Briefing to the 66th Meeting of the International Whaling Commission (IWC)

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PLIGHT OF THE OCEAN SENTINELS:

The grave and growing threats from human activities to the world's whales, dolphins and porpoises

ABOUT EIA

EIA is an independent campaigning organisation committed to bringing about change that protects the natural world from environmental crime and abuse. As part of our work we have campaigned for three decades for effective protection for whales, dolphins and porpoises globally.

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INTRODUCTION

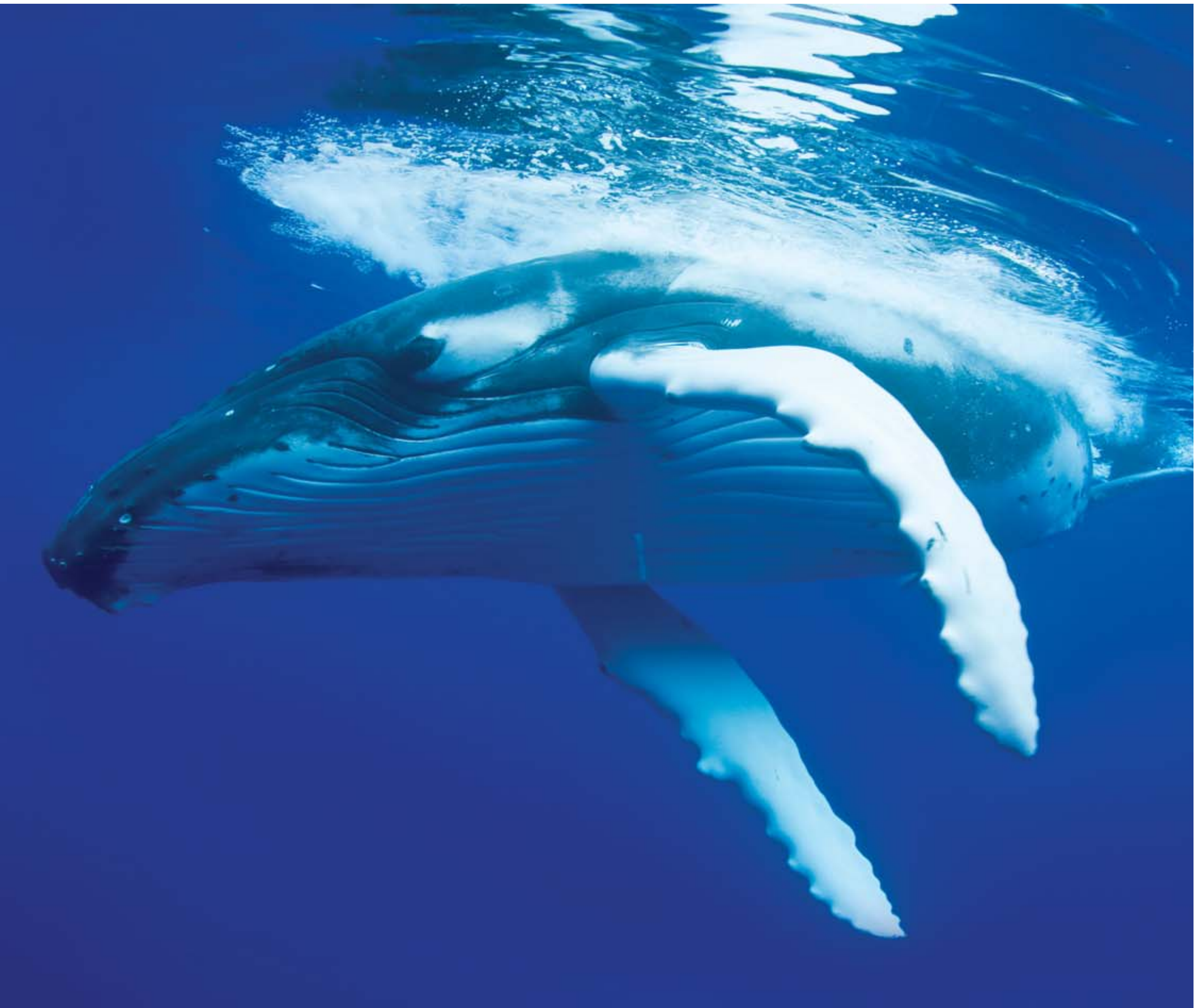
Thirty years after the International Whaling Commission (IWC) implemented the moratorium on commercial whaling – an agreement that ultimately saved many great whale populations from certain extinction – whales, dolphins and porpoises worldwide are facing grave and growing threats from a range of human activities.

During the 20th century, 2.9 million whales were killed by the whaling industry, likely the largest removal of any animal in terms of total biomass in human history.[1] Whale populations were decimated, with sperm whales reduced to about 30 per cent of their pre-whaling population and blue whales depleted by up to 90 per cent.[2] Some estimates suggest that the overall biomass of large whales was reduced to less than 20 per cent of original levels.[3]

Fin and sperm whales comprised more than 50 per cent of all large whales killed but a range of other species were also targeted, including blue, sei, Bryde's, minke, right and gray whales. Population after population was depleted, some completely extirpated.[4] Blue whales were reduced to around one per cent of their historical abundance in the Southern Hemisphere.[5] All efforts to manage commercial whaling failed and in 1982 the IWC agreed a moratorium on commercial whaling on the basis of uncertainty about whale numbers and their ability to withstand any further depletion through hunting. Three decades on, recovery is at an early stage for many species. Humpback, southern right, north Atlantic right and Antarctic blue whales remain at a fraction of their pre-exploitation levels, while others such as sperm, fin and possibly sei whales are also still significantly reduced.[6]

