Eating Plastic: a preliminary evaluation of the impact on cetaceans of ingestion of plastic debris.

Mark Peter Simmonds[1]

Whale and Dolphin Conservation Society, Brookfield House, 38 St Paul Street, Chippenham, Wiltshire SN15 1LJ, UK.

Abstract

This preliminary consideration of events recorded since 1997, confirms that plastics and other marine debris are at least occasionally found in the gastrointestinal tracts of cetaceans. Records include examples where the debris has caused morbidity and death and also examples where large quantities of material have been found that are likely to at least cause impairment to digestive processes. In some instances, debris may have been ingested as a result of the stranding process and, in others, it may have been ingested when feeding, and those species that are suction feeders may be most at risk.

The significance of the threat from ingested plastics and other debris remains unclear for any population or species. However, concerns remain about the growing amounts of marine debris in the oceans, especially plastics, making this an issue deserving of further careful attention.

Introduction

Marine litter has been characterised as an environmental, economic, human health and aesthetic problem that poses a complex and multidimensional challenge with significant implications for the marine environment and human activities all over the world (UNEP, 2009). In recent years much has been written about this pervasive pollution problem and there are many international initiatives now striving to address the problem, including the UNEP Global Initiative on Marine Litter. Plastic and synthetic materials are the most common types of marine debris and cause the most problems for marine animals and birds. At least 267 different species are known to have suffered from entanglement or ingestion of marine debris, including many cetaceans (Allsopp *et al*., 2006).

The United Nations Environment Programme (UNEP) has taken the lead globally in addressing marine debris with a series of initiatives and partnerships. In 2003, UNEP established a 'Global Initiative on Marine Litter' to provide an "international platform for the establishment of partnerships, co-operation and co-ordination of activities for the control and sustainable management of marine litter". It is coordinated by UNEP's Regional Seas Programme (RSP) and the Global Programme of Action for the

[1] mark.simmonds@wdcs.org

Protection of the Marine Environment from Land-based Activities (GPA).[2] In 2009, UNEP undertook a detailed analysis of the regional activities undertaken so far. Its resulting publication "Marine Litter: A Global Challenge" contained a number of recommendations including this one: "Marine litter is a global problem and mitigation actions should be developed around a global framework, coordinated at the regional level and implemented at the national level through development and implementation of national action plans or strategies". Another recommendation called on relevant international bodies to "enhance and coordinate their efforts to work on the marine litter problem" and work in close collaboration with civil society.

Most recently, in March 2011, UNEP and the United States' National Oceanic and Atmospheric Administration (NOAA) organized the Fifth International Marine Debris Conference in Honolulu, Hawai'i (NOAA/UNEP, 2011). This meeting, which brought together 440 participants representing 38 countries, adopted the "Honolulu Commitment" which outlined 12 actions to reduce marine debris and invited international organizations, governments at national and sub-national levels, industry, non-governmental organizations, citizens and other stakeholders, to commit to contribute to the development and successful implementation and review of the Honolulu Strategy – a framework for the prevention, reduction and management of marine debris.

Methods

A preliminary sweep has been made of the relevant literature in order to gain a sense of the scale of the problem, both in terms of the levels of marine debris in the oceans and incidents of ingestion by cetaceans. In addition, presented here are data from the last two years of pathological investigations of stranded cetaceans in the UK. Note that this paper was revised during the IWC Scientific Committee in Tromso in 2011 where it was presented in order to include information that came to light during the meeting. However, the review of information presented here is by no means comprehensive or complete and focuses on incidents recorded after the thorough review authored by Laist in 1997.

