# Contribution from the International Whaling Commission to Part I of the report from the UN Secretary-General to the seventeenth meeting of the United Nations Open-Ended Informal Consultative Process on Oceans and Law of the Sea

## Marine debris, including plastics and microplastics


**SUMMARY**

The IWC began formally to consider marine debris in 2011 following its endorsement of the United Nations Environment Programme's Honolulu Commitment. Subsequent work has shown that marine debris, including abandoned, lost and discarded fishing gear (ALDFG), plastics and microplastics, can be a conservation and welfare concern for cetaceans throughout the oceans.

Impacts of marine debris on individual cetaceans depends on the nature of the debris but can include direct entanglement, exposure through ingestion or inhalation and associated impacts including toxicity. More broadly, debris can have a detrimental effect on cetacean habitat and prey. The IWC has endorsed a need for more research on these impacts, especially with respect to quantifying potential population-level effects as a result of direct death, decreased reproductive capacity and/or decreased survivorship. However, as marine debris will clearly not have a positive impact on cetacean populations, awaiting the results of such studies must not preclude serious efforts to remove existing debris and prevent future accumulation in the environment. From an animal welfare perspective, injuries and deaths due to entanglements are a severe problem, irrespective of population-level effects.

In addition to regular work by its Scientific Committee, the IWC has: held two expert workshops on marine debris and three on large whale entanglement in all fishing gear, including ALDFG; established a global network for disentanglement of whales from gear, including a training and support programme for new teams around the world; and increased its efforts to further international collaboration.

Relevant IWC recommendations summarised in this report cover the broad areas below.

(1) Enhanced collaboration on issues related to marine debris with a variety of stakeholders including: intergovernmental organisations; national and local authorities; relevant industries including fishing, shipping, plastics and waste disposal; local communities, non-governmental organisations; and the development sector.
(2) Enhanced multi-disciplinary research on the effects of non-ADLFG marine debris on cetaceans and their habitats, at the level of individuals and populations.
(3) Enhanced development and testing of innovative approaches to preventing problems related to ADLFG including: gear marking; ADLFG collection and recycling; gear modifications and improved fishing practices.
(4) An enhanced training and capacity building approach in dealing with marine debris.
(5) Collaborative development of a range of effective measures (e.g. through education, legislation and economic incentives) to improve marine and terrestrial waste management, including: international and national policy and guidelines; stakeholder partnerships; industry training schemes; and reduction of public consumption of potential marine debris.

## INTRODUCTION

The IWC was set up in 1946 under the auspices of the International Convention for the Regulation of Whaling (ICRW). The Commission has a membership of 88 Contracting Governments. The ICRW contains an integral Schedule which sets out specific measures that the IWC has collectively decided are necessary in order to regulate whaling and other methods/mechanisms to conserve whale stocks. In addition, the IWC undertakes, co-ordinates and funds conservation work on many species of cetacean. Through its Scientific Committee it undertakes extensive study and research on cetacean populations, develops and maintains scientific databases, and publishes its own peer reviewed scientific journal, the *Journal of Cetacean Research and Management*. IWC is mandated, on many issues, to cooperate with other intergovernmental organisations including the International Maritime Organisation (IMO), the Regional Marine Fisheries Organisations (RFMOs), the Marine Council, UNEP, FAO and the biodiversity-related MEAs (CMS, CBD and CITES).

The work of the Commission and its sub-groups has increasingly considered a wide range of environmental issues that are also addressed by UN General Assembly resolutions on Oceans and Law of the Sea, for example marine debris, including plastics and microplastics. This report presents a summary of IWC work to date on marine debris (with a focus on fishing gear, plastics and microplastics) and on ways to mitigate these including through strengthened international collaboration.

The IWC added marine debris to its agenda in 2011 following its endorsement of the Honolulu Commitment. Much of the material in this report is drawn from reports of the IWC Scientific Committee and two expert IWC workshops (IWC, 2014 and IWC/65/CCRep04) on marine debris as well as the published and un-published evidence reviewed by those workshops. The full workshop reports, including full lists of references, presentations and contributors to these workshops can be found online at https://iwc.int/marine-debris and in Annex 1. These also contain a number of case studies on the distribution and impacts of marine debris and national and international programmes to address this problem.

### 1. Challenges of marine debris

Marine debris is a global problem and a threat to our environment, navigation safety, the economy and human health. Marine debris is widely recognised as a major threat to marine biodiversity (CBD 2012) and impacts on a wide range of species including Cetaceans and other species such as sea birds, Chelonioidea species (Sea Turtles) and Pinipeds (Seals and Sealions). Studies of the scientific aspects and impacts of marine debris on Cetaceans have shown that marine debris and its contribution to entanglement and exposures including ingestion or inhalation and associated impacts, including toxicity, are welfare and conservation issues for cetaceans on a global scale and a growing concern.

The evidence of impacts on Cetaceans is discussed in more detail below. Despite the need for more research on effects of marine debris on cetaceans including its population- level impacts, the IWC has agreed that any lack of strong evidence of quantified impacts for some Cetacean species and for some debris types at present should not preclude efforts to remove existing debris and prevent future accumulation in the marine environment. From an animal welfare perspective, the absolute number of cetacean entanglements and associated suffering and times to death are unacceptable, irrespective of population level effects.

Whilst there are often good legislative frameworks in place aimed at preventing marine debris, legal requirements for monitoring and responding to marine debris vary around the world, and their success has been hindered by poor implementation at national level, inadequate enforcement capacity and a lack of incentives for compliance and good waste management practices.

### 1.1 Distribution and quantities of marine debris

A recent comprehensive review submitted to the IWC for consideration by its Scientific Committee (Baulch and Simmonds 2015, which builds on published work by the same authors) provided an update on research into marine debris and cetaceans. The findings of this review, with respect to distribution and quantities of marine debris are presented below.

There remain many gaps in knowledge regarding the global quantity and distribution of marine debris, as well as the relative contribution of different point sources. However, there have been significant advances in knowledge during the last few years, with better quantification and mapping of the occurrence of plastic debris on coastlines, in Arctic Sea ice, at the sea surface and on the sea floor (Cózar *et al*., 2014; Obbard *et al*., 2014; Woodall *et al*., 2014).