Since the moratorium was agreed, the intensification of human activities has wrought unprecedented changes to the marine environment upon which cetaceans depend.[7] The survival of cetacean populations is threatened by direct, indirect and synergistic impacts of these activities, for example:

- bycatch kills hundreds of thousands of cetaceans annually;[8]
- specific chemical pollutants are associated with immunosuppression and reproductive impairment and are identified as key drivers of population declines in some European small cetacean species;[9]
- cetaceans are exposed to high levels of marine debris, including microplastic pollution, with direct and indirect impacts;
- noise pollution has escalated over the past 50 years and poses both a chronic and acute threat;[10]



- ocean changes due to climate change will likely pose one of the greatest threats to cetacean populations, through ocean acidification, melting of ice sheets, changes in ocean temperature, disruption of food chains and changes in the supply and cycling of nutrients.[11]

As knowledge of these devastating impacts has grown, so has our understanding of the importance of cetaceans to marine ecosystems – as predators, prey, as detrital sources of energy in the deep sea and as vertical and horizontal vectors for nutrients.[12] For example, defecation by baleen whales is a significant mechanism for recycling iron and nitrogen, bringing it to surface waters, supporting phytoplankton blooms and thereby enhancing ocean productivity.[13] Whales also facilitate carbon export to the deep ocean and play a role in the horizontal transport of nutrients.[14]

The world's oceans are in an increasingly fragile state and there now exists even greater cause for concern – and doubt about the ability of cetacean populations to withstand direct hunting – than ever before. There is a pressing need to better protect cetacean populations from anthropogenic threats to allow them a fighting chance in the face of unprecedented environmental changes. At such a time, the role of the moratorium in protecting cetacean populations from direct commercial hunting has never been so important.

This year marks the 70th anniversary of the IWC and the 30th anniversary of the moratorium on commercial whaling, presenting an opportunity to celebrate the achievements of the past while rising to the pressing challenges of the future. This report explores some of the major environmental threats facing cetacean populations and offers recommendations to IWC Contracting Governments on future steps to expand the IWC's efforts to conserve the world's cetacean populations.

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CLIMATE CHANGE

"The rate of acidification is expected to accelerate in the coming decades, with predictions that ocean acidity could increase by about 150 per cent by 2100."

On December 12, 2015 an historic global pact was agreed by 195 nations at the UN Climate Change Conference in Paris. The Paris Agreement, which will enter into force on November 4, 2016, commits governments to strengthening the global response to climate change by keeping global temperature rise this century well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C.[15]

This year has witnessed unprecedented evidence that climate change is happening: each month of the first half of the year set a new record for that month; July and August were the two hottest months on record; and Arctic sea ice crashed to its second lowest minimum extent on record.[16] Signals of climate change can also be seen in the tropics, where the combined forces of climate change and El Niño have led to the worst mangrove die-off in recorded history, impacted kelp forests and led to the longest global coral die-off on record.[17]

Reductions in global ocean phytoplankton productivity have been observed while sea surface temperature, ocean heat content, sea-level rise and melting of ice sheets all continue to increase – and at an accelerated rate.[18] It is clear that climate change will impact multiple aspects of ocean ecosystems, from changes in ocean chemistry and the supply and cycling of nutrients through to disruption of food chains and ocean circulation, with many potential impacts on cetacean populations.[19]

Ocean acidification

The oceans act as a sink for carbon dioxide and have absorbed up to 30 per cent of all man-made emissions, resulting in a decrease in pH levels.[20] Carbon dioxide (CO_2) in our atmosphere is now at levels unmatched for 800,000 years and ocean acidity has already increased by 0.1pH, a 30 per cent change since the start of the Industrial Revolution.[21] The rate of acidification is expected to accelerate in the coming decades, with predictions that ocean acidity will increase by about 150 per cent by 2100 relative to the beginning of the industrial era.[22]

Ocean acidification disrupts the ability of calcifying organisms such as pteropods, planktonic coccolithophores and corals to build their shells. Studies forecast changes in the distribution and abundance of key species that underpin the current functioning and productivity of marine ecosystems.[23] Such changes will impact both baleen whales which directly consume plankton species, as well as odontocetes via impacts on prey species; some groups of squid, for example, are also extremely sensitive to pH.[24]

Impacts are also predicted for essential nitrogen-fixing bacteria, one of the few organisms in the ocean which fix atmospheric nitrogen and provide vital supplies of nitrogen to the rest of the food web, which in turn would trigger effects much further up the food chain.[25]

Warming oceans

The world's oceans have absorbed more than 93 per cent of the excess heat due to rising anthropogenic CO_2 emissions since the 1970s and scientists predict an increase in mean global ocean temperature of 1-4°C by 2100.[26] A range of plankton and fish species have already shifted toward the cooler poles by up to 10 degrees latitude.[27]

For marine cetaceans, ecological niches seem to be primarily defined by water temperature, depth and factors affecting the distribution and abundance of their prey, and it is estimated that the ranges of 88 per cent of cetacean species may be affected by changes in water temperature resulting from climate change.[28] Although some populations may shift their range in response to climate change, leading to changes in species interactions, others will be unable to move south or north in response to warming oceans due to factors such as habitat and prey requirements or physical barriers.

The Polar Regions

Often referred to as ground zero for climate change, air temperatures in the polar regions have been warming at about twice the average rate since the 1990s.[29] The oceans around the poles are the most productive on Earth, constituting a critical habitat for many cetacean species, both migratory and non-migratory.

