APPENDIX A21 (1)

ASCOBANS
Conservation Plan
for Harbour Porpoises
(*Phocoena phocoena* L.)
in the North Sea

UNEP ASCOBANS

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1 INTRODUCTION

Harbour porpoises (*Phocoena phocoena*, Linnaeus 1758) are widely distributed in shelf waters of the temperate North Atlantic and of the North Pacific Oceans and in some semi-enclosed seas, such as the Black and Baltic Seas. The North Sea is an important habitat for harbour porpoises in the North East Atlantic. Harbour porpoises are exposed to a number of anthropogenic pressures (e.g. Bjørge & Donovan 1995) and are listed as threatened or endangered in several international conservation instruments (e.g. EC Habitats and Species Directive 1992 (92/43/EEC), Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention), Convention on Migratory Species (Bonn Convention), IUCN Red List of Threatened Species).

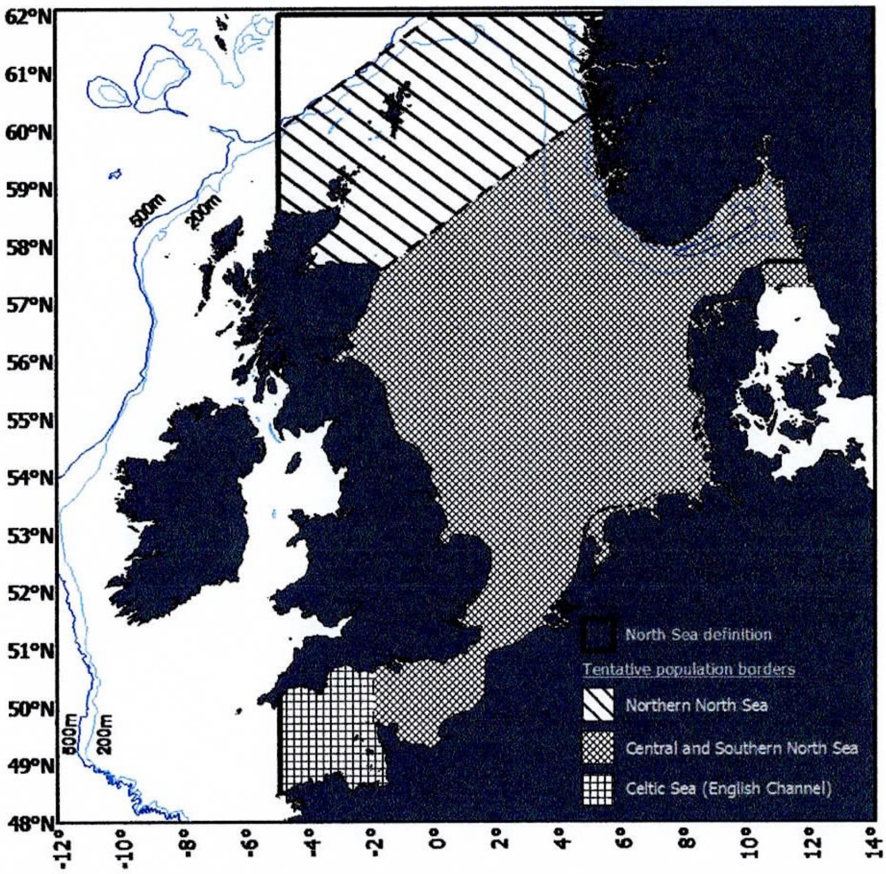

Figure 1: Map of the North Sea as defined at the 5th International Conference on the Protection of the North Sea in Bergen, Norway, 20 – 21 March 2002, showing the tentative harbour porpoise population borders. Note that the ASCOBANS agreement area does not cover all of the North Sea.

The 5th International Conference for the Protection of the North Sea (Bergen, Norway, 20-21 March 2002) called for a recovery plan for harbour porpoises in the North Sea to be developed and adopted (Paragraph 30, Bergen Declaration). Germany volunteered in 2003 to draft a recovery plan[1] within the framework of ASCOBANS and in association with Range State Norway.

[1] Due to data from SCANS-I, SCANS-II and national surveys on harbour porpoise abundance and distribution in the North Sea, ASCOBANS considered it more appropriate to call this document *Conservation Plan* rather than a Recovery Plan.

This document builds upon considerable work by a number of people. It summarises the current state of knowledge about North Sea harbour porpoises and the risk factors affecting them; detailed information is given in Eisfeld & Kock (2006). The Conservation Plan aims at achieving and maintaining a favourable conservation status, specifically by suggesting a series of priority actions.

2 BACKGROUND INFORMATION ON THE SPECIES

2.1 POPULATION STRUCTURE, ABUNDANCE AND DISTRIBUTION

Harbour porpoises occur throughout the North Sea and adjacent waters. They are highly mobile. Various lines of evidence suggest that there is stock structure within the North Sea (for details see Eisfeld & Kock, 2006) but the information is not sufficient to define strict or permanent boundaries between any (sub-) populations. IWC/ASCOBANS (2000) divided harbour porpoises occurring in the North Sea for practical management purposes into a Northern North Sea stock, a Central and southern North Sea stock and an additional one occurring in the western Channel (figure 1, table 1).

There are 'open' borders to the north, northwest, Kattegat and south west shelf seas. The implications of these open borders are that additional management actions may be needed outside the boundaries of the North Sea (as defined in this document) in order to achieve objectives within the North Sea. For instance, it is believed that harbour porpoises in the western Channel and the Celtic Sea are part of the same population.

The distribution of harbour porpoises is not static in space or time. For instance, in records from 1979-1997, sighting rates in the south eastern North Sea, the southern Bight and the northern English Channel were substantially lower than in areas further north (Evans *et al.* 2003; Reid *et al.* 2003). More recent surveys reported higher sighting (Scheidat *et al.,* 2003; 2004; Brasseur *et al.,* 2004) and strandings rates (Haelters *et al.,* 2002; Jauniaux *et al.,* 2002; Kiska *et al.,* 2004; Camphuysen, 2004) in the southern North Sea and southern Bight. This increase in both sighting and stranding rates in these southern parts of the North Sea over a relatively short period of time suggests a redistribution of animals from other areas in recent years rather than a sudden and rapid increase in population growth in the southern North Sea. Results from the SCANS II survey (SCANS-II, 2008) confirm that densities in the southern parts of the North Sea have increased while densities in more northerly regions have declined between 1994 and 2005 (Table 1 and Fig 2). Encouragingly, the results suggest that abundance in the North Sea as a whole has not changed significantly.

3 DEVELOPMENT OF THE CONSERVATION PLAN

This plan follows the general process used in the development of the Conservation Plan proposal for the bottlenose dolphin in the Spanish Mediterranean (Donovan *et al.* 2008).

3.1 OBJECTIVES

The development of this Conservation Plan was the result of a call by the 5th International Conference for the Protection of the North Sea. Similarly, the geographical boundaries of the Plan were set following those indicated at that Conference (Fig.1), rather than as a result of an evaluation of harbour porpoise stock structure. Consideration of the effect of the boundaries is a key component of the Conservation Plan. Similarly, the objectives of the Conservation Plan were defined by the 5th North Sea Conference and reflect Article 1 of the EU Habitats Directive.

These are:

"This Plan aims to restore and/or maintain North Sea harbour porpoises at a favourable conservation status, whereby

- population dynamics data suggest that harbour porpoises are maintaining themselves at a level enabling their long-term survival as a viable component of the marine ecosystem;
- the range of harbour porpoises is neither reduced, nor is it likely to be reduced in the foreseeable future;
- habitat of favourable quality is and will be available to maintain harbour porpoises on a long term basis; and
- the distribution and abundance of harbour porpoises in the North Sea are returned to historic coverage and levels wherever biologically feasible."

These objectives incorporate the ASCOBANS goal of to restoring and/or maintaining populations at 80% or more of the carrying capacity (ASCOBANS, 1997).

Currently it will be difficult to demonstrate the full achievement of these (long-term) goals as insufficient knowledge exists on past harbour porpoise distribution and abundance. The ability to predict the future is also difficult and will need to be based on modelling with assumptions for which we have limited data. However, in the shorter-term a pragmatic minimum objective is to at least maintain the present situation and, if possible, improve it. In any event, it is essential that an appropriate modelling framework is developed that will enable an evaluation of management goals. Progress has been made within the SCANSII project (SCANS-II 2008) building upon the work undertaken by the joint IWC/ASCOBANS working group (IWC, 2000).

Table 1: Abundance and densities of harbour porpoises in the North Sea and adjacent waters during SCANS I as estimated by Hammond et al., 1995 and SCANS II as estimated by SCANS-II, 2008. Figures in round brackets are coefficients of variation; figures in square brackets are 95% confidence intervals.

	SCANS I			SCANS II		
Greater Region	**SCANS block**	**Abundance [no. of animals]**	**Densities [animals/km2]**	**SCANS block**	**Abundance [no. of animals]**	**Densities [animals/km2]**
Northern North Sea	E	31,419 (0.49)	0.29	T	23,766 (0.33)	0.18
	D	37,144 (0.25)	0.36	Q*	10,002 (1.24)	0.07
	M	5,666 (0.27)	0.45	M	3,948 (0.38)	0.31
	J	24,335 (0.34)	0.78	J	10,254 (0.36)	0.27
Subtotal (northern North Sea)		98,564 [66,679-145,697]			47,970	n.a.
Central & southern North Sea	C	16,939 (0.18)	0.39	/*	/	/
	F	92,340 (0.25)	0.78	V	47,131 (0.37)	
	G	38,616 (0.34)	0.34	U	88,143 (0.23)	0.56
	H	4,211 (0.29)	0.10	H*	3,891 (0.45)	0.36
	L	11,870 (0.47)	0.64	L	11,575 (0.43)	0.56
	Y	5,912 (0.27)	0.81	Y	1,473 (0.47)	0.13
Subtotal (central & southern North Sea		169,888 [124,121 - 232,530]			152,213	n.a.
English Channel (mostly)	B	0,000	0.000	B	40,927 (0.38)	0.33
Celtic Shelf	A	36,280 (0.57)	0.18	P*	80,613 (0.50)	0.41
TOTAL		341,000 (0.14)			321,723 (0.15)	

*these areas differed slightly in shape and size between SCANS and SCANS-II

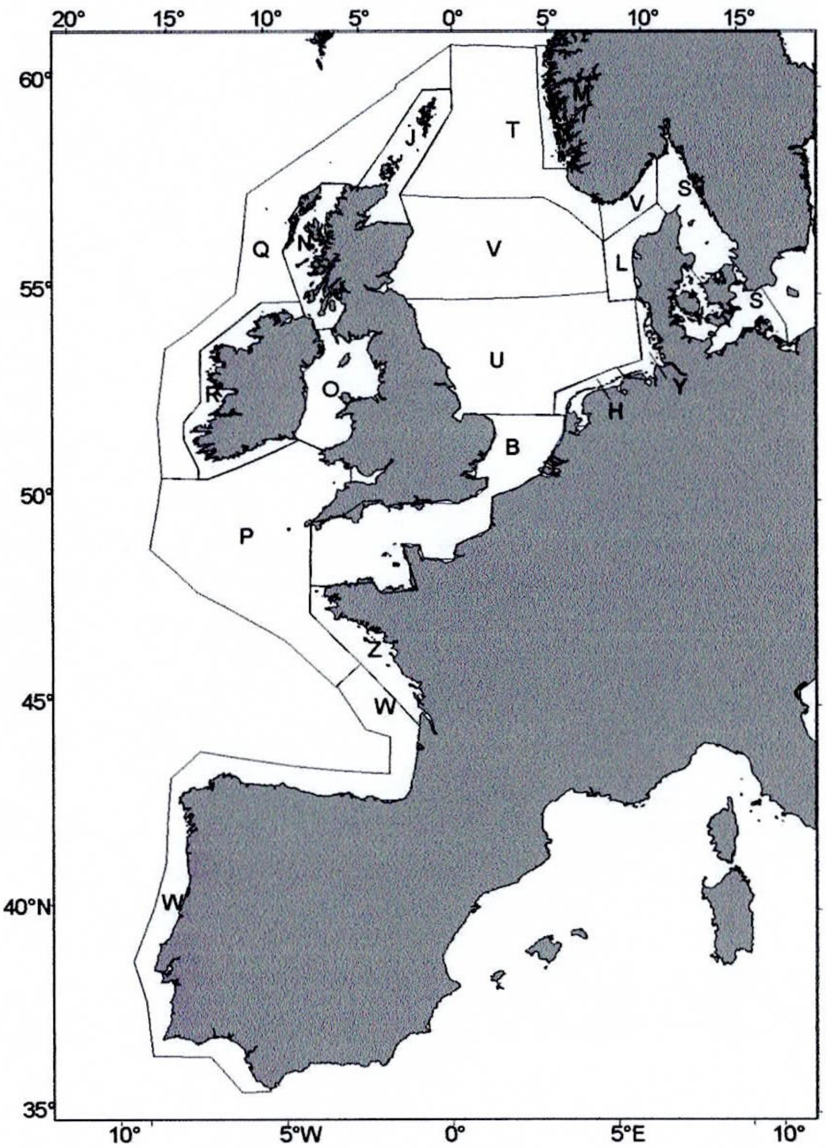

Figure 2: Survey blocks defined for the SCANS-II surveys. Those surveyed by ship were S, T, V, U, Q, P and W. The remaining blocks were surveyed from aircraft.

3.2 ACTUAL AND POTENTIAL ANTHROPOGENIC THREATS

In developing the Conservation Plan, it is important to evaluate the main threats that affect or could potentially affect harbour porpoises in the North Sea area (Fig.1, table 2). These were reviewed in for this Conservation Plan.

The primary focus of the Plan is on those threats that affect the status of the population, noting legitimate concerns that there may also be threats on the welfare of the individual animals.

It should be noted that some human activities (Table 2) may act cumulatively, and some threats may be caused by several human activities (alone or in combination).

Table 2: Approximate distribution and scale of human uses in the North Sea in relation to the notional harbour porpoise sub-populations

+++ = major use, ++ = medium use, + = minor use.

	Northern North Sea	Central & southern North Sea	Western English Channel
Fishing	+++	+++	+++
Contaminant discharge	+	++	+
Shipping	+	+++	+++
Hydrocarbon exploration	+++	+++	
Sewage discharge	+	+++	+
Construction	+	+++	
Aquaculture	++	+	
Mineral extraction		++	
Recreation	+	+++	++
Military	+	+	+

Table 3 is a summary of the various threats to harbour porpoises in the North Sea, the evidence for them and a qualitative categorisation of the threat, along with some comments on mitigation measures. This information was then used to determine a series of actions (and their priority/time-frame) under the Conservation Plan.

While there is inevitably some overlap, the actions can be categorised as follows:

(1) Research related to determining whether conservation objectives are being met (e.g. stock structure and distribution, abundance and trends, population modelling);
(2) Research related to the scale of potential threats (this will include research on the biology/ecology of the animals as well as collection of information on the nature and extent of relevant anthropogenic activities, including underwater noise);
(3) Assessing and monitoring levels of known threats (primarily bycatch in fishing gear)
(4) Implementation of mitigation measures for known threats, including monitoring the implementation and collecting data to assess efficacy;
(5) Evaluation of existing and development of new mitigation measures for identified threats.

