Annex K

Report of the Standing Working Group on Environmental Concerns

Members: Moore, S. (Convenor), Andriolo, Baba, Baldwin, Baulch, Bell, Betancourt, Bickham, Bjørge, Brandon, Bravington, Broker, Brownell, Butterworth, Caballero, Campbell, Castro, Charrassin, Chilvers, Cipriano, Cooke, Cosentino, de la Mare, Deimer-Schüette, Di Guardo, Donovan, Double, Elvarsson, Feindt-Herr, Fortuna, Fossi, Funahashi, Gales, Gallego, Hakamada, Hammond, Hernandez Mora, Hiruma, Holm, Ilyashenko, Iñíguez, Jaramillo-Legorreta, Jérémie, Kanda, Katsuyama, Kim, Kitakado, Kock, Konishi, Lang, Lauriano, Leaper, Lens, Leslie, Marcondes, Marquez, Mate, Mattila, Murase, New, Nuñez, Øien, Okamura, Oviedo Correa, Palacios, Palka, Panigada, Parsons, Pastene, Podestá, Punt, Reeves, Ridoux, Ritter, Robbins, Rojas-Bracho, Rosa, Rose, Rosenbaum, Sakamoto, Scheidat, Scordino, Simmonds, Sironi, Slooten, Stachowitsch, Stimmelmayr, Suydam, Tajima, Taylor, Thomas, Trejos, Uozumi, Urbán, Vermeulen, Víkingsson, Wade, Walløe, Weller, Williams, Wright, Yamada, Yasokawa, Ylitalo, Zerbini, Zhmaev.

1. CONVENOR'S OPENING REMARKS

Moore welcomed the participants to the Standing Working Group on Environmental Concerns (SWG).

2. ELECTION OF CHAIR

Moore was elected Chair.

3. ADOPTION OF AGENDA

The adopted Agenda is given in Appendix 1.

4. APPOINTMENT OF RAPPORTEURS

Ylitalo and Rosa were appointed rapporteurs.

5. REVIEW OF AVAILABLE DOCUMENTS

SC/64/E1-E15, Moore *et al.* (2012a; 2012b), Simmonds and Brown (2010), Fossi *et al.* (2012), Panti *et al.* (2011), Galgani *et al.* (2010), Mannocci *et al.* (2012) and IWC/64/CC10.

6. SOCER: RECEIVE THE STATE OF THE CETACEAN ENVIRONMENT REPORT

The SOCER provides an annual update, requested by the Commission, on: (a) environmental matters that potentially affect cetaceans; and (b) developments in cetacean populations/species that reflect environmental issues. It is tailored for a non-scientific audience. The 2012 SOCER (SC/64/E2; see Appendix 4) was restricted to the Indian Ocean as the regional focus. A primary source of information was the International Indian Ocean Cetacean Symposium, held in 2009 on the Maldives. Some papers from the symposium will be published in an upcoming volume of the *Journal of Cetacean Research and Management*. Other information will be placed on the Maldivian Marine Research Center website (*http://www.mrc.gov.mv*). Overall, the awareness of environment-related threats to cetaceans is high, but implementation and control measures are very poor. Many problems are common to cetaceans worldwide. This provides an opportunity to introduce best practices, state-of-the-art procedures for critical issues such as fisheries interactions, ship strikes, whalewatching, and new, well-thought-out Marine Protected Areas.

During discussion, it was noted that marine research in the Indian Ocean region, despite having expanded substantially over the past five years, is focused in a few specific locations. Cetacean, or indeed environmental, research is scant or absent in many areas and there are very few peer-reviewed reports from the region. There are clearly hotspots in terms of pollution, fisheries bycatch and environmental degradation in the Indian Ocean (e.g. Arabian Gulf). Reports of mass mortality events (152 small cetaceans in September 2007 and 200-250 March 2009) on the northern coast of the Indian Ocean are particularly concerning.

The SWG thanked the SOCER editors for compiling this year's report. Next year the focus of the SOCER will be on the Atlantic Ocean region. The SWG noted that, without funding from the IWC, the editors of SOCER will not be able to produce the breadth of overview, including a global section, as has been produced in the past. It was noted that the production of the SOCER is a request of the Commission and a lack of funding will impede the fulfilment of this mandate.

7. POLLUTION

7.1 Update on POLLUTION 2000+ Phase II progress

At the intersessional POLLUTION 2000+ Phase II Workshop held in February 2010 (IWC, 2011a), four objectives for the cetacean pollutant exposure and risk assessment modelling component were agreed, including:

(1) improve the existing concentration-response function for PCB-related reproductive effects in cetaceans (completed in 2011);
(2) derive additional concentration-response functions to address other endpoints (e.g. survival, fecundity) in relation to PCB exposure;
(3) integrate improved concentration response components into a population risk model (individually-based model) for two case study species: bottlenose dolphin and humpback whale (completed in 2011); and
(4) implement a concentration-response component for at least one additional contaminant of concern.

The authors of SC/64/E5 investigated how contaminant-induced effects on immune function could also be incorporated into the existing individual-based population framework constructed to assess the impact of polychlorinated biphenyls (PCBs) on cetacean populations (Objective 2 above). The first iteration of the population model, presented to the SWG in 2011 (IWC, 2012a), used an individual-based population framework to investigate the impact of maternal blubber PCB concentrations on calf survival probability and how this may affect the potential population growth rates of two case studies species, common bottlenose dolphin (*Tursiops truncatus*) and humpback whales (*Megaptera novaeangliae)*. Concentration-response

relationships based on studies in mink as a surrogate model species were incorporated and the model simulation outputs indicated the level of annual PCB exposure and accumulation likely to affect the potential population growth rates.

The effects of PCBs on the immune system was selected for the model, after a thorough review of the literature found a number of studies associating increased PCB exposure with reduced immune function for mammals, including both seals and cetaceans. However, only one study by the National Toxicology Program (NTP), carried out in the early 1990s (Luster *et al.*, 1993) on mice, provided an opportunity to *quantitatively* link immune function assays to decreased host resistance and thus reduced survival probability. Of the wide range of immune function assays reported, only T-lymphocyte proliferation, in response to stimulation with a mitogen known as Concavalin A (Con A), was used in both the NTP study and in a study on the impacts of PCBs on wild bottlenose dolphins (Schwacke *et al.*, 2011). Nonetheless, these two studies allowed the conversion of PCB-induced immune suppression in common bottlenose dolphins to impacts on survival following exposure to a pathogen.

In this model, the effect of additional immune impacts on potential population growth of bottlenose dolphins was investigated after additional concentration-response relationships were established. Following model simulations, when 10% of the population were exposed each year to a class 2 pathogen with similar pathogenicity and virulence to *Listeria monocytogenes* (used in the mouse model experiments), significant effects on the population's growth were seen at an annual PCB accumulation in the blubber of the dolphins of >1mg/kg. When a more virulent and pathogenic organism such as the *Streptococcus pneumoniae* used in the mouse experiments was included, effects were seen at annual accumulations of <0.5mg/kg.

Further model simulations found that at lower annual accumulations (<1mg/kg), exposing 20% of the animals each year to the less virulent bacteria caused a long-term decline in dolphin population growth. However, when 10% or 20% of the dolphins were exposed each year, impacts at the population level were seen only when annual accumulation concentrations were >2mg/kg. At the lowest pathogen encounter of 5% of the animals, effects were not seen until annual accumulation rates reached 3mg/kg. This represents a further 0.3% to 3% decrease in potential population growth, depending on the proportion of the population exposed each year, and the annual accumulation rate (i.e. degree of contamination in the prey), compared to a model with only effects on calf survival.

By determining how the blubber PCB annual accumulation rates relate to concentrations in breeding females (available as an output from the model simulations), comparisons with empirical data can be made and predictions about effects on various populations formulated. For example, based on the current blubber PCB concentrations determined in breeding females from two common bottlenose dolphin populations in Sarasota Bay and St Joseph Bay, Florida (Schwacke *et al.*, 2011; Wells *et al.*, 2005) the model suggests that these populations would remain stable or increase slightly over the 50-100 year timescales projected, but that the bottlenose dolphin population in Brunswick, Georgia, where levels in breeding females were 10 times higher, would decline over the same period without external population inputs through immigration.

In the future, impacts on other populations and species, such as humpback whales from the Gulf of Maine will be investigated, as they were included in the previous simulations (Hall *et al.*, 2011), as additional contaminant data for females become available. In addition, future developments of this model will include a sensitivity analysis; incorporation of a bioaccumulation model to estimate blubber concentrations for populations or species in which only levels in prey are known; and making the model available online with a user-friendly interface.

During discussion, the SWG noted that body condition of cetaceans may have a significant effect on susceptibility to impacts from contaminant exposure. For example, body condition could affect immune function independently so when food is limited and animals are in poor condition with low energy reserves this will further affect their ability to fight off pathogens. Furthermore, if PCBs are released from the blubber during periods of increased energy demand then more may be bioavailable. Although the current model does not account for body condition, the final phase of the project will incorporate a toxicokinetic model that will include body condition parameters. This would be a similar approach to that taken by Hickie *et al.* (1999) which models the uptake and release of contaminants, such as PCBs, over the lifetime of the animal. Such a model would incorporate growth, uptake from food and milk and deposition of the compounds into different tissues and losses by metabolism and excretion. For mature females it would include changes during pregnancy, birth and lactation.

The SWG recognised that cetaceans are exposed to a mixture of environmental contaminants and suggested that, if possible, mixtures of contaminants should be added to the model. Due to the extremely high levels of PCBs measured in the Brunswick, Georgia, common bottlenose dolphin population, the SWG **recommended** the continued monitoring of this dolphin population.

The SWG emphasised the importance of *in vitro* studies aimed at assessing the immunotoxicity of environmental pollutants as compared to *in vivo* studies. The latter, however, have the limitation of making it very difficult to 'dissect' the pathogenic effects of a single compound, given that under 'field conditions' a mixture of different substances is generally found in animal tissues. On the other hand, *in vitro* studies are far from recapitulating the intrinsic biological complexity of a whole living organism. As far as the immunotoxicity of environmental contaminants is specifically concerned, it was noted by the SWG that a number of issues could benefit from research being carried out in this area. These issues include the mode of action and the effects of immunotoxic contaminants in T-helper (Th)-1 versus Th-2 dominant individuals, as well as the effects of such compounds in age-related thymic involution, which could be of relevant concern in relation both to host susceptibility to a number of infectious/biological pathogens and to the pathogenic behaviour of these agents inside the host. The SWG **commends** the authors for their results presented on Pollution 2000+ Phase II objectives and **strongly supports** their continued work to develop the necessary tools to assess cetacean pollutant exposure risk.

7.2 Oil spill impacts

7.2.1 Update on response to Deepwater Horizon oil spill in the Gulf of Mexico

Ylitalo provided an update on the 2010 Deepwater Horizon (DWH) oil spill in the Gulf of Mexico. The injury assessment for cetaceans in the Gulf of Mexico after the DWH spill is continuing. The Natural Resource Damage Assessment (NRDA), a formal process in the US to assess damages to natural resources, has involved photo-identification, remote

biopsy, live capture health assessments and evaluation of stranding data for common bottlenose dolphins in nearshore waters. As part of the NRDA, live-capture release studies of bottlenose dolphins were completed in two geographic areas of the Gulf of Mexico: Barataria Bay, Louisiana, an area that was heavily oiled, and Sarasota Bay Florida, which received no oiling from DWH. Comparisons of the results of the Barataria Bay dolphin health assessment (2011) with those in Sarasota Bay (2011; 2010) found that the dolphins in Barataria Bay are showing signs of being in poor health. Data from the comprehensive physical examinations of 32 live dolphins from Barataria Bay show that many of the dolphins are underweight, anemic, have low blood sugar, and some signs of liver and lung disease. Nearly half also had abnormally low levels of hormones such as cortisol and aldosterone. These issues were not found in the 27 dolphins evaluated from Sarasota Bay.

In addition to the NRDA, an Unusual Mortality Event (UME) is ongoing in the northern Gulf of Mexico (Franklin County, Florida to the Louisiana/Texas border) principally involving common bottlenose dolphins[1]. The UME involved 745 cetacean strandings in the northern Gulf of Mexico from 1 February 2010 through 10 June 2012. The historical average (2002-09) for this area is 74 dolphins per year. The vast majority (95%) of stranded dolphins have been found dead, 35 have stranded alive and seven were taken to facilities for rehabilitation. However, stranding rates in the northern Gulf in April and May 2012 were near-average with the highest stranding numbers in Louisiana. The UME is still ongoing.

Although it is typical to see strandings of dolphins less than 115cm (perinates) in the spring, there was a significant increase in strandings of this younger age class in spring 2011. Of these perinatal dolphin strandings, most were found to have died *in utero*. Twelve of 51 cases targeted for testing were positive for *Brucella* and eight cases so far were confirmed to have died of brucellosis. Compared to 2011, the strandings of perinatal dolphins were lower during the spring of 2012. Currently *Brucella* testing is continuing in perinates (primarily in lung and lung-associated lymph nodes) and all animals showing pathological signs of bacterial infections. While the majority of perinatal strandings were in Mississippi and Alabama, strandings among all age classes were high throughout 2011 in Alabama, Mississippi and Louisiana. To help determine the potential reproductive effects of the spill on bottlenose dolphins from the Gulf (e.g. Barataria Bay, Louisiana and Mississippi Sound, Mississippi), studies to determine inter-year pregnancy rates, foetal/perinate mortality comparisons and survival of live calves are currently underway. The US National Oceanic and Atmospheric Administration (NOAA) is working with a team of marine mammal health experts to investigate the factors that may be contributing to the dolphin mortalities. Sample and data analyses and necropsies are continuing throughout the northern Gulf of Mexico.

