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Marine debris in harbour porpoises and seals from German waters

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ABSTRACT

Records of marine debris in and attached to stranded harbour porpoises (*Phocoena phocoena*), harbour seals (*Phoca vitulina*) and grey seals (*Halichoerus grypus*) were studied comprising information on 6587 carcasses collected along the German coast between 1990 and 2014, the decomposition state allowed for necropsy in 1622 cases.

Marine debris items were recorded in 31 carcasses including 14 entanglements (5 harbour porpoises, 6 harbour seals, 3 grey seals) and 17 cases of ingestion (4 harbour porpoises, 10 harbour seals, 3 grey seals). Objects comprised general debris (35.1%) and fishing related debris (64.9%). Injuries associated with marine debris included lesions, suppurative ulcerative dermatitis, perforation of the digestive tract, abscessation, suppurative peritonitis and septicaemia.

This study is the first investigation of marine debris findings in all three marine mammal species from German waters. It demonstrates the health impacts marine debris can have, including severe suffering and death. The results provide needed information on debris burdens in the North and Baltic Seas for implementing management directives, such as the Marine Strategy Framework Directive (MSFD).

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). Today, it is recognised as a major threat to the marine environment (Sheavly and Register, 2007). Debris has been shown to negatively affect many marine biota, including turtles, birds, seals and cetaceans (Laist, 1997; Page et al., 2004; Gregory, 2009; Allen et al., 2012; Moore et al., 2013; Kühn et al., 2015). In marine mammals, debris has been shown to cause injuries (Simmonds, 2012; Moore et al., 2013; Baulch and Perry, 2014), which often lead to secondary infections with negative health impacts (Allen et al., 2012; Moore et al., 2013), be responsible for suffocation and starvation (Sheavly and Register, 2007). Entanglement in plastic items and derelict fishing gear, as well as ingestion are the major risks marine debris poses to marine mammals (Sheavly and Register, 2007; Kühn et al., 2015). The North and the Baltic Seas are two of the most heavily utilized marine areas of the world (Halpern et al., 2008). The majority of marine debris originates land-based (UNEP, 2009) and the bordering states of the North and Baltic Seas are populous. The fact that they are exposed to a large variety of anthropogenic activities, such as fishing and tourism additionally promotes the input of debris. For both, the North and Baltic Seas concerns on debris amounts has officially been recognised, and embedded in the HELCOM agreement (Helsinki Convention; HELCOM, 2015) for the Baltic in 1972. Furthermore, in 1992 it was additionally included in the course of the Oslo-Paris Convention (OSPAR) for the Northeast Atlantic comprising the North Sea, amongst others (UNEP, 2009). Despite assumed large quantities of marine debris in both seas (Galgani et al., 2000) the impact of marine debris on native marine mammals in German waters has not yet been investigated. Necropsies performed on 22 out of 30 sperm whales (*Physeter macrocephalus*) stranded in the North Sea in 2016 revealed large amounts of marine debris in the gastro-intestinal tract (GIT) in nine of these animals (Unger et al., 2016), which had accidentally entered the North Sea. Several items recovered from the stomachs, such as nets which were classified as likely originating from the local shrimp fishery due to

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its mesh size and colour, suggested ingestion in the North Sea (Unger et al., 2016).

Harbour porpoise (*Phocoena phocoena; Ppho*), harbour seal (*Phoca vitulina; Pvit*) and grey seal (*Halichoerus grypus, Hgry*) are the three marine mammal species regularly inhabiting the North and Baltic Seas.

Harbour porpoises are widely distributed in both the North and the western Baltic Sea (Hammond et al., 2002, 2013). Lowest harbour porpoise densities in the study area are found in the eastern Baltic Sea, where the endangered Baltic Proper subpopulation resides (Hammond et al., 2002, 2008; Benke et al., 2014). Harbour seals occur in high numbers in the Wadden Sea (Galatius et al., 2016) and comparably low numbers in the Baltic Sea. Grey seal abundance is comparably low in both the southern North Sea and the Baltic Sea (Brasseur et al., 2016; Härkönen, 2016).

In general, all three species are categorized as “least concern” on the IUCN Red List of threatened species (Hammond et al., 2008; Bowen, 2016; Lowry, 2016). However, the Baltic Sea subpopulation of the harbour porpoise is “critically endangered” (Hammond et al., 2008). Within the EU habitats directive (Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora), all three species are listed as species of community interest within Europe in Annex II, the harbour porpoise additionally in Annex IV, harbour seals and grey seals in Annex V. OSPAR in the North Sea and HELCOM in the Baltic Sea, cover the conservation of all three species. The main focus is to reach a “good state of conservation” in terms of aiming a reduction of any restrictions within their range caused by anthropogenic impacts. Furthermore, the same objective is pursued for the harbour porpoise by the agreement on the conservation of small cetaceans in the Baltic, North East Atlantic, Irish and North Sea (ASCOBANS) under the auspices of the Convention on Migratory Species (CMS or Bonn Convention; Sherrington et al., 2014).

