Arvoredo Island is remarkable considering that this area reaches temperatures as low as 13°C in the winter (pers. obs. in July 2007). This work demonstrates that Brazil hosts important hawksbill turtle foraging grounds, which should be preserved for the recovery of *E. imbricata* populations. Forthcoming stable isotope analyses will provide further understanding of hawksbill diet and habitat use at these Brazilian islands. Genetic studies currently underway will link these foraging populations to their stocks of origin, improving our current knowledge on hawksbill connectivity in the Atlantic Ocean and enhancing our ability to protect this species.

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Case Report: Ingestion of a Massive Amount of Debris by a Green Turtle (*Chelonia mydas*) in Southern Brazil

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Marine debris is considered any solid waste (plastic, polystyrene, rubber, foam, glass, metal, cloth, and other man-made materials) that enters the marine or coastal environments from any source (Coe & Rogers 2000). The main sources of marine debris are litter carried into the sea from land-based sources in industrialized and highly populated areas and wastes from ships, fishing and recreational vessels (Derraik 2002). However, regardless of the source, marine debris can have serious ecological and economic consequences. These adverse impacts have been documented all over the world. According to Gregory & Ryan (1997), plastic pollution is estimated to represent between 60% and 80% of the total marine debris in the world's oceans. Within just a few decades since mass production of plastic products commenced in the 1950s, plastic debris has accumulated in terrestrial environments, in the open ocean, on shorelines and in the deep sea (Barnes *et al*. 2009).

Every year, many species of marine animals, including sea turtles, marine mammals, seabirds and fish die from becoming entangled or ingesting plastic debris (Laist 1987). According to Carr (1987) sea turtles are particularly prone to eating plastics and other floating debris. Juvenile sea turtles are frequently exposed to pollution in convergence zones and most species are exposed in nearshore habitats, where they feed (Bjorndal *et al.* 1994). Evidence indicates that the high occurrence of non-food items in sea turtle species may be related to mistaken ingestion of plastics, due to its similarity to prey items (Plotkin *et al.* 1993), or even to incidental ingestion along with a prey (Tomás *et al.* 2002).

On 18 July, 2010 a juvenile green turtle (*Chelonia mydas*) was rescued by Projeto Tamar (Brazilian sea turtle conservation program) after stranding at Mole Beach, in Florianópolis municipal district, Santa Catarina State, Brazil (Fig. 1). On admission, the

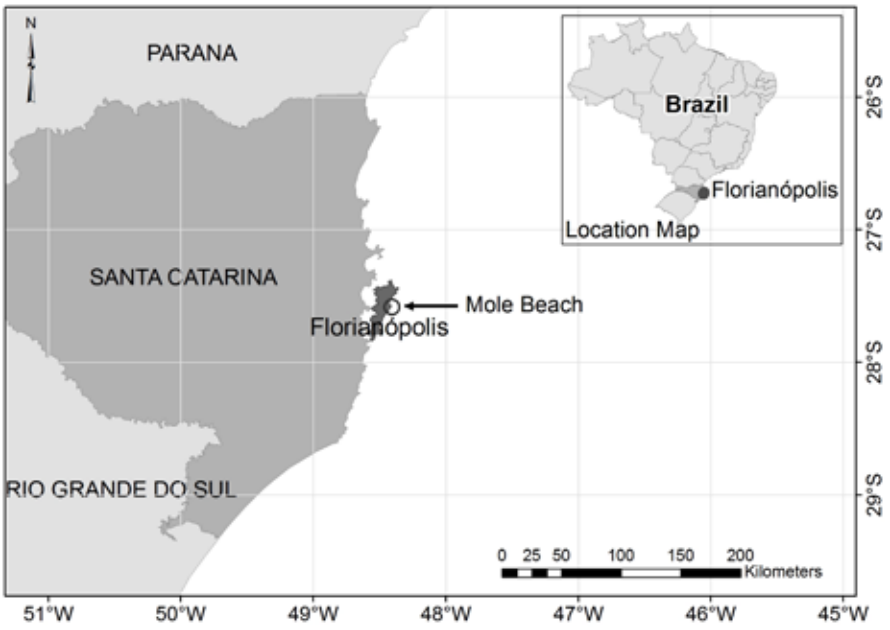

Figure 1. The location where the *C. mydas* stranded. Mole Beach is located on the island of Florianópolis, in Santa Catarina State, Brazil.

animal was measured (39 cm curved carapace length, 38 cm curved carapace width), weighed (6 kg), and received a thorough physical examination. The turtle was weak, in poor body condition, malnourished and emaciated. Clinical signs included dehydration, prostration and areflexia. Death occurred a few hours after initial supportive care. In order to determine the cause of death, a necropsy was performed on the individual. During the procedure, the turtle had its sex determined as a male by visual examination of the gonads. All coelomic organs were examined and no apparent gross pathology was noted. However, a massive amount of debris was found in its digestive tract and was apparently blocking food passage. The gastric and intestinal mucosa showed the presence of several ulcers, probably caused by the presence of debris, which could have possibly led to excess gastric acid production. The gut content was then separated according to its location: esophagus, stomach, small and large intestines. Contents were carefully rinsed in a sieve with a 1 mm mesh and marine debris was separated and dried at 50 °C.