Analyses of tissue, blood, and urine samples from cetaceans in the Gulf of Mexico for PAHs and PAH metabolites have continued as outlined in the NRDA plans[2]. As a normal part of the analytical component under the Marine Mammal Health and Stranding Response Program, the US National Institute of Standards and Technology (NIST) developed alligator blood and plasma control materials spiked with parent PAHs, alkyl PAHs, PAH metabolites and the dispersant component dioctyl sodium sulfosuccinate that were analysed as part of a interlaboratory comparison exercise. The results of this exercise have been presented in a draft report that will be finalised over the next few months. NOAA along with NIST will continue to develop control materials in biological matrices (e.g. bile) and offer interlaboratory comparison exercises for PAH analyses in biological matrices over the next few years.

Three additional cetacean studies related to the DWH spill are underway in the Gulf of Mexico. Hildebrand (Scripps) and Clark (Cornell) both have arrays of acoustic recorders in the Gulf, which were deployed in June 2010 and continue to sample the seasonal and spatial distribution of cetaceans via detection of calls. Prior to the capping of the wellhead, Mate (Oregon State University) instrumented sperm whales (*Physeter macrocephalus*) from the NOAA vessel *Gordon Gunther* in 2010 and from a chartered vessel in 2011 to look for possible impacts. In both years, passive acoustic arrays were towed to locate whales at night and EK-60 back-scatter data were collected to look at the abundance and distribution of prey species. Some of the deployed tags were equipped with 3-axis accelerometers that provided proxies for foraging events. Location data are being compared with previous data from the Sperm Whale Seismic Study (SWSS) collected in 2001-06 to determine if sperm whales are displaying differences in use of home ranges and core areas.

The SWG **commended** Rowles, Ylitalo and Mate for their research related to the DWH oil spill and expressed **strong support** of their continued investigations into the effects of the spill on Gulf of Mexico cetaceans, including cetacean mortality as well as sub-lethal and chronic impacts to these animals. A study to determine the true mortality of dolphins as it relates to dolphins carcasses found on the beach would be useful. Carcass recovery estimates (similar to those conducted for seabirds) could provide a more accurate mortality rate associated with the spill. The SWG noted that an unusual aspect of the DWH oil spill is the depth (approximately 1,500m) at which the spill occurred combined with the application of dispersant at this depth. It is unclear how this unique feature will impact marine organisms, including cetaceans. Studies in the Gulf of Mexico are important in an international context and provide a rare opportunity to better understand the effects of oil spills, noting that the oil industry is moving increasingly into the deep seas. The SWG **strongly recommends** the continued investigations into the impacts of the DWH oil spill on cetaceans, including exposure to oil spill related contaminants, biomarker investigations and health assessments. Furthermore, it **encourages** the early and full reporting of the findings of DWH studies into the public domain.

7.2.2 Capacity building regarding oil spill impacts on cetaceans

Every oil spill, both large and small, offers an opportunity to build prevention and response capacity. In the wake of the large-scale DWH oil spill in the Gulf of Mexico, the largest oil spill in US history, there have been more questions about the impacts of oil disasters on marine mammals, what might be done to mitigate the effects both short- and long-term and how to better prepare for future spills. In 2011, the SWG **agreed** that there is significant need and interest in cross-training between the oil spill and marine mammal communities and **recommended** that an intersessional e-mail group evaluate the possibilities for such training

[1] *http://www.nmfs.noaa.gov/pr/health/mmume/cetacean_gulfofmexico2010.htm.*

[2] Available at: *http://www.gulfspillrestoration.noaa.gov.*

(IWC, 2012a). As part of an effort to better understand and be prepared for oil spills and their impacts on marine mammals, particularly cetaceans, workshops and planning exercises are underway including: (1) an oil spill response workshop held at the International Conference on Marine Mammal Protected Areas (see below); and (2) dissemination of information and data on marine mammals at international meetings on oil spill response or with oil spill responders.

A workshop was held at the International Conference for Marine Mammal Protected Areas (MMPA) in Martinique in November 2011 (*http://second.icmmpa.org*) which brought together experts both in marine mammals and oil spills. The workshop included presentations from the Regional Marine Pollution Emergency Information and Training Centre (REMPEITC) in the Wider Caribbean Region and the Oiled Wildlife Care Network, industry, oil spill responders, and marine mammal scientists and managers. The workshop made a number of recommendations that the SWG reviewed and endorsed, in particular the desirability of international organisations such as the International Maritime Organisation (IMO), International Tanker Owners Pollution Federation (ITOPF), International Petroleum Industry Environment Conservation Association (IPIECA), Regional Association of Oil, Gas and Biofuels Sector Companies in Latin America and the Caribbean, and the American Petroleum Institute working in cooperation with marine mammal specialists on oil spill response plans.

In discussion, the SWG noted that some response plans that are currently under development, especially those related to the Arctic, focus on identifying sensitive areas for marine mammals. However, in most areas, important baseline data are lacking and the SWG **recommended** that these data gaps be filled. The SWG also **recommended** that oil spill response efforts in the Caribbean and other regions of the world should include pelagic as well as coastal areas.

In 2011, the SWG noted that a review of the capacity for oil spill response in the Arctic was an urgent priority in the aftermath of the DWH oil spill (IWC, 2012a). The Scientific Committee **concluded** that it would be useful to know more about the current capacities and mechanisms of oil spill recovery. The SWG noted that the recommendations from the 2011 MMPA workshop in Martinique could provide guidance on oil spill response in the Arctic at the upcoming intersessional Arctic Anthropogenic Impacts Workshop (see Item 10.3).

7.3 Other pollution related issues

Fossi provided information on Mediterranean odontocetes that are exposed to environmental stressors, in particular to persistent organic pollutants, emerging contaminants, polycyclic aromatic hydrocarbons and trace elements. In Panti *et al.* (2011), the response of 'gene expression biomarkers' was evaluated in Mediterranean striped dolphin (*Stenella coeruleoalba*) skin biopsies collected in three sampling areas: Pelagos Sanctuary (Ligurian Sea), Ionian Sea, and Strait of Gibraltar. The mRNA levels of five putative biomarker genes (aryl hydrocarbon receptor, E2F-1 transcription factor, cytochrome P450 1A, estrogen receptor 1, and heat shock protein 70) were measured for the first time by quantitative real-time PCR in cetacean skin biopsies. The different responses of most of the genes reflected contamination levels in the three sampling areas. Pelagos Sanctuary dolphins appeared to be the most exposed to toxicological stress, having the highest up-regulation of CYP1A and AHR. Striped dolphins from the northwestern Tyrrhenian Sea (Pelagos Sanctuary) are evidently more exposed to ecotoxicological hazard than those inhabiting the Ionian Sea and the Strait of Gibraltar. This evidence focuses attention on the potential risk to cetaceans inhabiting the largest pelagic marine protected area in Europe and underlines the importance of farsighted management of protected areas in order to preserve species in their habitats. Moreover, a cluster analysis distinguished the dolphin populations on the basis of the gene expression biomarkers, showing a different pattern between the Mediterranean Sea and Strait of Gibraltar. This molecular approach applied to non-destructive biopsy material is a powerful diagnostic tool for evaluating ecotoxicological impact on cetacean populations.

During discussion, it was noted that the sources of these contaminants in each of the study areas are not known. The SWG **recommended** that the sources of these contaminants, particularly those in the Pelagos Sanctuary, should be identified to help lay the groundwork for development and implementation of mitigation measures.

The SWG has considered information on 'stinky' gray whales since 2005, when members of the Conservation Committee at IWC/57 agreed that a research programme to address the issue of inedible 'stinky' gray whales caught by the Chukotkan aboriginal subsistence hunters should be established (IWC, 2006a). This year, the SWG received IWC/64/CC10, which presented information on the various chemical compounds measured in tissues of malodorous ('stinky') and clean gray whales collected from 2005 to 2011. These included polycyclic aromatic hydrocarbons (PAHs), persistent organochlorines, benzene derivatives and chlorinated PAHs. The authors noted that the odorous carbonyl compounds measured in tissues of 'stinky' whales may be a result of slow metabolism of petroleum hydrocarbons that occur in the Pacific Ocean. Concentrations of persistent organochlorines (e.g. DDT) in the gray whale tissues were low or not detected.

The SWG noted that this finding of non-detectable DDTs is in contrast to the finding of measurable DDT levels in gray whale calves and mothers sampled in the lagoons in the Baja California region reported in SC/64/E4. Differences in DDT levels among these gray whales is most likely due to differences in contaminant levels on their feeding grounds. It was emphasised that a clearer indication of which samples were 'stinky' and which samples were controls would make the information provided easier to interpret.

During discussion, the SWG noted that a ringed seal study conducted in the early 1990s also reported malodorous compounds, including naturally occurring hydrocarbons, being released from the facial glands of certain male seals in rut and these compounds have been reported to permeate the whole body (Ryg *et al.*, 1992). The SWG **reiterated** its previous **recommendation** (IWC, 2006b; 2007; 2008; 2009; 2010a) that steps should be taken to determine the cause of the 'stinky' whale condition.

8. CETACEAN EMERGING AND RESURGING DISEASE (CERD)

8.1 Update from CERD Working Group

Rosa presented an update to the CERD work plan agreed last year (IWC, 2012b), which included:

(1) identification of regional and national experts/points of contact via Steering Committee membership;
(2) creation of a listserve and a website;
(3) creation of a Framework Document; and
(4) identification of and contact with organisations synergistic with the goals of CERD.

Since SC/63, the CERD Working Group (CERD WG) has made significant progress on three of these tasks. The CERD WG was polled for regional/national disease experts and points of contact and a list of these representatives (who agreed to be included and were interested in assisting the CERD WG with its work) has been compiled. Membership of this group includes cetacean disease experts from regions of the world that previously have not been well covered. These experts will be invited to join the CERD WG, the most significant CERD-related progress made this year is with the website as described below.

8.2 Progress on CERD website

Rosa demonstrated a mock-up version of the CERD website, which is being developed in two phases. The first phase focuses on large cetacean species and will utilise a 'consultation and sharing' approach. The second phase will involve opening up the site to small cetaceans, as well as implementation of a potential 'reporting' role, if the IWC and the CERD WG deem this is appropriate. This website will have a 'public' level and a 'registered user' or restricted level. The public level will provide basic information on diseases in cetaceans, as well as access to selected discussion forum content. Registered users (who will be limited to those active in the areas of cetacean health/stranding/biology) will have full access to the site, with in-depth information on cetacean disease, full access to the discussion forum and posting ability. The listserve idea was abandoned in favour of a semi-private discussion board that will be nested within the new website.

The website will include information on general cetacean disease (e.g. viral, bacterial, fungal, parasitic, etc.), and specific website areas devoted to skin diseases, visual health assessment and mortality events and unusual mortality events (UMEs). A 'map it' feature on the main page will allow registered users to record geographic locations of incidents. The website includes an updated header on 'current events' that can alert website visitors to recent events in cetacean disease and perhaps more readily allow international communication. In addition, a link will be provided to discussion boards that can be shared with other groups (e.g. ship strikes, marine debris). Photographs of skin lesions on humpback whales were presented to the SWG as examples of information that could populate the CERD website. Further development of a draft framework document, originally created at IWC/63, will occur over the next several months and this document will be presented to the SWG at the next IWC Scientific Committee Meeting.

During discussion, it was noted that researchers examining photographs on the website may be able to distinguish between wounds from nets or marine debris and this discussion underlined the overlap between areas of disease, ship strike and entanglement. The issue of standardised tissue collection protocols was raised. It was agreed that it would be useful to have these protocols associated with the CERD website. The SWG thanked the CERD WG for their efforts on developing the website and **strongly encouraged** further development of this tool.

A side meeting of the CERD WG was held during SC/64 and focused on the need for website information and photos. The CERD WG members and other interested SWG members agreed to provide information to Rosa in the form of reference lists, documents specific to cetacean disease and photos.

Website forums and materials discussed and agreed by members of the CERD WG include:

(1) 'What is your diagnosis?' forum;
(2) normal tissue/organ appearance descriptions and pictures of non-specific pathological states (which may be linkable to specific disease states); and
(3) photographic descriptions of different levels of post-mortem autolysis in order to distinguish post-mortem change from pathological change.

CERD WG members agreed to provide current event content for the home page that will be passed through the entire group for approval. The CERD WG also discussed standardised collections. The group agreed that it would be best to start by compiling existing collection protocols. Consideration of adaptation of World Organisation for Animal Health (OIE) standards will be undertaken for Phase 2, secondary to the time involved in this adaptation task. Rosa agreed to flesh out the basic 'skeleton' of the site. The CERD WG agreed to choose specific diseases or other areas to work on each month as a means of expanding each section of the website.

The SWG **commended** Rosa and the CERD WG members for their planning efforts at SC/64 and **strongly supports** their continued work to develop an interactive website.

8.3 Other disease-related issues

In SC/64/E1, four out of six *Morbillivirus*-infected cetaceans stranded along the Italian coastline between 2009 and 2911 were found to harbour *Morbillivirus* antigen and/or genome exclusively in their brain. These four animals included three striped dolphins (*Stenella coeruleoalba*) and one common bottlenose dolphin, while the other two cetaceans were *Morbillivirus* infected whales, one of which also harboured a *Toxoplasma gondii* co-infection.

