REPORT OF THE 2023 ASCOBANS-ACCOBAMS MARINE DEBRIS WORKSHOP: NEW AND EMERGING ASPECTS

Issue: Marine debris

Background

On 15th April 2023, ACCOBAMS and ASCOBANS organized a joint Marine Debris Workshop in the framework of the ECS Conference.
It aimed at better understanding the effects of marine debris on cetaceans, and the relationship between marine debris and fisheries.
The workshop was asked to consider the following points:

- How to improve collection of relevant data from stranded cetaceans, including identifying guidance for appropriate pathology
- How to best investigate the relationship between fishing gear and marine debris
- Best practice for debris recording for both ingested and entangled materials
- Best practice for sampling and recording of micro-debris
- How to best share information between interested scientists

REPORT
OF THE ASCOBANS-ACCOBAMS MARINE DEBRIS WORKSHOP: NEW AND EMERGING ASPECTS

O Grove, Galicia, Spain

15 April 2023

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1. Welcome and introduction to the workshop

The participants were welcomed by Mark Simmonds, the Chair of the workshop, and proceeded with a tour-de-table introductions.

Introduction to the interactions between marine debris and cetaceans – an overview of the current state of knowledge

The Chair provided a brief overview based largely on two sources: the IWC workshop on marine debris held at the end of 2019[1] and Eisfeld et al. (2022)[2].

The accumulation of human-derived debris in the oceans is a serious threat to marine wildlife and plastics are the materials causing most concern because of their persistence and other qualities, including their potential to introduce toxic substances and pathogens into the bodies of animals that have ingested them. There are records of interactions between most species of cetacean and marine plastics, and in some instances large quantities have been found in the alimentary canal and, in some cases, associated pathology reported. Whilst reports tend to be opportunistic and scattered, current knowledge suggests that the observed differences in the rate and nature of interactions with plastics relate to differences in species-specific feeding strategies, including the location and depth at which animals feed.

The mass of ocean plastic could increase by several orders of magnitude in the next decades. The contribution of the ongoing COVID-19 pandemic to marine plastic pollution appears to have been substantial. More positively, there has been good progress on a new international treaty to control plastics in recent months. A draft treaty is planned to be produced by the end of 2023.

The Chair suggested that in addition to considering the latest information about marine debris and cetaceans in the ASCOBANS/ACCOBAMS region, two issues were of particular interest at this time. Firstly, the need to better understand microplastics (typically defined as pieces smaller than 5mm) and their impacts (including as conveyors of other substances and pathogens). Secondly, the need to standardise reporting of marine debris from cetacean-related studies to allow comparisons to be made between studies. Another issue is that it is difficult to differentiate between entanglement in marine debris grieved from fishing gear (i.e. entrapment in abandoned, lost or discarded fishing gear – ALDFG) and entanglement in active fishing gear. Methods to determine the status of gear when interactions with animals occur are needed.

After this comprehensive introduction, three presentations were aimed at setting the institutional context, including the most recent development at the international level, that frame this workshop. A review of the bibliography related to the impacts of marine debris on marine biota was also presented.

Overview of relevant ACCOBAMS & ASCOBANS mandates and ambitions for this workshop
(by Célia Le Ravallec & Jenny Renell)

Celia Le Ravallec introduced the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and contiguous Atlantic Area (ACCOBAMS) that was adopted in 1996 and

[1] IWC 2020. Report of the IWC Workshop on Marine Debris: The Way Forward, 3-5 December 2019, La Garriga, Catalonia, Spain (Workshop Report No. SC/68B/REP/03.
[2] Eisfeld-Pierantonio, S.M., Pierantonio, N., and Simmonds, M.P., 2022. The impact of marine debris on cetaceans with consideration of plastics generated by the COVID-19 pandemic, Environmental Pollution, 300,118967, https://doi.org/10.1016/j.envpol.2022.118967.

entered into force in 2001. She reminded that it is established under the aegis of the Convention on Migratory Species (CMS), like ASCOBANS which is its daughter Agreement. ACCOBAMS' purpose is to achieve and maintain a favourable conservation status for cetaceans, in particular by improving knowledge of species and reducing threats to cetaceans, including marine litter.

Ms Le Ravallec then briefly introduced ACCOBAMS Resolution 8.20 on Marine Litter & Chemical Pollution adopted by ACCOBAMS Parties in 2022. In this Resolution, ACCOBAMS Parties are in particular invited:

- to undertake post-mortem investigations according to the best practice guidelines, and to support:
  - collective scientific efforts on the development of standardized methods to detect the occurrence and effects of marine litter, including micro-plastics, in cetacean species; and
  - the use of standardized formats to report results across the ACCOBAMS Area
- to support the identification of hot-spot areas for marine litter accumulation
- to propose cetacean species as indicators of marine litter in the ACCOBAMS Area
- to focus on the assessment of cumulative effects and multiple stressors, including chemicals, marine litter, climate change, and emerging pathogens, on cetaceans in the ACCOBAMS Area.