Afterwards, the samples were divided into seven categories: soft plastics, hard plastics, nylon, other plastics, latex, textile and other/unknown. Only debris items larger than 5 mm were counted. Any particles smaller than 5 mm were considered fragments of another piece, and were only weighed.

In the esophagus, 18 items were found (total dry weight: 2.30 g), in the stomach there were 308 items (34.14 g), and in the large intestine there were 3,267 items (233.16 g, see cover photo). No anthropogenic debris was found in the small intestine.

It is likely that the obstruction caused by the marine debris ingestion led this individual to death. In terms of comparative data (Fig. 2), this turtle had an enormous amount of garbage in its stomach and large intestine. The mean number of items found in the gastrointestinal tracts of other turtles (16 animals) stranded in the same area was: 9.67 items ± 15 (range: 1 - 27; total dry weight: 0.01 - 0.4 g) in the esophagus; 54.2 ± 50.5 (1 - 136; 0.02 - 16.39 g) in the stomach, 11.4 ± 19.1 (1 - 45; 0.02 - 4.81 g) in the small intestine and 128 ± 182 (6 - 732; 0.08 - 40.92 g) in the large intestine. Additionally, a comparison was made between our results and those obtained in different studies (see Table 1). Our study shows a significantly higher amount of debris than the others, although only one case report is presented here.

Death by plastic ingestion may be caused by reduced stomach capacity (Ryan 1988); obstruction (Lazar & Gracan 2011) or exposure to toxic compounds (Bjorndal *et al.* 1994). According to Laist (1987), starvation is the major cause of death for animals that ingest anthropogenic debris. Nutrient absorption from food takes place as the items pass through the digestive tract. Therefore, in case of a gut blockage, the animal will starve to death. Additionally, even if there is no blockage, consumption of plastics in the place of food items may cause sublethal effects, such as partial obstruction of the gastrointestinal tract and reduction

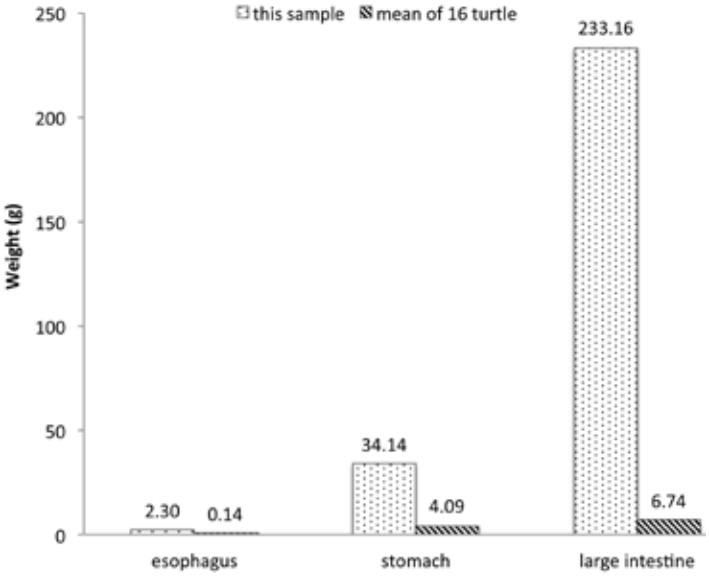

Figure 2. Comparative weight of items found in this sample and those found in 16 other turtles at the same area.

Sp.	N	Range	Debris	Min. size	Reference
Cc	43	1-59	366	1	Tomás et al. 2002
Cc	19	1-27	82	1	Lazar & Gracan 2011.
Cm	34	3-134	1602	n/a	Tourinho et al. 2010.
Cm	56	n/a	3737	<1	Guebert-Bartholo et al. 2011.
Cm	23	1-29	n/a	n/a	Bugoni et al. 2001.
Cm	1		3593	0.5	Present study

Table 1. Incidence and amount of debris in the digestive tracts of sea turtles reported in different studies. Sp = species; *Cc* = loggerhead, *Cm* = green turtle, Range = range of pieces of anthropogenic debris found in the digestive tracts of sea turtles, Debris = total debris found in the digestive tracts of sea turtles. Min. size = minimum size (in cm) of anthropogenic debris considered.

of feeding stimulus (Ryan 1988; Bjorndal *et al.* 1994; McCauley and Bjorndal, 1999). Floating plastic debris are also known to absorb toxic contaminants from surrounding waters, increasing considerably its toxicity when ingested. These contaminants include persistent organic pollutants such as polychlorinated biphenyls (PCBs), dichlorodiphenyldichloroethylene (DDE), nonylphenol and phenanthrene, which can become several orders of magnitude more concentrated on the surface of plastic debris than in the water column (Teuten *et al.* 2009).

Recently, it has been suggested that plastics could transfer harmful chemicals to living organisms (Oehlmann *et al.* 2009; Koch & Calafat 2009). A range of chemicals are used as additives in the manufacture of plastics, such as phthalate plasticizers and brominated flame retardants. These substances are potentially harmful and have been associated with carcinogenic and endocrine disrupting effects (Teuten *et al.* 2009).

Although only one case report is presented in this study, it shows how devastating marine debris can be to marine animals. Further research is required to better understand the impacts of ocean litter on sea turtle survival. Moreover, priority implementation measures should be discussed in order to prevent and reduce marine debris and its impacts on the environment. Efforts to reduce waste, increase recycling, increase use of reusable items, implement education programs and beach clean ups are also important as a means to mitigate the global marine debris problem.

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