Based upon the results of this work, the following conclusions can be drawn: (1) *Morbillivirus* infection continues to represent a major threat to cetacean health and conservation in the Mediterranean Sea area with an increasingly expanding 'host range' of the virus; and (2) the cases of morbilliviral infection characterised by an apparently exclusive involvement of the animal's brain tissues are a matter of concern, both from the conservation and from the comparative pathology standpoints, thereby underscoring the role of cetaceans as models for the study of their human neurological disease counterparts (such as subacute sclerosing panencephalitis).

Discussion by the SWG followed on the types of tests and assays performed on these animals and the need for increased surveillance for neurologic diseases in cetaceans. The SWG thanked the authors for presenting their findings and **encouraged** further studies on these pathogens in cetaceans.

In SC/64/E4 preliminary results were presented on contaminant levels (Organochlorine Compounds - OCs,) and cytochrome P450 1A1 (CYP1A1) and cytochrome P450 2B (CYP2B) expression on 21 specimens of gray whale blubber collected in San Ignacio Lagoon (Mexico), in two different periods of the breeding season in 2012 (January and March) using skin biopsy as a diagnostic tool. Blubber collected from six mother and calf matched pairs were also investigated to explore the potential transfer of OCs during lactation. These preliminary data show that:

(a) the levels of OCs in gray whale blubber are lower than in other mysticete species;
(b) blubber DDT concentrations of the mothers slightly increased at the end of the breeding season (March)

compared to those sampled early in the season (January) whereas PCB concentrations did not change during this time;

(c) despite the use of blubber reserves during lactation, increasing concentrations of OCs were found in the mothers blubber;

(d) DDTs level were slightly higher in calf blubber in comparison to the mother, suggesting the maternal transfer of OCs during gestation and lactation; and

(e) the protein level of CYP1A1, involved in responses to different endogenous and environmental stress, may be used as a potential indicator of toxicological health status of these whales during different phases of the breeding season in the San Ignacio lagoon.

In conclusion, these preliminary data point out that there is an accumulation of OCs in gray whale calves resulting from the lactational transfer of these compounds from their mothers. Exposure to OCs (such as DDTs) at early life stages may have toxic impacts on their developing endocrine, immune and neural systems. However, the impact of these contaminants on the health and development of gray whale calves is currently unknown.

The SWG thanked Fossi for her paper and discussions ensued on the various contaminants that were measured in the whales. The SWG noted that PCB congener data would be important to include due to differences in toxicities among these compounds. The finding of varying levels of DDTs in gray whale calves may be due to differences in the calf ages at the time of sampling, lipid content of biopsy sample, differences in feeding areas, as well as the number of calves that the mother had previously nursed. In the future, samples of matched gray whale calves and mothers will be conducted at two time points (early and late breeding season) to better understand the transfer and uptake of OCs while the whales are in the lagoons. Skin biopsy samples will be collected for analyses of PAHs and biomarkers, with a focus on biomarkers associated with microplastics due to their feeding strategy (sediment feeders). The SWG noted the relevance of these studies to its programme of work on pollution (POLLUTION 2000+) and **encouraged** their continuation.

SC/64/E8 provided a review of diseases and micro-organisms, as well as the public health and conservation impacts from cetaceans that stranded in Costa Rica during 2004-11. The authors reported detection of *Brucella*, *Toxoplasma gondii* and other parasites (e.g. cestodes, nematodes) in stranded cetaceans from this region of Central America. Of these organisms, *Brucella* poses the greatest risk. Brucellosis is a reproductive disease described in at least 32 species of cetaceans including odontocetes and mysticetes worldwide. Humans and cetaceans affected by marine *Brucella* can develop severe disease such as neurobrucellosis and osteomyelitis. Species that are infected with *Brucella* spp. are more likely to have reproductive problems. Therefore, conservation policies must support research that investigates incidence, prevalence, geographic distribution and host range of *Brucella* infection in cetaceans, especially those with known infection rates, lower birth rates and with described pathologies that can cause death in these animals. Additional information on this disease agent is available on the OIE website[3].

The SWG appreciated the information reported in SC/64/E8 and noted that data obtained from studies such as this are part of 'The One Health' concept. This concept is a worldwide strategy for expanding interdisciplinary collaborations and communications in all aspects of health care for humans, animals and the environment[4]. During discussion, clarification on the various pathogen assays (e.g. *Brucella*, *Toxoplasma gondii*), as well as the types of tissue samples sent for culture was provided to SWG. It was noted that there have been two reported cases of nematodes being carriers of *Brucella* in marine mammals and that a nematode isolated from a dolphin that stranded in Costa Rica in 2009 tested positive for this pathogenic bacteria. However, this finding has not recurred in cetaceans that have stranded in Costa Rica. Although three cases of marine *Brucella* have been documented in humans (two in Peru and one in New Zealand), the SWG noted that many cases of *Brucella* are misdiagnosed in humans. This is because the marine strain of this pathogen is difficult to isolate in humans. This is reported in SC/64/E8. The SWG recognised *Brucella* as an important zoonotic pathogen and **encourages** additional research on this disease agent.

9. ANTHROPOGENIC SOUND

9.1 Mitigation of effects of anthropogenic sound on cetaceans

In 2010, the SWG reviewed evidence of masking of cetacean calls from anthropogenic sound, with an emphasis on low-frequency sounds (<1kHz) from commercial shipping and airguns used during seismic surveys (IWC, 2011b). At that meeting (SC/62), the SWG recommended that: (i) the masking potential of anthropogenic sources be quantified and acoustic measurements be standardised; and (ii) IWC member governments work to develop a quantitative approach for assessing cumulative impacts of anthropogenic sound on cetaceans.

In the US, federal regulations require scientists and representatives of offshore industries to acquire incidental harassment authorisations for activities that may disturb marine mammals, but the potential impacts of sound are often considered on a project-by-project basis in isolation from one another. This precludes any possibility of a meaningful analysis of cumulative impacts from multiple sources. In response to consideration offshore industrial activities in the Alaskan Arctic, Moore *et al.* (2012a) proposed a three-step assessment framework based development of acoustic habitats, which constitute the aggregate sound field from multiple sources compiled at spatial and temporal scales consistent with the ecology of Arctic marine mammals. Assessment framework steps include: (i) the development of acoustic habitat maps depicting anticipated sound fields from multiple sources; (ii) an overlay of acoustic-habitat maps with marine mammal seasonal distribution and density maps to identify areas or periods of concern and data gaps; (iii) development of precautionary measures to protect marine mammals from potential impact and a prioritisation of data gaps and research needed to address those gaps. In the US, the Cetaceans and Sound (CetSound) project (described below) is now working toward mapping products envisioned in the first two steps of this framework.

In a January 2010, NOAA committed to develop the CetSound program to improve the tools used by the agency to evaluate the impacts of human-induced noise on cetacean species. Two working groups were convened to develop the tools required: the Underwater Sound-field Mapping

[3]*http://www.oie.int/for-the-media/onehealth/*.

[4]See *http://www.onehealthinitiative.com/index.php* and *http://www.oie.int/en/* for more information.

(SoundMap) group and the Cetacean Density and Distribution Mapping (CetMap) group. The overarching objective of the SoundMap group is to create mapping methods to depict the temporal, spatial and spectral characteristics of both chronic (e.g. shipping) and episodic (e.g. seismic survey) underwater noise. These tools use environmental descriptors and the distribution, density and acoustic characteristics of human activities within US waters to develop first-order estimates of anthropogenic noise levels for multiple depths and multiple frequencies. The overarching objective of the CetMap group is to create regional cetacean density and distribution maps that are time- and species-specific, using survey data and models that estimate density using predictive environmental factors. The CetMap identified a hierarchy of methodologies to apply, based on available science, and is producing and/or geospatially depicting one of the following for all areas, periods, and cetacean species within the US Exclusive Economic Zone (EEZ):

(1) habitat-based density estimates;
(2) stratified density estimates;
(3) probability of occurrence models;
(4) presence only information; or
(5) an indicator that no data are available.

In addition, to augment the more quantitative density mapping and provide additional context for impact analyses, the CetMap group is also identifying known areas of specific importance for cetaceans, such as reproductive areas, feeding areas, migratory corridors, and areas in which small or resident populations are concentrated. The working groups are guided by a steering committee, which convened initially in October 2010 and guided progress towards tool development and the first public Integrative Symposium in May 2012 (*http://cetsound.noaa.gov/index.html*).

The SWG **commended** the initial development of these powerful mapping tools, noting that they could be used in areas where there are no established shipping lanes (e.g. Bering Strait) to help minimise the impacts of human-induced noise to cetaceans. Data quality used in the maps was discussed and it was noted that the maps have data uncertainty (quality) included. The CetSound mapping tools will be made available to the public in July 2012 and comments on these products can be submitted. The SWG **endorsed** this work and **strongly recommended** support for further development and improvement of these tools.

9.2 Other anthropogenic sound related issues

Appendix G of IWC/64/4 (Cooperation with the International Maritime Organisation (IMO)) notes that the IMO has established a correspondence group (CG) under the purview of its Sub-Committee on Ship Design and Equipment (DE) to develop non-mandatory guidelines to address noise from commercial ships. Noise from commercial shipping is chronic, as reviewed by the SWG in 2010 (IWC, 2011b). Leaper noted that the IMO CG will finish the first draft of their report by the end of 2012 and it will be presented to the IMO in early 2013. The SWG **commended** the continued discussion between the IMO and IWC regarding efforts to reduce noise of newly built vessels. Further, the SWG noted the importance of identifying ship acoustic signatures and **encouraged** the collection of these data, as well as the coupling of this information with the appropriate automatic identification system data.

At past meetings, the SWG has received updates on the development of a modelling effort to determine the Population Consequences of Acoustic Disturbance (PCAD) on marine mammals initially proposed by the US National Research Council in 2005. In 2009, the US Office of Naval Research supported a Working Group whose objectives included building a formal mathematical structure for the framework. This research led to key adaptations to the original framework, including the incorporation of other sources of disturbance, physiological change and the use of health as the primary metric through which changes in individuals can potentially impact the population. Furthermore, it was acknowledged that the relationships between disturbance and population-level effects are not necessarily linear. Combined, this led to the framework being renamed the Population Consequences of Disturbance (PCoD). Progress has been made for four case studies that include (in the order considered): elephant seals (*Mirounga* sp.), coastal bottlenose dolphins (*Tursiops truncatus*), North Atlantic right whales (*Eubalaena glacialis*) and beaked whales (family *Ziphiidae*). The elephant seal case study is the most advanced, and provides a proof of concept for the PCoD approach. Work on all case studies is on-going, and the results to date provide support for the ability of the PCoD framework to estimate the population-level consequences of sub-lethal responses to disturbance.

During discussion, the SWG noted that PCoD is a significant improvement on the PCAD model in that it includes disturbance from a variety of factors (not just acoustics) and includes physiological changes and cetacean health as metrics. Although the current model focuses on single stressors, accumulative effects could be added by comparing a hypothetical accumulative model to a control model to observe differences. Also behavioural response studies could account for multiple and additive stressors; however sensitivity analysis will also need to be conducted to verify this. Other factors (e.g. masking) that could potentially affect health could also be added to the model. The SWG **strongly encouraged** further work on this model and looks forward to future iterations.

10. CLIMATE CHANGE

10.1 Progress on recommendations from the 2nd Climate Change Workshop

At the 2nd Climate Change Workshop (IWC, 2010b), three themes were recommended with regard to the study of cetaceans in the Arctic: (i) single species-regional contrast; (ii) trophic comparison; and (iii) distribution shift. With regard to the first theme, results of passive acoustic sampling in 2008-09 provided a means to compare seasonal patterns in call detection from bowhead whales in the B-C-B and Spitzbergen stocks, providing a contrast in seasonal occurrence for this species between the Atlantic and Pacific sectors of the High Arctic (Moore *et al.*, 2012b). Calls from bowhead whales of the B-C-B stock were recorded in October 2008, and from March-August 2009, on a recorder deployed on an oceanographic mooring near the Chukchi Plateau (*ca.* 75°N, 168°W). The rate of bowhead whale call detection was highest from May through August (i.e. calls detected on 40-90% days/month), when sea ice diminished from nearly 100% surface cover to zero and corresponded to a period of very high zooplankton backscatter signal from June through August. In contrast, calls from bowhead whales of the Spitzbergen stock were recorded in every month from September 2008 to September 2009, on a recorder deployed on an oceanographic mooring in western Fram Strait (79°N, 5°W). The rate of bowhead whale call detection was high (>50% days/month) from September 2008 through May

2009, including calls detected on every day of the month (i.e. 100%) from November 2008 through February 2009 when sea ice was 90-100% surface cover. Of note, sounds from seismic surveys were detected year-round at the Fram Strait site, but only in September and October at the Chukchi site.

In addition, the SWG received an overview of a new programme, the Synthesis Of Arctic Research (SOAR), which aims to bring together a multidisciplinary group of Arctic scientists and Alaskan coastal community representatives to explore and integrate information from completed and ongoing marine research in the Pacific Arctic sector[5]. While not focused specifically on cetaceans, eight projects that will be undertaken under the auspices of the SOAR program will focus on aspects of beluga and bowhead whale ecology, which are related to the three study themes of the 2nd Climate Change Workshop. The SWG expressed appreciation at receiving these updates on cetacean-related science in Arctic waters, **endorsed** the work compiled thus far and requested future updates.