Jenny Renell introduced the Agreement on the Conservation of Small Cetaceans in the Baltic, North East Atlantic, Irish and North seas (ASCOBANS). This legally binding UN treaty was opened for signatures in 1992, and entered into force in 1994. ASCOBANS promotes close cooperation between countries to achieve and maintain a favourable conservation status for small cetaceans.

In 2020, the 9th Meeting of the Parties to ASCOBANS adopted Resolution 9.3 on marine debris. Its operational paragraphs, for example, encourage Parties and Non-Party Range States to mitigate impacts of marine debris. MOP9 also agreed to support efforts to end unnecessary use of single-use plastics, and to address abandoned, lost or otherwise discarded fishing gear. MOP9 also agreed that this threat requires further research, including long-term efforts to document the presence of marine debris, post-mortem examinations using clearly defined diagnostic approaches, identifying that there may be species-specific vulnerabilities to different debris components, and standardized recording of debris. Finally, the resolution asks the Secretariat to explore ways of increasing coordination and collaboration to share information, and develop and implement best practices.

The 27th Meeting of the ASCOBANS Advisory Committee in September 2022 instructed the Secretariat to establish a Working Group to organise a Marine Debris Workshop, jointly with ACCOBAMS, aimed at better understanding the effects of marine debris on cetaceans, and the relationship between marine debris and fisheries. The workshop was asked to consider the following points:

- How to improve collection of relevant data from stranded cetaceans, including identifying guidance for appropriate pathology
- How to best investigate the relationship between fishing gear and marine debris
- Best practice for debris recording for both ingested and entangled materials
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Ms Renell concluded by saying that she was looking forward to the contributions from this workshop.

Review of the recommendations of the IWC 2019 workshop on marine debris
(by Laetitia Nunny)

The third IWC workshop on marine debris took place in La Garriga, Catalonia, Spain in December 2019. It aimed to review the latest evidence on interactions with cetaceans including ingestion and entanglement, and the associated toxicology. The workshop recommended: emphasising the importance of long-term studies, the need for standardised approaches to post-mortem studies, the importance of strandings networks, the assessment of floating debris during aerial surveys and the

integration of marine debris concerns into IWC's Conservation Management Plans. It also highlighted the vulnerability of some species and the potential for indicator species.

The workshop called on the IUCN to consider marine debris in its next assessment of the sperm whale. The workshop encouraged engagement with international bodies, establishment of a roster of marine debris experts by the IWC and the development of a marine debris database of information from post-mortem examinations. The workshop welcomed the Joint ACCOBAMS/ASCOBANS document on 'Best practice on cetacean post-mortem investigation and tissue sampling'.

Most recommendations from the IWC 2019 workshop are in the ASCOBANS Resolution 9.3.

An overview of developments since 2020 including mention of the new international agreement (by Pine Eisfeld-Pierantonio)

In the recent publication Eisfeld-Pierantonio et al. (2022), 61 of 90 cetacean species had been identified as affected by either ingestion or entanglement. The revision of the South Asian river dolphin, *Platanista gangetica gangetica*, into Indus River dolphin, *Platanista minor*, and Ganges river dolphin, *Platanista gangetica*, and the addition of the Rice's whale, *Balaenoptera ricei*, in the summer of 2022, meant that we now have 92 cetacean species, 62 of which have been affected by marine debris. Please note that this table is kept up to date by Eisfeld-Pierantonio and Pierantonio and is not in the public domain.

On 2nd March 2022, during the resumed fifth session of the United Nations Environment Assembly (UNEA-5.2) in Nairobi a decision was made to end plastic pollution and forge an international legally binding agreement by 2024 by adopting resolution 5/14 End plastic pollution: Towards an international legally binding instrument. This landmark agreement will address the full lifecycle of plastic from source to sea. An Intergovernmental Negotiating Committee (INC) was established to develop an international legally binding instrument on plastic pollution, including in the marine environment, beginning its work in the second half of 2022 with the ambition of completing its work by the end of 2024.

The first session of the INC meeting took place from 28th November to 2nd December 2022 in Punta del Este, Uruguay. Even though there is a common understanding about the adverse effects of plastic pollution on human health and the environment, governments and stakeholders have voiced a diverse set of options for an international regulatory response. During the first week, delegates' visions for a plastic treaty were largely reflective of the level of their country's development, and their country's associations with plastic production and/or plastic waste. While an understanding emerged on the need for the treaty to encompass the full lifecycle of plastics, the definition of "lifecycle" has not yet been agreed. Different views persisted on when this lifecycle begins and ends, with some considering the need to address the early stages of plastic production, and others prioritizing starting only at the product-design phase.

The second session of the INC is scheduled to take place in Paris from 29th May to 2nd June 2023.