Table 3: Summary of information of actual and potential threats to harbour porpoises in the North Sea area

Actual/ Potential Threat	Anthropogenic activity/ies	Evidence	Possible impact (in many cases an educated guess)	Prioritisation for action	Actual/potential mitigation measures
Bycatch	Commercial and recreational gillnets, wreck nets, tangle nets, bottom trawls	Strong. Based on observer programmes, stranded animals. See estimates in Table 4	Potentially high especially in some areas, depends on scale of fishing activity	High (implementation of mitigation measures, collection of data, incorporation into modelling framework, improved knowledge of stock structure and movements)	In short-term at least, pingers are effective for certain fisheries but adequate monitoring of implementation and effectiveness essential. Further research is needed into their medium-long-term efficacy and ways to improve them, and provide time to develop better methods
Serious injury/death (not bycatch)	Ship strikes from commercial and recreational vessels	Weak. Indications could be obtained from strandings programmes, photographs	Not believed to be high but possibly localised e.g. in areas with a relative high calve percentage	Low (effort should be directed at research to determine extent in targeted areas)	Shipping lanes, speed restrictions and/or protected areas may be effective if need established and good information on geographical and temporal distribution known
Mechanical destruction of habitat	Bottom trawls, infrastructure construction, oil and gas development, gravel extraction	Known that damage is caused.	Direct effect on harbour porpoises probably v. low but see 'prey depletion'	Low	Restrict activities and/or change methods based on EIAs
Prey depletion	Overfishing, habitat degradation due to pollution, climate change	Many fish stocks depleted due to factors such as overfishing, habitat damage, and possibly climate change(but unknown)	Potentially a problem but insufficient knowledge of harbour porpoise feeding ecology or fish dynamics	Medium (effort directed at research on feeding ecology; co-operation with fishery biologists)	Effective fishery regulations based on good science

Actual/ Potential Threat	**Anthropogenic activity/ies**	**Evidence**	**Possible impact (in many cases an educated guess)**	**Prioritisation for action**	**Actual/potential mitigation measures**
Acoustic pollution/harassment	Fishing vessels, general maritime traffic, acoustic harassment devices at fish farms, pingers, military activities, infrastructure construction, oil and gas development (including seismic surveys, explosions) recreational activities	Clear evidence that noise pollution is high and has increased in recent times due to a wide variety of human activity	Potentially a problem (could impede communication, affect distribution and hence feeding/reproduction) but lack of direct evidence of long-term impact on harbour porpoises	Medium (effort should be directed at better assessment of impact of various noise sources on harbour porpoises)	A number of mitigation measures have been proposed (e.g. for mitigating noise from pile driving for windfarms, seismic survey guidelines) but efficacy, especially for harbour porpoises unknown and needs evaluation. Cover in EIAs.
Chemical pollution	Terrestrial industrial development, terrestrial run-off harbours, ships, aquaculture, sewer discharges, aerial transport.	Clear evidence of chemical pollution within the North Sea	Some evidence certain pollutants may affect health status of harbour porpoises (increased susceptibility to infectious diseases). Quantitative evaluation not available	Medium (further effort at examining cause-effect relationships in a population dynamics framework)	A number of conventions deal with aspects of chemical pollution. Irrespective of scientific knowledge on effects on harbour porpoises, these must be implemented and efficacy monitored
Climate change	The global climate change is likely to increase the temperature of the North sea	Time series document increasing trend in North Sea temperature. Monitoring programs show increase of southern cetacean species	Increase d occurrence of new cetacean species can be unfavourable to porpoise due to competition for food or aggressive behaviour	Low (further effort to monitor northward shifts in distribution of cetaceans from warm temperate Atlantic)	A number of international and intergovernmental organisations and conventions are dealing with climate change and efforts to reduce increase in global temperature.

Table 4: Summary of bycatch information for harbour porpoises. Figures in square brackets are 95% confidence intervals.

* Extrapolated from bycatch rates determined from observers 1987 – 2001. First estimate is based on fleet effort, second is based on landings as used by Vinther (1999). Bycatch is probably overestimated due to use of pingers in cod wreck fishery not being accounted for.

Greater Region	ICES area	Country	Main gear type	Target species	Size of fisheries	Estimation method	Year	Total reported bycatch	Estimated annual bycatch	Seasonal peaks	Source
Norwegian coastal North Sea waters	VIa	Norway	Bottom-set gillnets	Angler fish, cod, mixed fisheries		observed	2006	4	Not yet available		Bjørge 2007
Norwegian Skagerrak	IIIa	Norway	Bottom-set gillnets	Angler fish, cod, mixed fisheries		observed	2006	10	Not yet available		Bjørge 2007
Kat./IDW/ German Baltic	IIIa	Sweden	bottom trawls			fishermen interviews	2001	-	80	-	ASCOBANS 2004
			pelagic trawls	herring				1	11		
			trammel nets	lumpfish				1	8		Lunneryd *et al.*, 2004
			gillnets	sole, cod, crab				6	70		
Skagerrak	IIIa	Sweden	gillnets, trammel nets, pelagic trawls	cod		fishermen interviews	2001	-	20	-	ASCOBANS, 2004
			bottom trawls					2	25	-	Lunneryd *et al.*, 2004
North Sea	IV	UK	set nets	cod, skate, turbot, sole, monkfish, dogfish			1995 - 2002	-	439 [371-640]	-	ASCOBANS, 2004

Greater Region	ICES area	Country	Main gear type	Target species	Size of fisheries	Estimation method	Year	Total reported bycatch	Estimated annual bycatch	Seasonal peaks	Source
Central & Southern North Sea	IV	Denmark	wreck nets, gillnets	cod, hake, turbot, plaice, sole	very large	observer program	1987 - 2002	-	5,817/ 5,591*	-	Vinther & Larsen, 2002
	IV b	Germany	gillnets	cod, turbot, sole, other demersal fish	small	observer program	2002 - 2003	-	25-30	-	Flores & Kock, 2003
	IVc	Belgium	gillnets gill + trammel nets	sole, plaice, cod		strandings	2003-2007	90		32 (2006)	ASCOBANS, 2004; Haelters & Kerckhof 2005, Haelters & Camphuysen 2009
	IVc	Netherlands	gillnets	unknown	unknown	strandings	2003 & 2004	-	100	-	Reijnders, 2005; García Hartman, *et al.*, 2004
Celtic Shelf (incl. Channel)	VII e, f	UK	gillnets	hake	medium	Observer program	August 1992 – March 1994	28	740 [383-1097]		Tregenza *et al.*, 1997
			tangle nets					1			
			wreck nets gill + tangle nets	hake and other white fish			2005 / 2006	0	453 / 728	March - May	ICES, 2008
	VII g, h, j, k	Ireland	gillnets, wreck and tangle nets					14	1497 [566-2428]		ICES, 2008
			gill + tangle nets		Big		2005-2007	-	350		
	VII e, h	France	Gillnets, tangle nets, trammel nets	Monkfish			1992 – 1993	0		-	Morizur *et al.*, 1996

4 SUMMARY OF ACTIONS

In addition to some specific actions, there are some important general considerations that require elucidation.

4.1.1 DEALING WITH INADEQUATE DATA

Ideally, all conservation plans and associated management actions should be based on full and adequate scientific data. However, there are occasions when the potential conservation consequences of waiting for confirmatory scientific evidence may mean that it is better to take action immediately whilst collecting the necessary information. This has become known as following the "Precautionary Principle". However, application of the precautionary principle must be carefully considered and adequately justified.

One of the main challenges encountered in the process of developing this initial version of the Conservation Plan has been that a lack of data, both with respect to:

(1) the target species (e.g. stock structure, movements and feeding ecology); and

(2) human activities and their actual/potential impact at different levels (e.g. adequate data on "effort / scale" of certain human activities; adequate data on the effect(s) on the species).

An important part of the development of this Conservation Plan has been to identify the major information gaps that need to be filled in order to improve recommended conservation measures. Consequently, the actions include a number of research and monitoring actions aimed at obtaining the necessary baseline information for the establishment of adequate scientifically-based management actions.

4.1.2 MONITORING

Establishing the necessary baseline information as a scientific reference for conservation actions is only the first step towards effective conservation. Once this is achieved, monitoring (of the species concerned, threats due to human activities, implementation of mitigation measures and effectiveness of those measures) **must** be seen as an integral and essential part of management, not an optional extra (as stressed by e.g. Donovan, 2005). Monitoring is required in order to obtain information on trends in the conservation status of harbour porpoises and to examine the effectiveness of the management actions and if necessary adjust them to achieve our established conservation aims. As stated by the European Union's Habitats Directive (Article 12(4): "Member States shall establish a system to monitor the incidental capture and killing of the animal species listed in Annex IV (a). In the light of the information gathered, Member States shall take further research or conservation measures as required to ensure that incidental capture and killing does not have a significant negative impact on the species concerned".

4.1.3 LIFE OF THE CONSERVATION PLAN

No conservation plan should be regarded as a definitive and unalterable document. It is rather a document that covers a temporal phase within the framework of the efforts for the conservation of a species, and therefore needs to be reviewed periodically to adjust the actions to the diverse changes that can occur, either in response to the results of the monitoring of the conservation plan actions themselves or to changing external factors.

4.1.4 IMPLEMENTATION OF THE CONSERVATION PLAN; CO-ORDINATION, INVOLVEMENT OF STAKEHOLDERS

Experience has shown that in order to be effective, Conservation Plans must have a recognised, full-time co-ordinator. This is particularly true where effective conservation requires action (including legislative action) by a number of stakeholders including: intergovernmental and national authorities, scientist from several disciplines, representatives from industry, local communities, and interested NGOs. The scale of work required by this Plan exceeds the resources available within the (part-time) ASCOBANS Secretariat. Ideally, the co-ordinator should have a scientific and management background and be an effective communicator to the various stakeholders. The importance of actively involving stakeholders, especially those whose livelihoods may be affected (e.g. fishermen), cannot be overemphasised. The co-ordinator should report to a Steering Committee appointed with close collaboration between ASCOBANS, the North Sea RAC (Regional Advisory Council), the EU, Norway and other appropriate authorities.

While measures to control and reduce pressures and impacts on the marine environment do exist on a national and European level, they have been developed in a sector by sector approach resulting in a patchwork of policies, legislation, programmes and actions plans at national, regional, EU and international level. It is necessary to encourage North Sea Member States to harmonise their national efforts to ensure that the Conservation Plan is implemented.

Amongst other things, the Co-ordinator/Steering Committee would be asked to:

- promote and coordinate the implementation of the Conservation Plan (including investigating funding) with particular attention paid to affected stakeholders;
- gather information on its implementation, the results obtained, the objectives reached, and the difficulties encountered;
- communicate this information to the general public through regular reporting in an accessible format;
- appoint a group of experts to evaluate the effectiveness of the Conservation Plan every three years and to update it. The conclusions of this group should be made public.

Finally, it has to be stressed that a Conservation Plan will be useless if sufficient funding is not found. At the very least, sufficient funds must be made available for the appointment of a co-ordinator and the functioning of the Steering Group at the earliest opportunity.

4.1.5 EXECUTIVE SUMMARY OF THE ACTIONS

As noted above, the Conservation Plan will be useless without appropriate co-ordination and support. This is the focus of

> *Action 1 implementation of the Conservation Plan: co-ordinator and Steering Committee.*

Table 3 summarises the present state of knowledge of actual and potential threats to harbour porpoises in the North Sea. It is clear from that table that the highest priority must be given to the question of **bycatch**. For that reason the majority of Actions focus on aspects of that problem ranging from:

Management (and related monitoring) actions

Action 2: implementation of existing regulations on bycatch of cetaceans;

Action 3: establishment of bycatch observation programmes on small vessel (<15m) and recreational fisheries;

Action 4: regular evaluation of all relevant fisheries with respect to extent of porpoise bycatch;

Action 9: collection of incidental catch data through stranding networks in the region;

Mitigation measure research Action

Action 5: review of current pingers, development of alternative pingers and gear modifications;

Scientific actions essential for providing adequate management advice

Action 6: finalise a management procedure approach for determining maximum allowable anthropogenic removals in the region;

Action 7: monitoring trends in distribution and abundance of harbour porpoises in the region;

Action 8: review of the stock structure of harbour porpoises in the region;

Of course, Actions 6-8 are relevant to all anthropogenic activities.

As shown in Table 3, our level of knowledge on the effects of **other anthropogenic activities** on harbour porpoises is limited. Before discussing specific actions aimed at improving our knowledge of these, it is worth emphasising that for certain potential threats, it is clear that at best the activities will be neutral and more likely negative; in such cases there is no reason for management action not to be taken before our knowledge of effects on harbour porpoises improves. It is therefore **strongly recommended** that existing legislation and agreements with respect to e.g. chemical pollution and climate change are implemented effectively. It is also clear that effective fisheries management based on sound science is essential.

That being said, there are a number of research actions aimed at improving our understanding of potential threats to harbour porpoises within the region:

Action 10: investigation of the health, nutritional status and diet of harbour porpoises in the region;

Action 11: investigation of the effects of anthropogenic sounds on harbour porpoises

Action 12: collection and archiving of data on anthropogenic activities and development of a North Sea-wide GIS based database

5 ACTIONS

The Actions are provided below, with each action beginning on a new page. At present no costs are associated with these actions but they will undoubtedly be expensive. One of the first tasks for the Co-ordinator/Steering Committee will be to develop detailed specifications for each action and where appropriate, assign costings and likely sources of funding

ACTION 1: IMPLEMENTATION OF THE CONSERVATION PLAN: CO-ORDINATOR AND STEERING COMMITTEE

Management Action Priority: HIGH

SPECIFIC OBJECTIVES

To ensure that timely progress is made with respect to the overall implementation of the Conservation Plan and the specific actions included therein, and to provide progress reports for appropriate bodies including ASCOBANS, the North Sea RAC (Regional Advisory Council) and the EU.

RATIONALE

This Conservation Plan is complex and for it to be effective it will require considerable co-ordination and the development of detailed workplans for the individual Actions. In particular, its success is dependent on a large number of stakeholders and a broad range of areas of expertise. Without a full-time co-ordinator to support a larger Steering Committee it is highly unlikely that the Conservation Plan will be successfully implemented.

TARGET

Appointment of a Steering Committee for the Conservation Plan and the appointment of a suitably qualified full-time co-ordinator (needs a conservation science background) for the Conservation Plan (with an appropriate budget)

TASKS

- Document and collate existing international and national regulations and guidelines that are relevant to the conservation and management of harbour porpoises in the North Sea and to provide this collation to all stakeholders.
- To promote and explain the Conservation Plan to relevant stakeholders, including:
    - International and supranational bodies
    - Range states
    - Appropriate industry representatives incl. fisheries, hydrocarbon exploration, shipping etc
    - Appropriate local authorities
    - NGOs
- To develop mechanisms to ensure that the Actions given in the Conservation Plan are implemented including the organisation of scientific workshops
- To make a recommendation for the evolution of some EU fishery regulations: data collection regulation, electronic logbooks, etc. in order to get the most appropriate data from effective fishing effort
- To co-ordinate the collection of and collation of appropriate data on anthropogenic activities in a format that will facilitate its use in a GIS context
- To manage the Conservation Plan Fund
- To develop progress reports on the implementation
- To arrange for periodic reviews of the Conservation Plan

ACTORS

- **responsible for co-ordination of the Action:** ASCOBANS, with the North Sea RAC (Regional Advisory Council) and the EU, to appoint the Steering Committee for the Conservation Plan; the Steering Committee to appoint the co-ordinator
- **stakeholders**: as listed above under 'Tasks'

ACTION EVALUATION

- ASCOBANS, with the North Sea RAC (Regional Advisory Council) and the EU
- Regular (e.g. biennial or triennial) meetings open to stakeholders

PRIORITY

- Importance: essential
- Feasibility: high if political will is there

ACTION 2: IMPLEMENTATION OF EXISTING REGULATIONS ON BYCATCH OF CETACEANS

Management Action Priority: HIGH

SHORT DESCRIPTION OF ACTION

- **specific objective**: implementing existing regulations appropriately (e.g. Habitats Directive, EU Regulation 812/2004)
- **specific threats to be mitigated**: bycatch
- **rationale**: while legislation exists (EU Fisheries Regulations) the overall level of implementation and effectiveness is unclear
- **target:** to ensure that existing regulations with respect to bycatch reduction measures are being effectively implemented and to collect data on their efficacy in reducing bycatch
- **method**:
    - through a scientifically designed and flexible observer scheme and review of existing schemes, and development and testing of reliable mitigation devices/methods.