As the polar regions warm, the seasonal distribution of many cetacean species may begin shifting in response, with changes to migratory arrivals and departures, reductions in the range of ice-associated species and northward range shifts. There is considerable evidence that this has already begun, with northward shifts of killer whales and potentially also sei whales and harbour porpoise.[30] Fin and humpback whales have successively shifted the date at which they arrive at their feeding grounds in the Gulf of St Lawrence by more than a day each year since 1984, due to earlier ice break-up and rising sea surface temperatures that have triggered changes in primary production.[31] Such shifts in spatiotemporal distribution will result in competition between species normally inhabiting different ecosystems (e.g. bowhead and migratory baleen whales), amplified risk of predation from killer whales and exposure to novel pathogens.[32]

Increasing temperatures and reductions in sea ice pose a particular risk to the three species of cetacean endemic to the Arctic – the narwhal, beluga whale and bowhead whale – in terms of habitat loss, potential changes in the distribution and abundance of prey and the degree of anthropogenic disturbance to populations.[33] The bowhead whale, for example, is predicted to lose almost 50 per cent of its habitat by 2100.[34] The narwhal has been identified as possibly the most vulnerable, being the most specialised of all Arctic cetaceans and highly adapted to a habitat of pack ice with only limited open water in the winter period.[35]

An additional concern in the Arctic is the increase in human activity in the region as sea ice recedes. Areas previously closed to human activity are opening, bringing enormous potential for new shipping lanes, oil and gas exploration and other activities and thus an increased risk of human-cetacean interactions in the form of bycatch, ship strikes, increased noise and chemical pollution, including a greater risk of oil spills.[36]

Krill, climate change and cetaceans

Unlike the Arctic, where a combination of *Calanus* copepods, krill and amphipods contribute to zooplankton production, a single krill species, *Euphausia superba* or Antarctic krill, forms the major link between phytoplankton and higher trophic levels in the Southern Ocean. Many apex species – fish, squid, whales, seals, penguins and other seabirds – are dependent on krill, so any change in the Antarctic krill population will have ecosystem-wide consequences.[37]

Overall, the greatest ocean warming is occurring in the Southern Hemisphere, contributing to the subsurface melting of the Antarctic ice shelves.[38] Antarctic krill are adapted to low temperature conditions which have remained stable

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ABOVE:
Beluga whale, one of three cetacean species endemic to the Arctic.

during the past 20–30 million years and are unlikely to tolerate large fluctuations in temperature; changes of 1–2°C are likely to have a significant impact on their physiology, behaviour and distribution.[39] Moreover, due to the effects of increased CO_2 on hatching rates, krill recruitment is likely to be sensitive to increasing ocean acidification, which is occurring at a greater rate in the Southern Ocean than elsewhere.[40] The combined influence of sea ice decline, ocean warming, acidification and other environmental stressors are likely to have a cumulatively negative impact on krill, reducing their abundance, distribution and life cycle.[41]

In addition to being the main food source for baleen whales and most other species in the Antarctic ecosystem and playing an important role in nutrient cycling, Antarctic krill are also the target of the largest fishery in the Southern Ocean, which takes place almost entirely in the areas where baleen whales and other predators forage.[42] Krill are harvested for livestock and aquaculture feed, fish bait and dietary supplements. Norway is currently the world's largest krill fishing nation, taking 58 per cent of the global catch from 2010-14, equating to a catch of over 165,000 tonnes in 2014.[43]

More than 50 per cent of Southern Ocean krill stocks are located in a productive south-west Atlantic area, a key nursery habitat and feeding ground for krill which is subject to the fastest rates of warming and sea ice loss.[44] Significant declines in krill density have been observed in this area since the 1970s, correlating with trends in the duration and extent of sea ice.[45] Such changes have profound implications for the food web in the Southern Ocean, with both the wide spatial extent and magnitude of the change in krill density affecting seabird and marine mammal predators.[46]

As the duration and extent of sea ice in the Antarctic contracts, Antarctic minke whales are expected to lose 5-30 per cent of ice-associated habitat in the Antarctic by the time temperatures reach 2°C above pre-industrial levels.[47] Migratory species, such as humpback, blue, sperm and fin whales, will have to travel further to reach the Southern Ocean fronts where they forage. Given that these species migrate and breed on finite energy stores accrued during summer foraging in the Antarctic, changes in sea ice and concomitant changes in krill abundance have long-term implications for their condition and reproductive success.[48] Sea surface temperatures have already been linked to breeding success in southern right whales, likely due to a complex relationship between breeding performance and krill availability, demonstrating that even small changes in oceanographic conditions in the Southern Ocean can affect cetacean population dynamics.[49]

Baleen whales in Antarctica exist for the most part at fractions of their former abundance and their future status will be determined by their ability to adapt to longer-term environmental change.[50] With increasing commercial fishing pressure on krill populations and dire warnings that the Southern Ocean krill population could collapse by 2300 unless CO_2 emissions are mitigated, there are grave concerns for the future status of these species.[51]

MARINE DEBRIS

Marine debris is now widely recognised as a major threat to marine biodiversity.[52] Research on this issue is a rapidly evolving field; however, action to prevent ongoing inputs into the marine environment appears to be developing less expeditiously. Plastics form the vast majority of marine debris and the predominant component of items collected in coastal clean-ups is packaging – single-use materials designed for short-term use and immediate disposal.[53]