The scale of the problem

Many studies have been carried out across the world to try to quantify marine debris and most of these have focused on large (macro) debris. These studies show marine debris is ubiquitous in the world's oceans and on its shorelines (Allsopp *et al*., 2006). Higher quantities are found in the mid-latitudes and tropics, with particular concentrations associated with shipping lanes, fishing areas and ocean convergence zones. Allsopp *et al*. (2007) provided a helpful review of studies:

- Floating marine debris has been generally reported in the range of 0-10 items per km^2, with higher concentrations in the English Channel (10-100+ items/km^2) and in Indonesia (more than 4 items/m^2);
- Seafloor debris is reported from locations in Europe, the USA, the Caribbean and Indonesia. The highest quantity reported in European waters was 101,000 items/km^2 and in Indonesia the equivalent of 690,000 items/$km^{2;}$ and

[2] http://www.unep.org/regionalseas/marinelitter/publications/default.asp

- The highest numbers of shoreline items were reported for Indonesia (up to 29.1 items/m^2) and for Sicily (up to 231 items/m$^{2)}$.

Concentrations of marine debris may occur in areas that are important for cetaceans, such as convergence zones where prey may be abundant. For example, in 1997 and 2000, surveys were made of the floating debris in the Ligurian Sea, a sub-basin of the Mediterranean Sea which includes the Ligurian Cetacean Sanctuary declared by the three neighbouring countries (Aliani *et al.,* 2003). Debris densities were determined of 15-25 objects/km^2 for 1997 and 1.5-3 objects/km^2 for 2000.

Williams *et al*. (in press) have recently mapped the at-sea distributions of both marine debris and eleven marine mammal species in the waters of British Columbia to identify areas of overlap. They commented that such areas were often far removed from urban centres and this suggested that the extent of marine mammal–debris interactions would be underestimated from opportunistic sightings and stranding records. They urged that high-overlap areas should be prioritized by stranding response networks.

Impacts on Wildlife

There are two primary types of impact for marine wildlife: entanglement and ingestion. Allsopp *et al*. (2007) record cetaceans, pinnipeds, turtles and seabirds as all suffering from entanglement and suggest that pinnipeds are particularly affected. Entanglement in marine debris is not considered further here, which is not to say that it is without significance, but the focus of this report is ingestion. This is a less well documented cause of marine mammal morbidity and mortality, although it is well recognised as a health problem in marine birds and turtles (Jacobsen *et al*., 2010).

Thirty one species of marine mammals have been reported to have ingested marine debris (Allsopp *et al*., 2007) and Jacobsen *et al*. (2010) comment that even small quantities can have large effects. Whilst, the most obvious effect of ingestion is arguably interference with alimentary processes (and examples are given below), another effect could be that the presence of plastics lodged somewhere in the alimentary tract could facilitate the transfer of pollutants associated with the plastics into the animals' bodies. The chemicals contained within plastics debris include polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons, petroleum hydrocarbons, organochlorine pesticides (2,2′-bis(*p*-chlorophenyl)-1,1,1-trichloroethane, hexachlorinated hexanes), polybrominated diphenylethers, alkylphenols and bisphenol A, at concentrations from sub ng g^{-1} to µg g^{-1} (Teuten *et al*., 2009). Some of these compounds are added during plastics manufacture, while others are adsorbed from the surrounding seawater. Teuten *et al*. (2009) report that the concentrations of hydrophobic contaminants adsorbed on plastics showed distinct spatial variations reflecting global pollution patterns. Model calculations and experimental observations consistently show that polyethylene accumulates more organic contaminants than other plastics such as polypropylene and polyvinyl chloride. Experiments and modelling have demonstrated transfer of contaminants from plastics to organisms.

A related topic of growing concern is 'microplastics' in the marine environment. This new term is defined by the NOAA Marine Debris Program (NOAA, 2011) as plastic debris pieces in the size range of 0.3-5mm and two categories are recognised. Primary microplastics are either intentionally produced for direct use, such as scrubbers in cleaning products, or as pre-cursors to other products, such as pre-production plastic pellets. Secondary microplastics are formed from the breakdown of larger plastic materials. Microscopic plastic debris now litters the global environment and there are growing concerns about its potential impacts, including impacts on filter-feeding marine invertebrates (and hence higher levels in the food chain) and, more generally, its role in transferring contaminants to wildlife. Teuten *et al*. (2009) comment on the potential importance of plastic fragments, including microscopic fragments, in the transference of contaminants to animals and they note that hydrophobic contaminants, such as PCBs, DDE and PAHs, sorb to marine plastic fragments. This matter is not considered further here, but its potential significance should not be forgotten.