      It is apparent that Regulation 812/2004 is not fully serving its purpose in certain areas/fisheries. A flexible implementation with the objective of minimising small cetacean bycatch would better serve harbour porpoise conservation.
    - consider how certification schemes could enhance the commercial value of fish caught with techniques that avoid harbour porpoise bycatch.
- **implementation-timeline**: immediate

ACTORS

- **responsible for co-ordination of action:** Parties to ASCOBANS/ Range States; EU
- **stakeholders**: Affected fishing fleets; co-ordinator/steering committee of CP

ACTION EVALUATION

- Co-ordinator/Steering Committee of Conservation Plan
- analyses by the ASCOBANS Advisory Committee (AC) of Parties' reporting to EU

PRIORITY

- importance: high
- feasibility: high

ACTION 3: ESTABLISHMENT OF BYCATCH OBSERVATION PROGRAMMES ON SMALL VESSEL (<15M) AND RECREATIONAL FISHERIES

Management Action Priority: HIGH

DESCRIPTION OF ACTION

- **specific objective**: address bycatch in fisheries in small vessel fisheries
- **specific threats to be mitigated**: bycatch
- **rationale:** while some aspects of EU Regulation 812/2004 applies to small vessel fisheries in the North Sea, there are particular difficulties in observing operations and applying any necessary mitigation in these fisheries. Similar difficulties are associated with "recreational fisheries".
- **target:** to further develop methods to observe and mitigate bycatch (including implementation monitoring) in small vessel fisheries.
- **method**:
    - further develop and implement a scientifically robust system for remote monitoring on vessels where placing onboard of observers is not feasible
    - develop a system involving small vessel fishermen to maximise the reporting/delivery of bycaught porpoises
    - collect effort data on recreational fisheries (e.g. number, length, soak time of nets), seek information on bycatch, and determine and apply appropriate mitigation techniques
- **implementation-timeline**: 2008-2010

ACTORS

- **responsible for co-ordination of action:** Range States/Parties to ASCOBANS (will need scientific and legal advice; consultation with fishermen)
- **stakeholders:** affected Fishing Fleets; co-ordinator/steering committee of CP

ACTION EVALUATION

- Co-ordinator/Steering Committee of Conservation Plan
- analyses by the ASCOBANS Advisory Committee (AC) of Parties' reporting to EU

PRIORITY

- importance: high
- feasibility: high

ACTION 4: REGULAR EVALUATION OF ALL FISHERIES WITH RESPECT TO EXTENT OF HARBOUR PORPOISE BYCATCH

Management Action Priority: HIGH

DESCRIPTION OF ACTION

- **specific objective**: evaluate bycatch levels in all relevant fisheries
- **specific threats to be mitigated**: bycatch
- **rationale**: although mitigation measures are in place for some fisheries, it is essential to assess, at regular intervals, whether those measures are achieving the desired goals or require adjustment
- **target:** to estimate levels of bycatch of harbour porpoises in the North Sea at regular intervals to enable mitigation measures to be reviewed and if necessary modified
- **method**: analyse data provided by Range States/Parties from observer schemes and elsewhere (e.g. from strandings, see Action 9) on bycatch and fishery data and incorporate this into a population dynamics modelling framework
- **implementation-timeline**: immediate, and at intervals of 3-5 years

ACTORS

- **responsible for co-ordination of action:** Range States/Parties to ASCOBANS (will need scientific advice)
- **stakeholders:** affected fishing fleets; fishery bodies; co-ordinator/steering committee of CP

ACTION EVALUATION

- Co-ordinator/Steering Committee of Conservation Plan
- analyses by the ASCOBANS Advisory Committee (AC) of Parties' reporting to EU

PRIORITY

- importance: high
- feasibility: high/medium

ACTION 5: REVIEW OF CURRENT PINGERS, DEVELOPMENT OF ALTERNATIVE PINGERS AND GEAR MODIFICATIONS

Research Action Priority: HIGH

DESCRIPTION OF ACTION

- **specific objective:**
  - review and as appropriate address uncertainties on (long term) efficacy and potential impact of conventional pingers on porpoises
  - develop new fishing gear and/or practices less likely to resulting in porpoise bycatch
- **specific threats to be mitigated:**

  potential adverse effects of conventional pingers on porpoises (including exclusion from habitat, habituation)
- **rationale:**
  - concerns have been expressed about the long-term effectiveness of existing pingers to reduce bycatch and their potential effects on the animals themselves and their habitat
  - concerns have also been expressed by the industry as to costs
  - it is timely to review the available data on pingers which are now widely used and to consider modifications as appropriate (including economic considerations)
  - other mitigation measures such as changes in fishing gear and practices should be investigated
- **target:** more universal acceptance by all stakeholders (and hence better implementation) of mitigation measures to reduce harbour porpoise bycatch
- **method:**
  - a full review of the use of existing information (from the viewpoint of reducing bycatch, effects on animals and practicality and cost to fishermen) initially via a specialist workshop including biologists, gear technologists and appropriate stakeholders
  - development and research evaluation of new pinger-related technology and deployment (e.g. interactive pingers, less pingers per length of net) and alternative porpoise alerting passive and active devices
  - further development and research evaluation of changes in fishing practices and/or fishing gear to reduce harbour porpoise bycatch
  - development and undertaking of appropriate field trials
  - recommendations for implementation where appropriate
- **implementation-timeline:** workshop in early 2010, research programmes ongoing

ACTORS

- **responsible for co-ordination of action:** co-ordinator/steering committee of CP, Parties to ASCOBANS/other Range States, EU-member States (will need input from biologists, gear technologists and other specialists)
- **stakeholders**: fishing industry, fisheries authorities, research institutes, legislators

ACTION EVALUATION

- Co-ordinator/Steering Committee of Conservation Plan
- analyses by the ASCOBANS Advisory Committee (AC)

PRIORITY

- importance: high
- feasibility: medium

ACTION 6: FINALISE A MANAGEMENT PROCEDURE APPROACH FOR DETERMINING MAXIMUM ALLOWABLE BYCATCH LIMITS IN THE REGION

Research and Management Action Priority: HIGH

SHORT DESCRIPTION OF ACTION

- **specific objective**: to meet the agreed objectives of ASCOBANS in relation to bycatch (Resolution 5, MoP5)
- **specific threats to be mitigated**: bycatch
- **rationale**: it is important that the conservation goals for the harbour porpoise are examined in the context of a management procedure context that takes uncertainty into account
- **target:** to finalise a population dynamics modelling framework for evaluating the effect of bycatches (and other anthropogenic activities) on harbour porpoises in the North Sea that anthropogenic activities do not prevent agreed conservation goals being met
- **method**: building upon the advances made by the IWC/ASCOBANS working group, the ICES/SGBYC and the SCANS II project and the recommendations therein and other Actions (2, 3, 4, 7) of this plan including: agreement of operational management objectives by policymakers; finalisation and scientific implementation of a management procedure by scientists; agreement by policymakers to develop and implement management advice based on the results of the management procedure
- **implementation-timeline**: begin immediately with aim for completion by 2010

ACTORS

- **responsible for co-ordination of action:** Range States/Parties to ASCOBANS/EU
- **stakeholders**: policymakers; co-ordinator/steering committee of CP; scientists incl. joint ASCOBANS/IWC Scientific working group

ACTION EVALUATION

- Co-ordinator/Steering Committee of Conservation Plan
- joint ASCOBANS/IWC Scientific working group

PRIORITY

- importance: high
- feasibility: high

ACTION 7: MONITORING TRENDS IN DISTRIBUTION AND ABUNDANCE OF HARBOUR PORPOISES IN THE REGION

Research Action Priority: HIGH

SHORT DESCRIPTION OF ACTION

- **specific objective**: to monitor whether the management actions of the Conservation Plan are meeting the management objectives with respect to abundance and distribution
- **specific threats to be mitigated**: the combined effects of anthropogenic activities
- **rationale**: without monitoring it is impossible to evaluate the success or otherwise of the Conservation Plan and to determine whether modifications are needed
- **target:** to provide regular information on the abundance and distribution of harbour porpoises in the region as input into the management procedure approach discussed under Action 6 , to provide information relevant to evaluating mitigation measures including a comparison of the relative distribution of animals with anthropogenic activity (see Action 7)
- **method**: build upon the advances made by the SCANS II project and the recommendations therein to develop an agreed monitoring programme (involving one or more scientific workshops) and to implement it
- **implementation-timeline**: begin immediately with aim for completion of the design of the programme by 2010 after which it is implemented

ACTORS

- **responsible for co-ordination of action:** Range States/Parties to ASCOBANS
- **stakeholders**: scientists especially those involved in the monitoring component of SCANS II, policymakers; co-ordinator/steering committee of CP

ACTION EVALUATION

- Co-ordinator/Steering Committee of Conservation Plan
- ASCOBANS scientific working group

PRIORITY

- importance: high
- feasibility: high

ACTION 8: REVIEW OF THE STOCK STRUCTURE OF HARBOUR PORPOISES IN THE REGION

Research Action Priority: HIGH

SHORT DESCRIPTION OF ACTION

- **specific objective**: to review stock structure and movements of harbour porpoises in the region
- **specific threats to be mitigated**: essential information to be able to evaluate threats caused by anthropogenic activities
- **rationale**: such information is fundamental to the management procedure approach outlines in Action 6
- **target:** to provide information on the stock structure and movements of harbour porpoises in the region that can be used in the management procedure
- **method**: to fully review the available data (from a suite of techniques including, genetics, telemetry, distribution, bycatches) and to provide appropriate information on plausible hypotheses for use in the management procedure and, if needed, to suggest research to reduce uncertainty (via a scientific workshop)
- **implementation-timeline**: to be completed in time for use by scientists in the management procedure

ACTORS

- **responsible for co-ordination of action:** Range States/Parties to ASCOBANS; Co-ordinator/Steering Committee of Conservation Plan
- **stakeholders**: scientists

ACTION EVALUATION

- Co-ordinator/Steering Committee of Conservation Plan
- ASCOBANS scientific working group

PRIORITY

- importance: high
- feasibility: high

ACTION 9: COLLECTION OF INCIDENTAL PORPOISE CATCH DATA THROUGH STRANDING NETWORKS

Research Action Priority: MEDIUM

DESCRIPTION OF ACTION

- **specific objective**: evaluate bycatch levels in all fisheries
- **specific threats to be mitigated**: bycatch
- **rationale**: stranded animals can provide, *inter alia*, an important additional source of information (to observer schemes) to investigate whether porpoise bycatch occurs as well as other forms of anthropogenic mortality (see Action 11)
- **target**: provide qualitative information on bycatch occurrence and an assessment of minimum number of annually bycaught porpoises
- **method**: regularly carry out full necropsies on all stranded porpoises for evidence of bycatch, ideally using an agreed protocol; in addition: data gathered along North Sea shores should be put together (n^0 of strandings/month/area, n^0 of bycatches/month/area)
- **implementation-timeline:** immediate and ongoing, with input into the regular reviews of the incidence of bycatch given under Action 4

ACTORS

- **responsible for co-ordination of action:** co-ordinator/steering committee of CP, Range States/Parties to ASCOBANS (will need scientific , especially veterinary, advice)
- **stakeholders:** fisheries authorities, experienced pathologists

ACTION EVALUATION

- Co-ordinator/Steering Committee of Conservation Plan
- analyses by the ASCOBANS Advisory Committee (AC)

PRIORITY

- importance: medium
- feasibility: high

ACTION 10: INVESTIGATION OF THE HEALTH, NUTRITIONAL STATUS AND DIET OF HARBOUR PORPOISES IN THE REGION

Research Action Priority: MEDIUM

DESCRIPTION OF ACTION

- **specific objectives:** to collect fundamental information the question of of human activities (other than bycatch) including contaminants, sewage and debris discharge, noise, presence, fishing (via competition for resources) for input into population dynamics modelling
- **specific threats to be mitigated:** this addresses one aspect of to contribute to our ability to avoid cumulative and synergistic adverse effects of human activities on the health and nutritional status of porpoises and thus the viability of harbour porpoises in the region
- **rationale:** Our knowledge of the qualitative and quantitative effects on porpoises of a range of human activities is incomplete. This action is designed to improve this situation by collecting information on health status (by toxicological and pathological investigations) and nutritional status (by examining their diet)
- **target**: to obtain good quality data on health parameters and the diet of porpoise populations in the area of application of the CP
- **method:** retrieving stranded and bycaught porpoises and:
    - performing full necropsies and general pathology to assess general health (incl. condition) of a representative sample (sex, age) of the retrieved animals
    - collecting inner ears and assessing acoustic trauma in connection with tissue examination for acoustic impact (see Jepson *et al.* 2002, for methodology)

      note: this matter proves to be very complex and results are not promising; however, it is still worthwhile to be pursued
    - collecting, archiving and analysing representative samples of porpoise tissues for relevant contaminants (including concentrations and biomarkers for exposure and effect); for methods see IWC-POLLUTION2000+ Programme (Reijnders et al. 1999).
    - collecting stomach and intestine contents, and tissue samples for fatty acid and stable isotope analyses, to investigate diet
    - collecting tissue samples for further analyses on immune- and bacteriological parameters
    - assessing parasitic infestation
- **implementation-timeline:** ongoing with a regular (every 3-5 years) review of results

ACTORS

- **responsible for co-ordination of action:** co-ordinator/steering committee of CP, Range States/Parties to ASCOBANS (will need scientific input)

- **stakeholders**: scientists from research institutes with experience in tissue and data collection from stranded and bycaught porpoises, scientists with experience in marine mammal toxicological, pathological (incl. acoustical), immunological, parasitological, bacteriological examinations and diet analyses on marine mammals.

ACTION EVALUATION

- Co-ordinator/Steering Committee of Conservation Plan
- analyses by the ASCOBANS Advisory Committee (AC)
- regular reporting by the relevant research institutes/strandings schemes

PRIORITY

- importance: medium
- feasibility: medium

ACTION 11: INVESTIGATION OF THE EFFECTS OF ANTHROPOGENIC SOUNDS ON HARBOUR PORPOISES

Research Action Priority: MEDIUM

DESCRIPTION OF ACTION

- **specific objectives:** to collect fundamental information on the effects of anthropogenic sounds on harbour porpoises
- **specific threats to be mitigated:** acoustic pollution
- **rationale:** a wide variety of anthropogenic activities introduce sound into the marine environment (e.g. vessels of all kinds, construction and operation of windfarms, general construction works, hydrocarbon exploration, military activities, pingers, acoustic harassment devices) yet we are still unsure of the actual or potential effects of such sounds on harbour porpoises in the short-term or long-term; it is essential to obtain a
- **target**: to obtain good quality data on the acoustic capabilities of harbour porpoises and relate this to 1) the acoustic properties of anthropogenic sounds (also see Action 12), and 2) the most relevant information on the effects of noise on porpoises
- **method:**
    - review/collect data on the acoustic properties of the variety of anthropogenic sound sources in the North Sea
    - review and if necessary obtain further data on the acoustic capabilities of harbour porpoises (incl. playback experiments where appropriate)
    - review work on the 'dose-based approach' to examining the effects of sound on cetaceans (including how to compute and how to interpret)
    - review effectiveness or otherwise of potential mitigation measures for various anthropogenic sound sources
- **implementation-timeline:** ongoing with a regular (every 3-5 years) review of results

ACTORS

- **responsible for co-ordination of action:** co-ordinator/steering committee of CP,
- **stakeholders**: harbour porpoise scientists; acoustics experts from industry

ACTION EVALUATION

- Co-ordinator/Steering Committee of Conservation Plan
- analyses by the ASCOBANS Advisory Committee (AC)

PRIORITY

- importance: medium
- feasibility: medium

ACTION 12: COLLECTION AND ARCHIVING OF DATA ON ANTHROPOGENIC ACTIVITIES AND DEVELOPMENT OF A GIS

Research action Priority: MEDIUM

DESCRIPTION OF ACTION

- **specific objectives:** to collect fundamental information on anthropogenic activities that may affect harbour porpoises in the region
- **specific threats to be mitigated:** will provide information relevant to all actual and potential threats
- **rationale:** a wide variety of anthropogenic activities occur in the North Sea region that may potentially affect harbour porpoises; it is necessary to be able to determine the occurrence and temporal/geographical distribution of these and any changes over time to be able to (a) compare these with the distribution of the animals to determine potential problem areas; (b) to have baseline information to compare if changes in harbour porpoise abundance and distribution are observed via Action 7
- **target**: to obtain data on relevant anthropogenic activities in the North Sea over time in a format suitable for incorporating into a GIS (along with data from Action 7)
- **method:**
    - review available sources of data on anthropogenic activities and determine their suitability for incorporation into a database or meta-database and GIS
    - identify information important gaps and possible ways to fill them
- **implementation-timeline:** ongoing

ACTORS

- **responsible for co-ordination of action:** co-ordinator/steering committee of CP,
- **stakeholders**: relevant stakeholders with information on anthropogenic activities

ACTION EVALUATION

- Co-ordinator/Steering Committee of Conservation Plan
- analyses by the ASCOBANS Advisory Committee (AC)

PRIORITY

- importance: medium
- feasibility: medium

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frontiers in Marine Science

ORIGINAL RESEARCH
published: 10 May 2021
doi: 10.3389/fmars.2021.682532

First Evidence of Retrospective Findings of Microplastics in Harbour Porpoises (*Phocoena phocoena*) From German Waters

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Microplastic ingestion by lower trophic level organisms is well known, whereas information on microplastic ingestion, egestion and accumulation by top predators such as cetaceans is still lacking. This study investigates microplastics in intestinal samples from harbour porpoises (*Phocoena phocoena*) found along the coastline of Schleswig-Holstein (Germany) between 2014 and 2018. Out of 30 individuals found along the North Sea (NS) and the Baltic Sea (BS) coast, 28 specimens contained microplastic. This study found a relationship between the nutritional status of cetaceans and the amount of found microplastics. Harbour porpoises with a good or moderate nutritional status contained a higher number of microplastics, when compared with specimens in a poor nutritional status. In addition, when individuals died accidently due to suspected bycatch in gillnets, where a feeding event is highly assumed or a pharyngeal entrapment happened, the microplastic burden was higher. In total, 401 microplastics ($\geq$100 μm), including 202 fibres and 199 fragments were found. Intestines of the specimens of the BS contained more microplastics than the ones from the NS. Differences in the share of fibres could be revealed: for BS fibres constituted 51.44% and for NS, fibres constituted 47.97%. The polymers polyester, polyethylene, polypropylene, polyamide, acrylic (with nitrile component) and an acrylic/alkyd paint chip (with styrene and kaolin components) were identified. This is the first study investigating the occurrence of microplastics in harbour porpoises from German waters and will, thus, provide valuable information on the actual burden of microplastics in cetaceans from the North and Baltic Seas.