Global plastic resin production has increased 620% since 1975, with the largest market sector being Packaging (Jambeck *et al*., 2015). New estimates of plastic waste inputs from land indicate that 275 million metric tons (MT) of plastic waste was generated in 192 coastal countries in 2010, with 4.8 – 12.7 million MT entering the ocean (Jambeck *et al*., 2015). Without improvements in waste management, the cumulative quantity of plastic available to enter the ocean from land is predicted to increase by an order of magnitude by 2025. There remain no current global estimates for other sources, such as losses from fisheries, shipping and other commercial vessels.

Based on regional surveys, estimates of the global load of plastic on the open ocean surface are in the order of tens of thousands of tons, 100-fold lower than expected based on conservative estimates of plastic released into the ocean from terrestrial sources (Cózar *et al*., 2014). Evidence indicates size-selective sinks, particularly removing millimetre-sized fragments from the ocean surface on a large scale, potentially through nano-fragmentation, transference into food webs or processes not yet discovered. Floating debris was found to be largely accumulating in the convergence zones of the five subtropical gyres, with comparable density (Cózar *et al*., 2014). Deep-sea sediments have since been identified as a likely sink for microplastics, with samples from the Atlantic Ocean, Mediterranean Sea and Indian Ocean containing abundances of microplastics (particularly in the form of fibres) up to four orders of magnitude greater than in surface waters (Woodall *et al*., 2014).

New research in 2014 found that Arctic Sea ice also contains concentrations of microplastic several orders of magnitude greater than those reported in debris hotspots such as the Pacific Gyre (Obbard *et al*., 2014). Historically representing a major sink of man-made particulates, polar sea ice now represents a significant source of microplastics that may be released back into the ocean as the extent of sea ice melting increases with climate change. With regards to the relative abundance of microplastics, studies in the Austrian Danube River found the abundance and mass of plastics to be higher than that of larval fish, with industrial raw material accounting for 79% of the estimated input of 4.2 tonnes per day in to the Black Sea (Lechner *et al*., 2014).

Regional surveys of sea-floor debris show differences in the type and density of debris in different areas and at different depths. Surveys of the Gorringe Bank, which lies between the Atlantic and Mediterranean and is characterised by intense maritime traffic and fishing, show a high frequency of lost or discarded fishing gear at 60-3015m depths (Vieira *et al*., 2014). A survey of European seas found litter in remote deep-sea areas, with the highest density in submarine canyons, and the lowest on continental shelves and ocean ridges (Pham *et al*., 2014). Plastic was the most prevalent component, with litter from fishing activities particularly common on seamounts, banks, mounds and ocean ridges.

Although there are no global estimates of fishing gear loss or discarding there are some regional estimates. In South Korea it is estimated 11,436 tonnes of traps and 38,535 tonnes of gillnets are abandoned annually (Kim & Moon, 2014), whilst in the Florida Keys National Marine Sanctuary it is estimated that 85,548±23,387 (mean±SD) ghost traps and 1,056,127±124,919 non-fishing traps or remnants of traps were present in the study area (Uhrin *et al*., 2013). This was attributed to the large numbers of traps in the fishery and the lack of effective measures for managing and controlling the loss of gear (Uhrin *et al*., 2013). Researchers conclude that certain areas of the seafloor may form focal points for litter due to topography, currents, fishing grounds or shipping lanes (Wei *et al*., 2012).

### 1.2 Impacts of marine debris on Cetaceans

The IWC is working through a number of programmes and activities (see Section 2) to better understand the threats to Cetaceans from different types of debris. This work to date is summarised below in relation to two major types of impact - entanglement, primarily entanglement in fishing gear; and ingestion of plastics and microplastics.

i. Entanglement

This section discusses the impacts of Cetacean entanglement including as a result of Abandoned, Lost or Discarded Fishing Gear (ALDFG). Entanglements in ALDFG are part of an even larger problem of entanglements in active fishing gear and by-catch. This is global problem of with a significant impacts on Cetaceans at individual and population levels that has been considered by the IWC for more than 30 years. It is critical for some species.

The entanglement of Cetaceans in both Commercial and other active fishing gears (COAFG) and Abandoned, Lost or Discarded Fishing Gear (ALDFG) have lethal and chronic impacts on Cetaceans and are both a conservation and animal welfare issue that occurs wherever their distribution overlaps with rope and net fisheries. "Ghost fishing" by ALDFG removes both target and non-target species of fish and shellfish as well as a range of non-target species including sea birds, sea turtles and marine mammals. The biggest problems come from passive fishing gear such as gillnets and pots (Gillman *pers. comm.* in IWC/65/CCRep04 page 15). Given its cryptic nature and most countries lack of reporting infrastructure, the problem of entanglement is often severely under-reported.
Whilst the extent to which marine debris contributes to cetacean entanglements is not fully understood (see below), the impacts and potential responses once entangled are largely the same. Welfare concerns related to cetacean entanglement in active fishing gear and marine debris have been well recognized by the IWC following publication of the extended time-to-death of chronic entanglement in right whales (Moore *et al.,* 2006). Recent publications have reinforced this concern (Moore *et al.*2013; Moore and van der Hoop, 2012).

Entangled cetaceans can become asphyxiated when entrapped below the surface of the water. If the animal can surface, it can remain anchored in place, or if it is cut free or can break away, the result may be chronic entanglement, with resultant laceration, incision, constriction, feeding impairment, increased drag (van der Hoop *et al*., 2013 a.), loss of body condition, bony proliferation, infection and ultimate death (Cassoff *et al.,* 2011). The timing of death can be minutes to years after the initial event (Moore *et al.,* 2006). The symptoms can include acute distress in whales that cannot surface and therefore drown at some point soon after the normal dive duration (ranging from minutes to more than an hour in the case of some whales). Chronic cases are likely to suffer from severe and chronic pain (Moore and van der Hoop, 2012).

In terms of population impacts for entanglements generally, scar studies looking at survivors show a high rate of large-whale entanglement ranging from 20-80% of the overall populations affected. The number of observed entanglement deaths has the potential to impact population viability (e.g., van der Hoop *et al*., 2013 b., Glass *et al.,* 2010). Entanglement rates are sufficient to be a threat to the recovery of endangered populations such as gray whales in the western North Pacific and some populations of right whales (e.g. North Atlantic right whales, North Pacific right whales, Southern right whales in the south-eastern Pacific) and the Arabian Sea humpback whales. In the case of North Atlantic right whales, research suggests that reproductive rates are also impacted by entanglement (Knowlton *et al.,* in press).