Odontocetes

Walker and Coe (1990) made an extensive survey of foreign body ingestion by odontocetes. They commented that the pathologic effects of foreign body ingestion on captive cetaceans are well known and provide details of materials ingested in captivity. They also investigated the situation for wild cetaceans and solicited information from relevant institutions covering the period between 1963 and 1986. Due to variations in data recording and pathology techniques, they were unable to determine frequency of occurrence of debris ingestion, but they did identify 43 examples of ingestion in stranded animals primarily from the east and west coasts of North America. Table 1 summarises the incidents recorded by Walker and Coe (1990), the notes section highlighting some records where ingestion of debris might potentially have been of health significance.

Walker and Coe (1990) found that plastic bags and plastic sheeting were the most common items ingested (62.5% of ingested materials). Other miscellaneous plastic items such as drinking straws, bottle caps, discarded fishing net, synthetic rope, and a small container occurred in 17.5% of cases. They concluded that odontocete cetaceans are affected to an unknown degree by the ingestion of oceanic debris but the sperm whale, *Physeter macrocephalus*, seemed to be primarily affected. Walker and Coe (1990) suggested that mistaken ingestion of debris due to its resemblance to prey is unlikely in odontocete cetaceans because of their echolocation skills. They suggested, that for these species at least, ingestion happens incidentally to feeding or may be part of the stranding syndrome. They also commented that ‘naturally occurring disease factors may predispose’ some animals to ingest abnormal items.

Jacobsen *et al*. (2010) cite accounts including two pygmy sperm whales, *Kogia breviceps* (see also table 1) with stomachs occluded by pieces of plastic bags and three bottlenose dolphins, *Tursiops truncatus*, asphyxiated by laryngeal entrapment by ingested fishing lines (see also table 1). The first account of ingestion causing mortality in sperm whales also comes from Jacobsen *et al*. (2010). They report that, in 2008, two male sperm whales stranded along the northern California coast with large amounts of fishing net scraps, rope, and other plastic debris in their stomachs. One animal had a ruptured stomach, the other was emaciated, and gastric impaction was suspected as the cause of both deaths. There was a remarkable 134 different types of nets in these two animals, all made of floating material, varying in size from 10 cm^2 to about 16 m^2. Jacobsen *et al*. (2010) concluded that the variability in size and age of the pieces suggested the material was ingested from the surface as debris.

In December 2009, a pod of seven male sperm whales stranded on the Adriatic coast of Southern Italy (Mazzariol *et al*., 2011). Stomach contents consisted mainly of highly digested cephalopod beaks and foreign bodies, including fishing gear and hooks, ropes, and several plastic objects. No evident obstruction or perforation of the alimentary tract was noted. (Note also the accounts featuring this species summarised in table 1.)

Beaked whales have also been suggested to be especially vulnerable (Macleod, 2009 and see table 1). Walker and Coe (1990) noted that marine debris had been reported from Baird's beaked whales, *Berardius bairdii,* taken at two localities in the coastal waters of Japan. In these animals, taken off the Pacific coast of central Japan, debris incidence in 86 stomachs was 26.7% and off northern Hokkaido, in the southern Okhotsk Sea, incidence of debris in 20 stomachs was 15.0%. Food habits data indicated that the lower frequency of debris ingestion reflected differences in feeding strategy. The high vulnerability of beaked whales may result from their reliance on suction-feeding for prey capture and some species in some regions, such as Cuvier's beaked whales, *Ziphius cavirostris,* in the northeast Atlantic, seem to have particularly high incidences of ingestion of and death from plastic bags (MacLeod, 2009). MacLeod (2009) commented that 'currently plastic bags are known to affect beaked whales at the individual level and may be of sufficient prevalence to affect some species at the local aggregation and population levels. As yet, it does not seem likely that plastic bag ingestion affects any beaked whales at the species level. However, this may be a possibility for some species with limited geographic ranges close to high concentrations of humans'.

