plástico por boto-cinza, *Sotalia guianensis*,
na costa do Nordeste do Brasil

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ABSTRACT

Debris in the marine environment is documented as one of the main threats to fish, birds and sea turtles. However, there are few records of the interactions of cetaceans with debris. This paper reports the presence of a scrap of plastic screen in the digestive tract of an estuarine dolphin, *Sotalia guianensis*, found dead on the beach sand of Sergipe State, Brazil. The animal showed marks of interaction with fishing and necropsy revealed an adequate nutritional state and a stomach full of food contents, indicating that the animal was feeding just prior to death. It is believed that in this case death did not occur due to the animal having ingested the piece of plastic screen yet, based on previous studies, it is likely that plastic debris can obstruct the gastrointestinal tract and reduce the feeding stimulus, thereby resulting in death. A reduction in marine debris requires addressing the question of debris discarding, especially plastics, and educational campaigns aimed at raising awareness regarding conservation for the maintenance and survival of marine species.

Keywords: *Sotalia guianensis*, plastic debris, stranding, stomach contents, marine pollution.

RESUMO

Resíduo no ambiente marinho está documentado como uma das principais ameaças aos peixes, aves e tartarugas marinhas. No entanto, existem poucos registros das interações de cetáceos com detritos. Este trabalho teve como objetivo relatar a presença de um pedaço de tela de plástico no trato digestivo de um boto-cinza, *Sotalia guianensis*, encontrado morto na costa do estado de Sergipe, Brasil. O animal apresentava marcas de interação com a pesca e durante a necropsia revelou um estômago repleto de conteúdo alimentar, portanto em processo nutrição antes de vir a óbito. Sabe-se que, neste caso, a morte não ocorreu devido à ingestão do pedaço de tela plástica, mas com base em estudos anteriores, acredita-se que esta possa ser causada pela obstrução do trato gastrointestinal por resíduos sólidos e decréscimo do estímulo à alimentação. Para que haja uma diminuição de lixo marinho faz-se necessária uma nova abordagem em relação a seu uso indiscriminado, destino de plástico descartado, e campanhas educacionais para aumentar a consciência sobre a necessidade da conservação para a manutenção e sobrevivências das espécies marinhas.

Palavras-chaves: *Sotalia guianensis*, lixo plástico, encalhe, conteúdo estomacal, poluição marinha.

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INTRODUCTION

Marine contamination originates from a wide array of anthropogenic sources. A total of 70 to 80% comes from terrestrial sources and 20 to 30% comes from direct *in situ* human activities, such as fishing operations, commercial ships, cruise ships and recreational craft; contamination from the mainland is also introduced into this environment through the drainage of rivers and carried on the wind (Laist *et al.*, 1999; Crossland *et al.*, 2005; Ryan *et al.*, 2009).

The impact of debris on the marine environment is documented as one of the main threats to marine life (Derraik, 2002). Studies in all oceans have been reported inadvertently ingestion of debris by marine animals, which can be explain by the fact that these animals may confuse plastics and polystyrene foam as food sources (Laist, 1987; 1997; Derraik, 2002; Araujo & Costa, 2003). According to Laist (1997), at least 267 species are directly affected by synthetic debris worldwide.

Inadvertent debris ingestion has considerable effects on the gastrointestinal tract causing injuries and entanglement, which can have direct consequences on the behavior activities, decreasing of the life conditions, resulting on the death of these animals (Kastelein & Lavaleije, 1992; Araujo & Costa, 2003; Tourinho *et al.*, 2010).

Little has been documented regarding the effect the ingestion of debris on the morbidity and mortality of marine mammals (Tarpley & Marwitz, 1993; Walker & Coe, 1990; Jacobsen *et al.*, 2010; Denuncio *et al.*, 2011).

In Brazil, debris has been found in six marine mammals species: *Pontoporia blainvillei*, *Sotalia fluviatilis*, *Globicephala macrorhynchus*, *Steno bredanensis* and *Mesoplodon densirostris* as well as the freshwater species *Trichechus inunguis*.

The estuarine dolphin, *Sotalia guianensis*, is a coastal species in South America for which the ingestion of debris plastics has been recorded (Geise & Gomes, 1992) and, although classified as insufficiently known by the International Union for Conservation of Nature (2011) and the Brazilian Ministry of the Environment (2004), it is supposed to suffer from the high pressure of human actions off the Brazilian coast. Thus, determining the potential impact of debris on *S. guianensis* can help broaden knowledge on this species and contribute toward the adoption of management measures aimed at the conservation of cetaceans.