At the IWC Commission meeting in Portorož, Slovenia, in October 2022, the Commission unanimously adopted the resolution on Marine Plastic Pollution which sets out activities to include increased collaboration and cooperation with relevant international organisations and Scientific Committee work towards identifying hotspots of cetacean exposure to plastic debris.

The Chair noted that this resolution included the following paragraph: "EMPHASISING the alarming scale of actual and projected increases in plastic pollution and the adverse impact of marine plastic pollution on cetaceans, which is more substantial than previously thought" and that it requested the IWC Scientific Committee to develop an approach to be considered by the IWC that would assess the current knowledge of the impact of marine plastic pollution on cetaceans and would provide a global risk assessment that identifies 'hotspots' of cetacean exposure to plastic debris.

During the discussion, it was highlighted the possibility for IWC to organize a next international workshop to take stock of the progress made since 2019

Discussion

The Chair suggested that perhaps the workshop participants could reflect on what the UNEA Resolution meant in practice.

University of Siena was keen to offer a venue for the next potential IWC workshop on marine debris.

It was noted that sperm whales ingested a lot of plastic, would not be able to orientate properly, and therefore were more prone to ship strike and stranding. Another thing for pathologists to consider was to look at intestines even if obvious cause of death was ship strike. Encouragement of funding to stranding networks would ensure that they don't only assess the approximate cause of death, i.e. ship strike in this case, but what actually killed the animal – which may lie underneath.

There was also a behavioural component: why did cetaceans consume plastics? Playing, enjoying chewing, or something else. The example of a young sperm whale chewing on a bucket was given.

2. How to improve collection of relevant data from stranded cetaceans, including identifying best practice guidance for appropriate pathology

2.1. Best practice for debris recording for both ingested and entangled materials

How to improve collection of relevant data on marine debris from stranded cetaceans
(by Andrew Brownlow)

This talk focused on the documented incidence and impact of marine debris, as evidenced by stranding records and post-mortem examinations conducted in Scotland by the Scottish Marine Animal Stranding Scheme from 1992 to 2023.

Plastic pollution is a recognised menace to global marine wildlife, driven primarily by its pervasive presence in the marine environment, stemming from diverse human activities including packaging agriculture, and fishing. The reckless disposal of plastic items amplifies the threat, leading to severe consequences through ingestion and entanglement.

By interrogating data from the Scottish Marine Animal Stranding Scheme (SMASS), we systematically quantified the prevalence of macroplastic ingestion in cetaceans along Scotland's coasts. The examination of stomach contents from specific stranding cases, namely a sperm whale (Physeter macrocephalus) and a Cuvier's beaked whale (Ziphius cavirostris), were used as examples of the frequency and nature of the risk posed to cetaceans by plastic debris ingestion.

Among 1664 stranded cetaceans necropsied since 1992, SMASS identified 11 cases of macroplastic ingestion involving eight different cetacean species, resulting in a microplastic ingestion incidence of 0.66% in Scottish strandings from 1992 to 2023. Significantly, the type of ingested debris varied notably between the two studied whales, with Cuvier's beaked whale primarily consuming plastic sheeting from domestic and agricultural processes, while the sperm whale mainly ingested discarded and lost fishing gear.

This divergence in plastic consumption underscores the ubiquitous presence of plastics across coastal, pelagic, and benthic levels of the water column, leaving no sanctuary for marine organisms. The diverse array of species found to ingest plastics highlights the pervasive and potentially harmful impact on a wide spectrum of marine life.

To understand the full extent of both micro and macroplastic impact on marine wildlife and guide targeted conservation efforts, there is an urgent need for the development of enhanced data

collection, analysis and frameworks for interpretation. A proposed tier system for impact assessment might include:

a) Physical presence: Analysing gastrointestinal content to detect the occurrence and rate of marine litter ingestion and associated pathology.
b) Exposure: Analysing plastic additive levels as a proxy for ingestion, applicable to both free-ranging and stranded organisms.
c) Physiological response: Analysing biomarkers for biological responses to detect potential toxicological effects.

In conclusion, improving the assessment of the extent and severity of marine debris impacts on aquatic mammals necessitates internationally agreed protocols for stranding surveillance programs. Additionally, implementing improved waste management practices, particularly for end-of-life fishing gear, is imperative in mitigating this environmental challenge.

Discussion

It was highlighted that the IWC had a welfare aspect, whereas ACCOBAMS and ASCOBANS did not. Two points were noted: the selective nature of what cetaceans eat, and macroplastic ingestion (visible component) on the other hand. The Chair pointed out that based on these data, this was a conservation and a welfare issue. Putting aside fisheries interaction, it was noted that evidence was needed to the management authorities that plastic is a cause of death. Graphic images were deemed useful for raising awareness, but did not necessarily show a major effect.