*Distinguishing entanglements in ADLFG vs active fishing gear*
The degree to which marine debris *per se* has population-level entanglement impacts in Cetaceans is an important issue that requires further study. A key difficulty is the difficulty in separating out COAFG and ALDFG entanglements. Entanglements have been reported for most cetacean species in a wide variety of fishing gear, but predominantly in gear that is either drifting or anchored. A large percentage of the materials removed are reported as being of "unknown" origin and only in a few instances (e.g. less than 5%), are the materials determined to have been lost, abandoned or otherwise discarded, prior to entanglement. However, one review of gear loss and continued ghost fishing found that in some regions it may account for up to 30% of entanglements (Mattila and Lyman, 2006). In addition, it is generally agreed that the numbers of both types of entanglements are widely and severely underreported.

Other major challenges to addressing the issue of entanglement in ADLFG include difficulties in detection (e.g. surface visibility) of ADLFG; lack of reporting of gear loss and of animal entanglements; a lack of reliable information on many factors related to gear (e.g. loss rates of different gear types, persistence of different gear types as threats in the water column and fishery of origin of recovered gear) and lack of incentives for fishing industry e.g. for collection and recycling of gear. In addition, there may be costs to the fishing industry of poorly tested but mandated gear modifications. Thus the solutions can only be reached through full engagement with the manufacturers of fishing gear and the raw materials used to produce it, fishers and other involved parties. Capacity building, better data collection, innovation and industry incentives are all fundamental to better management and ultimately prevention of this problem (See recommendations in Section 3).

Though prevention of entanglement is the far better solution, disentanglement of large whales on a case by case basis can be valuable for critically endangered species, particularly for smaller populations (e.g. North Atlantic right whales) in which each individual counts towards population or species survival. For more information on the IWC programme providing training and capacity development in disentanglement see Section 2.3

ii. Ingestion of plastics and microplastics

Primary and secondary sources of plastic are another major issue related to marine debris. Plastics can be ingested by marine life and lead to starvation and death. Sub-lethal effects may include dietary dilution and reduced appetite with resulting reductions in body condition and other fitness-related pathology. There are also many questions related to the chemical impacts of plastics and microplastics and research is underway to address these.

Literature reviews of data on debris ingestion by cetaceans (Simmonds 2012; Baulch and Perry, 2014a; 2014b) have found that ingestion of debris has been documented in 48 (56% of) cetacean species, with rates of ingestion as high as 74% in stranded animals analysed from certain populations. Plastics were the dominant type of debris ingested, with parts of fishing gear also frequently ingested.

Debris-induced mortality rates of 0–10% have been documented in stranded animals where a cause of death could be determined, suggesting that debris could be a significant threat to some populations. However data on ingestion and mortality rates is only available for a few species and regions and there is no information on rates of sub-lethal pathology in stranded animals examined. A significant problem is the lack of storage of information on debris interactions by strandings networks (groups responding to Cetacean strandings).

In a paper presented to the IWC Scientific Committee, Baulch and Simmonds (2015) reported on new cases of ingestion published in 2014 and 2015. Recently published cases of debris ingestion by cetaceans include a Longman's beaked whale (*Indopacetus pacificus*) which stranded on the Saurashtra coast, India which was presumed to have been killed by the ingestion of four plastic bags, blocking the passage of food to the intestine (Kaladharan *et al.*, 2014). In a rare stranding of True's beaked whales (*Mesopledon mirus*) in Ireland, macroplastic items were identified in the stomachs of both the adults, though not in quantities likely to cause satiation and with no signs of malnutrition (Lusher *et al.*, 2015). A comparison of debris ingestion in two coastal species in Brazil, Franciscana (*Pontoporia blainvillei*) and Guiana dolphin (*Sotalia guianensis*) found that prevalence of debris ingestion was higher in Franciscana (15.7% compared to 1.3% in *Sotalia guianensis*), a trend attributed to the feeding activity of Franciscana, which mainly feeds near the sea bed, the main zone of accumulation of debris in the study area (Di Beneditto *et al.*, 2014a, b).

A number of studies have suggested that deep-diving cetaceans (sperm whales and beaked whales) may be especially vulnerable to ingestion. Research based on strandings data from Japan (Yamada *pers comm.* in IWC 2014 (p17)) has also suggested that ziphiids (Beaked Whales) may be particularly susceptible to ingesting plastic debris because of their stomach structure.

The IWC has expressed concern regarding the high rates of debris ingestion in ziphiids, sperm whales and certain populations of Franciscana dolphins and found that, depending on the severity, the ingestion of debris is a welfare concern at the individual level comparable to that of entanglement. Whilst it remains unclear whether there are any species or areas where it is a population- level concern, the conservation threat should be assessed in the context of the local population size, where even low mortality levels may be of concern. There is a need for significant improvements in data collection and collation to improve the understanding of threats of ingestion of marine debris as well as further research on the physical and toxicological impacts of debris ingestion (Section 3).

*Microplastics*
The information below is drawn from reports of IWC expert workshops (IWC 2014 and IWC/65/CCRep04) as well as a recent review of evidence of the impacts of microplastics on Cetaceans (Baulch and Simmonds 2015) submitted for consideration by the IWC Scientific Committee.

By 2050, an extra 33 billion tonnes of plastic is expected to be added to our planet (Rochman *et al*., 2013). This material enters and persists in environments from the poles to the equator and down to the depths of the sea. Slow degradation into smaller particles means that microplastics[1] have been accumulating in the environment (Thompson *et al*., 2004; Browne *et al*., 2007; 2010; 2011). Once ingested by animals, microplastics can accumulate within the guts of organisms where it can be engulfed and stored by cells (Browne *et al.,* 2007; 2008). This provides a feasible pathway for microplastics to transfer absorbed contaminants, constituent monomers and additives into the tissues of animals and affect physiological processes that sustain health (Teuten *et al.,* 2007; 2009). Ingestion has been demonstrated in many marine species, including plankton, fish and several species of Cetacean including Mediterranean fin whales, in which they may act as endocrine disruptors (Box 1) (Fossi *et. al*., 2012; Fossi and Depledge, 2014; Frias *et al.,* 2014; Lusher *et al.,* 2013; Van Cauwenberghe and Janssen, 2014; Wright *et al.,* 2013*)*. However, whilst there are established techniques for quantifying other contaminants in tissues of cetaceans, there is still little information on the uptake and toxicological consequences of microplastics (e.g. endocrine disruption) and the physiological and toxiological effects of microplastic ingestion for Cetaceans are poorly understood.