Keywords: microplastic burden, FTIR, marine mammals, cetacean, North Sea, Baltic Sea, nutritional status, health

OPEN ACCESS

Edited by:
Robson G. Santos, Federal University of Alagoas, Brazil

Reviewed by:
Anish Kumar Warrier, Manipal Academy of Higher Education, India
André Ricardo Araújo Lima, Center for Marine and Environmental Sciences (MARE), Portugal

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Specialty section:
This article was submitted to Marine Pollution, a section of the journal Frontiers in Marine Science

Received: *18 March 2021*
Accepted: *14 April 2021*
Published: *10 May 2021*

Citation:
Philipp C, Unger B, Ehlers SM, Koop JHE and Siebert U (2021) First Evidence of Retrospective Findings of Microplastics in Harbour Porpoises (Phocoena phocoena) From German Waters. Front. Mar. Sci. 8:682532. doi: 10.3389/fmars.2021.682532

INTRODUCTION

The ubiquitous presence of marine litter, and especially the occurrence of small particles called microplastics (<5 mm) (Arthur et al., 2009) is already confirmed in different marine habitats and organisms (Fossi et al., 2014; Lusher et al., 2015b; Pereira et al., 2020). A trophic transfer of microplastic particles between species of different trophic levels can be assumed as this has previously been determined by other studies (Farrell and Nelson, 2013; Setälä et al., 2014;

Nelms et al., 2018). In addition, the ingestion and presence of microplastics has been highly studied throughout the food web in recent years (Miller et al., 2020). Besides the unintentional uptake of microplastics by prey species, an intentional uptake by organisms caused by a burdened environment or due to accidental prey resemblance has already been shown (Ory et al., 2017; Roch et al., 2020).

When focusing on the study area, a microplastic burden in the North-East Atlantic area and its organisms occupying different trophic levels has also been verified (Lusher et al., 2013; Karlsson et al., 2017). Furthermore, it is assumed that microplastics and pollutants accumulate in marine top predator species (Fossi et al., 2014; Jepson et al., 2016; Garcia-Cegarra et al., 2021). The ingestion of marine litter is already confirmed by previous studies in the North Sea (NS) and Baltic Sea (BS) (Unger et al., 2017; van Franeker et al., 2018). This is not surprising, since the NS and adjacent waters are assumed to be highly affected by anthropogenic exploitations (Halpern et al., 2008). Nevertheless, the knowledge on the burden of microplastics in top predators, particularly in cetaceans of the eastern North Atlantic region, including the BS, is still lacking. Both seas are different in topography, salinity, hydrology (Frid et al., 2003; Sjöqvist et al., 2015), and the occurring ship traffic (OSPAR, 2021). Thus, differences in the presence and absence of marine litter and in particular of microplastics between both seas could be hypothesised.

For investigating this knowledge gap, this study focusses on intestinal samples of harbour porpoises (*Phocoena phocoena*) originating from both seas. This species is the only regularly occurring cetacean in the southern NS, and the only cetacean inhabiting the BS (Hammond et al., 2017). Therefore, this study aimed to gain knowledge regarding the following three aspects: (i) assessment of the general risk of microplastic accumulation in harbour porpoises, (ii) evaluation of potential health impacts, and (iii) the comparison between the individuals originating from the NS and the BS. The porpoises found along the German NS coast are part of the North-East Atlantic population, and the Baltic individuals belong to the subspecies of the western Baltic population (Gaskin, 1984; Andersen, 2003; Lah et al., 2016).

This is the first retrospective investigation of microplastics in relation to the health status of harbour porpoises from German waters to date, examining particles which are smaller in size than 1 mm. Based on the collected information on sex, age and health status during necropsies, this study enables to determine potential relationships between a suspected microplastic burden and different health aspects in harbour porpoises originating from the NS and the BS for the first time. In addition, since the polymer types of found particles are determined by micro-Fourier-transform infrared spectroscopy (μFTIR), possible microplastic sources could be hypothesised and discussed.

MATERIALS AND METHODS

Based on the well-established stranding network in Schleswig-Holstein (Germany), carcasses of stranded and bycaught harbour porpoises from the NS and BS are collected in the course of a health monitoring (Siebert et al., 2001, 2020; Lehnert et al., 2005). This monitoring is established since 1990 at the Institute for Terrestrial and Aquatic Wildlife Research (ITAW), which regularly conducts necropsies of harbour porpoises using a standardised protocol (Siebert et al., 2001, 2020). Since 2014, intestinal samples of marine mammals, including harbour porpoises, were exclusively collected for microplastic analysis. Based on the necropsies, the age, sex, health status and the location in which each individual was found is assessed and recorded. Thus, this information is available for the investigated intestinal samples from harbour porpoises found between 2014 and 2018.

The following criteria were applied for choosing the most suitable samples: (i) the gastrointestinal tract (GIT) had to be intact, (ii) faeces were present, and (iii) the individual was already weaned. 30 individuals were chosen for analysis: 14 individuals from the NS and 16 individuals from the BS (**Figure 1**).

The intestinal samples were stored in pre-cleaned glass jars at −20°C until further processing. Then, each defrosted and opened intestinal sample was placed into a double-layered washing sachet made of nylon cloths. The inner bag of the washing sachet has a mesh size of 300 μm and the outer bag has a mesh size of 100 μm. Both cloths, including the sample, were sewn together with the help of a conventional sewing machine, resulting in a so-called washing sachet. These washing sachets were washed in a conventional washing machine at 60°C without spinning cycle. For the removal of biogenic matter, an enzyme based detergent and a conventional detergent were added for facilitating the washing procedure. Subsequently, a density separation, a vacuum filtration onto cellulose filters (Rotilabo®, Typ 11A, Ø 55 mm, retention 12–15 μm) and fluorescence microscopy enabled by Nile Red (diluted with chloroform) staining were conducted for microplastic isolation and identification. Subsequently, all potential microplastics found on the cellulose filters were photographed, counted, and measured in size. All steps of sample processing were conducted in a closed acrylic box to avoid airborne contamination. The whole implementation of sample handling and processing is described in detail in Philipp et al. (2020).

For polymer identification, selected microplastic particles were manually collected. In addition, a disinfectant step was conducted to exclude a passing on of bacterial or parasitical zoonosis. For this purpose, the cellulose filters containing the stained particles were sprayed with ethanol (70%). After evaporation, the particles showed the same fluorescence qualities as before. Thus, the potential microplastics were selected and manually collected with tweezers or needle pins and placed into a droplet of ethanol (70%) onto an aluminium oxide membrane filter (Anodisc, Ø 47 mm, 0.2 μm pore size, Whatman, Freiburg, Germany). The filter was kept still until the droplet was evaporated and the particles had attached to the filter. Since the transfer of particles was done manually, a loss of particles needs to be taken into account.

The polymer composition of 77 potential microplastics (incl. fragments and fibres) from intestinal sample were analysed by using a μFTIR spectroscope (Hyperion 2000, Bruker, Ettlingen, Germany). All measurements were conducted in transmission

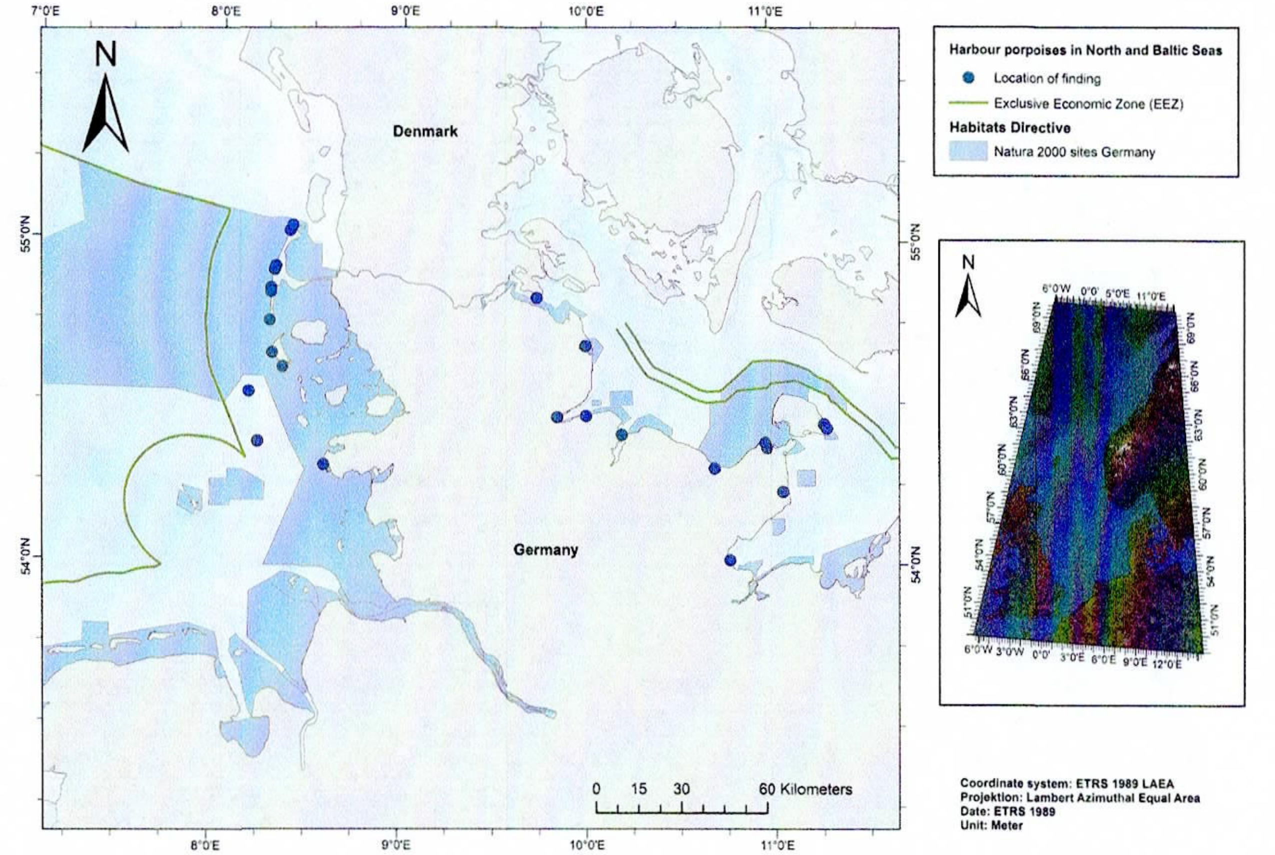

FIGURE 1 | Locations where investigated harbour porpoises were found (n = 30).

mode with 32 co-added scans (sometimes 100 scans for very thin fibres) and a spectral resolution of 4 cm^{-1} in a wavenumber range of 4,000–1,250 cm^{-1} as aluminium oxide membrane filters are infrared inactive between 3,800 and 1,250 cm^{-1}. For background measurements, the blank aluminium oxide membrane filter was used. For thick particles, for which transmission mode was not suitable, the measurements were conducted in attenuated total reflectance (μATR) mode. Those μATR measurements were conducted between 4,000 and 600 cm^{-1}.

Procedural blanks of the used detergents and materials, e.g., nylon sachets (n = 3), and the working environment (n = 10) were taken into account for avoiding an overestimation caused by secondary contamination. The analysed blank filters of the working environment accompanied the samples from time of collection until the staining procedure was finished.

On average, one fibre and seven particles were found in those procedural blanks and were finally subtracted from the microplastic counts in each parallel sample. Four of those potential microplastics could be collected, manually placed on the aluminium oxide membrane filter and were considered for μFTIR analysis. Moreover, the polymer composition of different equipment materials like the nitrile gloves and shavings of the used acrylic box were additionally determined by FTIR in ATR mode (Vertex 70; Bruker, Ettlingen, Germany) or by μFTIR to avoid an overestimation. For the Vertex measurements, ATR measurements were performed in a wavenumber range of 4,000–370 cm^{-1} with 8 co-added scans and a spectral resolution of 4 cm^{-1}.

The quantity of found microplastics in comparable groups is given in mean ± standard deviation (M ± SD) to enable a comparison between findings. Moreover, the results were statistically analysed by determining the Cohen's d and applying a paired t-test using the package "pwr" in the R software Version 4.0.2 (Champely et al., 2020; R Core Team, 2020). Thus, results were described as significant if $p < 0.05$. In addition, the **Figures 2**, **5–7** were visualised using the package "ggplot2" (Wickham, 2016).

RESULTS

Quantity and Size

In total, 30 intestinal samples were available for analyses. An amount of 611 potential microplastics (incl. fragments and fibres, > 100 μm) were found. A secondary contamination of one fibre and seven fragments were considered and subtracted from each sample. Thus, 401 microplastics were finally determined. This amount of microplastics was found in 28 intestinal samples,

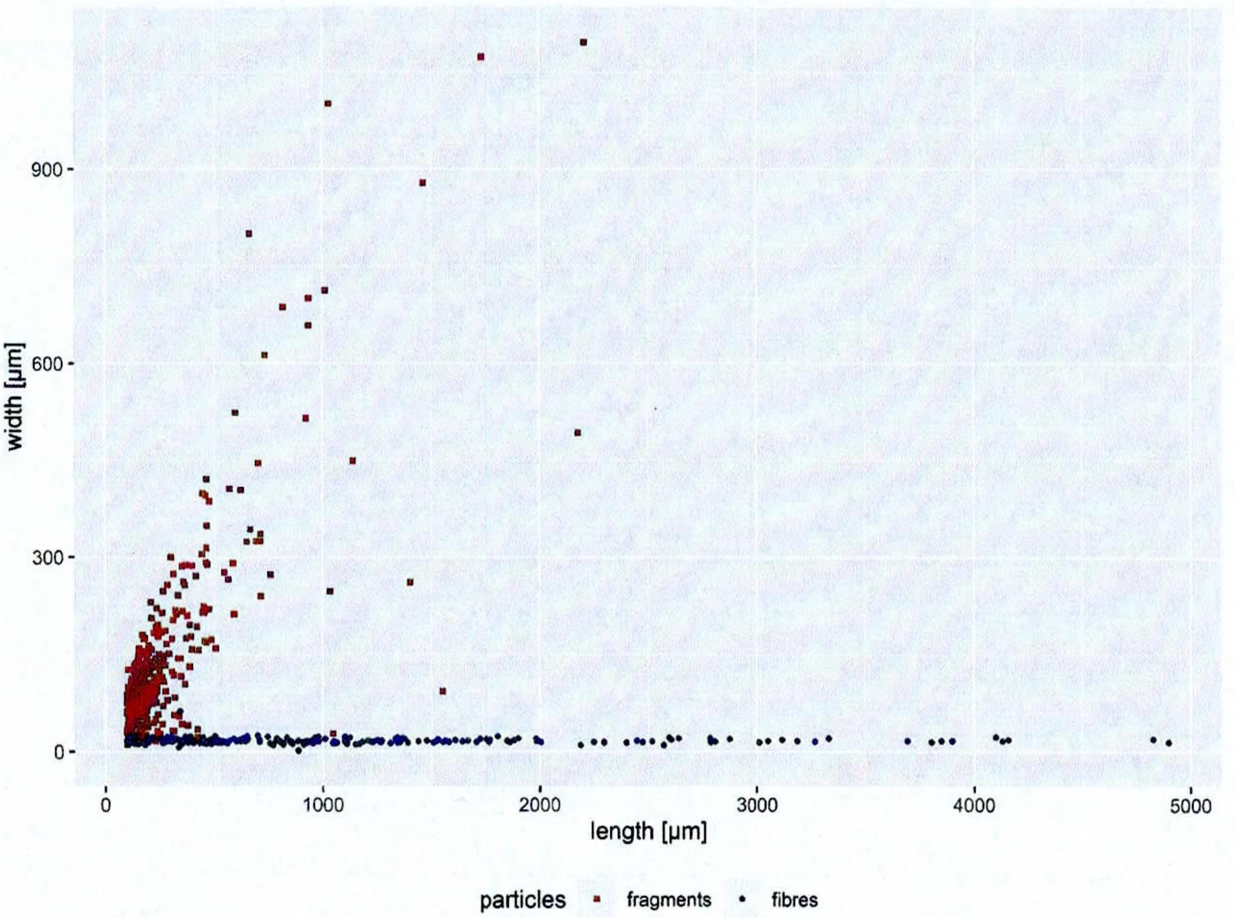

FIGURE 2 | Width-length distribution of all suspected microplastic particles in intestine samples of 30 harbour porpoise in the size range of 100 µm up to 5,000 µm (n = 611). Secondary contamination was not considered.

in the remaining an absence of microplastics was noticed. When categorising into particle type, 202 fibres and 199 fragments were found. Hence, only two intestines were free from microplastics. Most of the found fibres had a length between 100 and 2,000 µm (**Figure 2**).

Four additional fibres longer than 5,000 µm, thus defined as mesoplastics (Gregory and Andrady, 2003), were found. Three of them occurred in a sample of an adult male harbour porpoise found in 2017 (lengths: 8,450, 6,964, and 8,029 µm). The fourth fibre (7,365 µm in length) was found in a juvenile male stranded in 2014. Both carcasses were found in the BS. Based on the size, those four fibres were excluded from the results.