On October 9, 2010, an adult female measuring 1.82 m in length was found dead on the Abais Beach sand (11.39768°S, 37.31105°W) off the coast of

Sergipe State, northeastern Brazil. The carcass was in a good state of conservation (classified as Code 2, Geraci & Lounsbury, 2005), thereby enabling detailed necropsy, with a quality macroscopic evaluation and collection of biological samples for analyses. After the biometrics and external analysis, the specimen was taken for *post-mortem* examination at the office of the *Fundação Mamíferos Aquáticos* located in Aracaju, Sergipe's state capital.

The external exam revealed an adequate body state, with a nutritional status score of 2 (Jauniaux *et al.*, 2005), and marks suggestive of interaction with fishing gear on the rostrum as well as the pectoral, dorsal and caudal fins, and the mammary glands had breast milk.

The necropsy revealed that the second compartment of the stomach was filled with food contents (partially digested fish and shrimp) and contained parasites (*Halocercus brasiliensis* and *Anisakis* sp.) as well as a scrap of black polyethylene plastic (Figures 1 and 2), measuring 6.5 x 5.5 cm, with a 1-cm mesh and weighing 0.410 grams. This type of plastic is commonly used for fencing, gardening and the raising of animals (nurseries). The fact that the stomach was full indicated that the dolphin was feeding or had fed a few days prior to becoming stranded.

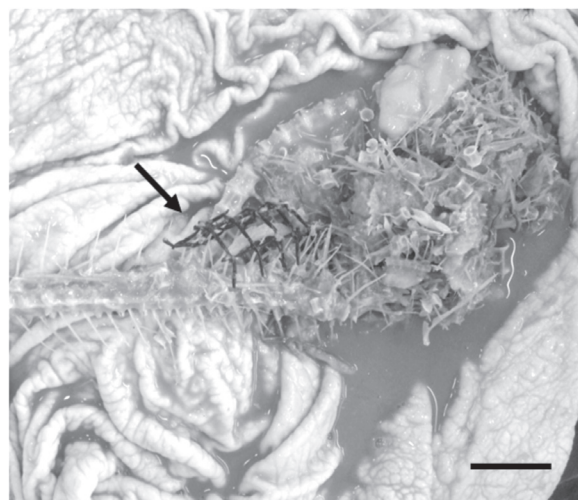


Figure 1 - Stomach contents of estuarine dolphin, *Sotalia guianensis*: partially digested fish and plastic (arrow); bar = 3 cm.

The internal examination of the organs revealed foam and fluid in the trachea and lungs and a bloody fluid in the pericardium. It was not possible to confirm the cause of death, but the presumptive diagnosis was drowning following entanglement in a fish net.

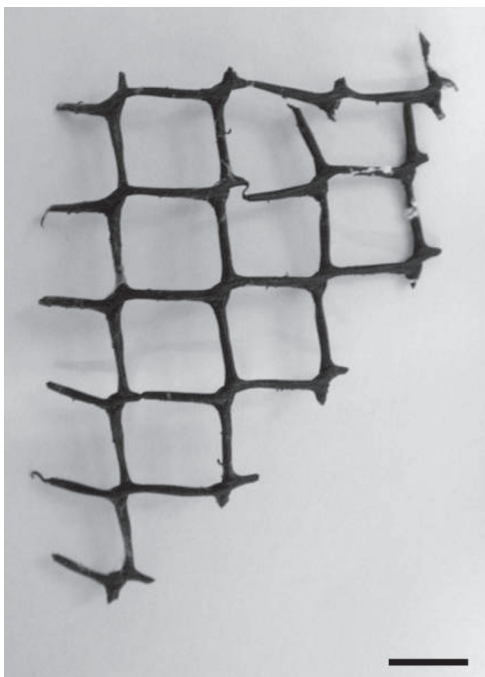


Figure 2- Detail of plastic debris found in the stomach of estuarine dolphin, *Sotalia guianensis*; bar = 1 cm

The small number of records likely stems from the difficulties in collecting samples of stomach contents due to the advanced state of decomposition in which such animals are generally found or simply due to the rare occurrence of such events.

Marine debris can cause gastric rupture (Jacobsen *et al.*, 2010), purulent skin injuries and ulcers, blockage of the digestive tract, starvation, general debilitation and death (Laist, 1997). Partial obstruction of the gastrointestinal tract can lead to a reduction in feeding stimulus and is one of the main long-term consequences of plastic debris ingestion (Bjørndal, 1997; McCauley & Bjørndal, 1999). A number of authors attribute the death of these animals to the complete obstruction of the gastrointestinal tract due to the ingestion of debris (Pierce *et al.*, 2004).

According to Walker & Coe (1990), marine debris is not the main cause of cetacean stranding, but the ingestion of plastic debris can lead to gastrointestinal disorders and trigger more serious conditions, thereby indirectly leading to the beaching of individuals. Stranded aquatic mammals are considerable sources of information and the ingestion of ocean debris by these organisms is generally detected during the post-mortem examination (Stamper *et al.*, 2006; Jacobsen *et al.*, 2010).