UN treaty on plastics was considered a high-profile success. However, a question came back on how we collect the data and who would do the biomarker. Contaminants were the trickiest one. Chemicals could come from the ingested plastic itself, could be in the food chain – it would be important to find the reason. It was considered that rather than looking for a single cause, we should think about multiple stressors.

It was noted that the EU would soon publish marine litter collection guidelines, which included cetaceans as indicators. The idea was to interact with the institutions involved.

The joint best practise protocol of ACCOBAMS and ASCOBANS[3] could be improved, and it was recognized that there was nothing similar out there.

Mr Brownlow was encouraged to publish a scientific paper based on his presentation.

Driving Solutions to the Problem of Lost and Abandoned Fishing Gear
(by Joel Baziuk, pre-recorded video)

The Global Ghost Gear Initiative (GGGI) is the world's largest collective impact alliance dedicated to solving one of the most critical challenges facing our ocean today – that of abandoned, lost and discarded fishing gear (ALDFG or "ghost gear"). ALDFG has been identified as the most harmful form of marine debris to marine biota, and recent estimates suggest it may account for as much as 86% of the floating macroplastic in the ocean gyres by weight, making it one of the most serious threats to aquatic biodiversity, fisheries sustainability, aquatic ecosystems and the health of coastal communities.

The GGGI is a collaborative, cross-sectoral alliance of stakeholders from fishing industry, private sector, non-governmental organizations, intergovernmental organizations, corporations, governments, and academia dedicated to tackling ALDFG at a global scale. Launched in September 2015 and founded on the best available science and technology, the GGGI aims to improve the health of marine ecosystems, protect marine life from harm, and safeguard human health and livelihoods. The GGGI's strength lies in the diversity of its ~135 member organizations, including the official support from 20 governments, and many intergovernmental organizations such as the

[3] Annex to ASCOBANS Res.8.10 (Rev.MOP9)

European Directorate General for Maritime Affairs and Fisheries (EC DG MARE), OSPAR Commission, and the Fisheries and Agriculture Organization of the United Nations (UN FAO). As part of our collective impact, we contribute to the objectives of the Global Partnership on Marine Litter (GMPL) as well as to the delivery of many of the UN Sustainable Development Goals of the 2030 UN Agenda. The GGGI's aims are to address ALDFG holistically at scale around the world through prevention, mitigation and remediation projects, policy interventions, implementation of best practices and building of evidence about the lasting effects of ALDFG.

Discussion

It was noted that there was collaboration between IWC and GGGI on the melting ice bringing marine debris in, and a lot of other things were being discussed. Examples were given of positive collaboration with fishers to remove ghost gear (Alaska, Poland). GGGI was keen to expand what data they were collecting

The IWC Expert Panel on Strandings would have a workshop in Venice in May 2023. The Chair noted that the IWC Expert Panel on Stranding, Ship Strikes group, and Bycatch Mitigation Initiative should ensure that they are talking with each other.

Following concerns raised by fishers regarding the amount of both active and derelict fishing gear associated with the Scottish inshore creel sector, gathered during in-person interviews as part of the Scottish Entanglement Alliance (SEA, www.scottishentanglement.org) project, an online survey aimed at commercial creel fishers was developed in late 2021. The survey included questions on current gear use, loss, and recovery, and challenges around the disposal of end-of-life fishing gear. 208 usable responses were received representing approximately 14% of commercially active Scottish creel vessels.

Results indicated that while gear losses, particularly as a result of poor weather and conflict with other fishing vessels are common, successful recovery of this is limited, with 45% (n=90) of respondents reporting recovery success of less than 20% of lost gear. Almost half of respondents (48%, n=99) reported encountering ALDFG on at least a monthly basis, and 23% (n=49) admitted disposing of their own fishing gear at sea at least once in the last five years. 59% of respondents said that they did not have access to suitable gear disposal facilities locally, and many voiced concerns over gear saturation, increasing conflict between fishing sectors, and the impact of ghost fishing gear on the marine environment. Incentives to recycle and dispose of gear responsibly, and stronger legislation and policing of inshore fisheries to reduce conflict and further expansion of the sector were called for. While the SEA project found that active creel fishing gear poses an entanglement threat to cetaceans in Scottish waters, the risk posed by ALDFG remains unclear.

The discussions highlighted the need to improve the collaboration with fishers on this issue, in order to better understand the life cycle of nets and raise awareness about the impact of ALDFG on cetaceans and the marine environment in general, including fisheries resources.

2.2. Approaches to best investigate the sources of marine debris, including active and lost fishing gear

UK fishing gear strategy and targets required to reduce waste and environmental impact
(by Pine Eisfeld-Pierantonio)

Eisfeld-Pierantonio presented the issue of waste and environmental impact caused by fishing gear in the UK and Europe. She highlighted the high percentage of fishing gear lost annually, leading to marine litter in European seas and on beaches. The complexity of fishing gear materials makes recycling difficult, and there are limited companies specialised in recycling fishing gear within the UK and Europe.