10.2 Small cetacean restricted habitats Working Group

Simmonds presented the results of the intersessional correspondence group on 'restricted populations potentially threatened by climate change'. This group had been asked to further develop this topic with regard to recommendations at the IWC Climate Change Workshop on small cetaceans in 2010 (IWC, 2012d) and at SC/63. The group presented a draft definition and a list of potential cetacean species and populations that this might apply to. The definition, as revised by the SWG, is as follows:

> A Restricted Population Threatened by Climate Change is one that occupies a geographical area being impacted by climate change and from that it is unlikely to be able to move away to new suitable habitat.

The spatial extent of the range occupied by these populations may vary by orders of magnitude, but one or more of the following conditions apply: (i) the species/population has narrow habitat requirements; (ii) the habitat is bounded by physiographic or oceanographic barriers; and (iii) other suitable habitat which the population might be able to access is unavailable because it is occupied by competitors. The SWG noted that the first condition might focus on fixed populations, such as the vaquita, and considered that the third condition in particular needed further development. In discussion, it was noted that populations of large whales might be also be considered, for example fin whales in the Mediterranean Sea and the Gulf of California.

The SWG urged caution with regard to which populations and species should be focused on with regard to this threat, so this would not distract from more imminent threats and stressors. In addition, the SWG noted the importance of integrating and considering the findings of climate change-related analyses that have been conducted for other marine mammal species (e.g. polar bears and ice seals).

10.3 Planning for intersessional Arctic Anthropogenic Impacts Workshop

At IWC/62, the Commission asked the Scientific Committee to develop an agenda for a proposed Workshop on Arctic Anthropogenic Impacts on Cetaceans. At SC/63, the SWG developed a draft agenda (IWC, 2012c) and formed a workshop steering group to further develop a plan for the Workshop. A revised agenda that focused on anthropogenic activities related to oil and gas exploration, commercial shipping and tourism was developed by the workshop steering group and presented to the SWG. In discussion, it was noted that the workshop agenda should be expanded to include consideration of other anthropogenic activities such as commercial fishing and scientific research. Because of the rapid environmental changes and increasing human activities in the Arctic, the SWG **encourages** the continued development of an Arctic Anthropogenic Impacts Workshop, but **strongly recommends** that it:

- carefully define the geographical area to be addressed;
- focus only on Arctic cetacean species (i.e. bowhead whales, white whales, and narwhals);
- consider a broad suite of anthropogenic activities; e.g. oil and gas development, commercial fishing, commercial shipping, tourism, continental shelf mapping and scientific studies;
- specifically include possible impacts from underwater sounds, spilled oil, dispersants, invasive species and discharges (including dumping of ballast water) related to exploratory drilling and shipping; and
- include a discussion about assessing the cumulative impacts of anthropogenic activities.

The SWG recognises that the topic of anthropogenic impacts to cetaceans in the Arctic is broad and complex. Accordingly, the SWG **recommends** that the Scientific Committee convene a workshop focusing on the scientific aspects of the topic, followed by a Commission workshop that addresses management and policy aspects of arctic anthropogenic impacts on cetaceans. It is anticipated that the scope, agenda and schedule for the workshop will be undertaken jointly by the workshop steering group and representatives of the IWC and the Secretariat.

10.4 Other climate change related issues

The SWG noted that the International Maritime Organization (IMO) is working to develop a mandatory Polar Code to manage the increases in ship traffic in Arctic and Antarctic waters anticipated with the reduction of sea ice associated with climate change (IWC/64/4G). The Polar Code work is coordinated by the sub-committee on Ship Design and Equipment, as is the work regarding ship quieting. Further, the SWG noted that the IWC endorsement of noise reduction goals advanced by the IMO's Marine Environmental Protection Committee (MEPC) in 2008 (i.e. 3dB in 10 years; 10 dB in 30 years) was re-iterated in a document entitled 'Status on Implementation of the AMSA 2009 Report Recommendations', available on the Arctic Council website (*http:arcticcouncil.gov/pame/amsa/*). The SWG welcomed this information, reiterated the **endorsement** of noise reduction goals and look forward to continued collaboration with the IMO on this topic.

11. OTHER HABITAT-RELATED ISSUES

11.1 Interactions between MREDs and cetaceans

Simmonds presented the report of the SC/64 pre-meeting Workshop on 'Marine Renewable Developments and Cetaceans Worldwide' (SC/64/Rep6). Twenty-seven participants attended, representing 14 countries. Simmonds expressed particular thanks to Workshop rapporteurs Wright and Scheidat, who produced an executive summary and a synthesis of Workshop recommendations for consideration by the SWG. Simmonds also thanked all the participants and especially noted support provided by a number of agencies including Ocean Care, the Dutch Ministry of Environment, the Belgian Ministry of Environment Health and Food Chain

[5] *http://www.arctic.noaa.gov/soar/*.

Security, Institute for Marine Resources and Ecosystem Studies, Cetacean Society International and the Whale and Dolphin Conservation Society.

Simmonds opened the Workshop, noting that a variety of MREDs are now being deployed around the world, with the highest concentrations in the Northern Hemisphere, especially in northern Europe. The three main forms of MREDs at this time are: (i) wind farms; (ii) tidal-stream driven devices; and (iii) wave energy converters. Each of these, as well as their supporting infrastructure, has the potential for interaction with cetaceans during the construction, operation and decommissioning phases. Possible interactions include the impact of noise, collisions and entanglements in tethering lines (Simmonds and Brown, 2010).

At the Workshop, detailed reports were provided on the current state of development of marine renewable energy in the waters of Germany, the UK, Belgium and the USA and also how the various nations are managing these complex activities, including the trans-boundary issues now arising in the busy waters of Europe (fig. 1 of SC/64/Rep6). The Workshop then conducted much of its business via break-out groups that then reported back to the Workshop plenary. Three groups initially focused on the three main types of MREDs. The break-out groups that followed considered potential impact to cetaceans of the 'supporting infrastructure' including:

(i) operational and decommissioning issues;
(ii) monitoring, mitigations and adaptive management;
(iii) noise and disturbance (including aversive sounds);
(iv) cumulative concerns;
(v) modelling approaches (including the identification of important habitat areas); and
(vi) overarching issues.

A number of papers and websites informed discussions throughout the Workshop (see SC/64/Rep6, appendix 2) and of particular importance had been a special synthesis of the work conducted by ICES (Murphy *et al.*, 2012).

Workshop participants noted that many forms of MREDs, other than windfarms, are still at the developmental or even experimental stage. MREDs may well play a major role in the mitigation of climate change, which may profoundly affect cetacean populations as discussed at prior climate change workshops (IWC, 1997; 2010b). Discussion of their impacts on the marine environment has, to date, been mainly undertaken on a project or national level. Many countries are currently considering putting MREDs into place, including for example South Korea. The Workshop considered that the IWC may be able to help lead a more biologically-appropriate population-focused approach and disseminate information related to best practice around the world.

To date, concerns about offshore windfarms have largely been focused on underwater noise, in particular that associated with pile installation, as reviewed during SC/63 (IWC, 2012a). A variety of foundation types have been developed for wind turbines including monopiles which are large steel pipes driven into the seabed and typically used in areas where water depths are a few tens of meters or shallower. These foundations typically use pile driving to punch foundations into the seabed with the consequent production of marine noise. As larger turbines are developed and deployed, the diameter of the piles are also increasing with consequences for the noise associated with installations. Tripod, tripile and jacket foundations are generally used at greater depths with their individual feet anchored using smaller diameter piles than the monopile designs. Alternatives to piled structures are being progressed that do not require significant seabed piercing. These include gravity foundations that consist of a large and heavy base constructed from either concrete or steel and floating structures that are secured using anchors and chains. Floating structures have the notable feature of being less depth constrained and so can be placed in deeper water (50m or more) and consequently at a greater distance from shore.

In discussion, the SWG **agreed** that there is an urgent need to develop or improve effective noise mitigation measures or quieter foundation installation methods, as noted in past reviews of anthropogenic sound (IWC, 2010a; 2012a). In addition, further research is needed with respect to the impact of multiple sound exposures and cumulative effects of underwater noise from different sources, as discussed in Item 9.1. The SWG **agreed** that the Scientific Committee should continue to monitor and act as a forum for the review of the developments of MREDs and their impacts on cetaceans, specifically with regard to the following points from the Workshop:

- encourage countries to provide information to the IWC about the development of MREDs, related research and relevant regulations in their waters;
- assist where appropriate with the design and evaluation of cetacean population monitoring procedures;
- encourage member countries to develop national and regional common strategic planning and evaluation strategies that include marine renewable energy developments. These should form a part of an overarching strategic management framework that could include other elements such as authorisation cycles and coastal and zonal planning;
- assist member countries in providing the developers of emerging technologies with appropriate information and advice concerning potential impacts early in their process, so they can better account for them in the design-phases;
- consider an interactive website, similar to that envisioned by the IWC Cetacean Emerging and Resurging Disease (CERD) working group, to facilitate communication (both national and international) as a means to share information on cetacean seasonal habitat use, as well as plans for offshore energy development;
- encourage member countries to meet both their impact assessment obligations and their various monitoring obligations as required by domestic legislation or international agreements; and
- hold two workshops to discuss issues that are applicable to, but broader than, the impacts of MREDs (see SC/64/Rep6 for details).

The SWG congratulated Simmonds on a successful Workshop. In discussion, Simmonds noted that the Workshop had produced many recommendations and he encouraged members of the SWG to review the entire report.

In addition to the Workshop report, the SWG received information on the topic of interactions between cetaceans and MREDs. Simmonds noted that paper SC/64/E3 drew attention to the development of marine renewable energy plants in Scotland and their overlap with, and implications for, important cetacean habitats. The recommendations from this paper had been considered during the marine renewables Workshop that preceded the Scientific Committee meeting.

Paper SC/64/E6 presented a preliminary assessment of the effectiveness of small Marine Protected Areas (MPAs) in the waters of Wales and considered their relationship to industrial developments there, including wind farms.

Simmonds noted that he and the other authors welcomed comments on their approach, noting that others in the Scientific Committee were also considering the role of MPAs in cetacean conservation (see SC/64/O1). Welsh waters host one small, protected area in the southern part of Cardigan Bay which is intended to help conserve the population of bottlenose dolphins which is resident in the Bay. Another area to the north is designated to protect other environmental features and the bottlenose dolphin is a secondary feature here and, currently, management measures are in development. These small sites that are Special Areas of Conservation (SACs), as required by the European Habitats and Species Directive, are intended to be part of a network of sites for the bottlenose dolphin being established across Europe. The authors of SC/64/E6 concluded that, despite an increasing array of threats, the SACs were likely to be making a significant contribution to the conservation of cetaceans.

The SWG thanked the authors of the papers presented on marine renewal energy projects. In response to a question regarding the capability to quantify the effectiveness of the MPAs with regard to dolphin conservation, the authors indicated that this was not possible at present, but welcomed comments on improving the information presented.

SC/64/E12 presented an update on a large-scale wind farm project planned for the shoreline of Isla de Chiloe, southern Chile. The waters along this shoreline are considered a critical habitat for several whale species. In 2010, a large wind farm project and the development of an associated port was proposed in Playa Mar Brava, a location that encompasses several delicate ecosystems. Potential impacts of this project include coastal habitat degradation that could impact coastal waters, and underwater noise associated with increased ship traffic and port construction. The project was initially approved without conducting an environmental impact assessment, but subsequently an impact assessment was required based on the need to consult with the local indigenous community. Additional wind farm projects have been proposed in Chile, most without environmental impact assessments. Although none of the proposed locations are offshore, paper SC/64/E12 provides model results of noise from ships that could be introduced to coastal waters if projects go forward. The authors suggested that careful consideration should be given to the selection of locations for wind farm and port constructions and that environmental impact assessments should be mandatory during the development of these projects. They also noted that cumulative impacts of several projects in a region should also be analysed.

The SWG thanked the authors for the update on Chilean renewable energy projects and noted that consideration should be given on the impacts of coastal wind farms, particularly in regions that support critical habitats for cetaceans. The SWG strongly **recommends** urgent development of environmental impact studies in this area and that a precautionary approach should be used with regard to cetacean habitats.

11.2 Cetaceans and marine debris

Prior to receiving papers on the topic of marine debris, the SWG was presented with the results from an intersessional working group (Debris WG) that had considered the issue of both ingestion and entanglement of cetaceans in marine debris. The intersessional group offered the following conclusions and recommendations to the SWG.

- Marine debris is a growing concern for marine wildlife in general, but its interactions with cetaceans are very poorly understood.
- To better evaluate the potential impacts of marine debris on cetaceans and to provide a forum where relevant data can be submitted it, the Debris WG recommend that a workshop on marine debris and cetaceans be convened.
- The primary aim of this workshop would be to determine how to best investigate quantitatively the ways in which marine debris is affecting cetaceans and how best to monitor and mitigate for these effects. The workshop could also consider how best to develop a centralised database to collate cases of debris interactions, including the development of standardised criteria for data to allow more certain identification of the types of debris and the interactions involved.

The Debris WG also noted two key issues fundamental to assessing impact of marine debris on cetaceans:

(1) how to distinguish cetaceans that have died in active fishing gear from those entangled in debris (including abandoned, lost and discarded or 'ghost' fishing gear) and the need to identify the 'worst culprit' types of fishing gear causing entanglement; and
(2) how to investigate the potential accumulation of debris in the deep sea feeding areas of beaked and sperm whales.