Recent estimates of plastic waste inputs from land indicate that 275 million tonnes (MT) of plastic waste was generated in 192 coastal countries in 2010, with 4.8–12.7 MT entering the ocean each year. In simple terms, this is the equivalent of dumping the contents of a full rubbish truck into the ocean every minute.[54] Without reductions in consumption and improvements in waste management, the cumulative quantity of plastic entering the ocean from land is predicted to increase by an order of magnitude by 2025, such that in a business-as-usual scenario the ocean is expected to contain one tonne of plastic for every three tonnes of fish by 2025 and more plastics than fish by 2050.[55]

Floating debris is accumulating in the convergence zones of the five subtropical gyres but much higher quantities are found on the sea floor, where an estimated 94 per cent of plastics entering the ocean end up.[56] It is estimated there is now on average 70kg of plastic in each square kilometre of sea bed, with certain areas of the seafloor likely forming focal points for litter due to topography, currents, fishing grounds or shipping lanes.[57] Deep-sea sediments and polar sea ice have been identified as sinks for microplastics, the latter now representing a significant source of microplastics that may be released back into the ocean as sea ice melt increases with climate change.[58]

Impacts on cetaceans

Ingestion of marine debris has been documented in at least 48 cetacean species. Rates of ingestion reach up to 31 per cent in some populations, demonstrating the high level of exposure to marine debris.[59] In some cases, ingestion can be clearly linked to internal injury or mortality but in others such evidence is lacking. Notable recent examples include: a Longman's beaked whale which stranded in India and was presumed to have been killed by the ingestion of four plastic bags; a sperm whale that had ingested 134 different net types of up to 16m^2; and a Cuvier's beaked whale that ingested 378 items with a collective weight of 33kg.[60] In the recent sperm whale strandings in the North Sea, marine debris, although not responsible for mortality, was found in nine of the 22 dissected individuals, comprising netting, ropes, foils, packaging material and even a part of a car.[61] Entanglement in ghost gear is also a threat in some areas, such as the entanglement of bowhead whales in lost pot gear in the Bering Sea.[62]

Understanding the impact of such incidences at a population level remains an important priority. While individual strandings provide important insights into the physiological impacts of debris, there is a clear need to incorporate marine debris into standard stranding protocols to better understand the consequences for populations.[63]

In addition to the threat posed by larger plastics, microplastics pose an emerging threat to many marine species. Cetacean-focused studies have primarily concentrated on the Mediterranean fin whale, finding they could potentially consume more than 3,600 microplastic particles per day, along with adsorbed and component persistent, bioaccumulative and toxic (PBT) chemicals. Studies have demonstrated that Mediterranean fin whales show a temporal increase in toxicological stress correlated with feeding in areas contaminated with high densities of microplastics.[64] Moreover, high concentrations of PBT chemicals, plastic additives and biomarker responses were detected in the biopsies of Mediterranean fin whales compared to whales inhabiting the Gulf of California, where microplastic densities are lower. Thus it has been concluded that exposure to microplastics from both direct ingestion and consumption of contaminated prey poses a threat to the health of fin whales in the editerranean Sea.[65]

"Recent estimates suggest that 4.8-12.7 million tonnes of plastic waste enter the ocean each year, this is the equivalent of dumping the contents of a full rubbish truck into the ocean every minute."

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CHEMICAL POLLUTION

"Without significant mitigation, PCBs will continue to drive population declines and supress recovery of cetacean populations in Europe for many decades to come."