All three species are confronted with a variety of anthropogenic impacts within their natural habitat, such as bycatch, noise and chemical pollution, as well as the reduction of available prey (Kock and Benke, 1996; Dähne et al., 2013; Siebert et al., 2012; Herr et al., 2009). Especially pollutant burdens are reflected in the health status, including parasitic and bacterial infections, emaciation and impairment of the immune system which promotes the vulnerability to illnesses (Beineke et al., 2005; Das et al., 2006; Siebert et al., 2007). Fatal consequences of entanglement in marine debris arising from chronic infections of associated skin lesions have been found in harbour seals between 1996 and 2005 (Siebert et al., 2007). Likewise, ingestion of marine debris with fatal consequences was found in a harbour porpoise with plastic items stuck in the oesophagus, resulting in suffocation (Baird and Hooker, 2000).

Collecting information on impacts of marine debris on marine mammals is difficult. Entanglements can sometimes be observed in the wild (Allen et al., 2012), however, only necropsies can reveal cases of ingestion and associated effects. Stranding events thus are a valuable source of information on the occurrence and possible impacts of marine debris on marine mammals (Simmonds, 2012).

In this study, information on marine debris found in and attached to marine mammal carcasses collected along the beaches of the German federal states of Schleswig-Holstein (SH) and Mecklenburg-Western Pomerania (MWP) collected since 1990 is summarized. This analysis aims to provide first information on marine debris interactions, both external and internal, of marine mammals from the German North and Baltic Seas. Marine debris records from carcasses collected within a stranding scheme are used to assess entanglement and ingestion rates in harbour porpoises, harbour seals and grey seals. These data are needed by management schemes and conservation plans assessing the health status of these populations including pollutant burdens. Both, entanglement and ingestion were taken into account for giving a complete overview of possible marine debris interactions.

2. Material and methods

2.1. Collection of carcasses

Marine mammal carcasses have been collected within the frameworks of two ongoing stranding schemes of the federal states of SH and MWP, respectively. The coasts of SH include beaches of the North and Baltic Seas, while the coasts of MWP are all located along the Baltic Sea (Fig. 1). Beaches are patrolled twice a day by seal rangers as well as trained volunteers. Additionally, strandings are also reported by tourists. Carcasses are then collected for further investigations. In SH, carcasses of harbour porpoises and seals have been fully investigated since 1990 and 1995, respectively. All protocols between 1990 and 2014 for porpoises and between 1995 and 2014 for seals were taken into account. For MWP, records on harbour porpoise from 1990 to 2014 were used, for seals the protocols from 2001 to 2014 were available for further investigation.

2.2. Pathological investigations of carcasses

Pathological investigations, including histopathological examinations, were conducted following the guidelines of Kuiken and Hartmann (1993) and Siebert et al. (2001). According to Siebert et al. (2001) the carcass state of decay was assessed in five categories (1 = extremely fresh to 5 = mummified). Depending on the state of decay not all carcasses could be fully necropsied. The necropsies were conducted in a dissection hall. In case of a high state of decay the carcasses were only examined externally. In the following only animals of which the gastro-intestinal tract (GIT) was investigated are referred to as necropsied. As part of the necropsies, the GIT was investigated macroscopically for the occurrence of marine debris (e.g. plastics). Histopathology was carried out from the tissue adjacent to the foreign bodies to identify and characterize the lesions most likely caused by marine debris. Items were then categorized as **a)** marine debris without evidence of tissue alterations or **b)** intralesional marine debris indicating that the debris represents the most likely cause of the tissue damage.

Among information detailed for each carcass, age class (juvenile or adult), and sex were recorded. The nutritional status was categorised as 'good', 'moderate' or 'emaciated' (Siebert et al., 2001). Marine debris findings were documented during necropsies and in some few cases the items were preserved. If the state of decay permitted, pathological lesions associated with marine debris were assessed histopathologically.

2.3. Documentation of marine debris

A detailed visual inspection was conducted on the outside of all carcasses and anomalies including e.g. attachments of marine debris were recorded. During the necropsies, the GIT was investigated for the occurrence of marine debris and histopathologically for associated lesions. If marine debris was found, the location of the debris item was noted. Wood is only considered as debris if it is processed and thus noted in the protocol.

2.4. Analysis of information

The following information was noted for each species and sea:

a) the total number of collected carcasses
b) the number of necropsied carcasses (i.e. carcasses of which the GIT was investigated)