Further, the Debris WG noted that more effort is needed to investigate the impacts of microplastics on cetaceans, including baleen whales, which potentially ingest micro-litter by filtrating feeding. Investigating this potential risk requires research to determine the: (i) presence of microplastics and plastic derivatives/additives (such as phthalates) in superficial neustonic/planktonic and water column samples; (ii) presence of plastic derivatives or additives in stranded and free ranging cetaceans; and (iii) development of specific biomarkers to detect exposure and effects of plastic derivates/additives in stranded and free ranging cetaceans.

Further to the report of the intersessional Debris WG, the SWG was provided with a proposal for a Workshop on Marine Debris and Cetaceans, which had been developed by a small working group of SWG members. The SWG reviewed and **strongly supported** this proposal for a Workshop (Appendix 3), noting specifically the need for participation by members of the Working Group on Bycatch (BC) with regard to entanglement issues.

In papers on cetaceans and marine debris provided to the SWG, it was noted that the impacts of microplastics on baleen whales, which potentially include the ingestion of micro-litter by filtrating feeding activity, are largely unknown. In Fossi *et al.* (2012), a case study supported by the Italian Ministry of the Environment, was presented on the Mediterranean fin whale (*Balaenoptera physalus)*, exploring the toxicological effects of microplastics on mysticetes. The work was implemented through three steps:

(1) collection/count of microplastics in the Pelagos Sanctuary (Mediterranean Sea);
(2) detection of phthalates in superficial neustonic/planktonic samples; and
(3) detection of phthalates in stranded fin whales.

Among the superficial neustonic/planktonic samples, 56% show the presence of microplastic particles. The highest microplastic abundance (9.63 items/m^3) was found in the Portofino MPA (Ligurian Sea). High concentrations of monoethylhexyl phthalate (MEHP) and diethylhexyl

phthalate were detected in neustonic/planktonic samples. Relevant concentrations of MEHP in the blubber of stranded fin whales suggest the use of phthalates as a tracer of microplastics consumption and represent a warning on this emerging threat in baleen whales. In conclusion, the present study represents the first evidence of the potential impact of plastic additives (phthalates) in baleen whales and it underlines the importance of future research both on the detection of toxicological impact of microplastics in filter-feeder species such as mysticetes and in the potential use of these species as sentinels to the presence and impact of micro-litter in the pelagic environment.

The SWG appreciated the information on the phthalate compounds associated with microplastics and noted that these compounds occur in a number of different products, including plastic, and are widespread. Bisphenol A was also examined in these samples but this plastic-associated compound was not detected. In future, the authors will investigate the toxicological effects of phthalates to determine the appropriate biomarker for these endocrine disruptors in cetaceans. During discussion, it was noted that the European Marine Strategy Framework Directive includes a requirement for EU member nations to ensure that the 'properties and quantities' of marine litter do not cause harm to the marine environment. The SWG **recommended** that research on cetaceans could usefully be included in striving to achieve this.

The authors of SC/64/E15 presented a brief overview of efforts to assess marine debris during dedicated cetacean aerial surveys. The advantage of collecting information on marine debris is that it can provide valuable information at the same temporal and spatial scale as used for the cetacean survey at no additional cost. However, data collection must not interfere with survey effort and survey quality for the target species. Moreover, a clear definition of marine debris is needed prior to the survey and what information on it will be collected. For areas with high density of debris or target species, the survey protocol might need to be adapted. As another option one might consider using a 'sample' type of debris that can be a proxy for overall debris distribution. It should be noted that extra funding for analyses of additionally collected data is necessary and that this should be thought of prior to the survey.

The SWG thanked the authors of this paper and noted the importance of including oceanographic information in studies such as this. The SWG discussed the size of debris that could be seen from these aerial surveys and, realising that very small debris was not likely to be detected, suggested that pathological effects of debris on cetaceans (if ingested) should also be included in future studies.

SC/64/E10 provided a review of the impacts of marine debris on cetaceans, which indicated an increase in the number of cetacean species affected and an increase in the number of cases of both entanglement and ingestion reported in recent years. The authors noted that the low ability to detect debris interactions, combined with the low power to detect changes in cetacean population abundance confounds efforts to quantify the scale of the impacts. However, because even low rates of entanglement can result in population-level impacts in small cetacean populations, such as the North Atlantic right whale, the authors concluded that the impact of marine debris on cetaceans therefore requires more dedicated research.

The SWG thanked the authors of SC/64/E10 and the Environmental Investigation Agency for sponsoring this thorough and timely review of the literature and other sources.

Simmonds presented SC/64/E13 for its authors. This reports a preliminary investigation of the types and locations, of surface debris obtained from commercial whalewatching vessels in the important whale feeding grounds of the southern Gulf of Maine, USA between April and October 2011. The data demonstrate that feeding whales are regularly exposed to debris and are at risk of morbidity and mortality and the authors recommended that necropsies of large whales that are found dead or bycaught include a thorough examination of all parts of the digestive tract. They also recommend that prey species be sampled for microplastics and that monitoring and enforcement of existing legislation that relates to marine debris be addressed.

During discussion, the SWG suggested that full necropsy examinations be conducted on all stranded cetaceans, with particular attention paid to the gastrointestinal tract, but it was noted that this would be a challenge due to the rapid degradation and autolysis of the gastrointestinal tract upon death.

The authors of SC/64/E7 had also considered the published literature on marine debris and whether any trends could be identified. This highlighted the relatively large number of reports of ingestion from beaked whales, as also noted in the discussions about ziiphids in the small cetaceans sub-committee this year (see Annex L). The authors concluded that trends in pathologies would only be safely identified when standardised methodologies are consistently used over time but, nonetheless, it is of concern that the literature indicates that ingestion of marine debris now affects a greater range of species and that the reports of associated pathology in cetaceans is increasing. The SWG appreciated the information presented in this paper and noted that information from CCAMLR for the Southern Ocean was a potentially useful dataset that has been kept on a regular basis for a number of years. In addition, Norway also has an ongoing program (20 years) to review lost fishing gear. The State of Alaska has a particular interest in marine debris, especially as it relates to the Japanese tsunami.

11.3 Issues related to the March 2011 tsunami in the northwestern Pacific

Concerns have been raised with regard to increased marine debris transport to the eastern Pacific Ocean, as well as radioactive contamination of marine debris as a result of the 2011 Japanese tsunami. NOAA modelling efforts estimate that the bulk of the debris related to this event is likely to be dispersed north of the main Hawaiian Islands and east of Midway Atoll[6]. Furthermore, as predicted by these modelling efforts, some buoyant debris reached the Pacific northwest coast during winter 2011-12 and continues to occur in the region. It is highly unlikely that debris transported from Japan to the eastern North Pacific poses a radioactive risk. However, transport of non-native, invasive species or pathogenic microorganisms on tsunami-released debris could occur and pose a threat to eastern Pacific coastal ecosystems. The NOAA Marine Debris Program is coordinating with other internal and external partners to help address the tsunami marine debris, including determining the fate and transport of the debris and identifying potential threats posed by these items. NOAA's Marine Mammal Health and Stranding Response Program is working with state and non-governmental partners to evaluate the potential impacts of the tsunami released marine debris on marine mammals and the potential increase in either ingested marine debris or risk of entanglement.

[6]*http://marinedebris.noaa.gov/info/japanfaqs.html.*

Results of radionuclide monitoring of marine biota have been reported in the aftermath of the 2011 Japanese tsunami (Buesseler *et al.*, 2012). Madigan *et al.* (2012) reported that juvenile bluefin tuna captured in August 2011 off the coast of San Diego, California transported Fukushima Dai-ichi radionuclides in their muscle. Although the levels of ^{134}Cs and ^{137}Cs were higher in the 2011 juvenile bluefin tuna than those measured in 2008 bluefin tuna, they were approximately an order of magnitude lower than the Japanese safety limit for seafood and were lower than the levels of certain naturally occurring radionuclides (i.e. ^{40}K) that were also measured in these fish. Currently, information on radionuclide levels in other highly migratory species (e.g. whales, turtles, sharks) that forage in or near Japanese waters is sparse (Madigan *et al.*, 2012). In SC/64, Japan reported that tissue samples of spring Kushiro minke whales were routinely being screened for radioactive contaminants as a fishery for their prey (sand lance) near the Fukushima Dai-ichi power plant had been closed due to levels of ^{137}Cs that exceeded the Japan public health level of concern (IWC, 2012a). They reported that tissues of a few whales had low concentrations of radioactivity that fell below the Japan Health, Labour and Welfare regulation value for food safety[7]. Additional information on other highly migratory species may warrant further investigation.

The SWG noted that the Pacific coast of the USA is investigating fishing gear that may be associated with the tsunami. Alaska is very interested in this issue, with native communities being very concerned about the potential contamination of their marine-harvested foods. The North Slope Borough is testing for radionuclides in the tissues of ice seals collected in 2011-12 and Russia is also looking at radionuclide concentrations in pinnipeds.

11.4 Cumulative impacts of anthropogenic activities

SC/64/E11 reported on cumulative impacts of a number of anthropogenic activities to cetaceans. While there are a number of quantitative processes for assessing the combined impacts of multiple stressors being developed, these are still some way from completion and active use in management. Five actions to mitigate cumulative impacts were developed during the permit cycle of the Greenland Bureau of Minerals and Petroleum for the mitigation of cetacean exposures to disturbance from seismic surveys:

(1) minimising total accumulated exposure, where possible;
(2) encouraging or regulating cross-company collaboration regarding environmental impact assessments and mitigation plans;
(3) offsetting increasing impacts from one industry by decreasing the impacts from another;
(4) instituting 'fallow' years, either singly, or in pairs, to allow the cetacean populations, as well as the ecosystem in general, to recover; and
(5) mandating the research of exposure and impacts pre-, during- and, where appropriate, post- activity, as well as fully public reporting of the results, to help support future management decisions.

Although some of these actions will likely encounter resistance from some stakeholders, they demonstrate that efforts to manage cumulative impacts of seismic surveys on cetaceans are possible. Given this, the author strongly urged that measures such as those listed above be used to manage cumulative impacts of anthropogenic activities on cetaceans, especially for populations that are substantially reduced in number or are data deficient.

[7]See details at *http://www.jfa.maff.go.jp/e/inspection/index.html.*

The SWG thanked the authors for the paper and for their continued efforts to develop effective tools to address concerns regarding cumulative impacts of anthropogenic activities on cetaceans. In discussion, it was noted that effects of climate change on marine ecosystems may compound the cumulative impacts of anthropogenic stressors, such as chemical pollutants and noise.

11.5 REMMOA aerial surveys in the French EEA

The SWG received an update of the REMMOA project, aimed at providing maps of hot spots for pelagic megafauna in the French tropical EEZ and some EEZ of neighbouring countries. Four tropical oceanic regions are of interest: the Caribbean-Guiana region around Guadeloupe, Martinique and off French Guiana; the southwest Indian Ocean around Réunion Island and other countries of the Indian Ocean Commission; the central South Pacific, with French Polynesia; and the western South Pacific around New Caledonia.

Mannocci *et al.* (2012) presented analyses of the Caribbean-Guiana survey. The aim of this study was to document top predator communities in terms of encounter rates, composition, abundance and spatial distribution and to compare them between these two contrasting ecosystems. Both conventional distance sampling analyses and geostatistics were used to estimate abundance and geostatistics also provided distribution maps. Cetacean encounter rate was three times higher in Guiana (1.8 groups/100km) compared to the Caribbean (0.6 groups/100km). Moreover, small delphinids strongly dominated in Guiana (representing 83% of odontocete groups) due to the predominance of the bottlenose dolphin (*Tursiops truncatus*). Relative abundance was estimated for several taxa of seabirds both in the Caribbean and off Guiana and for two cetacean taxa off Guiana only (bottlenose dolphin: 34,965 individuals, CV=0.28; Guiana dolphin: 2,076 individuals, CV=0.44). In terms of distribution, the bottlenose dolphin is ubiquitous in the area and the Guiana dolphin is restricted to the most coastal waters.

SC/64/E14 presented the analysis of the southwest Indian Ocean survey with a focus on comparing cetacean and other pelagic megafauna communities in areas characterised by contrasted oceanographic conditions. There is a general pattern showing that the Mozambique Channel in the west and the Seychelles Plateau in the north hold higher concentrations of seabirds and delphinids than the Mascarenes in the southwest of the area. Deep divers however appear not to show such a general pattern. Relative densities were estimated for six groups of cetaceans and for seabirds, sea turtles and elasmobranchs. Models of density surface were obtained for seven groups of cetaceans: small delphininae, large delphininae, small globicephalinae, Risso's dolphin (*Grampus griseus*), large globicephalinae, beaked whales and sperm whales. As examples, the best model for small delphininae explained 29% of the deviance and predicted habitats of higher densities along the continental and peri-insular slopes of the Mozambique Channel and the Seychelles. For the Risso's dolphin, the best model explained 49% of the deviance and showed hotspots in slope and oceanic habitats of the central and southern Mozambique Channel.

The long-term objectives of the REMMOA surveys is to establish an initial situation of cetaceans and other pelagic megafauna diversity and relative abundance and to build up a monitoring strategy to be implemented in the

future. Expertise from the marine mammal, seabird and fish scientific communities would be most welcome in designing the monitoring strategy.

During discussion, it was noted that overlaying satellite and oceanography data with the aerial survey data would be helpful. The SWG thanked the authors for presenting this update and **encouraged** the authors to complete the work and report results at SC/65.

12. WORK PLAN

The SWG **agreed** to the following draft agenda for its work plan for the 2013 Annual Meeting (SC/65).