Research supported by the Italian Ministry for Environment (Fossi *et al*., 2012 and Fossi *et. al*. 2014) provided the first evidence of the potential toxiological impact of microplastics in a baleen whale in a study of Fin Whale *Balaenoptera physalus*, in the Mediterranean Sea (Box 1 ). In the last two years microplastic ingestion has been identified in two further species including a stranded True's beaked whale (Lusher *et.al*. 2015), and in the intestines of a stranded Humpback whale. From an analysis of a section of the gastrointestinal tract it was estimated that the gut would contain up to 160 small particles or a volume of up to 137mm3 (Besseling *et. al*. 2015). It is suggested that other baleen whale species could have higher microplastic ingestion than the humpback due to the lunge feeding behaviour of the humpback as opposed to other baleen species that skim water or sediment when feeing. It has also been suggested that, as surface feeders, right whales may be exposed to high quantities of microplastics in the surface microlayer.

**Box 1 Microplastic ingestion in Fin Whales**
The Fin Whale is one of the largest filter feeders in the world. These whales feed primarily on planktonic euphausiid species. With each mouthful, fin whales can trap approximately 70,000 litres of water, and their feeding activities include surface feeding. They could therefore face risks caused by the ingestion and degradation of microplastics. Micro-debris can be a significant source of lipophilic chemicals (primarily persistent organic pollutants – POPs) and a source of pollutants such as polyethylene, polypropylene and, particularly, phthalates. The toxicological effects of microplastics on fin whales were studied comparing two populations living in areas characterized by different human pressure: the Pelagos Sanctuary (Mediterranean Sea, Italy and France) and the Sea of Cortez (Mexico). The work was implemented through four steps: 1) collection/count of microplastics in the Pelagos Sanctuary (Mediterranean Sea); 2) detection of phthalates in superficial neustonic/planktonic samples; 3) the detection of phthalates in Mediterranean stranded fin whales; and 4) the detection of phthalates and biomarker responses in skin biopsies of fin whales collected in the Pelagos Sanctuary and Sea of Cortez.

A high presence of plastic particles with high concentration of phalates has been detected in superficial neustonic/planktonic samples collected in the Pelagos Sanctuary areas that were investigated. In addition, concentrations of Phalates were detected for the first time in blubber samples of five stranded fin whales collected along the Italian coasts. Finally, relevant concentrations of phalates and elevated biomarker responses were detected in the skin biopsies of fin whales collected in the Mediterranean areas in comparison to the specimens from whales in the Sea of Cortez. The results of this study support a strategy of using phthalates as a tracer of microplastics consumption in fin whales, and represent a warning signal for this threat in baleen whales. These preliminary investigations underscore the importance of future research on the detection of the toxicological impact of microplastics in filter-feeding species such as mysticete cetaceans, the basking shark and the devil ray. These results also underscore the potential use of these species in the implementation of Descriptor 10 (marine litter) in the European Union (EU) Marine Strategy Framework Directive as indicators of the presence and impact of micro-litter in the pelagic environment.
Source: Fossi *pers comm*. in IWC, 2014 (p 5) reporting on Fossi *et al*. 2012; Fossi *et al*. 2014

[1] Defined by the IWC as fragments smaller than 5mm

Although the impact of microplastic ingestion by cetaceans is not yet well understood, there is increasing evidence of their uptake and impacts in a range of other species. As well as direct uptake of microplastics from the water column, cetaceans may also ingest microplastics and associated PBT chemicals via prey species. Uptake of microplastics has been recently demonstrated in zooplankton (Frias *et al*., 2014; Setälä *et al*., 2014), shellfish (Van Cauwenberghe & Janssen, 2014), benthic organisms (Browne *et al*., 2013; Besseling *et al*., 2013), planktivorous fish (Boerger *et al*., 2010) and pelagic and demersal fish (Lusher *et al*., 2012) and may be retained in the gut, translocate into tissues or be excreted (Browne *et al*., 2008; Wright *et al*., 2013). Once ingested, microplastics may cause physical harm or increase contaminant loads, either through the leaching of chemical additives or the release of PBT chemicals which concentrate on plastics in sea water and are then transported into the food chain where they may bioaccumulate. Impacts recorded thus far in a range of marine fauna include effects on feeding activity, survival, growth, metabolism, behaviour and reproduction (Besseling *et al*., 2014; Mattsson *et al*., 2015; Rochman *et al*., 2014; Wright *et al*., 2013). Ingestion of microplastics by individual organisms at lower trophic levels could have consequences for organisms at high trophic levels if contaminants that are transferred have the potential for biomagnification (Teuten *et al*., 2009).

## 2. Activities and actions undertaken by the IWC

This report focuses on the activities of the IWC as an intergovernmental organisation to address the issue of marine debris. Some examples of national actions and activities undertaken by IWC member countries to address this issue, as well as those of other organisations can be found in the two marine debris workshop reports in Annex 1.

The IWC has conducted extensive consideration of marine debris through its Scientific Committee, Conservation Committee, through its working group on Whale Killing Methods and Welfare Issues and through expert workshops on marine debris and on entanglement. The competence of the IWC on this issue falls into two important areas. The first is work to model population and human activities to determine priorities for action from a conservation perspective and to evaluate potential and actual mitigation measures. This is supported by the IWC's long term monitoring of Cetaceans. The second area concerns the welfare of individual animals independently of the conservation status of the population to which they belong; at present the IWC has focused on entanglement in fishing gear. IWC activities are summarised in more detail below.

### 2.1 Research

The IWC Scientific Committee and its sub-committee on environmental concerns have been receiving information on entanglement and ingestion of marine debris for several years. The ongoing and planned work of the Scientific Committee relevant to marine debris includes:

- *Expert workshops* on threats to Cetaceans including marine debris and entanglement (Section 2.2)
- *Long term monit*oring of Cetacean populations
- *Development of modelling approaches* and their application in a management context. This includes i) population modelling- examining status of whale populations and predicting future trajectories in light of known and expected human activities ii) habitat and spatial modelling to examine geographical and temporal density of whale populations. Comparison with similar models of actual or potential threats can be used to try and determine high risk areas or "hot spots" Future work will explore ways of combining estimates of oceanic debris and information on Cetaceans to identify priorities for mitigating and managing the impacts of marine debris on Cetaceans
- *Review of recent research* on threats to Cetaceans imposed by marine debris and identification of research priorities (Section 3).
- *Improvements to data collection*. Including means to improve and better share information on rates of marine debris ingestion and entanglement; potential ways to distinguish between entanglements in COAFG as opposed ALDFG; and data collection, monitoring and modelling exercises that might help to improve understanding of the extent and significance of the impacts of marine debris at the individual and at population level. This will include the development of standardised data collection protocols and data collection forms for strandings networks; as well as improvements to reporting of information relevant to marine debris through the annual progress reports and conservation reports submitted by IWC Member countries

- *Development of a Global entanglement database*. The IWC is developing a Global entanglement database to improve the understanding of the impacts of entanglements on whale populations and the factors associated with entanglement risks. This database could also help to identify the fisheries/gear types and practices leading to high risks of entanglement; differentiate COAFG from ALDFG and other debris; identify particularly vulnerable species and help to inform, prioritise and develop mitigation measures.
- *Review of mitigation approaches* and their effectiveness, included those reported by IWC members.
- Through its *Pollution 2020* workplan (https://iwc.int/chemical-pollution) the Scientific Committee is studying the fate and distribution of microplastics.