FTIR Results

Out of all 611 potential microplastics found in the 30 intestinal samples from the harbour porpoises, originally 94 particles (16%) were selected for polymer identification by µFTIR. Those fibres and fragments were manually collected and placed onto Anodisc membrane filters. Subsequently, 77 particles (12%, n_{fibres} = 28, $n_{fragments}$ = 49) found in the intestinal samples were finally analysed by µFTIR. The remaining 17 microplastics (n_{fibres} = 7, $n_{fragments}$ = 10) were either lost during the sample transport in closed petri dishes to the analysing site or could not be measured due to their small size. Polyester (PEST) was the most frequently found polymer in those investigated intestinal samples (n_{PEST} = 30), followed by polyethylene (PE, n = 17) and polyamide (PA, n = 12) (**Figure 3**). Furthermore, two polypropylene (PP) particles, one paint chip (acrylic/alkyd with kaolin and styrene) (see Figure in the **Supplementary Material**), one none further identified polyolefin and one cellulose acetate fibre (which is a semi-synthetic cellulose) were determined. Three acrylic particles, including two with nitrile component, were additionally found. A visualisation of the found polymers (n = 67) is given in **Figure 4**.

Moreover, the polymer composition of two fragments (one fragment found in an intestine and one from a procedural blank) could not be identified. However, both showed strong similarities and were excluded from the analysis. Only four potential microplastic particles (n_{fibres} = 2, $n_{fragments}$ = 2) were found on all procedural blank filters, and were additionally analysed by µFTIR. One fibre from the blanks was lost and one fragment could not be clearly spectroscopically identified.

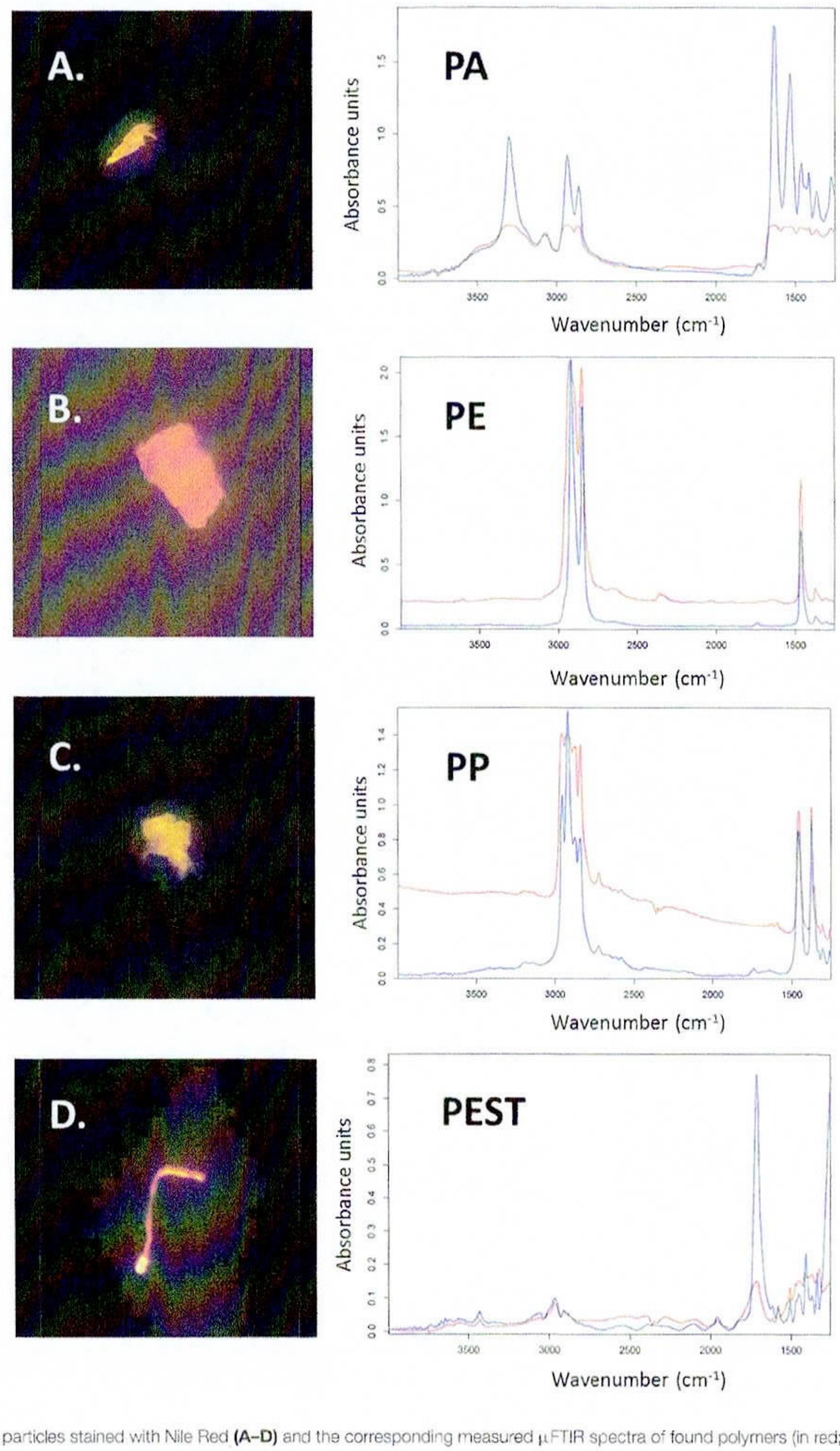

FIGURE 3 | Microplastic particles stained with Nile Red **(A–D)** and the corresponding measured μFTIR spectra of found polymers (in red; Polyamide: PA; Polyethylene: PE; Polypropylene: PP and Polyester: PEST). Reference spectra from the OPUS software are blue (Bruker, Ettlingen, Germany).

However, the other fibre was identified as PEST and the second fragment was determined as varnish with kaolin, styrene and calcium carbonate. Furthermore, two fragments from the intestinal samples had spectra which were highly similar to the varnish which was found in a procedural blank. Hence, those particles were excluded from the analysis. In five cases of potential microplastic particles, biogenic matter was identified and a sixth particle was clearly different from plastic. In addition,

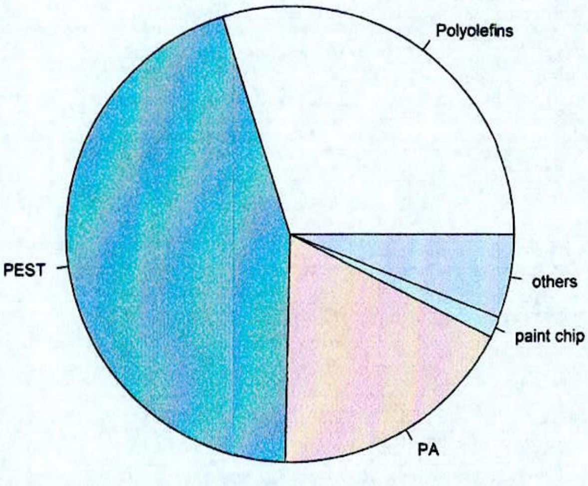

FIGURE 4 | Overview of identified polymer compositions of microplastics (n = 67) found in intestinal samples analysed by analysed by μFTIR spectroscopy: PEST: 30%, polyolefine: 20% (incl. PE and PP), PA: 12%, paint chip: 1%, others: 4% (incl. acrylic with nitrile component, and cellulose acetate). Polymer composition of microplastics found in procedural blanks was not considered for this overview, albeit the coincidence of polymers in procedural blanks and samples were considered, and thus not taken into account.

one particle could not be identified due to its small size, since it was broken during the manual collection and placement on the aluminium oxide filter.

Differences Between Seas

Comparing the samples based on their origin (NS or BS), there was a significantly higher amount of microplastics in individuals from the BS if compared to the NS (n_{BS} = 278; M ± SD = 18.27 ± 14.54; n_{NS} = 123; M ± SD = 8.2 ± 7.89; p-value = 0.03). Furthermore, the highest number of 48 microplastic particles was found in an adult female from the BS. When comparing the share of fibres in both seas, significant differences could be revealed (BS: 51.44%; NS: 47.97%; p-value = 0.02). The share of fragments, however, was similiar across locations (BS: 48.56%; NS: 52.03%; p-value = 0.1).

Differences Per Year

The annual mean values for each sea revealed a higher number of microplastic particles in harbour porpoises from the BS. Furthermore, the range of microplastics found in individuals from the NS was mostly between zero and up to 10 particles per individual in 2015, 2016, and 2018. Only in 2014 and 2017, more than 20 particles were found in the intestinal samples from the NS (2014: 29 and 2017: 21). However, in the BS samples more than 30 particles were found in 2015, 2017, and 2018. The years 2015 and 2018 were the ones with the highest number of findings per individual (44 particles in 2015 and 48 particles in 2018). In two cases from the NS, microplastics were not present (2014 and 2016). In comparison, in the BS microplastic was found in all samples. All this information is presented in **Figure 5**. However, no significant differences could be determined between the two sample sites (NS and BS; p-value = 0.21), mainly because of the low power of the statistical analysis, which resulted from the low sample size within each year and sea. Following the power analysis, a sample size of at least 12 individuals per year for each sea would be necessary for a reliable trend interpretation (power 80%, p-value = 0.05).

Differences in Age and Sex

This study investigates intestinal samples of 13 female and 17 male harbour porpoises (**Figure 6**). The microplastic burden in females is slightly higher (M ± SD = 13.38 ± 15.41), when compared to the amount of microplastics in males (M ± SD = 13.35 ± 10.56). Certainly, no significant difference in microplastic load could be revealed between sexes (p-value = 0.99). Moreover, no significant differences between adult harbour porpoises (n = 21; M ± SD = 13.82 ± 13.25) and juvenile ones (n = 9; M ± SD = 12.18 ± 12.31) were confirmed (p-value = 0.82), although the microplastic amount in adult ones seemed higher. The two unburdened samples from the NS originated from a juvenile male and an adult female. In both age classes the highest amount of microplastics was found in females (adult: 48 particles; juvenile: 44 particles; see **Figure 6**).

Health Status

The evaluation of the whole GIT revealed an absence of parasite specimens in all investigated intestines. A mild enteritis was found for seven individuals. In detail, in one of those harbour porpoises a mild diffuse eosinophilic enteritis was determined. Furthermore, in two cases (juveniles) a mild diffuse eosinophilic enteritis and a focal mural one were determined. A most likely parasitic etiology was observed in those two harbour porpoises. A fourth individual was affected by a diffuse mild lymphocytic-plasmacellular and eosinophilic infiltration of the lamina propria in combination with a moderate hyperplasia of the Peyer's plaques. Three further porpoises showed evidence of gastritis (mild and high grade) and enteritis. Whereof two individuals suffered from a mild non-suppurative enteritis, and the third one was also affected by a diffuse moderate lymphocytic-plasmacellular and eosinophilic infiltration of the lamina propria. In total, parasite infestations of e.g. *Pholeter gastrophilus* and *Anisakis simplex* in the multi-chambered stomach was confirmed in 12 harbour porpoises.

Harbour porpoises investigated in this study, which were either accidentally bycaught (Siebert et al., 2020) or affected by a pharyngeal entrapment (Gross et al., 2020), showed a microplastic burden of 19.8 particles (SD = 12.77; n = 11) per individual. Compared to the remaining ones (n = 19), where no accidental death could be diagnosed (incl. the three pregnant females), a lower mean value of 10 (SD = 11.59) microplastics per porpoise was identified. Furthermore, if the individual was in a good (n = 9) or moderate (n = 14) nutritional status, the mean number of particles was significantly higher ($Mean_{good}$ = 14.11; $Mean_{moderate}$ = 16.07) in contrast to a bad nutritional status (n = 7; $Mean_{bad}$ = 7) (**Figure 7**). This is also confirmed by the statistical analysis (p-value = 0.04).

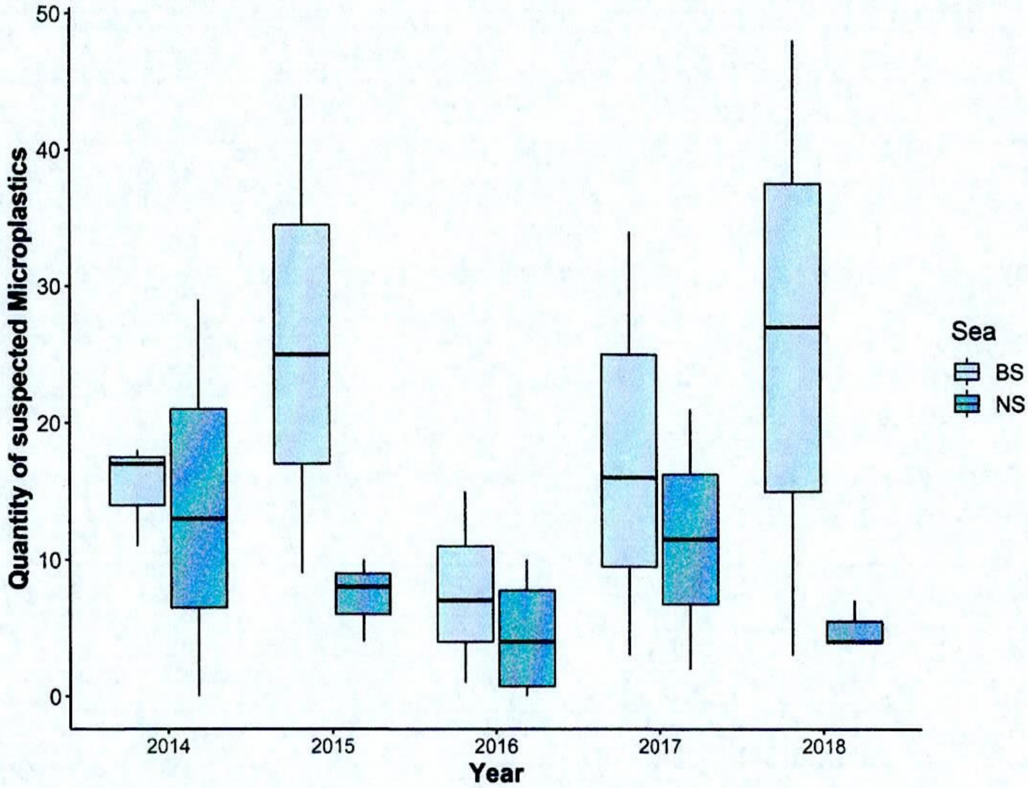

FIGURE 5 | Quantity of suspected microplastics from each year, divided per sea (BS = Baltic Sea; NS = North Sea; *n* = 401).

DISCUSSION

This study is the first to evaluate the microplastic burden in marine mammals inhabiting German waters focussing on particles smaller than 1 mm, in marine mammals inhabiting German waters. Furthermore, intestinal samples of harbour porpoises originating from the BS were investigated in microplastic research for the very first time. In total, 93% of all investigated samples from the NS and the BS show a burden of microplastic particles. Minor differences in the range of detected fibres, and no differences in the quantity of found fragments were revealed for both seas. Based on the loss of only 3% of hard parts during sample processing, and the considered secondary pollution, revealed by the preceding publication, the results are reliable and not overrated (Philipp et al., 2020).

Evaluation of the Method and Results

The Nile Red staining is a well-established method in microplastic pre-identification to preselect particles for further investigation (Erni-Cassola et al., 2017). Since some polymer types are melted or dissolved when stained with Nile Red diluted in chloroform (Tamminga et al., 2017), a loss of, e.g., polystyrene or cellulose acetate particles is highly likely. Hence, melted particles were excluded from pre-selection and further polymer identification based on their deficit in quality and the fragile consistency. Furthermore, based on the manual transferring of single particles onto the Anodisc filter, a loss of promising polymer particles has to be taken into account. For future analyses it is advisable to use the Anodisc filter straight away for filtering the samples, instead of transferring it manually after the filtration process.

Based on the fact that many potential microplastics (91%, 73 out of 80, incl. 77 analysed particles found in intestines and 3 analysed particles found on procedural blanks) could be identified as microplastics (incl. $n_{intestine}$ = 77 and $n_{proceduralsamples}$ = 3) by μFTIR analysis, it is highly likely that most particles counted in our study were microplastic. Taken this evaluation and the validation of Philipp et al. (2020) into account (90%), a reliable number of 361 microplastics out of the 401 suspected particles is assumed. Thus, the results show the applicability of the protocol introduced by Philipp et al. (2020) for intestinal samples of cetaceans and determine the actual burden in a reliable way.