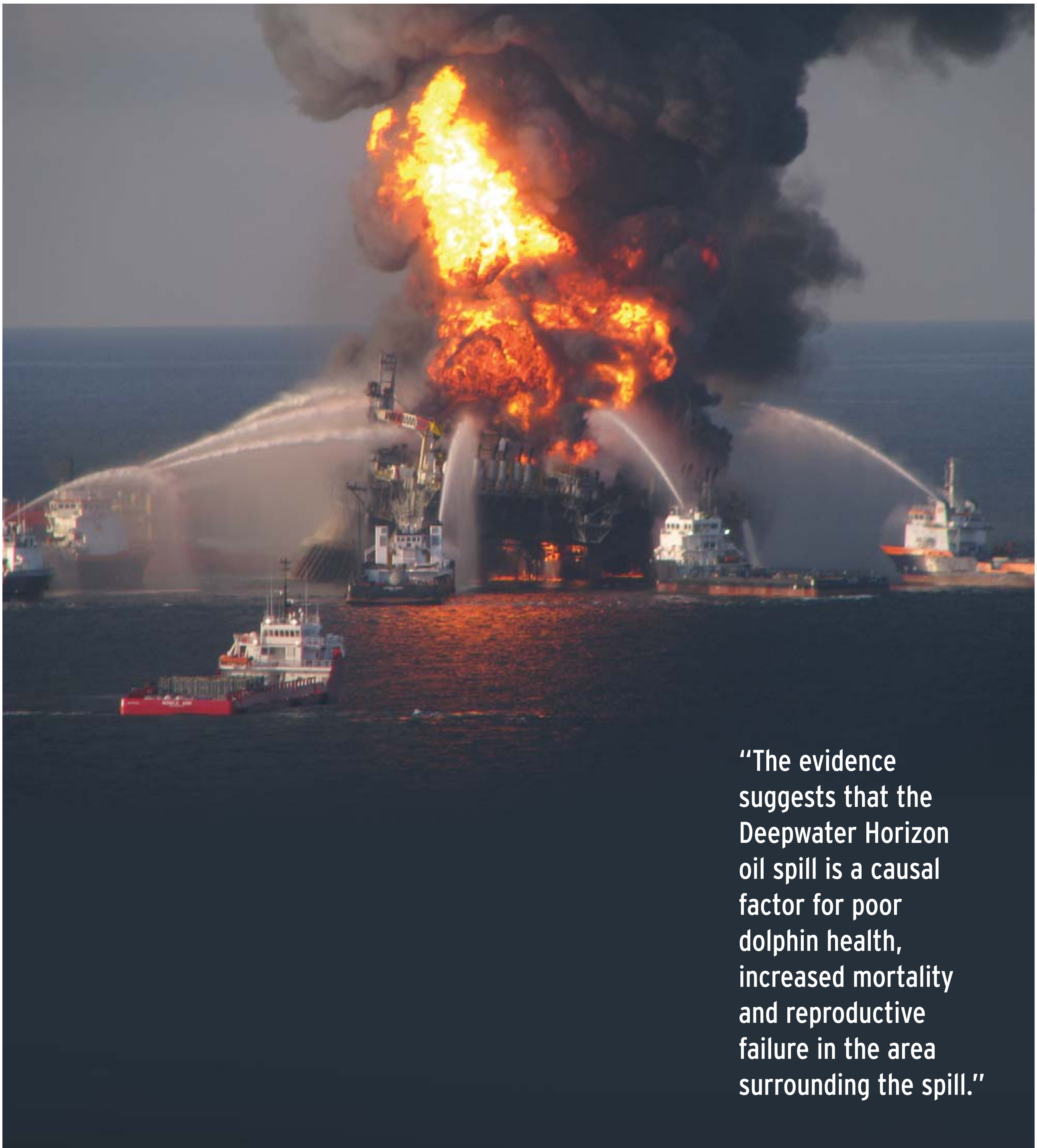
Waste from innumerable human activities enters the oceans from freshwater, air and terrestrial sources. Eighty per cent of chemical pollutants originate from land, often from agricultural, urban and industrial sources far upstream of coastline habitats.[66] Through a process of biomagnification, many contaminants become increasingly concentrated at higher levels of the food chain. Many cetacean species are long-lived apex predators and can accumulate high levels of contaminants. Their long lactation period also means that high concentrations can be passed from mother to calf. Compelling evidence now indicates that a particular group of pollutants, polychlorinated biphenyls (PCBs), has played a major role in cetacean population declines across Europe and, potentially, globally.

A toxic legacy: Persistent Organic Pollutants

Persistent organic pollutants (POPs) primarily originate from industrial and agricultural uses and include chemicals such as PCBs and organochlorine pesticides. Experimental studies have established a range of toxic effects of PCBs in mammals, including immunosuppression and reproductive impairment; however, the true scale and longevity of the impact on cetacean populations has only recently become apparent. Numerous studies have also demonstrated uptake and maternal transfer of other POPs such as pyrethroid insecticides and even sunscreen agents.[67]

Strandings and biopsy data from the Mediterranean and Western Europe demonstrate that, despite being banned for over 30 years, levels of PCBs continue to have significant negative effects on cetacean populations, with recorded levels in killer whales, striped dolphins and bottlenose dolphins markedly exceeding cetacean toxicity thresholds.[68] Whereas killer whales and other dolphin species were once widespread in Europe, there are now multiple small or declining populations which demonstrate low recruitment, consistent with PCB-induced reproductive toxicity. The subpopulation of killer whales in the Strait of Gibraltar (a PCB hotspot) has one of the lowest recorded reproductive rates globally and is assessed as critically endangered, whilst the killer whale population off north-west Scotland has had no calves recorded for over 19 years. In harbour porpoises, which have PCB levels 10 times lower than those found in North Atlantic killer whales, PCB levels are a predictor of reproductive failure in females and poor health status in both sexes.[69]

Across Europe, the highest levels of PCBs are associated with small populations that show evidence of a significant contraction of range and major declines since the 1960s, as well as low or zero rates of reproduction. The findings are consistent with PCB-induced reproductive toxicity and are unlikely to be restricted to Europe. Without significant mitigation, PCBs will continue to drive population declines and suppress recovery of cetacean populations in Europe for many decades to come.[70]



DEEP-WATER HORIZON: OIL SPILL IMPACTS ON CETACEANS

In 2010, an estimated 3.19 million barrels of oil were released into the Northern Gulf of Mexico following the explosion of the Deepwater Horizon oil rig.

Extensive monitoring has shown that nearly all cetacean populations within the oil spill footprint demonstrated direct impacts. In the initial post-spill study period of 2011, the highest and most sustained dolphin-stranding rates ever recorded in Louisiana were documented (more than 1,300 animals) in the regions which received heavy and prolonged oil contamination.[71] Studies identified rare, life-threatening and chronic adrenal gland and lung diseases in stranded dolphins, consistent with exposure to petroleum compounds.