1. SOCER (State of the Cetacean Environment Report): receive the SOCER, focus area to be the Atlantic Ocean
2. POLLUTION
   - 2.1 Update on POLLUTION 2000+ Phase II activities
   - 2.2 Oil spill impacts
     - 2.2.1 Update on response to the DWH oil spill in the Gulf of Mexico
     - 2.2.2 Update from the Capacity Building Working Group
   - 2.3 Other pollution-related issues
3. CERD (Cetacean Emerging and Resurging Disease)
   - 3.1 Update from CERD Working Group
   - 3.2 Progress on CERD website and work plan
   - 3.3 Other cetacean disease-related issues
4. Anthropogenic sound
   - 4.1 New information on effects of anthropogenic sound on cetaceans
   - 4.2 Update on approaches to mitigate effects of anthropogenic sound on cetaceans
   - 4.3 Other anthropogenic sound-related issues
5. Climate change
   - 5.1 Update on recommendations from past climate change Workshops
   - 5.2 Receive report from intersessional Arctic Anthropogenic Impacts Workshop
   - 5.3 Other climate change-related issues
6. Other habitat related issues
   - 6.1 Interactions between MREDs and cetaceans
   - 6.2 Cetaceans and marine debris - report from intersessional Workshop
   - 6.3 Cumulative impacts of anthropogenic activities
   - 6.4 Results of the REMMOA aerial surveys

Further, the SWG endorsed the following budget requests:

- a contribution towards development of the SOCER;
- support for an intersessional Workshop on cetaceans and marine debris; and
- work on Pollution 2000+ Phase II activities (see IWC, 2012a, pp.241-42) will be continued under the existing contractual arrangement; no new funds are requested.

Moore thanked the rapporteurs for their efficiency and hard work in producing the report. Moore also thanked the SWG for their work, and for their forbearance during the 5-year period of her service as Chair.

13. REVIEW AND ADOPT REPORT

The report was adopted at 11:30am on 19 June 2012.

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Appendix 1

AGENDA

1. Convenor's opening remarks
2. Election of Chair
3. Adoption of Agenda
4. Appointment of rapporteurs
5. Review available documents
6. SOCER, receive the State of the Cetacean Environment Report
7. POLLUTION 2000+ Phase II
   - 7.1 Update on POLLUTION 2000+ Phase II progress
   - 7.2 Oil spill impacts
     - 7.2.1 Update on response to DWH oil spill in the Gulf of Mexico
     - 7.2.2 Capacity Building Working Group
   - 7.3 Other pollution related issues
8. CERD (Cetacean Emerging and Resurging Disease)
   - 8.1 Update from CERD Working Group
   - 8.2 Progress on CERD website
   - 8.3 Other disease related issues
9. Anthropogenic sound
   - 9.1 Mitigation of effects of anthropogenic sound on cetaceans
   - 9.2 Other anthropogenic sound related issues
10. Climate change
    - 10.1 Progress on recommendations from the 2nd Climate Change Workshop
    - 10.2 Small cetacean restricted habitats Working Group
    - 10.3 Planning for intersessional Arctic Anthropogenic Impacts Workshop
    - 10.4 Other climate change related issues
11. Other habitat related issues
    - 11.1 Interactions between MREDs and cetaceans
    - 11.2 Cetaceans and marine debris
    - 11.3 Issues related to the March 2011 tsunami in the northwest Pacific
    - 11.4 Cumulative impacts of anthropogenic activities
    - 11.5 REMMOA aerial surveys in the French EEA
12. Work plan
13. Review and adopt report

Appendix 2

CERD WORK PLAN

(1) The continuation of work on the CERD website housed on/linked to the IWC homepage, and preparation for Phase 2 work leading into SC/65; and
(2) the creation of a framework document to outline the purpose, goals and future directions of the CERD working group.

Appendix 3

OUTLINE PROPOSAL FOR AN INTERSESSIONAL WORKSHOP ON ASSESSING THE IMPACTS OF MARINE DEBRIS

1. BACKGROUND

Marine debris is the term used to refer to solid materials of man-made origin in the marine environment, and includes plastics, abandoned, lost or otherwise discarded fishing gear, as well as glass, metal and wood products.

In 2011, the IWC agreed to:

(1) endorse the Honolulu Commitment;
(2) establish a standing item on marine debris on the Conservation Committee agenda; and
(3) request the Scientific Committee continue reviewing potential threats to cetaceans arising from marine debris.

It is proposed that a workshop be held on marine debris and cetaceans in order to better understand impacts and provide a forum for compiling relevant data. The primary aim of this workshop would be to develop tools that allow us to determine quantitatively whether or how marine debris is affecting cetaceans and how best to monitor and mitigate for these effects.

2. TERMS OF REFERENCE

The purpose of the Workshop is to:

- better understand the effects of debris interactions at an individual and population level;
- identify and classify key types and sources of debris that contribute to entanglements, or are ingested by cetaceans and examine the mechanisms by which they arrive in the marine environment, with the goal of identifying possible mitigation measures;
- design and develop a centralised database to collate cases of debris interactions in order to obtain more accurate estimates of the incidence of mortality and injuries, to help detect trends over time and to identify hotspots; and
- contribute towards a quantitative assessment of the extent of the threats for cetaceans.

The general terms of reference are as follows.

(1) Collate data and develop measures to improve data quality and availability.
   - Exchange, evaluate and analyse data on marine debris interactions involving cetaceans.
   - Bring together relevant strandings and fishery experts to examine methods that could be used to distinguish between active versus derelict fishing gear involved in cases of entanglement. This would greatly enhance measurement of the rates of debris entanglement and identification of the 'worst culprit' types of gear as well as informing the development of mitigation.
   - Bring together relevant necropsy experts to examine methods to classify the pathological effects of mega-debris ingestion and to promote the measurement of micro-plastic ingestion in stranded and free-ranging cetaceans and assessment of potential toxicological impacts for cetaceans.
   - Examine methods that could be used to investigate the potential accumulation of debris in the deep sea feeding areas of beaked and sperm whales.
   - Identify ways to improve data collection and geographical standardisation of data and coverage in order to maximise detection rates and reporting of debris interactions. In particular, to develop standardised methods and criteria for data to allow more certain identification of the types of debris and the effects at an individual and population level.

(2) Review data and identify priority actions:
   - review the available data and evaluate the current understanding of marine debris impacts on cetaceans.
   - identify priority areas for future research.

(3) Examine and evaluate existing mitigation approaches/regulations:
   - formulate actions to prevent and mitigate the impacts of marine debris on cetaceans, including identifying potential mitigation measures for priority populations/areas, and co-ordination with other relevant international and national governmental organisations (e.g. CCAMLR, NOAA, NCEAS) working on marine debris to promote synthesis of mitigation efforts.

(4) Develop recommendations and a two-year work plan for consideration by the IWC, ACCOBAMS, IMO and others.

3. INTENDED OUTCOME

The report of the Workshop will, in addition to providing the analyses, review and recommendations listed under Item 2 above, develop: (1) a series of research and conservation actions that will include a rationale, actions required and proposed responsible persons/groups; and (2) a two-year work plan to be considered. The report will be submitted to the IWC and made publicly available on their website. It is proposed to publish the results of the workshop in a peer-reviewed journal.

4. LOGISTICAL ASPECTS

4.1 Suggested steering group

The proposed steering group at this point would consist of Simmonds, Baulch, Perry, Gallego, Mattila, Fossi, Rosa, Parsons, Williams, Iñíguez, Leaper, Holm and Podestá and outside experts such as Laist. The proposed Convenors are Simmonds and another, still to be appointed.

4.2 Proposed title of Workshop

Intersessional Workshop on Assessing the Impacts of Marine Debris.

4.3 Tasks of the steering group

Taking into account any relevant discussions at the Conservation Committee and the Commission, the Steering Group will:

- finalise the agenda, terms of reference, timetable and venue for the Workshop;
- identify key data/papers/analyses/presentations needed for the Workshop, assign them to individuals and develop a timeline for their availability; and
- select the funded Invited Participants and ensure sufficiently broad stakeholder representation (including science, policy, industry, NGOs).

4.3 Practical considerations

- Format of workshop: 3-4 day workshop with invited participants.
- Timetable of workshop and number of participants: The workshop would include some 20-30 participants and meet for 3-4 days.
- Its report would be provided to the IWC Scientific Committee, Conservation Committee and Commission meeting.
- A provisional date of April 2013 has been proposed and an institution in Madeira has come forward to host and would provide the venue free of charge.
- Funding has to be found (a preliminary budget is given below).

Preliminary budget

This will be affected by meeting venue, so figures are approximate and the workshop can be scaled further to available funding:

	4 days, 25 participants	3 days, 20 participants
Travel costs	£25,000	£20,000
Meeting room	No cost	No cost
Accomodation for approx. 25 participants	£10,000	£5,000
Subsistence for approx. 25 participants	£6,000	£2,000
Communication costs	£500	£500
Miscellaneous additional costs	£500	£500
Total	$42,000	£28,000

Appendix 4

STATE OF THE CETACEAN ENVIRONMENT REPORT (SOCER) 2012

Editors: M. Stachowitsch*, E.C.M. Parsons+ and N.A. Rose¥

INTRODUCTION

Several resolutions of the International Whaling Commission, including Resolutions 1997-7 (IWC, 1998) and 1998-5 (IWC, 1999), directed the Scientific Committee (SC) to provide regular updates on environmental matters that affect cetaceans. Resolution 2000-7 (IWC, 2001) welcomed the concept of the State of the Cetacean Environment Report (SOCER) at the 52nd Annual Meeting in Australia and 'request[ed] the annual submission of this report to the Commission'. The first full SOCER (Stachowitsch *et al.*, 2003) was submitted in 2003 and subsequent editions continued a cycle of regional focuses encompassing the Mediterranean and Black Seas, the Atlantic, Pacific and Indian Oceans, and the Arctic and Antarctic Seas. Each SOCER also usually includes a Global section addressing the newest information that applies generally to the cetacean environment. This SOCER focuses exclusively on the Indian Ocean (no Global section), summarising key papers and articles published from *ca.* 2010 through 2012 to date.

INDIAN OCEAN

General

DISTRIBUTION MODELLING USED TO PREDICT IMPORTANT AREAS FOR OMAN CETACEANS

Oman has one of the highest population growth rates in the world, with increasing anthropogenic activities in the coastal zone, including fishing activity, but little is known about the distribution of cetacean species throughout Omani waters. Therefore, a distribution modelling exercise for the coast of Oman, extrapolating sightings data coincident with oceanographic and topographic parameters, was undertaken to predict habitat use. There was a clustering of humpback whales along part of the Dhofar coast, which may warrant protection. This was a useful effort in a data-poor region.

(SOURCE: Corkeron, P.J., Minton, G., Collins, T., Findlay, K., Willson, A. and Baldwin, R. 2011. Spatial models of sparse data to inform cetacean conservation planning: an example from Oman. *Endang. Spec. Res.* 15:39-52.)

HISTORICAL OVERVIEW OF THE ESTABLISHMENT OF THE INDIAN OCEAN SANCTUARY

The establishment of the International Whaling Commission's Indian Ocean Sanctuary in 1979 is outlined by the author, who actively participated in the process. The problems that led to the consideration of establishing a sanctuary in these waters are discussed, as is the role of the Seychelles as a range state in taking the initiative. Also presented is the concept of an Indian Ocean Alliance for Conservation, considered at that time but ultimately abandoned. The author concludes that '[t]o this day there is, unfortunately, no comprehensive plan or authority for the conservation and the management of use of the marine life of the region as a whole'.

(SOURCE: Holt, S. 2012. Negotiating the Indian Ocean Whale Sanctuary. *J. Cetacean Res. Manage.* 12(2): 145-150.)

*Department of Marine Biology, Faculty of Life Sciences, University of Vienna, Austria.
+University Marine Biological Station Millport (University of London), Great Cumbrae, Scotland and Department of Environmental Science and Policy, George Mason University, Fairfax, Virginia, USA.
¥ Humane Society International, Washington, DC, USA.

INTERNATIONAL CETACEAN SYMPOSIUM ON THE MALDIVES ISSUES DECLARATION

The Indian Ocean Cetacean Symposium (IOCS) was held in July 2009 and issued the Lankanfinolhu (Maldives) declaration. The declaration, adopted by 60 delegates from 22 countries; calls for maintaining the Indian Ocean Sanctuary in perpetuity; urges efforts to protect all cetaceans and their habitats within the Exclusive Economic Zones of the respective countries; suggests that Indian Ocean coastal states promote implementation of the Convention on the Conservation of Migratory Species of Wild Animals (CMS); reminds parties to the Convention on Biological Diversity of commitments to protect at least 10% of all ecosystems, including marine and coastal waters; supports the wider adoption of responsible whale and dolphin watching guidelines; and encourages Indian Ocean states, in collaboration with the IWC and other relevant organisations, to develop an action plan to improve conservation outcomes for cetaceans in the IOC.

(SOURCE: *http://ww.mrc.gov.mv/index.php/news_events/iocs_closing/*)

NEW AGREEMENT ON IMPROVING ENVIRONMENTAL MANAGEMENT IN THE WESTERN INDIAN OCEAN

Ten east and southern African nations have signed the 'Protocol for the Protection of the Coast and Marine Environment of the Western Indian Ocean from Land-based Sources and Activities'. This includes the shorelines of Tanzania, Kenya, Mozambique, South Africa and Somalia, as well as the Seychelles, Comoros, Mauritius, Madagascar and Réunion-France. The amended convention, ratified on 31 March 2010 in Nairobi, Kenya, covers pollution from ship-based sources, dumping, land-based activities, transboundary movement of hazardous wastes and airborne sources. This is only the third marine area in the world to achieve a multilateral agreement on land-based impacts on the marine environment (after the Mediterranean and Wider Caribbean). It pledges to 'conserve biological diversity and protect and preserve rare or fragile ecosystems, as well as rare, endangered or threatened species of fauna and flora'.