Comparison With Other Studies

The determined percentage of 93% (28 out of 30 examined intestines are burdened) coincides with the results of Lusher et al. (2018) investigating carcasses of cetaceans from Irish waters (98%), and Nelms et al. (2019) analysing marine mammals found along the coastline of Great Britain (100%). If focussing on harbour porpoises, the study by Lusher et al. (2018) determined

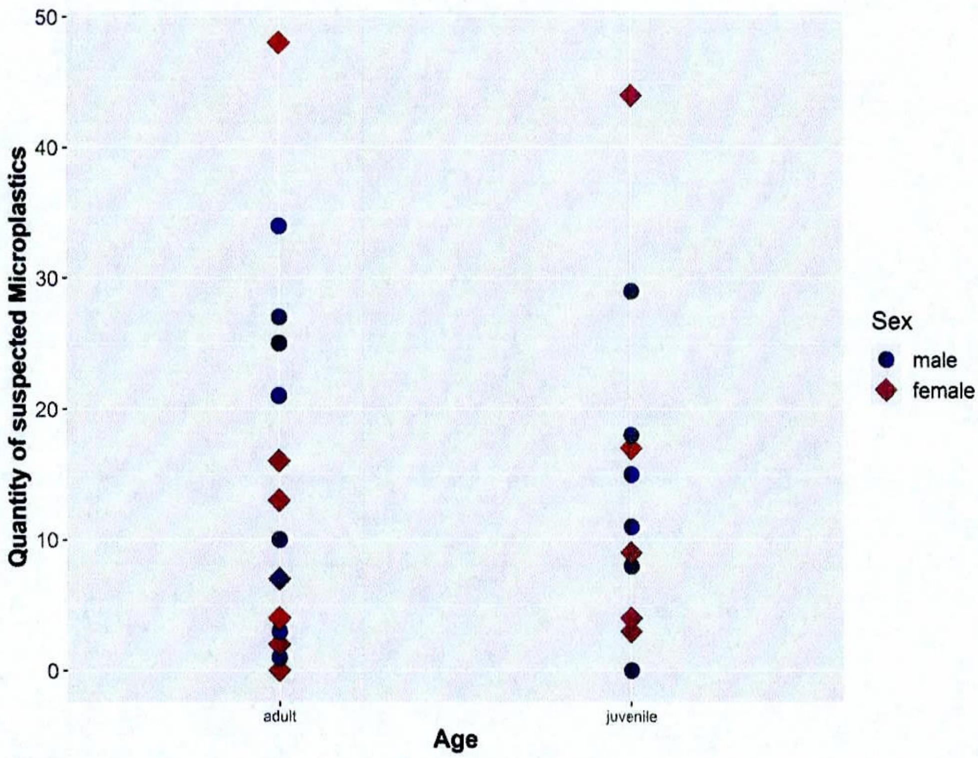

FIGURE 6 | Quantity of suspected microplastic particles (*n* = 401; secondary contamination was considered and subtracted) separated by sex and age of the investigated harbour porpoises (*n* = 30) from German waters (NS and BS).

a microplastic presence in only 6.25% of all investigated cetacean carcasses. One explanation for these differences in microplastic occurrences could be the chosen time period of the review by Lusher et al. (2018). It was conducted between 1990 and 2015. A second explanation could be the used mesh size of at least 300 μm, resulting in the loss of smaller particles, which are included in the study presented herein. Furthermore, no detailed information on the stranding site is given, which would be useful for comparison purpose, since differences in microplastic loads around Ireland (Irish Sea, Celtic Sea and the western coastline facing the open North Atlantic) were determined when the microplastic occurrence was compared at different prawn fishing grounds in 2016 (Hara et al., 2020). Furthermore, the study by Lusher et al. (2018), confirmed the microplastic burden in 21 individuals covering six different cetacean species summing up to 528 investigated GITs. In addition, microplastic (≥ 300 μm) was only found in Odontoceti species. The study of van Franeker et al. (2018) conducted on harbour porpoises stranded at the Dutch coast, revealed the presence of marine litter items [incl. macroplastic and microplastics (≥1 mm)] in 7% of all investigated stomachs. Van Franeker and colleagues are aware of the fact that due to the mesh size range of used sieves, particles smaller than 1 mm were lost and not considered during their study (van Franeker et al., 2018). As the here presented study confirmed that the main part of found microplastics are smaller than 1 mm (85%), the results of van Franeker et al. (2018) are not comparable with our study. In addition, the size limits of 100 μm and 5 mm, which are based on the used mesh sizes of the washing sachets (Philipp et al., 2020) and the definition of microplastics (Arthur et al., 2009), overlap with the size of zooplankton species, which a variety of invertebrates feed on (Devriese et al., 2015; Fischer, 2019). Thus, investigations in predatory fish or marine mammal species should also focus on these small-sized microplastic particles.

Reference studies of microplastics in marine mammals, especially from the BS, are scarce. Thus, studies investigating fish, sediment and water samples are considered for further discussion. The microplastic burden in different fish species is higher in the BS (11–22%) (Lenz et al., 2016; Beer et al., 2018) when compared to the southern NS (5.4%) (Foekema et al., 2013). In addition, studies investigating fish species inhabiting waters between Norway and Denmark determined a low risk of microplastic occurrence in fish (1.2%) (Foekema et al., 2013). In contrast, the microplastic concentrations in surface waters and sediment samples show higher concentration in the southern NS (Karlsson et al., 2017; Lorenz et al., 2019), compared to findings of the BS (Graca et al., 2017; Tamminga et al., 2018). Whereas, a model on the global fibre distribution in surface waters estimated a higher accumulation in the BS ($\sim$1,760 ± 4,500 m^{-3}), compared to the North Atlantic region ($\sim$1,800 ± 1,720 m^{-3}) (Lima et al., 2021). Nevertheless, an ubiquitous distribution of

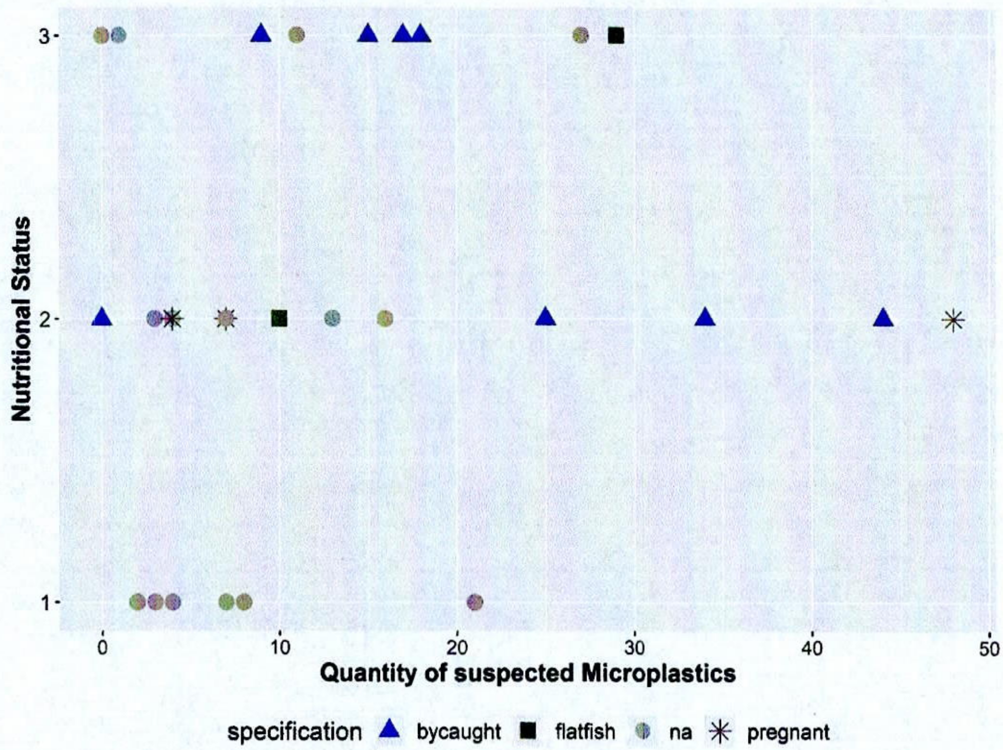

FIGURE 7 | Quantity of suspected microplastics (n = 401) in combination with the nutritional status and further information about the carcasses (bycaught: the harbour porpoise was (suspected to be) bycaught by a fishing boat or in a gillnet; flatfish: the harbour porpoise was affected by a pharyngeal entrapment; na: no extraordinary finding could be revealed; pregnant: pregnancy in female was noticed). The nutritional status is coded as follows: (1): bad, (2): moderate, and (3): good.

synthetic particles along the German BS coast is assumed (Stolte et al., 2015). Furthermore, the fact that marine mammals of the BS might be more exposed to marine litter than in the NS was already confirmed (Unger et al., 2017). Thus, a higher risk of microplastic burden in the BS could be hypothesised. The results obtained in this study underline the findings of marine litter and support the following hypothesis: Investigated harbour porpoises of the BS show a higher number of microplastic particles (incl. fibres and fragments), in contrast to individuals from the NS in each year. In particular, two females from the BS show a high amount of microplastics (44 and 48 particles). For avoiding an overassessment in future research, higher sample sizes per sea are highly recommended.

It will be worth to strive for a reference study investigating the area of the Baltic Proper, since this area is assumed to accumulate pollutants from the whole BS (Stolte et al., 2015), and the here occurring harbour porpoise subspecies is critically endangered (Carlén et al., 2018). Nevertheless, the time span of the available sample collection and the quantity of samples is still too low for identifying a trend in both seas. After statistical assessment with paired t-test and Cohen's d, the samples size has to be increased if reliable comparisons in microplastic burden of individuals of both seas should be evaluated. Thus, a continuation of the herein presented approach is advisable and is intended.

Polymer Findings

In this study, the most frequently found polymer was PEST. Based on the fact that six fragments and 24 fibres were found in the intestinal samples and only one PEST fibre was identified in one of the procedural blanks, PEST microplastics were still taken into account and were not excluded from this study. Additionally, the procedural blanks show a low amount of fibres ($\varnothing_{fibres}$ = 1 and $\varnothing_{fragments}$ = 7 per procedural blank) and were already subtracted from the results presented here. To control for microplastic contamination, only cotton gloves and lab coats were worn while processing the samples (Philipp et al., 2020). Other studies investigating GIT samples of marine mammals from the North Atlantic found PEST particles, even though high protective measurements were used (Lusher et al., 2015a; Nelms et al., 2019). In addition, a high amount of synthetic fibres like PEST fibres were determined in the Northeast Atlantic region (Thompson, 2004; Lusher et al., 2014), and in inhabiting fish species (Lusher et al., 2013; McGoran et al., 2017; Pereira et al., 2020). The twelve found polyamide particles were not excluded from the analysis, since fibres of the used nylon cloth (PA) are obviously identifiable due to their unique fibre pattern (Philipp et al., 2020), and are clearly different from the PA particles found in the intestinal samples. Thus, those fibres were immediately excluded while pre-selecting, counting and collecting particles for microplastic with no evidence of parasite occurrence. Similar pathological findings were identified for individuals from the BS (Siebert et al., 2020). Thus, a relationship between the accumulation of microplastics and intestinal parasites could not be confirmed in harbour porpoises, as it was previously suggested for grey seals by Hernandez-Milian et al. (2019). In addition, a parasite infestation in the four-chambered stomach of harbour porpoises is more likely than an affection of the intestine (Lakemeyer et al., 2020). Furthermore, only 11 and 27 microplastic particles were found in the intestinal samples in those two cases. Hence, a relationship between tissue damage and microplastics seems to be unlikely. However, tissue damage and inflammations are assumed to be caused by micro- and nanoplastic occurrence (Carr et al., 2012; Stock et al., 2019). In addition, the occurrence of an enteritis in harbour porpoises seems to be rare, since only 9% of the Baltic individuals found in German waters seems to be affected (Siebert et al., 2020). Thus, it is still speculative if the presence of microplastics may cause the tissue damages found in the harbour porpoises as it has already been observed in beluga whales (Moore et al., 2020).

No positive or negative impacts could be revealed in pregnant females: (I) the observed quantity differs extremely between those three specimens (4, 7, and 48 microplastics were found per individual); (II) the number of examined pregnant specimens is, thus, too low. It has to be taken into account that on the one hand, the occurrence of solid particles (microplastics in this study) does not necessarily have to be accompanied by tissue damage. On the other hand, the observation of tissue damage does not absolutely indicate the presence of microplastics. Moreover, it was shown that synthetic materials adsorb pollutants and toxins, and serve as a vector (Yu et al., 2019) and, thus, most likely cause contaminant accumulation.

CONCLUSION

For analysing the microplastic burden in marine mammals most studies investigate the whole GIT (Lusher et al., 2015a; Nelms et al., 2019). The study presented herein revealed three benefits of focussing on only one part of the GIT: (1) avoidance of secondary contamination in smaller samples is easier, (2) the remaining carcass and GIT can be entirely evaluated for a health monitoring, and (3) the findings in the rectum and faeces confirm the egestion of microplastic particles. For evaluating the intake and egestion rate, further research is needed. Nevertheless, microplastic investigations and experiments in mammals, and especially in free-ranging marine mammals, are complicated based by field conditions. Furthermore, ethical concerns arise as indicated by Nelms et al. (2018). Thus, samples of carcasses and faecal samples of alive individuals are the most feasible approach to assess the microplastic burden in marine mammals.

This is the first study investigating harbour porpoises from different subpopulations for microplastics, and revealed differences in microplastic presence in the NS and the BS. A higher risk of exposure to microplastics was revealed for the western Baltic population, if compared to the North-East Atlantic population. Thus, a higher microplastic burden in the BS is assumed. Furthermore, evidence for the continuous accumulation of microplastics via the food web was given, but could not significantly be confirmed in adult individuals, compared to juvenile ones. Additionally, there is no significant difference in the quantity of synthetic particles in male or female harbour porpoises. To gain further knowledge on differences in sex or age, the quantity of samples has to be increased in future research.

An important relationship between a good or moderate nutritional status and the occurrence of microplastics is demonstrated in this study. Moreover, the egestion and thus, a discharge of microplastic particles out of the organism could be confirmed. No relationship between parasites, tissue damage and microplastic presence could be identified. Therefore, a histological investigation of cell damage or tissue damage localisation with the help of biomarkers would be advisable in future research. Further investigations are needed for evaluating the rate of accumulation and burden in harbour porpoises in the different seas. Indeed, this study outlines first evidence in retrospective microplastic burden. Nevertheless, a higher sample size, as well as a larger temporal coverage is needed to reliably estimate trends in the microplastic burden in harbour porpoises. Furthermore, this study supports the need for a comprehensive marine litter monitoring in predatory species to gain knowledge on accumulation processes and health assessment in apex species of the marine food web.

DATA AVAILABILITY STATEMENT

The original contributions presented in the study are included in the article/**Supplementary Material**, further inquiries can be directed to the corresponding author/s.

ETHICS STATEMENT

Ethical review and approval was not required for the animal study because the investigations on marine mammals for scientific and conservation purpose were conducted in accordance with national and international regulations. During this study samples of dead found specimens were analysed and thus no invasive methods were used.

AUTHOR CONTRIBUTIONS

CP, BU, and US conceptualized the study and acquired funding. CP conducted the laboratory analysis of processing the samples and isolate microplastics, assisted by BU. CP did the statistical analysis. JHEK provided the μFTIR and FTIR for polymer type analysis. SME conducted the polymer identification by μFTIR and FTIR. CP and SME generated the figures. The manuscript was prepared by CP, and contributed editing with perspectives and arguments was done by BU, SME, JHEK, and US. All authors approved the submitted version.

FUNDING

The stranding network and the health monitoring are partly funded by the Schleswig-Holstein Agency for Coastal Defence, National Park and Marine Conservation, Germany. The pathological investigations of the marine mammals are partly funded by the Ministry of Energy, Agriculture, Environment, Nature and Digitalisation of Schleswig-Holstein, Germany. The Federal Environment Agency (UBA) partly funded the analysis of samples within the project "Assessment and implementation for long-term monitoring of pollution of diverse marine compartments and biota with marine litter" (FKZ 3717252250).

ACKNOWLEDGMENTS

We would like to thank all seal rangers in Schleswig-Holstein, Germany for reporting and collecting carcasses. Further thanks go to our colleagues in the ITAW necropsy team for collecting and dissecting carcasses, as well as for collecting samples for our purpose continuously throughout the year. Special thanks go to Dieter Steinhagen for improving this study with his valuable comments. Besides, we would like to thank the reviewers for their valuable comments and advice, which helped to improve the manuscript.