Reproductive impacts were also documented; live dolphins from heavily oiled estuaries showed low reproductive success and stranded animal studies confirmed a high rate of perinatal loss within the oil spill footprint.[72] The evidence suggests that the Deepwater Horizon oil spill is a causal factor for poor dolphin health, increased mortality and reproductive failure in the area surrounding the spill, resulting in a reduction in population of up to 51 per cent.[73]

INTERACTIONS WITH FISHERIES

Bycatch in fisheries is one of the primary direct threats to whales, dolphins and porpoises worldwide.[74] At the same time, commercial fisheries have dramatically altered the structure and functioning of marine ecosystems through depletion of fish stocks and habitat degradation.[75]

The majority of cetacean bycatch occurs in gillnet (entangling net) fisheries; however, trap, trawl and purse seine fisheries also cause entanglement.[76] The 1990 IWC Workshop on the Mortality of Cetaceans in Passive Fishing Nets and Traps highlighted urgent action for a number of species and populations, including the baiji, which is now considered to be extinct, and the vaquita, which will be extinct within a few years unless bycatch in gillnets is completely eliminated (see p10 'Dual Extinction').[77]

Many cetacean populations are currently threatened by unsustainable levels of bycatch including, but not limited to, populations of harbour porpoise in the Baltic Sea and the Black Sea; the franciscana, dusky dolphins, Chilean dolphins and Commerson's dolphins in South America; Hector's dolphins in New Zealand; J-stock minke whales in Japan and South Korea; Indo-Pacific and humpback dolphins off the coast of South Africa and Tanzania; common and striped dolphins in Peru, Ecuador, the Mediterranean and potentially other parts of the European Atlantic; North Atlantic right whales off the east coast of the US; sperm whales in the Mediterranean; and populations of finless porpoises and river dolphin species in Asia.[78] Urgent action is needed to better address this threat as well as improved monitoring of the efficacy of mitigation methods, quantification of bycatch rates and the status of populations.

Global declines in fish stocks are well-documented and there is clear potential for prey depletion to also impact cetacean populations, in some cases contributing to population declines and in others causing cetacean species to switch to alternative prey or alter their distribution.[79] In the Mediterranean, studies have indicated that the local decline of common dolphins is consistent with prey depletion resulting from intensive exploitation of local fish stocks.[80] In the Gulf of Maine, declines in fish stocks caused changes in the dominant species: humpback and fin whales were replaced by plankton-eating right and sei whales; harbour porpoises moved nearer shore; Atlantic white-sided dolphins became abundant and white-beaked dolphins rare.[81] Such examples, drawn from well monitored populations, demonstrate that prey-depletion can cause population declines and shifts in spatiotemporal distribution and underline the need for adequate monitoring in order to detect and mitigate fishery impacts.

DUAL EXTINCTION

The critically endangered vaquita is the world's smallest cetacean and the most threatened marine mammal.[82] Between 2011-15, the vaquita population decreased by an estimated 80 per cent as a result of bycatch in gillnets, set illegally to capture the large and endangered totoaba fish. Fewer than 60 vaquitas remain and the species is on the brink of extinction.[83]

The immediate threat to the survival of the vaquita is illegal gillnet fishing to supply the trade in dried totoaba swim bladders, which fetch high prices in Hong Kong and mainland China.[84] In 2015, the Mexican Government announced a strategy to save both the vaquita and the totoaba, involving a two-year gillnet exclusion zone covering the area of vaquita distribution, financial compensation to fishermen and the allocation of considerable resources to surveillance and enforcement.[85] A number of seizures of illegal gillnets and totoaba swim bladders were made but illegal fishing for totoaba continued in 2015 and 2016, particularly during the legal corvina fishing season.[86] In March 2016, three dead vaquita were found, all due to entanglement in gillnets.[87]

Additional protection measures were announced in July 2016, including a permanent ban on entangling nets that affect the vaquita, a ban on night fishing and a restriction on the docks fishermen can use in order to aid enforcement. These measures, if fully implemented with a complete ban on all gillnets, even if used for other fishing methods, give the vaquita hope of survival.[88] However much more also needs to be done to effectively enforce against totoaba smuggling and sales, especially in the main consumer markets in China.

In June 2016, the IWC's Scientific Committee stated: "***The choice is simple and stark:*** *either gillnetting in the Upper Gulf ends or the vaquita will be gone – the second entirely preventable cetacean extinction that the Committee will have witnessed in the last 10 years.*"[89]


Vaquita killed in gill-net.


Dried totoaba swim bladders observed during EIA investigations in Guangzhou, China, November 2015.

SHIP STRIKES

In recent decades, there has been rapid increase in shipping, other maritime traffic and vessel speeds, leading to a rise in both noise pollution and ship strikes.[90] As a result, mortality and injuries of cetaceans from ship strikes have become an important conservation issue, with the majority of incidents involving large cetaceans.

The rates at which collisions occur are typically unknown; however, there are some areas where they clearly pose a conservation threat to species or populations. These hotspots include the population of blue whales off the south coast of Sri Lanka, sperm whales in the Canary Islands and the Hellenic Trench, Bryde's whales in the Hauraki Gulf, New Zealand and North Atlantic right whales off the east coast of the United States.[91]

The IWC has reviewed technological, operational and educational solutions including speed restrictions, routing measures and real-time alerts. Such measures have been employed for critically endangered North Atlantic right whales, which have an estimated population of just 465 individuals. At least 38 per cent of confirmed right whale deaths from 1985-2005 were due to ship collisions.[92] Mandatory 10 knot speed restrictions in several 'Seasonal Management Areas' along the Atlantic coast of the US have been an effective mitigation tool in reducing the rate of ship strikes.[93]

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NOISE POLLUTION

Cetaceans live in a world of sound, using acoustics to perform vital activities in their life cycle including communication, mating behaviours, locating prey and predators and navigation.[94] As the quantity and level of anthropogenic sound increases in our ocean, so the ability of cetaceans to perform these key tasks is affected, with impacts ranging from chronic stress, deafness, increased energy expenditure, habitat displacement and reduced communication range through to mortality.[95] Key sources include sonar, seismic surveys and shipping as well as pile-driving, drilling and dredging.