(SOURCE: Anon. 2010. News. *Mar. Pollut. Bull.* 60(a): 1,150; Anon. 2010. News. *Mar. Pollut. Bull.* 60(5): 639; *http://www.unep.org/NairobiConvention/Publications/index.asp*)

THREE AREAS IN BANGLADESH TO BE DECLARED DOLPHIN SANCTUARIES

The UNESCO-listed Sundarbans mangrove forest is home to large populations of Ganges River and Irrawaddy dolphins. Dozens of dolphins have died after entanglement in the fishing nets of tens of thousands of fishermen. Bangladesh will designate three river areas in its southwest as dolphin sanctuaries to protect the country's endangered population of freshwater cetaceans.

(SOURCE: Anon. 2011. News. *Mar. Pollut. Bull.* 62(12): 2,587; *http://www.iucn-csg.org/index.php/2012/03/01/three-new-wildlife-sanctuaries-for-ganges-river-and-irrawaddy-dolphins-declared-by-the-government-of-bangladesh/*)

DOLPHIN WATCHING INDUSTRY IN OMAN LACKING CURRENT INDUSTRY STANDARDS

Apart from a Ministerial decision (4/94) protecting cetaceans from consumptive use, there are no official guidelines in place for dolphin watching in Oman. Based on tourist questionnaires, the authors determined that the awareness levels of visitors were low and that they were largely unable to recognise poor boat handling techniques and inappropriate

cetacean watching practices. Based on the potential for the dolphin watching industry to expand considerably in Oman, the author suggests introducing codes of conduct and/or accreditation or certification schemes for tour companies.

(SOURCE: Ponnampalam, L.S. 2010. Dolphin watching in Muscat, Sultanate of Oman: tourist perceptions and actual current practice. *Tour. Mar. Environ.* 7(1): doi: 10.3727/154427311X13038402065866.)

MAJOR NEW MARINE PROTECTED AREA IN THE INDIAN OCEAN

The Chagos Marine Protected Area (half-a-million-square kilometres) has been created in the middle of the Indian Ocean. Beyond protection for coral reefs, this initiative bans pelagic fisheries, including tuna fisheries. This area, 450 n.miles in diameter, is considered to be the most important marine wilderness area in the Indian Ocean and doubles the no-take pelagic area in the world's oceans. It is part of an initiative to also make MPAs no-take zones and marks a trend to consider ecosystem-scale protection as the best approach to ensuring the survival of all components of the ocean environment.

(SOURCE: Sheppard, C. 2010. Marine protected areas and pelagic fishing: The case of the Chagos Archipelago. *Mar. Pollut. Bull.* 60(11): 1,899-1,901; Nelson, J. and Bradner, H. 2010. The case for establishing ecosystem-scale marine reserves. *Mar. Pollut. Bull.* 60(5): 535-637.)

INTERNATIONAL CONVENTIONS IDENTIFIED AS A STRATEGY TO PROTECT MARINE ECOSYSTEM HEALTH IN THE INDIAN OCEAN

Management and conservation efforts for small cetaceans in the Indian Ocean are 'sorely lacking at the local, national and international levels'. The author calls for stronger incorporation of those international conventions whose overall goal is to 'maintain the health and stability of the marine ecosystem', specifically the Convention on Migratory Species and the Convention on Biological Diversity. They are 'well placed to address issues of marine mammal by-catch and depredation in the Indian Ocean region'.

(SOURCE: Thomas, P.O. 2009. Assessing international priorities for marine mammal conservation. Indian Ocean Cetacean Symposium, Maldivian Marine Research Centre website: *http://www.mrc.gov.mv*)

Chemical pollution

ORGANOTINS MEASURED ALONG THE COAST OF INDIA

The organotin compound tributyltin (TBT), used in antifouling paints, was analysed near various ports along the coast of India. Many of the areas had contamination levels high enough to pose a risk to aquatic and benthic organisms. Although the International Maritime Organization (IMO) has totally prohibited the use of these compounds in antifouling paints, India currently has no water quality guidelines with respect to TBT or any legislation prohibiting the use of TBT-based paints on ship hulls. TBT can suppress the normal functioning of the immune system of mammals and has been implicated in health problems in cetaceans ranging from cytotoxic effects to increased susceptibility to infectious diseases.

(SOURCE: Garg, A., Meena, R.M., Jadhav, S. and Bhosle, N.B. 2011. Distribution of butyltins in the waters and sediments along the coast of India. *Mar. Pollut. Bull.* 62(2): 423-431.)

CONTAMINATED KILLER WHALES IN THE INDIAN OCEAN

Despite the remoteness of Possession Island, Crozet Archipelago, contaminant levels from biopsy samples collected from killer whales inhabiting its waters in the southern Indian Ocean were high. 'Over 70% of our study animals had PCB concentrations which exceeded a 1.3mg/kg PCB threshold established for endocrine disruption and immunotoxicity in [pinnipeds],' according to the researchers (p.196). The high levels of pollutants in the whale tissues led the authors to conclude that 'contaminants cannot be excluded as a possible risk factor in the decline of this population' (p. 201). Total TEQ: 76.45±5.00 (juvenile female); 44.24±8.37 (adult female); 109.02 (male). Maximum contaminant levels (lipid weight): PCB: 20.5mg/kg^{-1}; PCDD: 77.1ng/kg^{-1}; PCDF: 36.1ng/kg^{-1}

(SOURCE: Noël, M., Barrett-Lennard, L., Guinet, C., Dangerfield, N. and Ross, P.S. 2009. Persistent organic pollutants (POPs) in killer whales (*Orcinus orca*) from the Crozet Archipelago, southern Indian Ocean. *Mar. Environ. Res.* 68: 196-202.)

Habitat degradation

General

GANGES RIVER DOLPHIN DISTRIBUTION AND RIVER FLOW RATES

A survey and analysis of Ganges River dolphin distribution found that changes in river flow rate caused by dams and barrages could impact the species. The survey was conducted along 332km of the flow-regulated Gandak River, India (in the Ganges River basin). Dolphins were sighted in 40% of the river segments surveyed, with an estimated population of 257 (range 250-267) animals. Dolphin distribution was affected by river depth and presence of meanders in the river. Moreover, distribution corresponded closely with gillnet fishing and there may be conflict for diminishing fish resources. Minimum channel depth at which dolphins were found ranged from just over 2m (for females with calves) to just over 5m. As river flow was reduced, dolphins were more often clustered in pools and were absent in sections of the river that had low flow rates/shallow depth. Females and calves may be particularly vulnerable when river flow is reduced by dam systems, as they tend to inhabit shallower channels. The researchers concluded that 'these results suggest that local and landscape-level alteration of river flows in the Gangetic basin can have serious impacts on river dolphins, and support the need for [river flow rate management] for their conservation' (p.23).

(SOURCE: Choudhary, S., Dey, S., Sagar, V., Nair, T and Kelkar, N. 2012. River dolphin distribution in regulated river systems: Implications for dry-season flow regimes in the Gangetic basin. *Aq. Conser.* 22: 11-25.)

CETACEANS IN PAKISTAN

Twelve species of cetaceans are reported from Pakistani waters. Close work with fishers helped identify entanglement in fishing gear (in light of major recent increases in fish exports by Pakistan) and opportunistic exploitation for use as food, bait or medicine as two major threats to local cetaceans. Additional issues along Pakistan's 1,050km of coastline include very high levels of chemical pollution near Karachi and the ship-breaking area of Gadani. The paper outlines a comprehensive project incorporating policy development, the preparation of a marine cetacean biodiversity action plan, the designation of a Marine Protected Area in Balochistan, the establishment of a national whale and dolphin conservation society, and trials of whale and dolphin watching.

(SOURCE: Gore, M.A., Kiani, M.S., Ahmad, E., Hussain, B. Ormond, R.F., Siddiqui, J., Waqas, U. and Culloch, R. 2012. Occurrence of whales and dolphins in Pakistan with reference to fishers' knowledge and impacts. *J. Cetacean Res. Manage.* 12(2): 235-247.)

POTENTIAL ENVIRONMENTAL THREATS TO WHALES IN THE SAVU SEA, INDONESIA

The Savu Sea in eastern Indonesia is the crossroads between two oceans and thus an important habitat for cetaceans. Efforts are being made to protect such migratory bottlenecks/marine corridors in the framework of MPAs. For example, the Dampier Strait MPA (Raja Ampat, Papua Barat, Indonesia) has recently been expanded from *ca.* 46,000 to 302,00 hectares. The Savu Sea study area is also traversed by two major shipping channels. The author identified this

as an 'unknown but possibly significant threat to large cetaceans', as is the common practice of reef bombing. A multi-year visual and acoustic survey and research program in the Savu Sea followed a tagged blue whale; the high proportion of time this animal spent on the surface at night implied increased vulnerability to offshore gillnets and long-lines. There is also intensive whaling pressure for sperm and baleen whales by traditional whaling communities in Lamalera, Lambala Island.

(SOURCE: Kahn, B. 2009. Blue whales of the Savu Sea, Indonesia; Kahn, B. 2009. Deep-sea yet nearshore cetacean habitats within the Marine Protected Area networks of Indonesia: Managing critical habitats for migratory and oceanic whale species. Indian Ocean Cetacean Symposium, Maldivian Marine Research Centre website: *http://www.mrc.gov.mv*)

INDUS DELTA INDO-PACIFIC HUMPBACK DOLPHIN POPULATION IN PAKISTAN FACES SEVERAL THREATS

A 4-year survey (2005-09) showed that the Indus delta was a very important habitat for Indo-Pacific humpback dolphins. The threats identified were 'increasing competition for food resources, bycatch, boat strikes, deforestation, pollution and increasing marine traffic'. The authors call for 'a sound conservation and management strategy which will also help fulfil the national conservation strategy of Pakistan'.

(SOURCE: Kiani, M.S., Gore, M. and Siddiqui, P.J.A. 2009. Photo-identification mark-recapture studies on Indus delta Indo-Pacific humpback dolphins of Pakistan. Indian Ocean Cetacean Symposium, Maldivian Marine Research Centre website: *http://www.mrc.gov.mv*)

CETACEANS IN INDIA

Twenty-five cetacean species have been recorded to date from Indian waters. The main threats to their survival are identified as fisheries interactions, domestic consumption (e.g. a lower estimate of 2,000 cetaceans caught per year in Malpe) and pollution. The authors identify a failure to develop a professional approach to cetacean research and conclude that the above threats are compounded by the lack of quality information to inform management. A first step is taken by summarising over 2,000 records to propose an inventory by state and identifying the level of data available (in five categories) for the respective species and/or areas.

(SOURCE: Kumarran, R.P. 2012. Cetaceans and cetacean research in India. *J. Cetacean Res. Manage.* 12(2): 159-172.)

GANGES RIVER DOLPHIN UNDER THREAT

The Ganges River dolphin is highly threatened in the Brahmaputra River system due to fisheries bycatch, poaching for their oil, habitat degradation and proposed seismic surveys related to oil prospecting. Approximately 240-300 of the total population of this species (2,000 individuals) inhabits the Brahmaputra system. Research conducted by the IUCN identified eight river sections as potential protected areas to save the dolphins.

(SOURCE: Anon. 2011. News. *Mar. Pollut. Bull.* 58(10): 1,424; Wakid, A. and Braulik, G. 2009. Protection of endangered Ganges River dolphin in Brahmaputra River, Assam, India. Final technical report to Sir Peter Scott Fund, IUCN, 44pp.)

CETACEANS IN SRI LANKA

Twenty-seven species of cetaceans have been recorded in Sri Lankan waters. Small cetaceans, however, are increasingly threatened due to the developing fishing industry, with bycatch being the key concern. Direct takes of small cetaceans by hand-held harpoons is also on the increase. The author identifies increasing shipping traffic and unregulated marine tourism as additional threats. Several large whales have been killed by ship strikes in recent years, and no specific regulations are in place to control or monitor whalewatching. Despite national legislation that protects cetaceans, implementation of the relevant laws and conservation efforts are hampered by resource constraints.

(SOURCE: Ilangakoon, A.D. 2012. A review of cetacean research and conservation in Sri Lanka. *J. Cetacean Res. Manage.* 12(2): 177-183.)

THREATS TO CETACEANS ALONG COAST OF BALOCHISTAN, PAKISTAN

A large proportion of stranded dolphins along the coast of Balochistan show signs that cause of death was interaction with fisheries. The author identifies two other main threats: shark fishing because fishermen use cetaceans as bait, and biotoxins from plankton blooms associated with the upwelling of nutrient-rich waters.

(SOURCE: Rahim, A. 2009. Stranding status and threats to cetaceans at coast of Balochistan. Indian Ocean Cetacean Symposium, Maldivian Marine Research Centre website: *http://www.mrc.gov.mv*)

POOR PROGNOSIS FOR THE ARABIAN GULF

The Arabian or Persian Gulf has experienced substantial changes to its marine habitats, leading to a poor prognosis for the Gulf to continue to provide abundant natural resources. The combination of anthropogenic disturbances (e.g. coastal development, overfishing), outside disturbances (e.g. sea-water warming) and poor cross-border and intra-country collaboration have severely impacted numerous benthic habitats, ecosystems and species groups. This has implications for many coastal cetaceans, which have distinct home ranges restricting their ability to move to alternative habitats. The status of cetaceans is poorly known in the Gulf, but marked declines have been reported for dolphins in the United Arab Emirates, for example. One explanation advanced for mass die-offs of dolphins is a reduction of prey species and changes associated with anthropogenic alteration of habitats.