The macroscopic evaluation of the specimen analyzed herein revealed adequate nutritional status and a full stomach with food content, indicating that the ingestion of the plastic debris was not the cause of death. However,

being impossible to determinate how recent the plastic debris was ingested, it would not be viable to assess the plastic consequences found inside the specimen because debris ingestion consequences need to be evaluate in long terms.

There is a need for solutions with regard to the final destination of solid waste, especially plastics. For instance, the development of biodegradable plastic would significantly reduce the time needed to break down this material (Song *et al.* 2009; Thompson *et al.* 2009). Moreover, there is a need for better enforcement of existing legislation, with the appropriate collection and destination of solid waste and recycling, which could help reduce this problem. Education campaigns aimed at raising the awareness of the general public regarding the need for conservation should be carried out (Meirelles & Barros, 2007).

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REFERENCES

- Araújo, M.C.B. & Costa, M.F. Lixo no ambiente marinho. *Ciência Hoje*, v.32, n.191, p.64-69, 2003.
- Barros, N.B.; Gasparini, J.L.; Barbosa, L.A.; Netto, R. F. & Moraes, C. S. Ingestão de plástico como provável causa mortis de uma baleia-piloto-de-peitorais-curtas, *Globicephala macrorhynchus* Gray, 1846, no litoral do Estado do Espírito Santo, p.336, in *Anais do 7º Congresso Nordestino de Ecologia*, Ilhéus, 1997.
- Bjørndal, K.A. Foraging ecology and nutrition in sea turtles, in Lutz, P.L. & Musick, J.A. (eds.), *The biology of sea turtles*, 1997.
- Cadée, G.C. Seabirds and floating plastic debris. *Mar. Poll. Bull.*, v.44, n.11, p.1294-1295, 2002
- Crossland, C. J.; Kremer, H. H.; Lindeboom, H. J.; Marshall-Crossland, J. I. & Lê Tessier, M. D. A. *Coastal fluxes in the Anthropocene*. Springer Verlag, Berlin, 2005.