SUPPLEMENTARY MATERIAL

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fmars.2021.682532/full#supplementary-material

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Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

Annex to Resolution 12.14

CMS Family Guidelines on Environmental Impact Assessment for Marine Noise-generating Activities

These **CMS Family Guidelines on Environmental Impact Assessment for Marine Noise-generating Activities** have been developed to present the Best Available Techniques (BAT) and Best Environmental Practice (BEP), as called for in CMS Resolutions 9.19, 10.24 and 10.15, ACCOBAMS Resolution 5.15 and ASCOBANS Resolutions 6.2 and 8.11. In addition to the parent convention, CMS, these guidelines are relevant to:

- Agreement on the Conservation of Cetaceans of the Black Seas Mediterranean Seas and Contiguous Atlantic Area (ACCOBAMS)
- Agreement on the Conservation of Seals in the Wadden Sea (Wadden Sea Seals)
- Agreement on the Conservation of Small Cetaceans in the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS)
- MOU Concerning Conservation Measures for the Eastern Atlantic Populations of the Mediterranean Monk Seal (*Monachus monachus*) (Atlantic Monk Seals)
- MOU Concerning Conservation Measures for Marine Turtles of the Atlantic Coast of Africa (Atlantic Marine Turtles)
- MOU Concerning the Conservation of the Manatee and Small Cetaceans of Western Africa and Macaronesia (Western African Aquatic Mammals)
- MOU for the Conservation of Cetaceans and their Habitats in the Pacific Islands Region (Pacific Islands Cetaceans)
- MOU on the Conservation and Management of Dugongs (*Dugong dugon*) and their Habitats throughout their Range (Dugong)
- MOU on the Conservation and Management of Marine Turtles and their Habitats of the Indian Ocean and South-East Asia (IOSEA)
- MOU on the Conservation of Migratory Sharks (Sharks)

Contents

I. Introduction

1. These **CMS Family Guidelines on Environmental Impact Assessment for Marine Noise-generating Activities** are designed to provide regulators with tailored advice to apply in domestic jurisdictions, as appropriate, to create EIA standards between jurisdictions seeking to manage marine noise-generating activities. The requirements within each of the modules are designed to ensure that the information being provided by proponents will provide decision-makers with sufficient information to make an informed decision about impacts. The modules should be read in tandem with the **Technical Support Information to the CMS Family Guidelines on Environmental Impact Assessments for Marine Noise-generating Activities** (available at www.cms.int/guidelines/cms-family-guidelines-EIAs-marine-noise). They are structured to stand as one complete unit or to be used as discrete modules, tailored for national and agreement approaches.

2. The sea is the interconnected system of all the Earth's oceanic waters, including the five named 'oceans' - the Atlantic, Pacific, Indian, Southern and Arctic Oceans - a continuous body of salty water that covers over 70 per cent of the Earth's surface. This vast aquatic environment is home to a wider range of higher animal taxa than exists on land. Many marine species have yet to be discovered and the number known to science is expanding annually.

3. The sea also provides people with food—mainly fish, shellfish and seaweed—as well as other marine resources. It is a shared resource for us all.

4. Marine wildlife relies on sound for vital life functions, including communication, prey and predator detection, orientation and for sensing surroundings. The ocean environment is filled with natural sound (ambient noise) from biological (marine animals) and physical processes (earthquakes, wind, ice and rain) (Urick, 1983). Species living in this environment are adapted to these sounds.

5. Over the past century many anthropogenic marine activities have increased levels of noise (Hildebrand 2009; André et.al. 2010; Miksis-Olds and Nichols 2016) These modern anthropogenic noises have the potential for physical, physiological and behavioural impacts (Southall et.al. 2007).

6. Parties to CMS, ACCOBAMS and ASCOBANS have in several resolutions recognized underwater noise as a major threat to many marine species. These resolutions also call for noise-related considerations to be taken into account as early as the planning stages of activities, especially by making effective use of Environmental Impact Assessments (EIAs). The Convention on Biological Diversity Decision XII/23 also encourages governments to require EIAs for noise-generating offshore activities, and to combine acoustic mapping with habitat mapping to identify areas where these species may be exposed to noise impacts. (Prideaux, 2017b)

7. Wildlife exposed to elevated or prolonged anthropogenic noise can suffer direct injury and/or temporary or permanent auditory threshold shifts. Noise can mask important natural sounds, such as the call of a mate, or the sound made by prey or predator. Anthropogenic noise can also displace wildlife from important habitats. These impacts are experienced by a wide range of species including fish, crustaceans, cephalopods, pinnipeds (seals, sea lions and walrus), sirenians (dugong and manatee), sea turtles, the polar bear, marine otters and cetaceans (whales, dolphins and porpoises) (Southall et.al. 2007; Aguilar de Soto, 2017a; 2017b; Castellote, 2017a; 2017b; Frey, 2017; Hooker, 2017; McCauley, 2017; Marsh, 2017; Notarbartolo di Sciara, 2017a; 2017b; 2017c; Parks, 2017; Truda Palazzo, 2017; Vongraven, 2017). Where there is risk, full assessment of impact should be conducted.

8. The propagation of sound in water is complex and requires many variables to be carefully considered before it can be known if a noise-generating activity is appropriate or not. It is inappropriate to generalize sound transmission without fully investigating propagation (Prideaux, 2017a). Often, statements are made in Environmental Impact Assessments that a noise-generating activity is 'X' distance from 'Y' species or habitat and therefore, will have no impact. In these cases, distance is used as a basic proxy for impact but is rarely backed with scientifically modelled information. (Wright et.al. 2013; Prideaux and Prideaux 2015)

9. To present a defensible Environmental Impact Assessment for any noise-generating activity proposal, proponents need to have expertly modelled the noise of the proposed activity in the region and under the conditions they plan to operate. Regulators should have an understanding of the ambient or natural sound in the proposed area. This might require CMS Parties or jurisdictions to develop a metric or method for defining this, by drawing on the range of resources available worldwide. (Prideaux, 2017a)

10. All EIAs should include operational procedures to mitigate impact effectively during activities, and there should be proof of the mitigation's efficacy. These are the operational mitigation procedures that should be detailed in the national or regional regulations of the jurisdictions where the activity is proposed. Operational monitoring and mitigation procedures differ around the world, and may include industry/company best practices. Monitoring often includes, *inter alia*:

a. periods of visual and other observation before a noise-generating activity commences
b. passive acoustic monitoring
c. marine mammal observers
d. aerial surveys

Primary mitigation often includes, *inter alia*:

e. delay to start, soft start and shut-down procedures
f. sound dampers, including bubble curtains and cofferdams; sheathing and jacket tubes
g. alternative low-noise or noise-free options (such as compiled in the OSPAR inventory of measures to mitigate the emission and environmental impact of underwater noise)

Secondary mitigation, where the aim is to prevent encounters of marine life with noise sources, includes *inter alia*:

h. spatial & temporal exclusion of activities

11. Approaches to mitigate the impact of particle motion (e.g. reducing substrate or sea ice vibration) should also be investigated. Assessment of the appropriateness and efficacy of all operational procedures should be the responsibility of the government agency assessing Environmental Impact Assessments (EIA).

II. Technical Support Information to the CMS Family Guidelines on Environmental Impact Assessment for Marine Noise-generating Activities

12. **Technical Support Information to the CMS Family Guidelines on Environmental Impact Assessments for Marine Noise-generating Activities** is provided as a full document and as stand-alone modules at: www.cms.int/guidelines/cms-family-guidelines-EIAs-marine-noise.

13. This **Technical Support Information** has been specifically designed to provide clarity and certainty for regulators, when deciding to approve or restrict proposed activities. The document provides detailed information about species' vulnerabilities, habitat considerations, impact of exposure levels and proposed assessment criteria for all of the CMS-listed species groups and their prey.

14. The document is structured to cover specific areas, as follows:

- 'Module A: Sound in Water is Complex' provides an insight into the characteristics of sound propagation and dispersal. This module is designed to provide decision-makers with necessary foundation knowledge to interpret the other modules in these guidelines and any impact assessments that are presented to them for consideration.
- 'Module B: Expert Advice on Specific Species Groups' presents twelve separate detailed sub-modules covering each of the CMS species groups, focusing on species' vulnerabilities, habitat considerations, impact of exposure levels and assessment criteria.
- 'Module C: Decompression Stress' provides important information on bubble formation in marine mammals, source of decompression stress, source frequency, level and duration, and assessment criteria.
- 'Module D: Exposure Levels' presents a summary of the current state of knowledge about general exposure levels.
- 'Module E: Marine Noise-generating Activities' provides a brief summary of military sonar, seismic surveys, civil high-powered sonar, coastal and offshore construction works, offshore platforms, playback and sound exposure experiments, shipping and vessel traffic, pingers and other noise-generating activities. Each section presents current knowledge about sound intensity level, frequency range and the activities' general characteristics. The information is summarized in a table within the module.
- 'Module F: Related Intergovernmental or Regional Economic Organization Decisions' presents the series of intergovernmental decisions that have determined the direction for regulation of anthropogenic marine noise.
- 'Module G: Principles of EIAs' establishes basic principles including strategic environmental assessments, transparency, natural justice, independent peer review, consultation and burden of proof.
- 'Module H: CMS-Listed Species Potentially Impacted by Anthropogenic Marine Noise'

15. The evidence presented in the **Technical Support Information** Modules B, C and D establishes that the effective use of EIA for all marine noise-generating activities is in line with CMS Resolutions 9.19, 10.24 and 10.15, ACCOBAMS Resolution 5.15 and ASCOBANS Resolutions 6.2 and 8.11.

16. The **Technical Support Information** was developed before the release of ISO 18405: Underwater acoustics – Terminology that provides valuable consistency to language used. The Guidelines have been slightly adapted to reflect this new ISO standard, without losing the vital connection to the **Technical Support Information.** Decision-makers should refer to both documents wherever possible.

III. Technical Advisory Notes

17. The following advisory notes should be considered in conjunction with the individual EIA Guideline tables, as presented in Modules IV through XI.

III.1. Ambient Sound

18. ISO 18405 refers to ambient sound as "*sound that would be present in the absence of a specified activity*" and "*is location-specific and time-specific*". These Guidelines more specifically define it as the average ambient (non-anthropogenic) sound levels from biological (marine animals) and physical processes (earthquakes, wind, ice and rain etc) of a given area. It should be measured (including daily and seasonal variations of frequency bands), for each component of an activity, prior to an EIA being developed and presented.

III.2 Sound Intensity

19. ISO 18405 defines sound intensity as "the product of the sound pressure", which is the contribution to total pressure caused by the action of sound, "and sound particle velocity", which is the contribution to velocity of a material element caused by the action of sound.

III.3. Exclusion Zones

20. Where exclusion zones are referred to in these Guidelines, these are areas that are designed for the protection of specific species and/or populations. Activities, and noise generated by activities, should not propagate into these areas.

III.4. Independent, Scientific Modelling of Noise Propagation

21. The objective of noise modelling for EIAs is to predict how much noise a particular activity will generate and how it will disperse. The aim is to model the received sound levels at given distances from the noise source. The amount of sound lost at the receiver from the sound source is propagation loss.

22. The intention of EIAs is to assess the impact of proposed activities on marine species and the environment. EIAs should not only present the main output of interest to the activity proponent, but should fully disclose the full frequency bandwidth of a proposed anthropogenic noise source, the intensity/pressure/energy output within that full range, and the principal or mean/median operating frequency of the source(s). (Urick, 1983, Etter, 2013; Prideaux, 2017a)

23. Many propagation models have been developed such as ray theory, normal modes, multipath expansion, fast field, wavenumber integration or parabolic equation. However, no single model accounts for all frequencies and environments. Factors that influence which propagation model/s should be used include the activity noise frequencies, water depth, seabed topography, temperature and salinity, and spatial variations in the environment. (Urick, 1983, Etter, 2013; Prideaux, 2017a)

24. The accuracy (i.e. bias) of sound propagation models depends heavily on the accuracy of their input data.

25. Commonly missing in EIAs is the modelling of particle motion propagation. Invertebrates, and some fish, detect sound through particle motion to identify predator and prey. Like sound intensity, particle motion varies significantly close to noise sources and in shallow water. Excessive levels of ensonification of these animal groups may lead to injury (barotrauma). Specific modelling techniques are required to predict the impact on these species.

III.5. Sound Exposure Level cumulative (SEL_{cum})

26. Sound Exposure Level (SEL) is generally referred to as dB 0 to peak or peak to peak (dB 0 to peak or dB p to p) for impulsive noise like air guns or pile driving, and dB Root Mean Squared (dB_{rms}) for non-impulsive noise such as ship noise, dredging or a wind farm's constant drone. Often this metric is normalized to a single sound exposure of one second (NOAA, 2016). The SEL cumulative (SEL_{cum}) metric allows the cumulative exposure of an animal to a sound field for an extended period (often 24 hours) to be assessed against a predefined threshold for injury. (Southall, 2007; NOAA, 2016)

27. NOAA recommends a baseline accumulation period of 24 hours, but acknowledges that there may be specific exposure situations where this accumulation period requires adjustment (e.g., if activity lasts less than 24 hours or for situations where receivers are predicted to experience unusually long exposure durations). (NOAA, 2016) The limit value for pile driving in Germany is a sound exposure level of SEL_{05} and the sound pressure level L_{peak} at a distance of 750 metres.

III.6. Particle Motion/Displacement

28. Sound exposure levels works well for marine mammals but not well for a number of other marine species, including crustaceans, bivalves and cephalopods, because these species are thought to mainly detect sound through particle motion. Particle motion or particle displacement is the displacement of a material element caused by the action of sound. For these Guidelines the motion concerned is the organism resonating in sympathy with the surrounding sound waves, oscillating back and forth in a particular direction, rather than through the tympanic mechanism of marine mammals or swim-bladders of some fish species. (Mooney, et.al., 2010; André, et.al., 2011; Hawkins and Popper, 2016; NOAA, 2016)

29. The detection of particle motion or particle displacement requires different types of sensors than those utilized by a conventional hydrophone. These sensors must specify the particle motion in terms of the particle displacement, or its time derivatives (particle velocity or particle acceleration).

IV. EIA Guideline for Military and Civil High-powered Sonar

This EIA Guideline should be used in combination with the appropriate modules on species and impact from the **Technical Support Information** (B.1-12, C and D) as required for individual regional and domestic circumstances.

The EIA Guideline for Shipping and Vessels Traffic (V) should be used when the vessel is underway/making way with sonar off.

Component	Detail
Description of area	• Detail of the spatial extent and nature of the activity – including seabed bathymetry and composition, description of known stratification characteristics and broad ecosystem descriptions – as well as the spatial area that will experience anthropogenic noise, generated by the proposed activity, above natural ambient sound levels • Detail of the typical weather conditions and day length for the area during the proposed activity period • Identification of previous and simultaneous activities, their seasons and duration in the same or adjoining areas, existence and location of any marine protected areas, and a review of activity findings and implications

Component	Detail
Mitigation and monitoring plans	• Detail of: a. Scientific monitoring programmes before the survey to assess species distribution and behaviour, to facilitate the incorporation of monitoring results into the impact assessment. b. Scientific monitoring programmes, conducted during and after the activity, to assess impact c. Transparent processes for regular real-time public reporting of activity progress and all impacts encountered d. Most appropriate methods of species detection (e.g. visual/acoustic) and the range of available methods, and their advantages and limitations, as well their practical application during the activity. e. Impact mitigation proposals: i. 24-hour visual or other means of detection, especially under conditions of poor visibility (including high winds, night conditions, sea spray or fog) ii. establishing exclusion zones to protect specific species, accompanied by scientific and precautionary justification for these zones iii. soft start and shut-down protocols iv. spatio-temporal restrictions
Reporting plans	• Detail of post operation reporting plans including verification of the effectiveness of mitigation
Consultation and independent review	• Description of consultation, prior to EIA submission: a. List of stakeholders consulted b. Detail of information provided to stakeholders, opportunities given for appropriate engagement and the timeframe for feedback c. Explanation of what amendments and changes have been made to the proposed activity in response to the comments, queries, requests and concerns d. Explanation of which comments, queries, requests and concerns have not been accommodated and why • Description of independent review of draft EIA: a. Detail of the independent reviewers (species experts) including affiliation and qualifications b. Description of the comments, queries, requests and concerns received from each reviewer c. Explanation of what amendments and changes have been made to the proposed activity in response to the comments, queries, requests and concerns d. Explanation of which comments, queries, requests and concerns have not been accommodated and why

V. EIA Guideline for Shipping and Vessels Traffic

This EIA Guideline should be used in combination with the appropriate modules on species and impact from the **Technical Support Information** (B.1-12, C and D) as required for individual regional and domestic circumstances.

This EIA Guideline is directed to shipping regulators, including port and harbour authorities. Cumulative impact of shipping, identifying appropriate exclusion zones and shipping lanes should be the focus.