UK harbours have different waste management approaches, with some providing facilities for separating and recycling fishing gear while others require fishermen to request skips for disposal (at

their expense). The MARPOL convention and two EU Directives (revised Port Reception Facilities (PRF) Directive and the Single Use Plastic (SUP) Directive) aim to address waste management, but the UK, having left the EU, still relies on pre-2019 legislation which does not provide sufficient incentives to return fishing gear to shore for collection and treatment which means that discharges of waste at sea still occur.

Marking fishing gear is essential to avoid conflicts, locate lost gear, and distinguish legal from illegal gear. While marking gear is mandatory in the EU and still applies to the UK, the current marking practice may not be sufficient for tracing back lost gear to its owners, which disincentivises retrieval efforts.

Despite expressing ambitions to address plastic pollution, the UK lacks a comprehensive strategy to tackle waste fishing gear, resulting in regional disparities in waste retrieval, collection, and recycling practices.

The presentation ended with some recommendations for a comprehensive strategy to effectively tackle end of life and abandoned, lost or otherwise discarded fishing gear that aligns with global efforts at the International Maritime Organisation (IMO) and UN plastics treaty level, as well as at regional seas and Regional Fisheries Management Organisation (RFMO) level, to ensure cohesion, particularly given the transboundary nature of plastic pollution

Discussion

Besides the lack of strategy to implement ambitious policy to manage and reduce ghost gears, the discussions highlighted the difficulties for scientists to distinguish between active and passive gear from stranding data: except in the case where old gear is embedded in the skin (i.e. biofouling), the description of the gear in scientific articles is often too limited to determine properly if the cause of death is due to bycatch in an active fishing gear or entanglement in a ghost gear. Highlighting the overlap between strandings and bycatch fields of research, the need to look at this issue more holistically was then concluded.

It was also pointed out that this situation creates a problem of responsibility between the different competent authorities: active gears are under the control of fisheries ministries whereas passive gears represent a cross-cutting issue that should be handle by several ministries.

For example, at CMS, discussions of which field ghost-gear belongs in concluded that it is not the same as marine debris. In that perspective, it was noted that a report on the relationship between Fishing Aggregating Devices (FADs) – known to produce a lot of debris – and marine debris will be considered at the next Conference of Parties to CMS. This report would be reviewed at the July 2023 meeting of the Sessional Committee of CMS Scientific Council.

Participants noted that aquaculture may also be a source of plastics debris, like mussel nets.

The workshop recommended then to establish an ASCOBANS-ACCOBAMS Working Group to deepen the knowledge on the relationship between fisheries/aquaculture and marine debris and their impact on cetaceans.

2.3. Best practice for sampling and recording of micro-debris (by Matteo Baini)

Marine debris ingestion by marine mammals is a significant problem that requires effective investigation methods. Traditional gastrointestinal tract (GIT) analysis protocols limit the potential for comprehensive investigation, leading to the loss of essential information. To cover this gap, a new standardized methodological approach to the GIT of marine mammals has been developed and applied. The study examined the GIT of 40 cetaceans stranded along the Italian coast from 2017 to 2022, including Ziphius cavirostris, Globicephala melas, Tursiops truncatus, Stenella coeruleoalba and Balaenoptera physalus. The examination revealed 790 debris items in 80% of the specimens, with artificial polymer being the only litter category isolated, mainly from the intestine rather than the

stomach. Polyethylene and polypropylene microplastic were the most ingested debris in the five species.

The results of this study also highlight the importance of analyzing items smaller than 1mm, which represents the majority of the litter found in marine mammals and can have significant impacts on individual health. The approach shows that a multidisciplinary sampling and evaluation of the GIT of marine mammals is possible with a few procedural adjustments. The approach presented contributes to the investigation of the ingestion and potential effect of marine litter, especially regarding microlitter on marine mammals interpreting and integrating results in a health assessment of the organisms. To obtain reliable information on changes (or stability) in ingested debris quantities, extensive and continuous sampling is required to provide the background information necessary to define 'health status' and to assess possible temporal trends. The protocol and results support the promotion of cetaceans as indicators of marine debris in governance programmes.

Discussion

It was noted that there is a difference in which species we see macro- and micro-litter. Whether micro-plastic is present due to secondary or primary ingestion may depend on the species and the age of the individual animal. More data is needed on certain species e.g. Cuvier's beaked whales.

It was confirmed that in Italy they are collecting data for all of the Universities to look at parasitology, pathology, diet and micro-plastics. The real health of the animal can be determined by collecting all this data.

In the Netherlands a similar process was used previously but there was no funding for debris of less than 1mm and because they could not prove harm, the funding was stopped. The Chair noted. that the presumption that there is no harm just because no harm is recorded, may be wrong.