- Derraik, J.G.B. The pollution of the marine environment by plastic debris: a review. *Mar. Poll. Bull.*, v.44, p.842-852, 2002.
- Geise, L. & Gomes, N. Ocorrência de plástico no estômago de um golfinho, *Sotalia guianensis* (Cetacea, Delphinidae), p.26-28, in *Anais da 3ª Reunião de Trabalho de Especialistas em Mamíferos Aquáticos da América do Sul*, Montevideo, 1992.
- Geraci, J.R. & Lounsbury, V.J. *Marine mammals ashore. A field guide for strandings*. Texas A&M. Sea Grant University, Texas, 2005.
- Gregory, M.R. Environmental implications of plastic debris in marine settings-entanglement, ingestion, smothering, hangers-on, hitch-hiking and alien invasions. *Phil. Trans. Royal Soc.*, v.364, n.1526, p.2013-2025, 2009.
- International Union for Conservation of Nature [IUCN]. 2011 *The IUCN Red List of Threatened Animals*. Retrieved 30 May 2011 from www.redlist.org, 2011.
- Jacobsen, J.K.; Massey, L. & Gulland, F. Fatal ingestion of floating net debris by two sperm whales (*Physeter macrocephalus*). *Mar. Poll. Bull.*, v.60, p.765-767, 2010.
- Jauniaux, T.; Beans, C. & Dabin, W. *Stranding, necropsy and sampling: collection data, sampling level & techniques*. European Cetacean Society, 2005.
- Kastelein, R.A. & Lavaleije, M.S.S. Foreign bodies in the stomach of a female harbour porpoise (*Phocoena phocoena*) from the North Sea. *Aquat. Mamm.*, v.18, p.40-46, 1992.
- Laist, D.W. Overview of the biological effects of lost and discarded plastic debris in the marine environment. *Mar. Poll. Bull.*, v.18, n.6, p.319-326, 1987.
- Laist, D.W. Impacts of marine debris: entanglement of marine life in marine debris including a comprehensive list of species with entanglement and ingestion records, p.99-140, in Coe, J.M. & Rogers, D.B. (eds.), *Marine debris: sources, impacts and solutions*. Springer-Verlag, New York, 1997.
- Laist, D.W.; Coe, J.M. & O'Hara, K.J. Marine debris pollution, in Twiss Jr., J.R & Reeves, R.R. (eds.), *Conservation and management of marine mammals*. Smithsonian Institution Press, 1999.
- Mato, Y.; Isobe, T.; Takada, H.; Kahnehiro, H.; Ohtake, C. & Kaminuma, O. Plastic resin pellets as a transport medium for toxic chemicals in the marine environment. *Environ. Sci. Technol.*, v.35, p.318-324, 2001.
- Mascarenhas, A.; Santos, R. & Zeppelini, D. Plastic debris by sea turtle in Paraíba. *Mar. Poll. Bull.*, v.49, p.354-355, 2004.
- McCauley, S.J. & Bjørndal, K.A. Conservation implications of dietary dilution from debris ingestion: sublethal effects in post-hatchling loggerhead sea turtles. *Conserv. Biol.*, v.13, p.925-929, 1999.
- Meirelles, A.C.O. & Barros, H.M.D.R. Plastic debris ingested by a rough-toothed dolphin, *Steno bredanensis*, stranded alive in northeastern Brazil. *Biotemas*, v.20, n.1, p.127-131, 2007.
- Ministério do Meio Ambiente *Instrução Normativa Nº 5, de 21 de Maio de 2004*. Lista Nacional das Espécies de Invertebrados Aquáticos e Peixes Ameaçadas de Extinção, 2004.
- Moser, M.L. & Lee, D.S. A fourteen-year survey of plastic ingestion by western North Atlantic seabirds. *Colonial Waterbirds*, v.15, p.83-94, 1992.
- Nollkaemper, A. Land-based discharges of marine debris: from local to global regulation. *Mar. Poll. Bull.*, v.28, n.11, p.649-652, 1994.
- Pierce, K.E.; Harris, R.J.; Larned, L.S. & Pokras, M.A. Obstruction and starvation associated with plastic ingestion in a northern gannet, *Morus bassanus* and a Greater shearwater, *Puffinus gravis*. *Mar. Ornithol.*, v.32, p.187-189, 2004.
- Pinedo, M.C. *Análises dos conteúdos estomacais de Pontoporia blainvillei (Gervais & D'Orbigny, 1844) e Tursiops gephyreus (Lahille, 1908) (Cetacea, Platanistidae e Delphinidae) na zona estuarial e costeira de Rio Grande, RS, Brasil*. Tese de Mestrado, Universidade do Rio Grande, Rio Grande, 1982.
- Ryan, P.G. The effects of ingested plastic and other marine debris on seabirds, p. 623-634, in Shomura, R.S. & Godfrey, M.L. (eds.) *Proceedings of the Second International Conference on Marine Debris*, U.S. Department of Commerce, NOAA Tech., 1990.
- Ryan, P.G.; Moore, C.J.; van Franeker, J.A. & Moloney, C.L. Monitoring the abundance of plastic debris in the marine environment. *Phil. Trans. Royal Soc.*, v.364, p.1999-2012, 2009.
- Secchi, E.R. & Zarzur, S. Plastic debris ingested by a Blainville's beaked whale, *Mesoplodon densirostris*, washed ashore in Brazil. *Aquat. Mamm.*, v.25, n.1, p.21-24, 1999.
- Silva, A.B. & Marmotel, M. Ingestão de lixo plástico como provável causa mortis de peixe-boi amazônico (*Trichechus inunguis* Natterer, 1883). *Uakari*, v.5, n.1, p.105-112, 2009.
- Song, J.H.; Murphy, R.J.; Narayan, R. & Davies, G.B.H. Biodegradable and compostable alternatives to conventional plastics. *Phil. Trans. Royal Soc.*, v.364, p.2127-2139, 2009.

- Stamper, M.A.; Whitaker, B.R. & Schofield, T.D. Case study: morbidity in a pygmy sperm whale *Kogia breviceps* due to ocean-bourne plastic. *Mar. Mamm. Sci.*, v.22, n.3, p.719-722, 2006.
- Tarpley, R.J. & Marwitz, S. Plastic debris ingestion by cetaceans along the Texas coast: two case reports. *Aquat. Mamm.*, v.19, n.2, p.93-98, 1993.
- Tomás, J.; Guitart, R.; Mateo, R. & Raga, J.A. Marine debris ingestion in loggerhead sea turtles, *Caretta caretta*, from the western Mediterranean. *Mar. Poll. Bull.*, v.44, p.211-216, 2002.
- Thompson, R.C.; Moore, C.J.; von Saal, F.S. & Swan, S.H. Plastics, the environment and human health: current consensus and future trends. *Phil. Trans. Royal Soc.*, v.364, p.2153-2166, 2009.
- Tourinho, P.S.; Ivar do Sul, J.A. & Fillmann, G. Is marine debris ingestion still a problem for the coastal marine biota of southern Brazil? *Mar. Poll. Bull.*, v.60, n.3, 396-401, 2010.
- Walker, W.A. & Coe, J.M. Survey of marine debris ingestion by odontocete cetaceans. *NOAA Technical Memorandum NMFS-SWFSC*, v.154, p.747-774, 1990.