2.2 Expert workshops and knowledge exchange

The IWC has held two expert workshops on marine debris. The first workshop (IWC, 2014 and Annex 1) focused on an evaluation of known effects of marine debris on cetaceans. The workshop made many recommendations, and highlighted the importance of trying to distinguish whether or not entangling gear was active or derelict at the time of entanglement. It also called for improved data-sharing and recommended that marine debris interactions should be reported by Commission Members in National Progress Reports. It also recommended that debris sampling should be conducted during cetacean field studies; there should be improved efforts to work with industry and fishermen; and that the Scientific Committee should work to further evaluate the risks of ingestion. Finally, the desirability of working in collaboration with other intergovernmental bodies on this issue was highlighted.

The second workshop (IWC/65/CCRep04 and Annex 1) was held in August 2014 in Hawaii. The primary objectives were to explore how the IWC can engage with the existing international and regional mitigation efforts concerning the management of marine debris, determine how best to ensure that these efforts are updated on cetacean-specific impacts of marine debris, and advise on how best the Commission can lead and engage in regions where marine debris has the greatest potential impacts on cetacean populations. Topics that were discussed included fishing gear marking, potential gear modifications, fishing gear recycling programmes and methods for identifying debris hotspots, modelling approaches, and work conducted on other species, such as seabirds and turtles. In addition, , the role and responsibilities of other Inter-governmental Organisations (IGOs) such as the International Maritime Organisation's (IMO) International Convention for the Prevention of Pollution from Ships (MARPOL)and governmental and non-governmental marine debris programmes were also discussed. The Workshop agreed that the Commission's primary contribution should be to ensure that cetacean-related issues are adequately represented within existing initiatives, and that its strong scientific and other expertise is made available in collaborative efforts. It made specific recommendations for the IWC to collaborate with a number of other Intergovernmental Organisations.

The IWC has also held three entanglement workshops (IWC, 2012; IWC, 2013 and SC/66a/COMM2) that have focused on entanglement of large whales, including in ALDFG and capacity building for entanglement response. A forthcoming IWC workshop (anticipated May 2016) on prevention of the incidental capture of cetaceans will incorporate discussion of ALDFG as well as in-use gear.

2.3. Disentanglement

Whilst it is recognised that prevention is a much better solution than disentanglement, in smaller populations, e.g. North Atlantic right whales, disentanglement is still important as each individual counts towards the population or species survival. Until there is a preventative solution, people will attempt to release entangled whales, whether it is a fisher trying to recover his gear, or a well-meaning member of the public. This can have serious negative results for both the rescuer and the whale.

*The IWC entanglement programme* was established in 2011 to address the growing problem of whale entanglement by building a global network of professionally trained and equipped entanglement responders. Since its first training workshops of 2012, with the support of the USA (NOAA), UNEP-CEP-SPAW, SPREP, CPPS, World Animal Protection and other NGOs, along with the support of many of the countries for which training occurs, this initiative has reached more than 500 scientists, conservationists and government representatives from over 20 countries.

The training curriculum includes techniques and methodologies for investigating the causes, scope and impact of large whale entanglements, including in marine debris, as well as current information on attempts to prevent it. Capacity building is undertaken in partnership with the country in which training is taking place and, in some cases, in partnership with regional IGOs under regional action plans (e.g. the SPAW marine mammal action plan in the Wider Caribbean, and the SPREP whale and dolphin action plan in the South Pacific).The trainees, who are chosen by the respective government may be a mix of natural resource personnel, eco-tour operators, fishers, Navy personnel, scientists, etc. At the end of training, key participants are identified who may be able to undertake a three week apprenticeship with one of the existing networks- in an effort to train future trainers for the country represented. Two apprentices from Mexico are now involved in delivering training in Spanish speaking countries, most recently on the Chilean coast- an important habitat for the critically endangered Southern Right Whale.

2.4 Conservation Management Plans

The IWC introduced Conservation Management Plans (CMPs) (https://iwc.int/conservation-management-plans) as a practical tool to help member nations to coordinate conservation work being undertaken. The CMP approach has thus far been used for southeast Pacific right whales, South Atlantic right whales and gray whales in the western North Pacific and other populations are being considered for candidate CMPs (e.g. Arabian Sea humpback whales). In response to recommendations from the IWC expert workshops on marine debris, marine debris considerations are being integrated into existing CMPs and the Commission is further considering the development of a threat-based CMP.

2.5 International collaboration

IWC expert workshops on marine debris have stressed the absence of a single overarching agreement or Convention dealing with the issue of marine debris and the importance of International collaboration on this issue to ensure consistency of approach, synergy of efforts and exchange of information. To this end it has agreed that the IWC's primary contribution should be to ensure that cetacean-related issues and specific impacts on cetaceans are adequately represented within existing marine debris initiatives and that its strong scientific and other expertise is made available in collaborative efforts. The expert workshops highlighted a number of opportunities for the IWC to work together with the Secretariats of other IGOs including with RFMOs, FAO, IMO and the biodiversity-related MEAs and these are currently being pursued by the Secretariat in liaison with the Marine Debris Intersessional group and other IWC Committees.

2.6 Outreach

The IWC Scientific Committee has asked the IWC Secretariat examine ways in which it and its member nations can most effectively communicate its recommendations to the relevant target audience(s) including IGOs, appropriate government agencies and NGOs. In addition, the IWC has developed a dedicated section of its website to the issue of marine debris. The IWC seeks to highlight the IWC's work on the impacts of marine debris on cetaceans at meetings of other IGOs and to input expert advice as appropriate.