(SOURCE: Sheppard, C. *et al.* (24 co-authors). 2010. The Gulf: A young sea in decline. *Mar. Pollut. Bull.* 60: 13-38.)

Fisheries

HIGH PROPORTION OF BYCATCH IN 10-YEAR SURVEY IN TANZANIA

In a report by the marine mammal research group established in Zanzibar, Tanzania, in 1999, 235 bycaught and stranded animals (whales, dolphins, and dugongs) were examined in a 10-year period. Of these, 210 (91%) animals were bycaught. The authors identify the bycaught animals as stemming from drift and bottom-set gillnets, suggesting fisheries are a threat to cetaceans here.

(SOURCE: Amir, O.A., Berggren, P. and Jiddawi, N.S. 2009. Records of marine mammal species in Tanzania after 10 years of research. Indian Ocean Cetacean Symposium, Maldivian Marine Research Centre website: *http://www.mrc.gov.mv*)

FISHING TECHNIQUES WITH NO BYCATCH CITED AS ONE REASON FOR CETACEAN ABUNDANCE IN THE MALDIVES

Most forms of fishing with nests, including gillnetting and purse seining, are banned in the Maldives to protect traditional pole and line tuna fishing. The authors attribute the rich cetacean community here (23 species and considerably higher acoustic detection and sightings rates than in the eastern Indian Ocean) to the favourable habitat and to the no-bycatch fishing techniques practiced in these waters.

(SOURCE: Clark, R.A., Johnson, C.M., Johnson, G., Anderson, R.C., Payne, R., Kerr, I., Godard, C.A.J. and Madsen, P.T. 2009. Cetacean sightings and acoustic detections in the offshore waters of the Maldives during January-March of 2003 and 2004; Anderson, R.C., Sattar, S.H. and Adam, M.S. 2009. Cetaceans in the Maldives – A review. Indian Ocean Cetacean Symposium, Maldivian Marine Research Centre website: *http://www.mrc.gov.mv*)

SEYCHELLES TAKES AN ACTIVE APPROACH TO SOUTHWEST INDIAN OCEAN REGIONAL COOPERATION ON CETACEAN RESEARCH

The Seychelles has made human-cetacean interactions a national priority. This involves hosting an international workshop on shark and cetacean depredation of longlines in 2007 under the umbrella of the IOTC (*http://www.iotc.org*).

Research on cetacean depredation of longlines is ongoing, pointing to the significance of cetacean interactions with fisheries here, with potential negative repercussions to both cetaceans and the industry.

(SOURCE: Gendron, G., Rowat, D., Lucas, V., Vély, M. and Giroux, F. 2009. Cetacean studies and conservation in Seychelles: Country report. Indian Ocean Cetacean Symposium, Maldivian Marine Research Centre website: *http://www.mrc.gov.mv*)

HIGH LEVELS OF DEPREDATION IN THE SEYCHELLES

The overall depredation rate of the semi-industrial swordfish and tuna fishery in the Seychelles was estimated to be 21%, one of the highest loss rates in the world. Sharks and several species of cetaceans were identified as potential culprits. This depredation entails considerable economic losses. Worldwide, such losses prompt actions by fishers against cetaceans. In order to avoid this, an action plan was drawn up, including the testing of two different types of mitigating devices. Neither proved successful, prompting future testing of an improved model.

(SOURCE: Lucas, V., Rabearisoa, N., Giroux, F., Vély, M., Rowat, D., Gendron, D., Tixier, D., Adam, O. and Guinet, C. 2009. Mitigating depredation in the Seychelles' semi-industrial longline fishery. Indian Ocean Cetacean Symposium, Maldivian Marine Research Centre website: *http://www.mrc.gov.mv*)

SCARRING FROM FISHING GEAR ON ENDANGERED ARABIAN SEA POPULATION OF HUMPBACK WHALES

The IUCN Red List has recently classified the Arabian Sea subpopulation of humpback whales as Endangered. A survey off the coast of Oman yielded estimates here of less than 100 individuals. Based on the analysis of scarring on the caudal peduncle region, 30%-40% of these animals 'are likely to have been involved in entanglements with fishing gear'. Although this value is lower than reported elsewhere (Gulf of Maine humpbacks or North Atlantic right whales), the authors conclude that, when viewed in relation to the stock's isolated status and low population estimates, 'this entanglement rate may represent a significant threat'. Considering Oman's rapidly developing economy and infrastructure, much of it focused on coastal and marine areas, the authors reiterate calls for research, management and conservation efforts to protect this stock.

(SOURCE: Minton, G., Collins, T., Findlay, K., Ersts, P., Rosenbaum, H., Berggren, P. and Baldwin, R. 2011. Seasonal distribution, abundance, habitat use and population identity of humpback whales in Oman. *J. Cetacean Res. Manage. (special issue)* 3: 185-198.)

STOMACH CONTENTS REVEAL POTENTIAL FISHERIES INTERACTIONS WITH DOLPHINS

The examination of three species of stranded dolphins along the Oman coastline – 11 bottlenose dolphins, five Indo-Pacific humpback dolphins and two spinner dolphins – revealed that all three were feeding in areas where artisanal and/or commercial fishing occurs. Although only a small percentage of the prey items in the stomachs were of commercial interest (pointing to little or no direct competition between fisheries and these cetaceans), the authors concluded that 'a number of animals examined in this study showed signs of mortality due to fisheries interaction, indicating that these dolphins still face significant risk of incidental capture from feeding in the same highly productive areas where fishing occurs'.

(SOURCE: Ponnampalam, L.S., Collins, T.J.Q., Minton, G., Schulz, I., Gray, H., Ormond, R.F.G. and Baldwin, R. M. 2012. Stomach contents of small cetaceans stranded along the Sea of Oman and Arabian Sea coasts of the Sultanate of Oman. *J. Mar. Biol. Assoc. U.K.* doi: 10.1017/S0025315411002104.)

Directed takes

HIGH LEVELS OF DOLPHIN HUNTING IN MADAGASCAR

In southwest Madagascar, traditional fishermen hunt coastal dolphins for local consumption and sale of meat. An interview survey indicated that about 6,000 dolphins (mostly spinner, Indo-Pacific bottlenose and Indo-Pacific humpback dolphins) were killed from 1985-2000; in addition, a drive hunt of 100-200 spinner dolphins was observed in 2005. A similar survey in an area where no hunts take place showed a dramatic difference in group sizes and encounter rates of humpback dolphins. In response, the authors initiated an education and awareness-raising program along with a series of stakeholder workshops, resulting in a stakeholder association explicitly devoted to cetacean conservation. MPAs are being considered as a further strategy.

(SOURCE: Cerchio, S., Andrianarivelo, N., Mendez, M., Razafindrakoto, Y. and Rosenbaum, H.C. 2009. Coastal dolphin hunting in Madagascar: Status of populations, human impacts and conservation actions. Indian Ocean Cetacean Symposium, Maldivian Marine Research Centre website: *http://www.mrc.gov.mv*)

Disease and mortality events

DOLPHIN MASS STRANDINGS IN IRAN

Two mass mortality events involving at least 152 small cetaceans occurred in southern Iran in 2007. The first event involved 79 spinner dolphins, which drifted ashore along 13km of coastline within about 24 hours. This led the authors to interpret this mortality to have been caused by a single acute event at sea. This event was 'spatially and temporally coincident with an active fishing ground, and other potentially bycaught and discarded species were found on the beach'. The authors also found traumatic injuries. Since they were able to exclude a Harmful Algal Bloom (HAB) and found no evidence of chemical or oil pollution, as well as no indications of seismic surveys or military exercises, they hypothesise that it was caused by fishing operations.

(SOURCE: Braulik, G., Savadkouhi, O.S., Fadakar, S., Mohammadi, H., Brownell, R.L., Jr., Reeves, R.R., Nabavi, M.B. and Fernandez, A. 2010. A retrospective investigation of two dolphin mass mortality events in Iran, autumn 2007. *Zoology in the Middle East* 49: 13-26.)

UNUSUAL MASS STRANDING OF SPOTTED DOLPHINS ON THE COAST OF PAKISTAN – A MILITARY EXERCISE LINK?

A mass stranding of pan-tropical spotted dolphins (200-250) occurred on 6 March 2009 on Gaddani Beach (25°09.024'N 66°44.298'E) on the Balochistan coast of Pakistan, approximately 50km northwest of Karachi. Animals began to strand at about 10:00 hours and continued until 14:00 hours, although some animals stranded on the following day (7 March). This is the first record of this species from the coast of Pakistan, and the largest mass stranding recorded of this species by an order of magnitude (three strandings of 3-11 animals have been reported from Florida and one of 13 animals occurred in Western Australia). A multi-national naval exercise (20+ warships from the US, UK, France and Australia; AMAN 09) was conducted in Pakistan waters between 5-14 March, and its commencement in Karachi coincided with the onset of the mass stranding. Therefore, data on warship location and sonar use/noise production must be analysed before military exercises can be ruled out as the cause of this unusual mass stranding.

(SOURCE: Kiani, M.S., Iqbal, P. and Siddiqui, J.A. 2011. First confirmation of occurrence of the pan-tropical spotted dolphin, *Stenella attenuata*, in Pakistani waters through a mass stranding event. *Mar. Biodivers. Rec.* 4(e60): 1-3 (doi:10.1017/S1755267211000601.)

ANTIBIOTIC-RESISTANT PATHOGENS INDICATE HEAVY POLLUTION WITH SEWAGE

Bacterial samples taken from the water and sediment in three coastal areas in southern India show a high frequency of resistance to antibiotics. This indicates that the coastal environment is highly exposed to antibiotic sources, apparently through sewage. This widespread occurrence

of pathogenic pollution indicators and antibiotic-resistant microorganisms would lead to a water quality classification of E (very poor) according to the World Health Organization. The bacteria examined (*E. coli, Salmonella, Vibrio, Enterococcus*) can have a pathogenic effect on humans and include forms that are known to impact cetaceans.

(SOURCE: Vignesh, S., Muthukumar, K. and James, R.A. 2012. Antibiotic resistant pathogens versus human impacts: A study from three eco-regions of the Chennai coast, southern India. *Mar. Pollut. Bull.* 64: 790-800.)

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Glossary of terms

Benthic: of or related to the bottom, particularly the bottom of the ocean.

Butyltin: a toxic chemical commonly used in anti-fouling paints on ship hulls (as tributyltin or dibutyltin, a break-down product of tributyltin).

Cytotoxic: toxic to cells.

Depredation: a predatory act; in the context of fisheries, the taking of fish from fishing gear by predators such as cetaceans.

E. coli (*Escherichia coli*): a bacterium present in the human digestive tract that, when found in a water body, indicates human fecal contamination and can cause infections such as gastroenteritis and other illnesses.

Endocrine system: a system of ductless glands producing hormones that control and moderate metabolic processes in the body.

Endocrine disrupter: any outside substance (chemical) that interferes with an organism's endocrine system.

Enterococcus: a bacterium present in the human digestive tract that, when found in a water body, indicates human fecal contamination and can cause urinary tract infections, bacteremia, bacterial endocarditis, diverticulitis and meningitis.

Immunotoxic (immunotoxicity): toxic to the immune system, caused by exposure to a chemical.

IOTC: Indian Ocean Tuna Commission

IUCN: International Union for Conservation of Nature.

Lipid weight: a basis of measurement whereby concentrations of a substance are compared to the lipid (fat) content of a material.

Mitigating device: a means of alleviating or reducing a concern or threat.

MPA: Marine Protected Area.

Organotin: organic chemicals containing tin.

Pathogenic: capable of causing disease.

PCB: polychlorinated biphenyls (209 different forms containing differing numbers of chlorine atoms arranged in various positions on the aromatic rings) are industrial organochlorines manufactured for use in electrical transformers and other applications. These man-made chemicals do not occur naturally and all traces reflect pollution. PCB (CB-154) is 2,2',4,4',5,5'-hexachlorobiphenyl, one of the most prevalent PCB congeners.

PCDD: polychlorinated dibenzodioxins (also simply dioxins) are a group of organic polyhalogenated compounds that are significant environmental pollutants.

PCDF: polychlorinated dibenzofurans are a group of halogenated organic compounds that are significant environmental pollutants.

Salmonella: a pathogenic genus of bacteria responsible, for example, for typhoid fever, paratyphoid and foodborne illness.

TBT: tributyltin, a form of butyltin.

TEQ: toxicity equivalent.

Vibrio: a pathogenic genus of bacteria responsible, for example, for cholera (*V. cholerae*) and other illnesses.

Species glossary

Bottlenose dolphin	*Tursiops* spp.
Ganges River dolphin	*Platanista gangetica gangetica*
Humpback whale	*Megaptera novaeangliae*
Indo-Pacific humpback dolphin	*Sousa chinensis*
Indo-Pacific bottlenose dolphin	*Tursiops aduncus*
Irrawaddy dolphin	*Orcaella brevirostris*
Killer whale	*Orcinus orca*
Pan-tropical spotted dolphin	*Stenella attenuata*
Spinner dolphin	*Stenella longirostris*
Tuna	*Thunnus* spp.

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