It was noted that if you are not collecting samples for diet and parasitology, you can skip some processes e.g. the use of certain sieve sizes. The process used can be adapted depending on the specific research question. The analysis process has improved and can now be done by two people.

The same analysis was being done on sea turtles in Tunisia. The size of the animal impacts the size of micro-debris found and that turtles have more meso- and micro-plastic than cetaceans.

The Chair reminded the workshop that we do not know what the impacts of micro-plastic are on the individual animal and whether or not impacts are different for different sized animals. Mr Baini suggested that what he has presented is a starting point for a common approach.

The importance of a standard protocol was highlighted. This will help when making comparisons between geographical areas, as well as between species and species with different diets.

Trials could be carried out to see if reasonable data comes from sub-sampling.

3. Investigating the relationship between ingested marine litter and associated toxic chemicals, pathogens and pharmaceuticals (by Cristina Fossi and Cristina Panti)

Pressures on dolphins and whales in ocean and sea waters worldwide are higher than they have ever been in the last decades and have different origins. In the last 30 years, there has been growing concern about hazards to cetaceans occasioned by multiple stress factors, due to bioaccumulation and effects of anthropogenic contaminants combined with the impact of infectious diseases, marine litter including microplastics, climate change, food depletion (overfishing), noise, ship collisions, whale watching activities, and genetic erosion. The simultaneous combination of some or all of these pressures for different cetacean species may produce dramatic effects on population stability. While the levels of some legacy contaminants may be slightly declining in the marine environment, those of others such as polybrominated diphenyl ethers (PBDEs) and emerging contaminants including

plastic additives seem to be increasing. The need for sensitive markers of both legacy and emerging contaminants in cetaceans and for alternative ex vivo models to explore susceptibilities to these compounds led the scientific community to develop several biomarker techniques applicable to skin biopsies or tissues collected from stranded animals as a new nonlethal investigative tool.

In this context there are the needs: (1) to identify specific endpoints that can help to determine which pollutants and other stressors (e.g. plastic pollution) are of particular concern for cetacean species; (2) to describe case studies with a special focus on the effects of plastic additives and emerging contaminants, (3) to focus on the development of new promising –omics techniques to define the different levels of stress in cetaceans by a broad analysis of multiple biological pathways; (4) to identify hot spot sensitive areas for Mediterranean cetaceans.

Three case studies of cumulative effects of multiple stressors in cetaceans inhabiting the Mediterranean have been described: a) striped dolphin as sentinel of the marine health in the Mediterranean Sea; b) Fin Whales exposure to the ingestion of microplastics, POPs and emerging contaminants in the Mediterranean by using omics techniques; c) the identification of sensitive areas of risks for cetaceans inhabiting the Mediterranean Sea.

The discussions highlighted the lack of communication on the consequences of this contamination for the health of the animals. Because toxic contamination is not visible, it's an issue that attracts little attention. The need to make this issue more visible and to show that ingestion of plastics has an impact on animal health was emphasised. In particular, for new contaminants compared to old ones, no thresholds are defined to determine how dangerous the contamination is and the consequences for animal health.

4. Introduction to consideration of cetacean hot spots

Utilising cetacean species distribution data to identify hotspots in European Seas
(by P.G.H. Evans and J.J. Waggitt)

In order to determine where risk of impacts from ingestion of marine debris, it is important to identify abundance hotspots for different cetacean species that may have different vulnerabilities to particular sources of debris. Large-scale synoptic surveys such as SCANS and the ACCOBAMS Survey Initiative) are valuable to provide snapshot estimates of abundance for various species. However, they are not suited to identifying hotspots and how these may vary both seasonally and from year to year. For that, it is necessary to undertake surveys at shorter time intervals and at different times of year. In several European countries, regional surveys have been undertaken at more frequent intervals. By collating as many surveys as possible across time periods, there is greater possibility to obtain a more robust picture of variation in density distributions for cetaceans.

A data collation of 3 million km of survey effort (aerial, digital, and vessel effort) from 55 research groups for different time periods between 1980 and the present was used to model density distributions of 12 cetacean species regularly inhabiting the waters between Norway and southern Portugal. Data were standardised to derive effective strip widths for different platforms and estimates of G(0) (the probability of detection along the track-line) taking account of availability and perception bias. A hurdle model approach combining generalised linear modelling and general estimating equations was used alongside environmental variables believed to be relevant to the ecologies of the different species. The resultant density distributions were plotted in R on a monthly and seasonal basis at 2.5km and 10km resolution.

In order to demonstrate how maps of cetacean densities can be used to identify hotspots of risk for different human pressures, seasonal maps were produced showing the overlap between high density areas and high levels of fishing effort such as static gillnets indicating areas where lost or discarded nets (“ghost” nets) were most likely to be a threat to various cetacean species.