## 3. Recommendations for future action

The IWC added the issue of marine debris to the agendas of its Scientific and Conservation Committees in 2011. Since then the IWC has convened two expert workshops, and the consideration of marine debris and related issues by the IWC have led to a number of recommendations for future action. Those most relevant to discussions under the United Nations Open-Ended Informal Consultative Process on Oceans and Law of the Sea are summarised here. In some cases this reflects information gained from follow up consultations with other IGOs. The IWC recommendations in their full and original form can be found in the two workshop reports in Annex 1.

3.1 International collaboration.

The IWC Secretariat and those of other major IGOs and RMFOs relevant to this issue should work together on issues related to marine debris to ensure consistency of approach, synergy of efforts and exchange of information to develop appropriate mitigation strategies that recognise that a) prevention is the ultimate solution but that b) removal is important until that idea is realised. Individual countries should be encouraged to collaborate with such initiatives. Given that the issue of marine debris is multi-dimensional, dealing with it requires considerable co-operation amongst intergovernmental organisations, governments, industry and nongovernmental organisations.

In addition, there is a need to identify a coordinating body to review all of the international efforts related to marine debris and compare the resolutions and recommendations, identify those that overlap and facilitate prioritisation and implementation. This could be undertaken, for example, by the UNEP Global Partnership on Marine Litter.

Strengthened engagement with international aid agencies and international financial institutions (such as World Bank) involved in the development of fisheries management in developing countries would also be useful- for example, to ensure they take into account the impacts from unintended consequences of the various types of fishing gear being brought into communities as an economic development strategy.

3.2 Research and Data collection

Addressing the problem of marine debris will require multidisciplinary research solutions, with all relevant partners such as international organisations, governments, industry, NGOs and local communities all involved in marine debris prevention, research and response. The IWC Scientific Committee and IWC expert workshops have made a number of detailed recommendations concerned with research and data collection on marine debris and impacts on Cetaceans. These are summarised below:

*i) Fisheries research*

Since fishing gear, both active and derelict, is a major cause of injury and mortality in cetaceans there is a need for more research and experimentation to develop and evaluate the efficacy of alternative fishing practices, including innovative methods, gear and management regimes.

*ii) Macrodebris ingestion and microplastics*

Microplastics, their associated chemical pollutants and microbes, and macrodebris ingestion should be prioritised for further research. These represent a potentially significant but poorly understood threat to cetacean and other marine mammals. Further research might include: developing and validating the use of direct (vibrational spectroscopy) and indirect (e.g. contaminants associated with plastic: phthalates, PCBs, PBDEs) measures of ingested microplastics; examining whether ingested micro- and nano-plastic can transfer into the food chains of cetaceans; evaluating the use of established biomarkers of exposure to assess the toxicity of microplastics, including endocrine disruption; and laboratory and field experiments to investigate the bioavailability and toxicity of priority pollutants and additives from microplastics.

Future research on the uptake and toxicological impacts of microplastics in filter-feeding species of whales should include both species with intense surface feeding activities (e.g. right whales) and species with feeding related to the sediment (e.g. gray whales).

*iii) Research on Cetacean-debris interactions*

This should include development and use of global models that help identify locations where there is greater potential for interactions of cetaceans with debris. Modelling approaches should examine the relationship between marine debris "hot spots" and information on distributions, feeding strategies and mortality rate data already collected by the IWC and other organisations. The determination of hazard function of specific debris could be connected to the modelling data.

Modelling of debris "tracks" is of potential use in cetacean marine debris interaction estimations. This modelling considers the path of debris that the animal encounters as well as general distribution of debris, and uses this information to make projections that may be applicable to stock assessment.

The IWC recommend debris sampling when conducting cetacean research at sea and the reporting of these results to relevant groups including the IWC.

Obtaining more acoustic information on how marine debris is perceived by cetaceans would help understanding of the causes of ingestion and establish whether and which debris items are being selectively ingested by cetaceans.

*iv) Cumulative impacts*

There is a need for more research on and modelling of the cumulative effects of different stressors on Cetaceans including marine debris and other environmental threats.

*v) Improved fisheries data*

The collection of small-scale commercial and artisanal data on total global distribution of fisheries effort extrapolated from global catch would be useful- given that there are limitations to the data that FAO collects. In addition, estimates of gear loss from relevant fisheries would be very helpful toward understanding the relative risk of active versus derelict gear.

*vi) Improved information from Cetacean strandings*

Such information would include rates of debris occurrence in animals necropsied (presence/absence) as well as rate and type of pathology (impact on animal) to gain a better understanding of the extent of the threat debris poses to different species and populations. Wherever feasible, all gear removed from cetaceans be retained, documented and detailed, archived, and analysed, though collection of entangling gear should not compromise human or cetacean safety. (For more detailed guidance on diagnosis of entanglement and ingestion impacts of marine debris in Cetaceans see IWC 2014 p13-15).

*vii) Improved reporting by Member States*

Rates of marine debris interactions with Cetaceans (e.g. stranding and by-catch) should be reported by countries (e.g. IWC member countries, in the appropriate data fields within their National Progress Reports) and data should be recorded in such a way that it is available for future analysis.

*viii) Database development.*

The IWC recommend the promotion and utilisation of existing database frameworks and protocols with the aim of establishing a centralised database for a comprehensive picture of global marine debris impacts on cetaceans.

3.3 Capacity building

The IWC encourages all members and non-members of the IWC to take advantage of the IWC disentanglement network and opportunities for IWC training especially in those regions where entanglement of large whales represents a threat at the population level (e.g. Western Pacific, Eastern South Atlantic and Arabian Sea).

More widely, it stresses the importance of a training and capacity building approach (including through existing marine debris initiatives) in dealing with marine debris. Such an approach could assist in developing technical expertise and activities related to marine debris including: (1) removal of ALDFG from marine areas where it accumulates (e.g. pilots studies in areas where whales are most likely to encounter and become entangled in such material); (2) collection and proper disposal of end of life fishing gear and (3) marine debris outreach and awareness campaigns that target fisheries and other sectors from which debris originates to explain their impacts, the importance of reducing the amount of such debris, and actions that can be taken to prevent its impacts.

3.4 ADLFG- Fisheries management and fishing gear

There have been some promising developments of potential ways to address ADLFG including alternative fishing practices, including innovative methods, gear and management regimes. Some of these are addressed below.

*i) Gear marking*

Recognising their past and existing efforts, FAO COFI should be encouraged to include its work on gear marking and take into account the value that gear marking can contribute to mitigation approaches.