Sonar: a deadly threat

Over the past few decades, mass strandings of cetaceans associated with mid-frequency naval sonar have raised conservation concerns, particularly given that known strandings likely represent a small proportion of unobserved mortalities at sea.[96] Strandings associated with sonar have largely, but by no means exclusively, involved beaked whales. Common pathologies including the formation of ‘gas bubble lesions’ similar to those seen in decompression sickness in humans.[97]

Despite the difficulties inherent in demonstrating causation, there are multiple incidences where naval activity was identified as the most probable cause of mass strandings, including a stranding of 16 whales of three species in the Bahamas in 2000, at least eight mass strandings of beaked whales around the Canary Islands and the UK’s largest mass stranding event of short-beaked common dolphins, in which at least 26 dolphins died and a similar number were refloated.[98] Other incidents have indicated that such impacts are not restricted to mid-frequency sonar; a mass stranding of 100 melon-headed whales in Madagascar was triggered by a multi-beam echosounder system, the first known marine mammal mass stranding event of this nature to be closely associated with high-frequency mapping sonar systems.[99]

Seismic surveys

Seismic surveys for oil exploration utilise arrays of air guns that create a powerful sound wave able to penetrate miles beneath the sea floor. They can operate over areas of more than 35,000km^2 for more than a month, exposing cetacean populations to chronic noise pollution.[100]

Many cetacean species have shown strong avoidance responses, leaving the seismic survey area even when not in the near vicinity of the survey vessel. For example, harbour porpoises show apparent avoidance responses over 70 km from the airguns and fin whales have been observed to move away from the airgun array source and out of the detection area, with displacement persisting well beyond the duration of seismic airgun activity.[101]

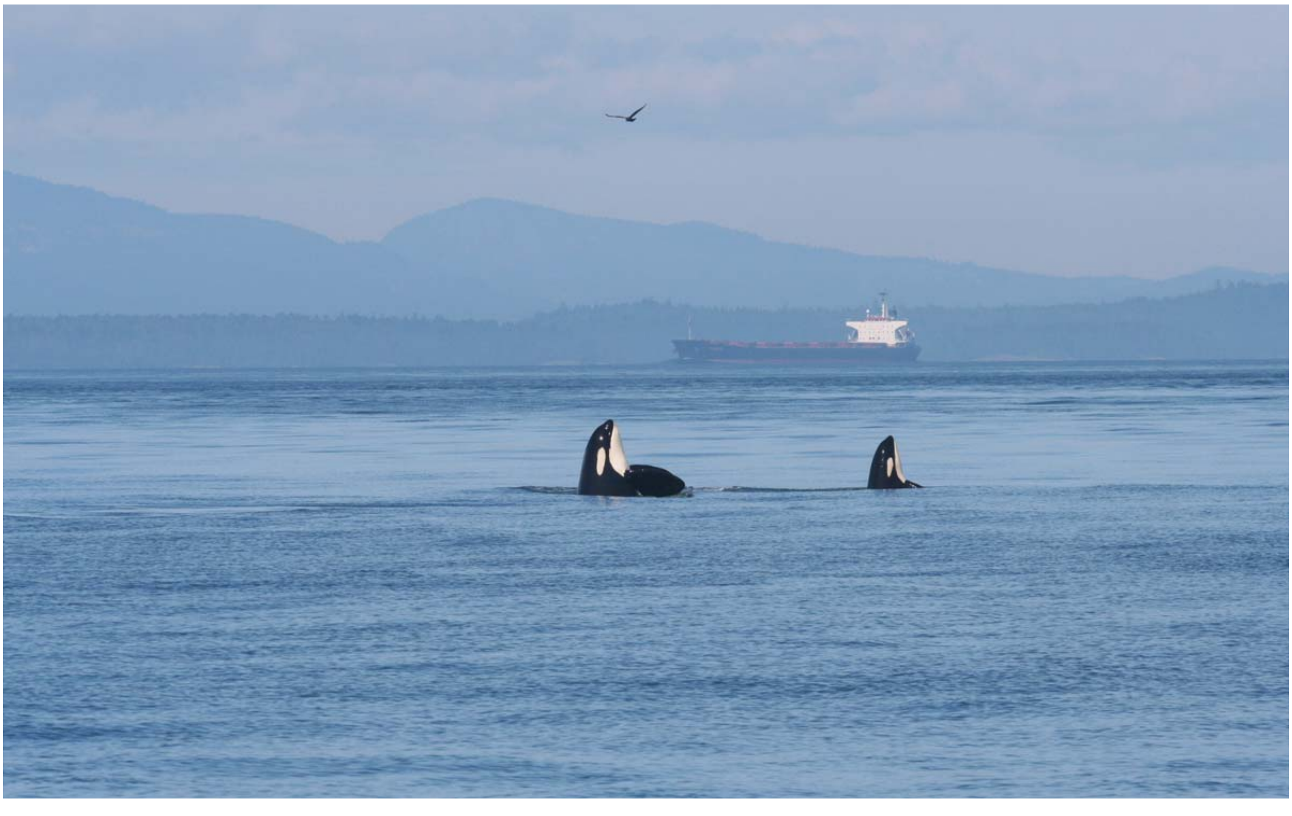
Recent modelling exercises indicate that seismic surveys also mask communication, with air gun noise likely changing from impulse to continuous noise between 1,000-2,000km from the source, reducing communication ranges for species such as blue and fin whales as far as 2,000km from the source.[102] Although mitigation measures, such as the use of marine mammal observers and ramp-up procedures may be employed, issues with detection probability and range limit their effectiveness, particularly with regards to mitigating impacts from chronic noise.[103]