Poncelet *et al*. (2000) report on an immature male, Cuvier's beaked whale stranded at Biscarosse, Landes, France on 29th January, 1999**.** The animal was highly emaciated, with a blubber layer almost half that expected for an animal of its age, sex and size. The stomach was found to be full of plastic, weighing approximately 33kg when wet and estimated to consist of 378 separate plastic items. A sub-sample of the plastic (786g) consisted of seven supermarket plastic bags and two plastic sheets. A small number of cephalopod and fish remains were also found in the stomach, but no fresh prey. The debris was covered with dark viscous fluid, possibly from erosion of the stomach lining and resulting haemorrhaging, which Poncelet *et al*. (2000) suggested may have been the cause of death.

Santos *et al*. (2001) report on the stomach contents of three Cuvier's beaked whales, two of which stranded in Galicia, north-west Spain, in 1990 and 1995 and the other in North Uist, Scotland in 1999. Both the whales that stranded in Galicia had plastic remains in their stomachs, and the Scottish animal contained the remains of at least six plastic bags or refuse sacks, one of which was recorded as 'tightly screwed up and apparently jammed in the entrance to the stomach'.

Santos *et al*. (2007) analysed stomach contents from three species of beaked whales which mass-stranded shortly after a naval exercise conducted in the Canary Islands in September 2002. Samples from seven Cuvier's beaked whales, a single Blainville's beaked whale, *Mesoplodon densirostris*, and a single Gervais' beaked whale, *Mesoplodon europaeus*, were examined. All the whales were reported to have appeared to have been in good body condition with the exception of one of the male

Cuvier's beaked whales. This animal was 'visibly emaciated' and necropsy showed a high parasite burden load (nematodes) in the stomach and also a plastic sheet. The stomach of this specimen was also the only one that did not contain fresh food remains.

Fernandez *et al*. (2009) considered the stomach contents of 23 cetaceans stranded in the Canary Islands between 1996 and 2006. Five of the animals examined had plastic debris in their stomachs with big plastic items being taken by deep diving teuthopagus whales. The sample set comprised 5 sperm whales, 2 pygmy sperm whales, 1 Gervais' beaked whale, 1 Risso's dolphin, 2 short-finned pilot whales, 1 Frazer's dolphin, 3 Atlantic spotted dolphins, *Stenella frontalis*, 3 striped dolphins, *Stenella coeruleoalba*, 1 bottlenose dolphin, 1 rough-toothed dolphin, *Steno bredanensis*, 3 common dolphins, *Delphinus delphis* and 1 Cuvier's beaked whale. One of the sperm whales had a plastic bag in its stomach. One of the pygmy sperm whales contained a plastic filament. One of the Gervais' beaked whales had a complete plastic bag (44x24cm) and pieces of another two in its stomach. The Frazer's dolphin contained some small plastic pieces and finally one of the striped dolphins had ingested a plastic filament around 10 cm long. All the animals that had ingested plastic also had food remains in their stomachs. In addition, in February 2004, a Cuvier's beaked whale was found washed ashore on the Isle of Mull, Scotland. The entrance to this animal's stomach was found to be completely blocked by a cylinder of tightly packed shredded black plastic bin liner bags and fishing twine (HWDT, pers comm. 07/06/2004).