In discussion, it was noted that small vessels were not included in the statistics because they didn't carry VMS. It was also noted that it was possible to define "cold" spots on survey efforts.

Introduction to Consideration of Cetacean Hot Spots
(by Maria Cristina Fossi, Matteo Baini, Cristina Panti)

The main objectives of this presentation are to describe the current knowledge on the interactions between cetaceans and marine litter in the ACCOBAMS area and the hotspot accumulation area which can threaten cetacean species. The bibliographic research has been carried out considering mainly peer-reviewed papers, but also reports of projects on these issues and grey literature (ACCOBAMS Report "STUDY ON THE HOTSPOTS OF INTERACTIONS BETWEEN CETACEANS AND MARINE LITTER IN THE ACCOBAMS AREA, TO BE PREPARED IN LIAISON WITH RELEVANT EXPERTS AND SCIENTISTS FROM THE ACCOBAMS AREA", 2023).

One of the most important challenges to be faced in order to define the potential risk of cetaceans inhabiting ACCOBAMS areas, in relation to the presence of marine litter, is linked to the identification of the Hot Spot areas, as defined by the distribution ML models and the potential overlap with the core area of the different species. In order to make a contribution on this complex topic, this presentation describes two strategies, carried out by two important international projects, devoted to identifying risk assessment methodologies based on the presence of the ML and the species distributions. During the presentation we have we present the methodologies used and the preliminary results obtained from the application of risk analyses carried out in the study area by two projects and divided into the following sub-sections: ASI and Plastic Busters MPAs (PB-MPAs) Sinergy, Plastic Busters MPAs (https://plasticbustersmpas.interreg-med.eu/) methodology.

In conclusion, the interaction between plastic pollution and some cetacean species is strong and the particular feeding habits, and widespread distribution some cetacean species means that they can be proposed as ocean health indicators for macro- and micro-litter impacts at global scales, helping steer research. The species concerned are sperm whales (Physeter macrocephalus), for macro-litter at depth, and fin whales (Balaenoptera physalus), for micro-debris. Once appropriate techniques have been fully developed for non-lethal assessment, other whale species might also be used as indicators of litter pollution in their specific feeding zones. To coordinate scientific efforts to improve knowledge of marine litter (including seasonal distribution, quantification of floating marine litter in the SE Mediterranean, identify hotspots of marine litter to propose mitigation measures) and establish basin-scale monitoring on a regular basis to track changes over time.

5. Discussion, recommendations, outputs, future work

Using cetaceans as indicator species of the impacts of marine litter
(by Celia Le Ravallec)

Within the framework of the EU Marine Strategy Framework Directive, Marine Litter is considered under Descriptor 10 "Properties and quantities of marine litter do not cause harm to the coastal and marine environment".
As per Commission Decision 2017/848/EU, 2 secondary criteria address more particularly the interactions between litter and marine animals:

- D10C3: The amount of litter and micro-litter **ingested** by marine animals is at a level that does not adversely affect the health of the species concerned. Member States shall establish threshold values for these levels through regional or subregional cooperation
- D10C4: The number of individuals of each species which are adversely affected due to litter, such as by **entanglement**, other types of injury or mortality, or health effects. Member States shall establish threshold values for the adverse effects of litter, through regional or subregional cooperation.

The 2017 Commission Decision also recommend that these criteria should be monitored for species of birds, mammals, reptiles, fish or invertebrates which are at risk from litter and whose list should be established by Member States through regional or subregional cooperation.

In OSPAR for example, Member States have agreed to monitor plastic in fulmar stomachs in the North Sea and marine litter ingested by sea turtles. In the Mediterranean, as part of the Integrated Monitoring and Assessment Program (IMAP), the Contracting Parties to the Barcelona Convention have adopted the Candidate Indicator 24 “Trends in the amount of litter ingested by or entangling marine organisms focusing on selected mammals, marine birds and marine turtles (EO10)” and have started monitoring activities on sea turtles as part of the INDICIT projects.

The scientific evidence of recent years, particularly concerning the ingestion of marine litter by cetaceans, shows that cetacean species could also be used as indicator species for the impact of marine litter to the marine environment. Efforts are now needed to make progress in this direction and convince decision-makers and managers to consider cetacean species as indicator species for the level of marine debris pollution.

Discussion

The EU/JRC report recommended that beaked whales and sperm whales be considered as indicator species for collecting marine debris data. Participants discussed whether fin whales could also be considered as indicator species, because there were enough of them to model trends – which was more difficult for beaked whales – and they were more widely distributed. A concern was raised that sperm whales were not common in the waters of North Africa and, therefore, may not be appropriate as an indicator species. However, it was pointed out that there were no species that were common in all waters and the Chair suggested that different indicators could be used for different (sub-)regions. Harbour porpoises were also recommended to be included.

In discussion about efforts regarding data standardization, it was noted that if countries needed to report a bit different data to different entities, in the end they may not report at all, or report to only one.

