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Incidence of plastic debris in Sooty Tern nests: A preliminary study on Trindade Island, a remote area of Brazil



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ABSTRACT

Plastic is abundant in the oceans, reaching pelagic zones away from continents. Here we present the first recordings of plastic used as nest material in Sooty Tern nests, on a remote oceanic island. We describe our findings in terms of quantity, size and color of plastic debris. A total of 78 plastics were noted in 54 nests. Four color categories were found: Blue, White, Green and Red. Blue fragments were the most frequent color, present three times as much as white debris. This pattern was present despite blue fragments being smaller and lighter. The plastic debris of lowest frequency were the larger and heavier pieces (red). To our knowledge this is the first record of plastic in Sooty Tern nests. Trindade Island is on an oceanic zone expected to accumulate garbage due to the dynamic ocean currents. Such findings call for a closer inspection of pollution in the Atlantic Ocean.

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Pollution by plastic is one of the greatest threats to marine environments, causing concerns to marine biota conservation (Eriksen et al., 2014; Vegter et al., 2014). Plastic fragments disperse across long distances and tend to accumulate at the water surface of oceanic gyres (Lebreton et al., 2012; Van Sebille et al., 2012). Some gyres even present higher plastic biomass than plankton and zooplankton, e.g. the Central Pacific Gyre (Moore et al., 2001, 2002) and the North Atlantic Subtropical Gyre (Law et al., 2010). Plastic debris releases toxins into the marine environment, often as persistent organic pollutants that can have a negative impact on many marine taxa, including seabirds (Rios et al., 2007; Goutte et al., 2014; Kühn et al., 2015).

The presence of plastic in the ocean can cause an increase in seabird mortality, resulting from accidental ingestion of these fragments (Petry and Fonseca, 2002; Petry et al., 2009; Vegter et al., 2014). These events have been well documented for many seabird species in the Atlantic Ocean (Petry et al., 2007, 2008; Provencher et al., 2014; Rodríguez et al., 2012). The presence of plastic in the stomach of seabirds results in death for the individual, mainly through starvation and debilitation

(Gregory, 2009). Besides being accidentally ingested by seabirds, the higher abundance of plastic fragments has been utilized by some species as nest materials (Podolsky and Kress, 1989; Votier et al., 2011; Bond et al., 2012). Marine debris is prevalently recorded in different colonial seabird species, and in some cases can contribute to the chicks mortality by entanglement or ingestion (Votier et al., 2011; Lavers et al., 2013; Verlis et al., 2014). Seabirds are top predators and environmental indicators, and therefore their long-term monitoring is important to help understand the amplitude of the environmental effects of ocean pollution (Burger and Gochfeld, 2004; Montevecchi et al., 2012).

Trindade Island (13 km²) is 1200 km off the Brazilian coast (Fig. 1) in the Atlantic Ocean, between South America and South Africa. The Island has many endemic flora and fauna species, most of which are of threatened status (Mohr et al., 2009). Five seabird species breed on the Island: Trindade Petrel *Pterodroma arminjoniana*, Masked Booby *Sula dactylatra*, Brown Noddy *Anous stolidus*, Common White Tern *Gygis alba*, and Sooty Tern *Onychoprion fuscatus*. Sooty Terns breed between September and March and there are around 4000 individuals breeding on Trindade Island (Fonseca Neto, 2004). During the field work on Trindade Island we observed plastic debris in the nests of the Sooty Tern *O. fuscatus*. This work aims to (1) describe the first recordings of plastic used as nest material in Sooty Tern nests (2) describe our findings in terms of quantity, size and color of plastic debris found in Sooty Tern nests that breed on Trindade Island.

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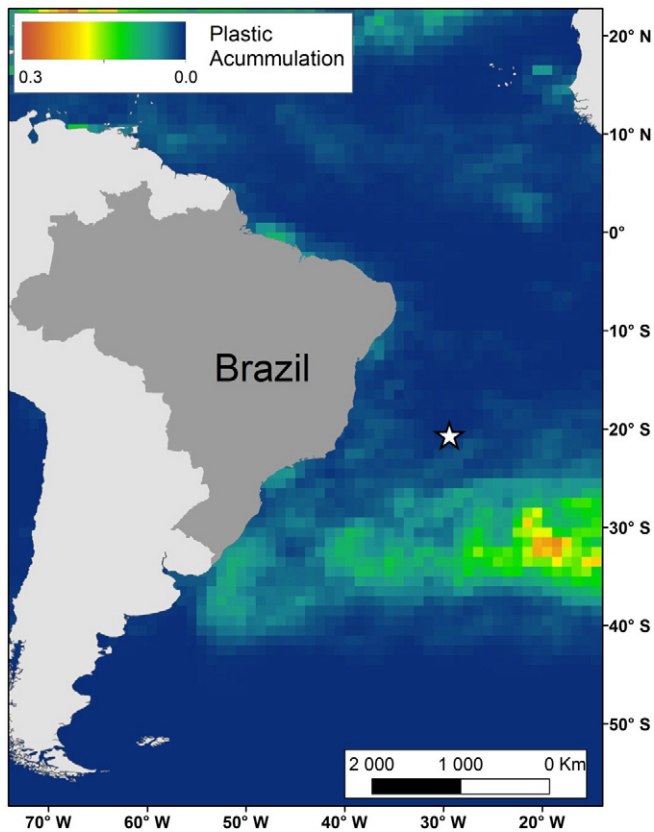


Fig. 1. Trindade Island (black star) in the South Atlantic Ocean and the estimated accumulation of plastic in percentage (estimated from data of Van Sebille (2014, 2015), with authorization of the author).