A bottlenose whale, *Hyperoodon ampullatus*, which stranded in August 2006 in Skegness, UK, was found to have ingested some plastic (Deaville and Jepson, pers comm.). The fundic stomach contained copious brownish watery fluid, a piece of plastic and a section of some green netting (resembling fishing gear). The mucosal lining at the base of the stomach (area in direct contact with the plastic) was reddened and haemorrhagic in appearance and a single round mucosal ulcer with a red haemorrhagic base (measuring 1-1.5cm diameter) was noted towards the entrance to the stomach.

Plastic ingestion by beaked whales obviously also occurs elsewhere outside of the North Atlantic, although accounts seem rare. For example, Secchi and Zarzur (1999) report on a Blainville's beaked whale, *Mesoplodon densirostris*, washed ashore in Brazil with a 'blueish bundle of plastic threads occupying a large part of its main stomach chamber. They note that the whale had not fed for some time. In addition, a Gervais' beaked whale stranded on the south-eastern coast of Puerto Rico was recently found to have more than ten pounds (4.5 kilos) of twisted plastic inside its stomach and its death was attributed to the plastic preventing it obtaining adequate nutrition (Associated Press, 2011[3]).

Other small cetaceans

In addition, in September 1997, a small harbour porpoise, *Phocoena phocoena*, (probably not yet weaned) was found dead near Pictou, Nova Scotia. It was visibly emaciated and its stomach and intestines were empty, apart from small amounts of bile stained liquid (Baird and Hooker, 2000). Upon examination of the oesophagus, a

[3] See also: http://www.elnuevodia.com/encuentranballenamuertaenplayademaunabo-958777.html

balled up piece of black plastic (about 5 by 7cm) was found adjacent to the junction with the stomach. Cranially to this was a mass of fish bones and flesh and three intact fish. The authors note two earlier published reports of plastic ingestion by this species and several other unpublished records of the same. The UK strandings network has recorded two porpoises in recent years with ingested marine debris (tables 2&3), but the quantity was small and no associated pathological changes were reported.

Tonay *et al*. (2007) examined the stomach contents of 42 harbour porpoises bycaught or stranded between April to June in 2002 and 2003, on the Turkish western Black Sea coast. Plastic debris was found in five stomachs and in one of these, a bycaught female 130cm long, this consisted of plastic bags and sheeting with dry weight of 40.9g.

An adult male rough-toothed dolphin, *Steno bredanensis*, that stranded alive on Poço da Draga Beach, Fortaleza, Ceará State, northeastern Brazil was found to have ingested two plastic bags and four pieces of sea sponges were found in the fore-stomach chamber, where the mucosa had several ulcers (Oliveira de Meirelles and Duarte do Rego Barros, 2007). A small net fragment was found in the cardiac stomach of a common dolphin found stranded at Kennack Sands in Cornwall, UK, in 2010, but no pathology was associated with this (table 3).

Plastic debris ingestion was examined in a large sample (106) of franciscana dolphins (*Pontoporia blainvillei*) incidentally captured in the artisanal fisheries of the northern coast of Argentina (Denuncio *et al*., 2011). Twenty-eight percent of the dolphins had plastic debris in their stomachs, but no ulcerations or obstructions were recorded. Plastic ingestion was more frequent in the dolphins using an estuarine environment rather than those living in a fully marine environment, but the type of debris was similar in both. Packaging debris (cellophane, bags, and bands) was found in 64.3% of the dolphins which had ingested plastics, with a lesser proportion (35.7%) ingesting fishery gear fragments (monofilament lines, ropes, and nets). 25.0% had ingested plastics from unknown sources. Denuncio *et al*. (2011) did not record obstructions or ulcers in any of these animals and commented 'that the small number and size of the fragments found in healthy dolphins suggest that this material is not lethal… [but] cannot be ruled out as a potential cause of death.' They also noted that sub-lethal effects, such as partial obstruction of the gastrointestinal tract and reduction of feeding stimulus might occur. This large sample size also revealed that there is a potential relationship between age and plastic ingestion. The franciscana dolphins of north Argentina are weaned between 2 and 7 months of age and Denuncio *et al*. (2011) suggest that the sharp increase of plastic ingestion that occurs during the weaning phase could be a consequence of the learning process in the young animals as they start to catch prey by themselves.