Draft recommendations

Draft recommendations from the workshop were displayed and elaborated on the screen. The final list of recommendations is available in Annex 1.

6. Close of the workshop

The Chair thanked everyone for working so hard and a round of applause was given for a well-chaired workshop. ACCOBAMS received thanks for the financial contribution, without which the workshop would have not taken place, and ASCOBANS was thanked for the initiative and for inviting ACCOBAMS to co-organize the workshop. The workshop was closed at 18:15 CET on Saturday 15 April 2023.

Annex 1:

Recommendations from the ACCOBAMS-ASCOBANS Workshop on Marine Debris

- Noting the ongoing importance of long-term strandings networks and the associated pathological investigations, countries are encouraged to support them across the ASCOBANS and ACCOBAMS regions.

- Support research to better understand the distribution of marine debris in the water column and on the seabed and the risk it poses to different species and populations.

- Given the high levels of ingestion of marine debris by some species, it would be helpful to better understand the behavioural aspects of this (i.e. why do some species ingest plastics and under what circumstances).

- Experts from the ACCOBAMS and ASCOBANS regions were encouraged to review and further develop and improve the joint protocol *Best practice on cetacean post mortem investigation and tissue sampling* to better inform our understanding of the impact of marine debris and microplastics (down to 100 µm, when feasible) on cetaceans, including by making it better suited to conditions in the field. Additionally, consideration should be given to sharing of knowledge, facilities and samples for a multidisciplinary analysis (e.g. diet and pathogens).

- The potential high importance of the IWC in collecting and collating information about interactions between cetaceans and marine debris was highlighted and taking note of the recent commitment made by the IWC parties to better understand and map such interactions in Resolution 2022:1, the workshop encouraged suitable development of an IWC database for marine debris.

- ASCOBANS and ACCOBAMS are encouraged to support integration and harmonization of data collection and management systems which relate to marine debris.

- The workshop encouraged the IWC Scientific Committee to again convene an international workshop to help take forward its work on marine debris (an offer to host was gratefully received from the University of Siena).

- Establish an ACCOBAMS-ASCOBANS Working Group to look at interaction with fishers with regards to marine debris; a correspondence group was established to further discuss how to best progress this. Eisfeld-Pierantonio was requested to convene the correspondence group.

- The workshop encouraged the Scottish Entanglement Alliance (SEA) to continue its important work on research and mitigation of marine animal entanglements and encourages similar initiatives in other areas.

- Support research to better understand the health implications of marine debris at an individual and population level by
  a) defining new methods to evaluate the exposure to plastics and plastic additives in free-ranging organisms, which includes plastic-associated contaminants and biological responses,
  b) evaluating the presence and effects of micro and nanoscale plastics, including sub-lethal effects which can affect population in critical areas, and
  c) integrating data towards understanding the cumulative stress to cetaceans (ranging from contaminants of emerging concern to climate change).

- Enhance awareness raising by communicating to other scientists, young people and other citizens, stakeholders and policy makers.

- Reiterates the point made at the 2019 IWC workshop that the IUCN should take into account marine debris in its next assessment of the sperm whale.

- Support using cetaceans (e.g. sperm whales, fin whales, beaked whales) as indicator species for marine debris under relevant policy frameworks.

Annex 2: List of Participants

First Name	Family name	Affiliation	Country
Andreea-Mădălina	Ciucă	NIMRD Grigore Antipa Constanta	Romania
Andrew	Brownlow	University of Glasgow	United Kingdom
Célia	Le Ravallec	ACCOBAMS Secretariat	Monaco
Cristina	Panti	University of Siena	Italy
Elisa	Bravo Rebolledo	Waardenburg Ecology	Netherlands
Ellie	MacLennan	Scottish Entanglement Alliance (SEA)	United Kingdom
Emma	Neave-Webb	International Whaling Commission	United Kingdom
Heidrun	Frisch-Nwakanma	CMS Secretariat	Germany
Jenny	Renell	ASCOBANS Secretariat	Germany
Kate	Kaminska	The Fisheries Department	Poland
Laetitia	Nunny	OceanCare	Spain
Maria Cristina	Fossi	University of Siena	Italy
Mark	Simmonds	OceanCare	United Kingdom
Matteo	Baini	University of Siena	Italy
Matteo	Galli	University of Siena / Physical Sciences, Earth and Environment	Italy
Morgana	Vighi	Independent researcher	Spain
Olfa	Chaieb	INSTM - Institut National des Sciences et Technologies de la Mer	Tunisia
Peter	Evans	Sea Watch Foundation / School of Ocean Sciences	United Kingdom
Raquel	Puig Lozano	IUSA - ULPGC/ IIM - CSIC/ CEMMA	Spain
Sonja (Pine)	Eisfeld-Pierantonio	Whale and Dolphin Conservation	United Kingdom