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Large amounts of marine debris found in sperm whales stranded along the North Sea coast in early 2016

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ABSTRACT

30 sperm whales (*Physeter macrocephalus*) stranded along the coasts of the North Sea between January and February 2016. The gastro-intestinal tracts of 22 of the carcasses were investigated. Marine debris including netting, ropes, foils, packaging material and a part of a car were found in nine of the 22 individuals. Here we provide details about the findings and consequences for the animals. While none of the items was responsible for the death of the animal, the findings demonstrate the high level of exposure to marine debris and associated risks for large predators, such as the sperm whale.

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1. Introduction

Marine debris is defined as “any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment” (UNEP, 2009). It is a serious threat to marine life. Marine debris can be found in all of the world's oceans (Barnes et al., 2009; Thompson et al., 2004). It can be ingested (internal findings) (de Stephanis et al., 2013) or cause entanglement which may lead to lesions or even strangulation (external findings) (Gregory, 2009). Furthermore, if too much debris is swallowed, stomach fullness can be reached without obtaining nutrients (Sheavly and Register, 2007) and might lead to starvation and death (Page et al., 2004; Allen et al., 2012; Moore et al., 2013). Marine debris may consist of many different materials. Due to their characteristics, such as durability, synthetic materials (plastics) constitute the highest proportion of marine debris (Barnes et al., 2009).

Depending on the size of the organism and its habitat, different debris items are of concern. Marine debris findings are recorded in many different marine biota, including copepods (Cole et al., 2015), bivalves (Cole and Galloway, 2015), fish (Lusher et al., 2013), birds (Van Franeker and Law, 2015) and seals (Bravo Rebolledo et al., 2013).

Occurrence and impacts in cetaceans were recently summarized by Baulch and Perry (2014) and Kühn et al. (2015). For sperm whales, 17 cases of debris ingestion have been documented worldwide between 1895 and 2009 (listed in de Stephanis et al., 2013). Debris findings in marine mammals raising concerns also for deep diving cetaceans, such as sperm whales (Simmonds, 2012). Another recent case was a plastic bottle found in a sperm whale stranded in Denmark (Hansen et al., 2015). Among the effects of marine debris ingestion in cetaceans, gastric ruptures, pylorus blockage and gastric obstruction were identified as fatal consequences (Tarpley and Marwitz, 1993; Jacobsen et al., 2010). The negative impact of marine debris was also observed during an endoscopic procedure of a pygmy sperm whale (*Kogia breviceps*), where removal of a plastic piece found between the main and pyloric stomach healed the previous lack of appetite in the animal (Stamper et al., 2006). These findings demonstrate that ingested marine debris may severely affect cetaceans.

Information on debris ingestion in cetaceans can usually only be obtained from necropsies. Thus, stranding events provide a valuable source of information on ingested debris. Sperm whales live in deep-water habitats of depths ≥ 1000 m (Rice, 1989; Whitehead, 2003). Strandings of sperm whales are occasional events, that seem to occur clustered in a few places around the world, one of them being the North Sea (Jauniaux et al., 1998; Pierce et al., 2007; Vanselow et al.,

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2009); a shallow marginal sea that is also referred to as the “sperm whale trap” (Smeenk, 1997). Sperm whales of the North Atlantic population migrating from the Norwegian shelf edge to the Azores sometimes swim into the North Sea, for reasons that are still hypothesized about (Vanselow and Ricklefs, 2005; Pierce et al., 2007). This shallow water habitat is highly unsuitable for a deep-diver like the sperm whale. Sandbanks, mudflats and tides make the coastline of the southern North Sea prone to sperm whale strandings (Camphuysen, 1995; Smeenk, 1997; Jauniaux et al., 1998). Strandings of sperm whales in the North Sea have been reported for centuries and well documented in the past (Camphuysen, 1995; Smeenk, 1997; Pierce et al., 2007).

In early 2016, 30 sperm whales stranded in the North Sea (Ijsseldijk et al., 2016, submitted). In this paper we report on the findings of marine debris in the necropsied animals, describe the debris items in detail and suggest conclusions about potential origin and risks associated with ingestion.

2. Material and methods

Between 8th January and 24th February 2016, 30 sperm whales stranded on different locations along the North Sea coast (Ijsseldijk et al., 2016, submitted; Fig. 1). A total of 14 sperm whale stranding events of groups of up to 8 individuals were recorded along the coasts of Germany, The Netherlands, the United Kingdom, France and Denmark. The gastro-intestinal tract (GIT) of 22 of these animals was opened from stomach to anus and investigated for debris (Table 1). Seven of these GITs were additionally rinsed and the contents were sieved over 500 and 1000 μm mesh. Five of the obtained sieve fractions were machine-washed (following Bravo Rebolledo et al., 2013, online supplement) to dissolve organic materials and isolate hard prey remains (bones, otoliths and beaks) and foreign objects (such as plastic particles). For details on GIT treatment see Table 1. Prey remains found in the GITs were preserved for further analysis. Additionally, faeces samples of 12 animals were taken and stored in glass jars for later analyses on the presence of microplastics. The nutritional status of each whale

was judged according to the blubber thickness and muscle condition. Samples for histopathological examinations were taken from most stomachs and intestines in which marine debris was found (Table 1).

Any debris items found were isolated and most were measured and photographed. All measurements were conducted with a folding rule and a calliper. The floating capacity of objects was tested if uncertain (netting, rope, car part, bucket, foil). Thin plastic pieces (mostly transparent) were categorized as “foil” when no suture was discovered to classify it as “plastic bag”. Thicker, black foil, which is mostly used in agriculture for protecting e.g. hay bails is categorized as “agricultural foil”.

Findings were classified into fishing related and general debris objects. Items were grouped according to the material they were made of (plastic, wood, etc.), and evaluated visually. Where appropriate, details were obtained from manufacturers. Monofilaments (net remains after netting is unravelled) were counted and listed as “bundle”.

3. Results

Marine debris was found in nine out of 22 dissected sperm whales. In total, 322 debris items of varying sizes were collected (Table 2) from the GITs of these animals. Among the collected items, 250 (78%) were classified as fishing related including monofilaments (Fig. 4d), nets (Fig. 2, Fig. 7b), ropes (Fig. 2, Fig. 6b), pieces of netting yarn (Fig. 4a, Fig. 7a) and a fish hook. The remaining 72 (22%) were classified as general debris. In this category were two chocolate/cereal bar-wrappings (Fig. 4f), a coffee capsule (Fig. 4c), foils, duct tape, parts of plastic bags, agricultural foils, strapping tapes, a screw-cap (Fig. 4e), a plastic bucket (listed as two objects, since one part was discovered in the pharynx, the other in the stomach) (Fig. 5a and b) and a plastic part of a car engine cover (Fig. 5c). All debris items were made of synthetic materials, apart from six pieces of wood and a fish hook. For netting and yarn, the fabric was identified as Polyethylen/Polypropylene. Based on expert opinion the nets from sperm whales (GER-02, GER-06, GER-15) were recognised as fishing nets, likely “protection nets” from shrimp fisheries. Protection nets are rather solid nets placed around the actual



Fig. 1. Stranding locations of all 30 sperm whales. Numbers of stranded animals/investigated gastro-intestinal tracts/animals with debris findings are listed in brackets behind each stranding location.

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