Gear marking can bring positive benefits to the fishing industry as a tool to reduce gear loss, address unintended biodiversity impacts and to distinguish bona fide gear from IUU gear. There are considerable advantages in gear marking from a cetacean entanglement perspective If gear is traceable it can be further studied to understand the factors leading to entanglement. Even a 'low-tech' gear marking scheme in combination with examinations of gear removed from whales could resolve three key questions: (1) the region in which gear is set; (2) the fisheries from which gear came (e.g. traps vs gillnets); and (3) the part of fishing gear from which it came (e.g. buoy lines vs. groundlines between traps). This could be used to analyse factors related to incidental capture and to gear including gear types, loss rates of the various gear types, persistence of ghost gear by type as a threat in the water column, and the origin of ALDFG. This information is particularly important in helping to develop mitigation measures and priorities. Gear identification also creates an opportunity for communication with the fisherman, who can provide useful information for 'real-time' entanglement response as well as long-term solutions.

Related issues that could be considered, include placing simple generic marks (e.g., painted or tape bands of specific colours or colour combinations) at strategic points on fishing gear. Consideration should also be given to appropriate intervals for marks to be placed. For example, typical lengths of line found on and removed from entangled whales would suggest intervals of every 30 to 40m. Marks would need to be broad enough (e.g. 30cm or 1ft long) to be visible from boats 100m or more away or from aerial photographs of entangled whales. Such a system is currently being developed by the National Marine Fisheries Service for trap and gillnet fisheries along the US east coast to improve information on the sources of lines removed from North Atlantic right whales and humpback whales.

Although there is clear value in a standardised global marking system, it is important to recognise that approaches that may be appropriate in developed large scale fisheries may be impractical or economically infeasible in artisanal fisheries or fisheries in the developing world. However, there may be value in a centralised global database (or perhaps regional databases) for gear and the reporting of lost gear.

The IWC has reviewed several successful national initiatives on gear marking (see Box 2). Similar initiatives and pilot studies should be funded and encouraged.

Box 2. Gear marking in Dungeness Crab Fisheries

The California, Oregon and Washington Dungeness crab trap fisheries, the largest trap fisheries off the US west coast, mark individual traps as part of a trap limit system. Fishermen are allowed to apply for replacement tags for up to 10% of their trap allotment. Through this system, the state fishery management can quantitatively measure and track the (reported) trap loss. The report of a whale entanglement in California highlights the information that can be gleaned with traceable gear marking. On 30 June 2014, a highly degraded humpback whale fluke was found off San Clemente Island in southern California wrapped in commercial fishing line and five fishing buoys. The buoys were marked with commercial fishing license numbers and California Dungeness crab buoy tags. The gear markings allowed for contact with the owners of the two sets of gear, through the California Department of Fish and Wildlife. The fishermen stated that they had set their gear off the San Francisco area and had lost their gear at the end of March or April. The fluke was found over two months later and approximately 360 n.miles south of the original gear set location. The buoy tags were industry initiated and implemented in California in 2013 as part of a trap limit system.

Source: Saez *pers comm*. in IWC/65/CCRep04 p.11 and Saez *et al*. 2013

*ii) Gear collection and recycling*

A challenge in addressing ADLFG is the lack of facilities in some places for collection of end of life fishing gear and the lack of incentives for fishermen to use these facilities- for example, revenue from recycling. There are some successful national initiatives (Box 3 and Box 4) for the collection and recycling of discarded fishing equipment. Though these are promising, changes to legislation is required in some countries where currently there are laws that fisheries waste must go to landfill.

At the global level, MARPOL Annex V requires signatory nations to provide adequate port reception facilities for accepting garbage (including ALDFG) generated by ships. The Global Integrated Shipping Information system (GISIS) website, provided and managed by IMO, provides a database of garbage management facilities searchable by port and waste type. There is the potential for this to be more up to date in terms of specific identification of those ports and waste management providers that accept and/or recycle end of life fishing gear. Improved knowledge of where end of life fishing gear could be responsibly disposed of (ideally free of charge or with a financial incentive), if combined with education outreach, could reduce the incidence of gear discards.

The relevant Member states should be encouraged to review national level implementation of MARPOL Annex V and other conventions relevant to marine debris reduction. In cooperation with IMO they should also be encouraged to ensure that the GISIS port reception facility database is updated to specify which ports accept end of life fishing gear, and additional useful information (such as any restrictions on gear and recycling potential) and to encourage an expansion of the provision of no-special-fee port reception facilities. Greater reporting of inadequate port facilities would also be useful.

Box 3. Fishing gear collection and recycling in Norway

The Norfir project (http://www.nofir.no) for recycling fishing gear in Norway has created a profitable national system for collecting and recycling discarded fishing equipment, now being extended into several other European countries. Norway has a very long coastline and an important fishing sector. Large-scale fisheries include trawl nets, gillnets and aquaculture. Fisheries waste, particularly old nets, was not welcome at waste facilities as it entangles the machinery. Old gear therefore either went to landfill, was dumped at sea or was burnt. The Nofir project collects discarded gear for free; selling the valuable plastic contents of the gear pays for the disposal of net components (including other types of plastics) that cannot be recycled or are less valuable as well as collection of the more remote debris. The Norwegian Directorate of Fisheries collects and recycles discarded gear and the dismantling and processing is carried out in a plant in Lithuania. In part this has been possible because of the large size and number of nets. Some of the challenges of the project include transport, laws and regulations regarding hazardous waste (since copper is used on the nets as an antifouling agent and difficulties in dismantling and recycling (plastics recycling is complex). In addition effort is needed to increase awareness of the problem for the fishing sector as well as to improve the ability to make a profit from the enterprise.

Source: Rudd *pers comm*. In IWC/65/CCRep04 (p17)

Box 4. Philippines- NET-WORKS

Net-works is a partnership between the Zoological Society of London (ZSL), Aquafil (nylon net recyclers), and Interface (carpet company). Communities living in the Danajon Bank of the Philippines collect and sort nets, which are a major entanglement hazard and threat to the reef and its ecosystem. ZSL coordinates the collection efforts and payment structure through the creation of community banks, Aquafil then processes the netting into yarn, and Interface buys the yarn to make carpet tiles, fulfilling their company mission of a closed-loop supply chain. Since June 2012, 9,000 kilos of discarded fishing nets have been converted to carpet tiles; 892 local fishers and their families collect fishing nets in exchange for payment; for every 2.5 kilos of nets collected, villagers receive enough money to buy 1 kilo of rice. This project, which actively pursues a role for the private sector continues to succeed, by assigning a commercial value and price point to the 'product' of marine debris.