Shipping

Ninety per cent of global trade is transported by sea, with shipping likely the most constant and ubiquitous source of noise pollution in the marine environment. Shipping noise tends to be low frequency in nature, overlapping with the low frequency communications of many species of baleen whales.[104] There is great potential for shipping noise to 'mask' a number of important behaviours, including foraging, communication, migration, finding a mate and predator detection.[105] This is of particular concern for endangered species that have crucial habitats overlapping with areas of high anthropogenic activity and for species which likely communicate over enormous distances (e.g. blue and fin whales).[106] Low frequency ship noise has also been associated with chronic stress in the endangered North Atlantic right whale, with implications for population recovery.[107]

BELOW:
Beaked whales appear to be particularly vulnerable to sonar-induced strandings.

BOTTOM:
Endangered southern resident killer whales observe an oil tanker passing through their critical habitat.



CONCLUSIONS AND RECOMMENDATIONS

In recent decades, the IWC has significantly expanded its work to examine non-hunting anthropogenic threats to cetaceans.

Within the Scientific Committee this has included the establishment of the Small Cetaceans Sub-Committee in 1979, the Standing Working Group on Environmental Concerns in 1996 and the Working Group on Estimation of Bycatch and Other Human-Induced Mortality in 2001 (now known as the Working Group on Human-Induced Mortality).[108]

In 2003, the IWC established a Conservation Committee which considers a number of current and emerging cetacean conservation issues, including ship strikes, whale watching, the development of Conservation Management Plans (CMPs) for at-risk cetacean populations and a joint programme with the Scientific Committee to consider the impact of marine debris on cetaceans. IWC Workshops have been held on a wide range of environmental issues, including chemical pollution, marine debris, climate change, noise pollution, Arctic cetaceans and marine activities, strandings response and global entanglement response.

Several key initiatives have been established, including: the Pollution 2000 (and thereafter a 2000+ and 2020) programme – a comprehensive research programme which initially focused on examining the impact of PCBs; the Small Cetaceans Voluntary Fund, which has funded over 15 small cetacean research and conservation projects around the world; a ship strikes database, now being used to gather data and build understanding of where and why collisions occur between whales and ships; and the global entanglement response network, which in just five years has delivered training to more than 500 representatives from over 20 countries.[109]

Through such initiatives, the IWC has made a huge contribution to the advancement of scientific understanding of the impacts of anthropogenic activities on cetacean populations and the development of mitigation actions. The initiatives have been especially successful where there has been sustained financial investment and the allocation of a staffed coordinator role.

It is abundantly clear that cetacean populations worldwide are facing ever-increasing threats as a result of human activities and it is essential that the IWC remains at the forefront of efforts to better understand and address such threats. EIA calls upon the IWC and its Contracting Governments to prioritise this work, increase support for existing initiatives and, in line with recommendations from the Scientific Committee and IWC workshops in the 2015-16 biennial period, to consider the following:

- Increased efforts to expand the IWC's coordination with other intergovernmental organisations in line with Resolution 2014-2 on Highly Migratory Species, including with:
  - The IMO on ship strikes, marine debris and chemical pollution;
  - The FAO on bycatch and ghost gear;
  - The UNFCCC, CCAMLR and the Arctic Council on climate change impacts and monitoring of Antarctic and Arctic ecosystems and cetacean populations;
  - The Stockholm Convention on PCB pollution of the marine environment;
  - The Convention on Migratory Species and its relevant subsidiary agreements;
  - The United Nations Environment Programme, UN Global Partnership on Marine Litter and the UN Open-Ended Informal Consultative Process on Oceans and the Law of the Sea on marine debris.
- Development of CMPs for additional populations, including those species identified as priority candidates by the Scientific Committee - Arabian Sea humpback whales, common minke whales in the coastal waters of China, Japan (especially the west coast) and Republic of Korea, North Atlantic right whales, blue whales in the northern Indian Ocean, fin whales in the Mediterranean, sperm whales in the Mediterranean, North Pacific right whales and the franciscana;[110]
- Development of a dedicated work-stream on bycatch under the Conservation Committee in coordination with the Scientific Committee;
- The establishment of an expert panel and coordinator to assist in the development of a national strandings response network in order to improve investigation of the causes of strandings and rescue responses;
- Continued support for the Small Cetacean Task Team initiative and adoption of the approach for other species or populations as appropriate;
- A review of the data fields in National Progress Reports and voluntary national reports on cetacean conservation to recommend changes that will allow the Scientific Committee and Conservation Committee to better quantify the impacts of specific threats and responses to them;
- Development of a database of IWC Scientific Committee and Conservation Committee recommendations to assist in tracking progress in their implementation;
- Support for Draft Resolution IWC/66/15 on Cetaceans and Ecosystem Services which seeks to incorporate the consideration of ecosystem services into the conservation and management work of the IWC;
- Support for Draft Resolution IWC/66/14rev on Minamata Convention with the additional specification that all research should be non-lethal research. The Resolution seeks to expand collaboration between the IWC and the Minamata Convention and gather information on mercury levels in stranded cetaceans to identify potential areas of environmental concern;
- Maintenance of strong support for the moratorium on commercial whaling, oppose efforts to undermine the moratorium and any establishment of whale catch limits and call on Japan, Norway and Iceland to permanently end all commercial and Special Permit whaling operations.

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