Censuses of all breeding seabirds were made between September and November 2014 on Trindade Island (Fig. 1). All breeding sites were mapped and monitored during the incubation period. During the counts of the Sooty Tern we observed plastic debris in the nests. Sooty terns nest on the ground over bare sandy and rocky substrates, with few or no vegetation. Nests, are fairly visible, and distributed with enough space to pass between them without harming the eggs. Furthermore, the only current egg predator on the island is a terrestrial crab, which is nocturnal. Therefore, no egg loss due to predation occurred during the short time the adults left the nest. Just one researcher carefully entered the colony to collect the plastics. The plastic fragments were collected separately by nests (Fig. 2). In the laboratory the fragments were weighed in micrograms (μg), to two decimal places. All plastics were measured in three dimensions (length, height and width), using a pair of calipers. Despite not all plastics having a cubic shape, by using this approach we standardized their measures and quantified an approximate volume in mm^3 . Some seabird species seem to illustrate a color preference to the items. This may be associated with feeding or nest material selection (Rodríguez et al., 2012; Lavers et al., 2013; Verlis et al., 2014). Due to this, we classified plastic debris by their color.

We found a total of 78 pieces of plastic debris in 54 out of 1800 nests of Sooty Terns, representing 3% of the breeding group observed. Most nests ($n = 37$) had a single piece of plastic present, while 15 nests had two fragments, one nest had four fragments and another had seven fragments. All pieces of plastic debris were mixed with rocks and vegetation in the nests.

Four color categories of plastic were found: Blue, White, Green and Red. The blue fragments were more numerous than the other categories (Fig. 3). The average mean weight of all fragments was $11 \pm 13.9 \mu\text{g}$. The average volume was $76.1 \pm 62.8 \text{ mm}^3$. There was difference in

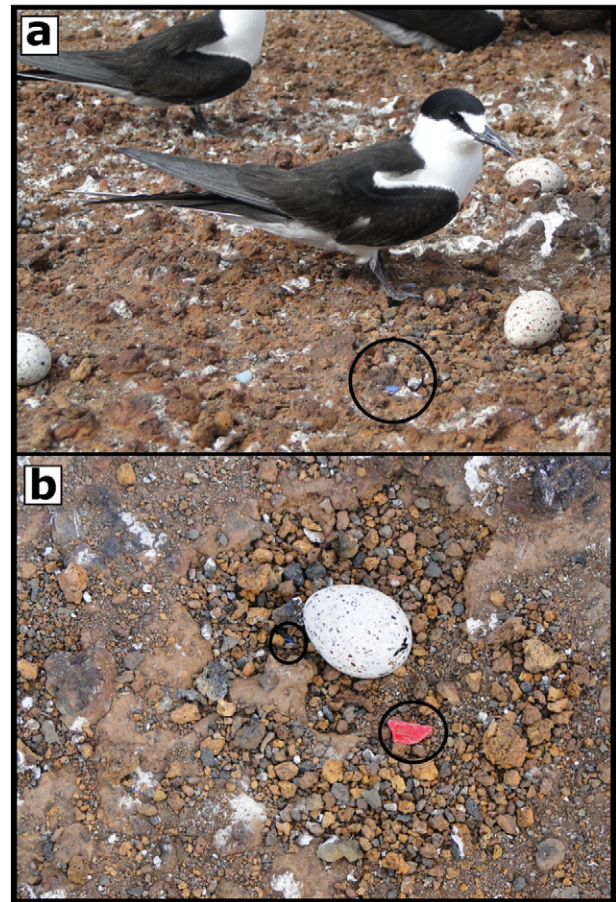


Fig. 2. Two examples of plastic on Sooty Tern nests (circles), a nest with a blue fragment (a) and a nest with two fragments, blue, and red (b).

measurements of plastic when grouped by colors (Table 1). In mean, the blue fragments were smaller and lighter, whereas the two red fragments were larger and heavier (Table 1).

Plastic has been recorded as nesting material in other seabird species as well; e.g. the Double-crested Cormorant (Podolsky and Kress, 1989), the Northern Gannet (Votier et al., 2011) and the Brown Booby (Lavers et al., 2013; Verlis et al., 2014). However this is the first record of plastic being used as nest material in the Sooty Tern. Plastic debris can contribute to chick mortality in the nest; mainly as a consequence of entanglement with nets, lines or ropes (Montevecchi, 1991; Votier et al., 2011). The small fragments we observed may contribute to a lower breeding success of the species, as a consequence of accidental ingestion of plastics by chicks (Podolsky and Kress, 1989). This prediction requires further investigation.

We are unable to form a hypothesis about color selection by the Sooty Tern as we did not conduct an analysis of plastic availability on the beaches of the island. However, seabirds seem to show signs of a color preference, illustrated through the higher frequency of blue, green and white plastic in their nests (Lavers et al., 2013; Verlis et al., 2014). Furthermore, these colors have been found in higher abundance in plastics ingested by seabirds (Rodríguez et al., 2012), sea turtles (Bugoni et al., 2001; Schuyler et al., 2012) and even fish (Carson, 2013; Choy and Drazen, 2013). While sea-animals ingest plastic because they confound it with for prey (Schuyler et al., 2012), the reason why species like terns take plastic to their nest is unknown. Seabirds are known to collect synthetic materials that resemble natural nesting materials, and use for nest building, e.g. Northern Gannets use fragments of fishing lines and ropes that look like seaweed (Votier et al., 2011). It is possible that Sooty Terns are mistaking the plastic for

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