Other species

In 2000, a Bryde's whale, *Balaenoptera edeni*, was found on the shore in Cairns, Australia with a considerable amount of plastic inside it including 30 whole plastic bags and three lengths of plastic sheeting (Townsville Bulletin, 2001). The plastic when stretched out was reported to cover an area of 6 m^{2}.

In April 2002, a dead minke whale, *Balaenoptera acutorostrata*, washed up on the Normandy coast of France was found to have 800kg of plastic bags and packaging, including two English supermarket plastic bags in its stomach (GECC 2002 in MCS, 2004).

Reports from the UK strandings network
The results of post mortem studies conducted in parts of the UK between 2009 and 2010 are presented here in tables 2 and 3. Overall, the incidence of ingestion of foreign materials can be seen to be low, with debris reported in 3 of 149 animals. However, the number of bodies examined from the species that may be most at risk (i.e. beaked and sperm whales) is also low. No significant incidents with ingestion debris have been recently noted in the Scottish strandings network (Brownslow, pers comm.).

Conclusions

The extent of the threat posed by ingestion of marine debris to cetaceans is not well characterised and given that few cetaceans living in deeper waters that die at sea are subject to pathology, its importance could be significantly overlooked. Most authorities focus on the potential likely high significance for suction feeders - i.e. sperm and beaked whales.

Although there is evidence that they can be affected by debris ingestion, it is strongly suggested in the literature that the small cetaceans living in surface waters are less likely to ingest harmful materials. Some of the cases in small and larger cetaceans could result from ingestion of beach debris during their stranding. Agonal ingestion of beach material (sand, mud, small pebbles etc) is a common finding in the oesophagus and stomach chambers in many UK cetaceans that stranded alive (Jepson 2006; Jepson and Deaville 2009). From this initial trawl of the literature it seems that the issue of debris ingestion for baleen whales is even less clear.

All in all, at this time, it does not seem possible to determine the significance of the issue for any cetacean taxon, beyond an enhanced concern for beaked whales and sperm whales. Given however that marine debris is increasing and there have been incidents where debris ingestion has caused morbidity and is likely to have contributed to the death of cetaceans, its significance for these animals deserves further elucidation.

UNEP concludes in “Marine Litter, a Global Challenge” in 2009 that “deficiencies in the implementation and enforcement of existing international, regional, national regulations and standards that could improve the situation, combined with a lack of awareness among main stakeholders and the general public, are other major reasons why the marine litter problem not only remains, but continues to increase worldwide” (UNEP, 2009). The IWC Scientific Committee is well placed to contribute the issue of the growing problems posed by marine debris by

i. defining research needs and facilitating or undertaking such research on stranded and bycaught cetaceans;
ii. in due course providing advice on mitigation (which could be based in part on studies which identify which debris are particularly an issue – for example plastic bags); and, potentially

iii. through education and outreach to Contracting Governments and civil society (this is something that might be expanded upon at Commission level).

The 2011 Honolulu Commitment calls on international organizations to contribute to the development and successful implementation of the Honolulu Strategy – a “results-oriented framework of action with the overarching goal to reduce impacts of marine debris over the next 10 years” that requires the collective action of committed stakeholders at global, regional, country, local, and individual levels. The IWC can make an important contribution to the effectiveness of multi-lateral initiatives aimed at preventing, reducing and managing marine debris and the success of the Honolulu Strategy, including improving global knowledge, understanding and monitoring of the scale, nature, source and impact of marine debris and raising awareness of its impact on biodiversity.

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Table 1. Summary of incidents of ingestion of plastics and other debris reported in Walker and Coe (1990) between 1963 and 1986.