Source: Case study in IWC/65/CCRep04 (p18)

*iii) ADLFG recovery*

Lost gear recovery provides immediate benefits to marine animals, including cetaceans, by removing gear that is a threat to entanglement and ingestion (McElwee and Morishige, 2010) and has saved thousands of animals. It has also been shown to be economically viable (Box 5). Combining government mandates to conserve endangered species and marine mammals with conservation of commercially valuable species makes a strong case for supporting lost gear recovery. Although some people have considered lost gear as 'artificial habitat', the entanglement risk of man-made materials on the sea bed and other environmental consequences likely exceed the perceived benefits that items may have by creating artificial habitat.
Where possible, the IWC recommend that gear recovery efforts ensure that a dedicated observer (biologist) is on board to collect data on the species, composition, and numbers encountered in the gear, as well as on the type and condition of the gear.

There are a number of successful gear recovery programmes in different parts of the world and knowledge and experience from these on-going programs could be beneficial to other countries that have not yet tackled the problem of derelict fishing gear.

Box 5. Modelling economic benefits of gear recovery in Puget Sound
In collaboration with the Northwest Straits Initiative, derelict nets in Puget Sound in Washington State, US were monitored by divers over two-month periods to measure entanglement rates, in order to develop a predictive model for estimating total mortality caused by a net during its lifetime as derelict (Gilardi *et al.*, 2010). This model was then used to estimate the cost-to-benefit ratio for commercial fisheries of derelict gear removal, based on true costs and market values. This evaluation suggested that, regarding entanglement of Dungeness crab in derelict gill nets specifically, the cost-to-benefit ratio was 1 to 14.5. When the model was applied to estimate total mortality of marine mammals in derelict gillnets in Puget Sound, and costs of gear recovery compared to costs to rehabilitate marine mammals impacted by oil spills, derelict gear removal was determined to be a highly cost-effective.
Source: Gilardi *pers comm.* in IWC 2014.

*iv) Gear modifications and Fisheries management*

There have been some promising developments in gear technology methods to reduce "ghost fishing" by ADLFG (see report from Gilman et. al., In prep in IWC/65/CCRep04). Efforts to reduce ghost fishing by derelict gillnets and trammel nets include increasing gillnet filament diameter, modifying the weaves (e.g. using multi-monofilament instead of single monofilament- which has been shown to give them shorter fishing efficiency), using larger floats on the top rope and heavier weights or lead-core on the bottom rope, and infusing compounds to make the net stiffer (increase net tension), reducing the likelihood of entangling large organisms. Efforts to make nets more detectable, such as through net colour, thicker twine diameter and attaching corks or other visual markers within the net, has in some cases been shown to effectively reduce bycatch rates of marine mammals and turtles. Similarly, attaching materials such as thick polyester rope and chains to fishing nets, and infusing nylon nets with metal compounds such as barium sulphate and iron-oxide has the potential to reduce cetacean captures either because the materials increase acoustic reflectivity when using echolocation, increase the net's visibility or the infused metals increase twine stiffness.

The use of less durable materials (e.g. thinner net twine diameter and weaker material) to produce a breaking strength that allows large organisms to break free of the gear and escape might also reduce ghost fishing mortality. Designs that employ degradable materials have been developed to reduce the duration of the fishing power of ALDFG. Degradable escape panels and cords can be used to reduce ghost fishing by traps, and are required in some fisheries. Synthetic gear materials have been developed that can be broken down by microbes and ultraviolet light. Acoustic pingers and alarms and illuminating nets with chemical or battery-operated light sticks might reduce bycatch but would likely be ineffective methods to reduce ghost fishing mortality once the energy source has drained.

Concern has been expressed that some gear modifications mandated by government regulators whilst intuitively believed to reduce whale entanglements, have yet to produce scientific proof of their effectiveness. These may prove costly to fisherman without producing the desired results. The onus should therefore be on collaborative research with industry (including gear manufacturers and the fishing industry) as well as with small-scale and artisanal fisherman to identify practical solutions that provide local incentives to adopt alternative fishing methods.

In addition, it is possible that some gear modifications to reduce by-catch might increase the amount of gear (marine debris) in the environment. It is therefore important that the assessment of such alternatives in active fishing gear include evaluation of their potential to alter the contribution of marine debris in the environment and the risk of entanglement or ingestion by marine species.

In addition, the importance of individual behaviour and operator proficiency (e.g. some individuals using the same gear as others may have higher bycatch rates and gear loss rates) should be considered as part of mitigation strategies. Addressing this may in some cases prove more effective than general, industry or sector-wide measures.

In some cases, fisheries management schemes such as Individual Transferable Quotas, and Total Allowable Catches (TACs) can facilitate the incorporation of fishing methods that can be better for cetaceans and that lead to a reduction of marine debris. Marine spatial planning and technological innovations might also help to reduce conflicts between different maritime activities that may result in the creation of marine debris.

3.5 Waste management

Countries should be encouraged to prioritise the strategic use of a range of measures to improve marine and terrestrial waste management, including national legislation and policy, stakeholder partnerships, industry training schemes and economic tools aimed at reducing public consumption of key types of debris such as packaging waste.

There are some calls (see IWC 2014 p5-6; Rochman *et. al.* 2013 in Simmonds and Baluch 2015) for marine debris, particularly plastic wastes to be classified as and addressed as hazardous wastes and assertions that this would increase the power of environmental agencies to restore affected habitats and prevent more dangerous debris from accumulating.

*3.6 Outreach*

It is essential that action to tackle the issue of marine debris is led through outreach to all relevant stakeholders including policy makers, the public and scientific community, industry and local communities particularly (with respect to ADLFG) gear manufacturers and the fishing industry. There are opportunities for outreach to lead to better data on marine debris (e.g. from the fishing sector, mariners and beach users) as well as to help bring about behaviour change, and inform the identification and development of innovative solutions. There are many good examples of outreach tools including those developed at national level and by international organisations and partnerships such as the Global Partnership on Marine Litter.

In general, outreach materials on this topic should be developed in cooperation with all key stakeholders, including industry and be tailored to specific target audiences. Different strategies will be needed in different parts of the world with regards to the best approach to different target audiences. In many parts of the world, cetaceans can be good educational and outreach tools that can help relate the problems of the oceans to wide audiences. In this context, information from the IWC Scientific Committee and ongoing disentanglement initiatives could be of assistance to other organisations to inform their work, including outreach to policy makers and the public.

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