Species	No. of incidents	Locations	Notes
Sperm whale, *Physeter macrocephalus*	3	Florence, OR, New Jersey and Newfoundland.	One animal of 38 examined from a mass stranding in Oregon had 1 litre of tightly packed trawl net in its stomach.
Dwarf sperm whale, *Kogia simus*	1	Corolla, NC	
Pygmy sperm whale, *Kogia breviceps*	3	Sullivan's Island, SC, Galveston, TX, and Brevard Co., Florida	The Texas animal had 'pounds of plastic bags clogging its stomach chambers'.
Cuvier's beaked whale, *Ziphius cavirostris*,	3	San Diego, CA, Assawaman, VA and Seaford, VA	
Blainville's beaked whale, *Mesoplodon denirostris*	1	East Hampton, NY	
Gervais' beaked whale, *Mesoplodon europaeus*	2	Hatteras Island, NC and Cape May, NJ.	The NJ animal has its stomach full of plastic.
Short-finned pilot whale *Globicephala macrorhynchus*	1	Corolla, NC	
Rough-toothed dolphin, *Steno bredanensis*	3	Maui, HI and 2 from Sandbridge, VA	
Pacific white-sided dolphin, *Lagenorhynchus obliquidens*	4	Three from Santa Monica, CA, one from Long Beach Ca.	The fore stomach of the Long Beach animal was half full of four plastic bags, two plastic bottle caps and various organic materials.
Common dolphin, *Delphinus delphis*	4	Two from Los Angeles County, CA, one from Malibu, CA and the other from Hermosa Beach, CA.	The LA County animal had one partial red balloon (3x13cm), one piece of clear plastic (8x13cm), and kelp fronds in its stomach.
Bottlenose dolphin, *Tursiops truncatus*	9	All from the California coastal population – stranded on various CA shores.	Along with other organic and plastic debris, three of the animals contained hooks.
Risso's dolphin, *Grampus griseus*	2	Martha's Vineyard, MA and Manhattan	The animal from MA was recorded as having a

		Beach, CA.	plastic bag in its throat.
Striped dolphin, *Stenella coeruleoalba*	1	Cape Point, NC	
Northern right whale dolphin, *Lissodelphis borealis*	2	Los Angeles County, CA and Santa Monica, CA	
Harbour porpoise, *Phocoena phocoena.*	1	Corolla, NC	
Dall's porpoise, *Phocoenoides dalli*	3	Venice Beach, CA, and two from Santa Barbara, CA.	The Venice Beach animal had its stomach 'jammed with debris' including 13 pieces of clear plastic sheet, 3 heavy clear plastic bags, 2 plastic bread bags and two plastic sandwich bags.

Table 2. Marine litter ingestion or entanglement in strandings examined at post-mortem in England and Wales during 2009

Species	Number of animals examined	Marine litter ingestion	Marine litter entanglement
Harbour porpoise	28	1	0
Short-beaked common dolphin	14	0	0
Striped dolphin	6	0	0
Bottlenose dolphin	2	0	0
Northern bottlenose whale	2	0	0
White beaked dolphin	1	0	0
Pilot whale	1	0*	0
Risso's dolphin	1	0	0
Humpback whale	1	0*	0
Basking shark	1	0	0
Total	**57**	**1**	**0**

*- stomach contents not examined in these individuals

Table 3. Marine litter ingestion or entanglement in cetacean strandings examined at post-mortem in the UK during 2010

Species	Number of animals examined	Marine litter ingestion	Marine litter entanglement
Harbour porpoise	62	1	0
Short-beaked common dolphin	9	1	0
Minke whale	5	0	1
Risso's dolphin	3	0	0
White beaked dolphin	4	0	0
Bottlenose dolphin	3	0	0
Striped dolphin	3	0	0
Atlantic white-sided dolphin	1	0	0
Long-finned pilot whale	1	0	0
Sperm whale	1*	0	0
Sowerby's beaked whale	1	0	0
Total	**93**	**2**	**1**

*- Stomach contents not examined in this individual