Component	Detail
Description of area	• Detail of the spatial extent and nature of the activity – including seabed bathymetry and composition, description of known stratification characteristics and broad ecosystem descriptions – as well as the spatial area that will experience anthropogenic noise, generated by the proposed shipping, above natural ambient sound levels • Detail of the typical weather conditions and day length for the area during the proposed activity period • Existence and location of any marine protected areas
Description of vessels and equipment	• Description of vessel/s (tonnage, propulsion and displacement) and equipment activity • Detail of all activities including sound intensity levels (dB_{rms}) @ 1 metre and frequency ranges (all frequencies to encompass, *inter alia*, propeller resonance, harmonics, cavitations, engine and hull noise) • Identification of other activities having an impact in the region accompanied by the analysis and review of potential cumulative or synergistic impacts
Modelling of noise propagation loss	• Detail of independent, scientific modelling of noise propagation loss in confined areas (harbours and channels) and accounting for local propagation features (depth and type of sea bottom, local propagation paths related to thermal stratification, SOFAR or natural channel characteristics) from point source out to a radius where the noise levels generated are close to natural ambient sound levels • Identification and mapping of proposed species exclusion zones and description of how noise propagation into these zones will be minimized, taking into consideration the local propagation features

Component	Detail
Species impact	• General: a. Identification and density of species likely to be present that will experience sound transmission generated by the proposed activity above natural ambient sound levels. Calculated from this, the extent of the impact zones, and the number of animals affected by the activity. b. Specification of the type of impact predicted (direct and indirect) as well as direct and indirect impacts on prey species c. Information on the behaviour of each species group, and the ability to detect each of the species for mitigation purposes (e.g. for marine mammals this will include diving behaviour, vocal behaviour, and conspicuousness when at the surface). • For each species group, also detail of the following (refer to module B species summary): a. Species vulnerabilities: i. specific vulnerabilities to noise ii. lifecycle components of these vulnerabilities b. Habitat: i. specific habitat components considered ii. presence of critical habitat (calving, spawning, feeding grounds, resting bays etc.) c. Scientific assessment of impact: i. exposure levels ii. total exposure duration iii. determination of precautionary safe/harmful exposure levels (direct impact, indirect impact and disturbance) that account for uncertainty and avoids erroneous conclusions
Monitoring plans	• Explanation of access to the evaluation of ongoing scientific monitoring data to assess impacts • Quantification of the effectiveness of proposed mitigation methods • Spatio-temporal restrictions
Consultation and independent review	• Description of consultation, prior to EIA submission: a. List of stakeholders consulted b. Detail of information provided to stakeholders, opportunities given for appropriate engagement and the timeframe for feedback c. Explanation of what amendments and changes have been made to the proposed activity in response to the comments, queries, requests and concerns d. Explanation of which comments, queries, requests and concerns have not been accommodated and why • Description of independent review of draft EIA: a. Detail of the independent reviewers (species experts) including affiliation and qualifications b. Description of the comments, queries, requests and concerns received from each reviewer c. Explanation of what amendments and changes have been made to the proposed activity in response to the comments, queries, requests and concerns d. Explanation of which comments, queries, requests and concerns have not been accommodated and why

VI. EIA Guideline for Seismic Surveys (Air Gun and Alternative Technologies)

This EIA Guideline should be used in combination with the appropriate modules on species and impact from the **Technical Support Information** (B.1-12, C and D) as required for individual regional and domestic circumstances.

Component	Detail
Description of area	• Detail of the spatial extent and nature of the survey – including seabed bathymetry and composition, description of known stratification characteristics and broad ecosystem descriptions – as well as the spatial area that will experience anthropogenic noise, generated by the proposed survey, above natural ambient sound levels • Detail of the typical weather conditions and day length for the area during the proposed activity period • Identification of previous and simultaneous activities, their seasons and duration in the same or adjoining areas, existence and location of any marine protected areas, and a review of activity findings and implications
Description of the equipment and activity	• Explanation of all survey technologies available (including low-noise or noise-free options) and why the proposed technology has been chosen. If low-noise options have not been chosen, an explanation should be provided about why these technologies are not preferred • Description of the survey technology including: a. name and description of the vessel/s to be used b. total duration of the proposed survey, date, timeframe c. proposed timing of operations – season/time of day/during all weather conditions d. sound intensity level (dB peak to peak) in water @ 1 metre and all frequency ranges and discharge rate e. if an air gun technology is proposed: i. number of arrays ii. number of air guns within each array iii. air gun charge pressure to be used iv. volume of each air gun in cubic inches v. official calibration figures supplied by the survey vessel to be charted, for noise modelling vi. depth the air guns to be set vii. number and length of streamers, distance set apart and depth the hydrophones are set • Specification of the survey including anticipated nautical miles to be covered, track-lines, speed of vessels, start-up and shut-down procedures, distance and procedures for vessel turns including any planned air gun power setting changes • Identification of other activities having an impact in the region during the planned survey, accompanied by the analysis and review of potential cumulative or synergistic impacts

Component	Detail
Modelling of noise propagation loss	• Detail of independent, scientific modelling of noise propagation loss in the same season/weather conditions as the proposed activity accounting for local propagation features (depth and type of sea bottom, local propagation paths related to thermal stratification, SOFAR or natural channel characteristics) from point source out to a radius where the noise levels generated are close to natural ambient sound levels • Identification and mapping of proposed species exclusion zones and description of how noise propagation into these zones will be minimized, taking into consideration the local propagation features
Species impact	• General: a. Identification and density of species likely to be present that will experience sound transmission generated by the proposed activity above natural ambient sound levels. Calculated from this, the extent of the impact zones, and the number of animals affected by the activity. a. Specification of the type of impact predicted (direct and indirect) as well as direct and indirect impacts to prey species b. Information on the behaviour of each species group, and the ability to detect each of the species for mitigation purposes (e.g. for marine mammals this will include diving behaviour, vocal behaviour, and conspicuousness when at the surface). • For each species group, also detail of the following (refer to module B species summary): a. Species vulnerabilities: i. specific vulnerabilities to noise ii. lifecycle components of these vulnerabilities b. Habitat: i. specific habitat components considered ii. presence of critical habitat (calving, spawning, feeding grounds, resting bays etc.) c. Scientific assessment of impact: i. exposure levels ii. total exposure duration iii. determination of precautionary safe/harmful exposure levels (direct impact, indirect impact and disturbance) that account for uncertainty and avoids erroneous conclusions

Component	Detail
Mitigation and monitoring plans	• Detail of: a. Scientific monitoring before the survey to assess baselines, species distribution and behaviour to facilitate the incorporation of monitoring results into the impact assessment b. Scientific monitoring programmes, conducted during and after the survey, to assess impact, including noise monitoring stations placed at specified distances c. Transparent processes for regular real-time public reporting of survey progress and all impacts encountered d. Most appropriate methods of species detection (e.g. visual/acoustic) and the range of available methods, and their advantages and limitations, as well their practical application during the activity. e. Impact mitigation proposals: i. 24-hour visual or other means of detection, especially under conditions of poor visibility (including high winds, night conditions, sea spray or fog) ii. establishing exclusion zones to protect specific species, including scientific and precautionary justification for these zones iii. soft start and shut-down protocols iv. protocols in place for consistent and detailed data recording (observer/PAM sightings and effort logs, survey tracks and operations) v. detailed, clear, chain of command for implementing shut-down mitigation protocols vi. spatio-temporal restrictions • Quantification of the effectiveness of proposed mitigation methods
Reporting plans	• Detail of post operation reporting plans including verification of the effectiveness of mitigation, and any shut-down procedures occurring and reasons why
Consultation and independent review	• Description of consultation, prior to EIA submission: a. List of stakeholders consulted b. Detail of information provided to stakeholders, opportunities given for appropriate engagement and the timeframe for feedback c. Explanation of what amendments and changes have been made to the proposed survey in response to the comments, queries, requests and concerns d. Explanation of which comments, queries, requests and concerns have not been accommodated and why • Description of independent review of draft EIA: a. Detail of the independent reviewers (species experts) including affiliation and qualifications b. Description of the comments, queries, requests and concerns received from each reviewer c. Explanation of what amendments and changes have been made to the proposed survey in response to the comments, queries, requests and concerns d. Explanation of which comments, queries, requests and concerns have not been accommodated and why

VII. EIA Guideline for Construction Works

This EIA Guideline should be used in combination with the appropriate modules on species and impact from the **Technical Support Information** (B.1-12, C and D) as required for individual regional and domestic circumstances. This guideline should be applied to all forms of marine construction, including dredging and similar vessel based activities where ships may be stationary, but under way. All commissioning and decommissioning activities should also follow these guidelines.

Component	Detail
Description of area	• Detail of the spatial extent and nature of the activity – including seabed bathymetry and composition, description of known stratification characteristics and broad ecosystem descriptions – as well as the spatial area that will experience anthropogenic noise, generated by the proposed activity, above natural ambient sound levels • Detail of the typical weather conditions and day length for the area during the proposed activity period • Identification of previous and simultaneous activities, their seasons and duration in the same or adjoining areas, existence and location of any marine protected areas, and a review of activity findings and implications
Description of the equipment and activity	• Explanation of all activity technologies available and why each proposed technology is chosen, including consideration of noise-free installation methods • Specification of: a. total duration of the proposed activity b. proposed timing of operations – season/time of day/during all weather conditions c. sound intensity level (dB peak to peak) in water @ 1 metre and frequency ranges d. If explosives are proposed: i. what type of explosive and what charge weight is proposed, also whether the explosive is going to be used on the seabed or subsurface ii. specification of sound intensity level (dB 0 to peak) in water @ 1 metre, frequency range and number of detonations and interval time • Description of noise counter measures e.g.: bubble curtains, noise dampers and cofferdams, including a description of state-of-the-art technology, Best Environmental Practice (BEP) or Best Available Technology (BAT) • Identification of other activities having an impact in the region during the planned activity, accompanied by the analysis and review of potential cumulative or synergistic impacts
Modelling of noise propagation loss	• Detail of independent, scientific modelling of noise propagation loss in the same season/weather conditions as the proposed activity accounting for local propagation features (depth and type of sea bottom, local propagation paths related to thermal stratification, SOFAR or natural channel characteristics) from point source out to a radius where the noise levels generated are close to natural ambient sound levels • Identification and mapping of proposed exclusion zones for species and description of how noise propagation into these zones will be minimized, taking into consideration the local propagation features

Component	Detail
Species impact	• General: a. Identification and density of species likely to be present that will experience sound transmission generated by the proposed activity above natural ambient sound levels; and calculated from this, the extent of the impact zones b. Specification of the type of impact predicted (direct and indirect) as well as direct and indirect impacts to prey species c. Information on the behaviour of each species group, and the ability to detect each of the species for mitigation purposes (e.g. for marine mammals this will include diving behaviour, vocal behaviour, and conspicuousness when at the surface). • For each species group, also detail of the following (refer to module B species summary): a. Species vulnerabilities: i. specific vulnerabilities to noise ii. lifecycle components of these vulnerabilities b. Habitat: i. specific habitat components considered ii. presence of critical habitat (calving, spawning, feeding grounds, resting bays etc.) c. Scientific assessment of impact: i. exposure levels ii. total exposure duration iii. determination of precautionary safe/harmful exposure levels (direct impact, indirect impact and disturbance) that account for uncertainty and avoids erroneous conclusions
Mitigation and monitoring plans	• Detail of: a. Scientific monitoring programmes, conducted before, during and after the activity, to assess impact, including noise monitoring stations placed at specified distances b. Transparent processes for regular real-time public reporting of activity progress and all impacts encountered c. Most appropriate methods of species detection (e.g. visual/acoustic) and the range of available methods, and their advantages and limitations, as well their practical application during the activity. d. Impact mitigation proposals: i. 24-hour visual or other means of detection, especially under conditions of poor visibility (including high winds, night conditions, sea spray or fog) ii. establishing exclusion zones to protect specific species, including scientific and precautionary justification for these zones iii. soft start and shut-down protocols iv. spatio-temporal restrictions • Quantification of the effectiveness of proposed mitigation methods
Reporting plans	• Detail of post operation reporting plans including verification of the effectiveness of mitigation, and any shut-down procedures occurring and reasons why

Component	Detail
Consultation and independent review	• Description of consultation, prior to EIA submission: a. List of stakeholders consulted b. Detail of information provided to stakeholders, opportunities given for appropriate engagement and the timeframe for feedback c. Explanation of what amendments and changes have been made to the proposed activity in response to the comments, queries, requests and concerns d. Explanation of which comments, queries, requests and concerns have not been accommodated and why e. If it is decided that BEP or BAT is not used, this should be justified • Description of independent review of draft EIA: a. Detail of the independent reviewers (species experts) including affiliation and qualifications b. Description of the comments, queries, requests and concerns received from each reviewer c. Explanation of what amendments and changes have been made to the proposed activity in response to the comments, queries, requests and concerns d. Explanation of which comments, queries, requests and concerns have not been accommodated and why

VIII. EIA Guideline for Offshore Platforms

This EIA Guideline should be used in combination with the appropriate modules on species and impact from the **Technical Support Information** (B.1-12, C and D) as required for individual regional and domestic circumstances.

All commissioning and decommissioning activities should also follow these guidelines. Where impulsive activities, such as offshore platforms being constructed through impact driven piles, the guidelines for VII: Construction Works should also be applied.

Component	Detail
Description of area	• Detail of the spatial extent and nature of the activity – including seabed bathymetry and composition, description of known stratification characteristics and broad ecosystem descriptions – as well as the spatial area that will experience anthropogenic noise, generated by the proposed activity, above natural ambient sound levels • Detail of the typical weather conditions and day length for the area during the proposed activity period • Identification of previous and simultaneous activities, their seasons and duration in the same or adjoining areas, existence and location of any marine protected areas, and a review of activity findings and implications

Component	Detail
Description of the equipment and activity	• Explanation of all activity technologies available and why each proposed technology is chosen, including consideration of alternatives • Description of the activity technology including name and description of the vessel/s and sea floor equipment to be used • Specification of: a. total duration of the proposed activity b. sound intensity level (dB_{rms}) in water @ 1 metre (from noise source e.g.: platform caissons or drill ship's hull etc.) and frequency ranges c. sound intensity levels (peak and rms) during planned maintenance schedules • Identification of other activities having an impact in the region during the planned activity, accompanied by the analysis and review of potential cumulative or synergistic impacts
Modelling of noise propagation loss	• Detail of independent, scientific modelling of noise propagation loss in the same season/weather conditions as the proposed activity accounting for local propagation features (depth and type of sea bottom, local propagation paths related to thermal stratification, SOFAR or natural channel characteristics) from point source out to a radius where the noise levels generated are close to natural ambient sound levels • Identification and mapping of proposed exclusion zones for species and description of how noise propagation into these zones will be minimized, taking into consideration the local propagation features
Species impact	• General: a. Identification and density of species likely to be present that will experience sound transmission generated by the proposed activity above natural ambient sound levels; and calculated from this, the extent of the impact zones b. Specification of the type of impact predicted (direct and indirect) as well as direct and indirect impacts to prey species c. Information on the behaviour of each species group, and the ability to detect each of the species for mitigation purposes (e.g. for marine mammals this will include diving behaviour, vocal behaviour, and conspicuousness when at the surface). • For each species group, also detail of the following (refer to module B species summary): a. Species vulnerabilities: i. specific vulnerabilities to noise ii. lifecycle components of these vulnerabilities b. Habitat: i. specific habitat components considered ii. presence of critical habitat (calving, spawning, feeding grounds, resting bays etc.) c. Scientific assessment of impact: i. exposure levels ii. total exposure duration: iii. determination of precautionary safe/harmful exposure levels (direct impact, indirect impact and disturbance) that account for uncertainty and avoids erroneous conclusions

Component	Detail
Mitigation and monitoring plans	• Detail of: a. Scientific monitoring programmes, conducted before, during and after the activity, to assess impact, including noise monitoring stations placed at specified distances b. Transparent processes for regular real-time public reporting of activity progress and all impacts encountered c. Most appropriate methods of species detection (e.g. visual/acoustic) and the range of available methods, and their advantages and limitations, as well their practical application during the activity. d. Impact mitigation proposals e. 24-hour visual or other means of detection, especially under conditions of poor visibility (including high winds, night conditions, sea spray or fog) f. Spatio-temporal restrictions • Quantification of the effectiveness of proposed mitigation methods
Reporting plans	• Detail of post operation reporting plans including verification of the effectiveness of mitigation
Consultation and independent review	• Description of consultation, prior to EIA submission: a. List of stakeholders consulted b. Detail of information provided to stakeholders, opportunities given for appropriate engagement and the timeframe for feedback c. Explanation of what amendments and changes have been made to the proposed activity in response to the comments, queries, requests and concerns d. Explanation of which comments, queries, requests and concerns have not been accommodated and why • Description of independent review of draft EIA: a. Detail of the independent reviewers (species experts) including affiliation and qualifications b. Description of the comments, queries, requests and concerns received from each reviewer c. Explanation of what amendments and changes have been made to the proposed activity in response to the comments, queries, requests and concerns d. Explanation of which comments, queries, requests and concerns have not been accommodated and why

IX. EIA Guideline for Playback and Sound Exposure Experiments

This EIA Guideline should be used in combination with the appropriate modules on species and impact from the **Technical Support Information** (B.1-12, C and D) as required for individual regional and domestic circumstances.

Component	Detail
Description of area	• Detail of the spatial extent and nature of the activity – including seabed bathymetry and composition, description of known stratification characteristics and broad ecosystem descriptions – as well as the spatial area that will experience anthropogenic noise, generated by the proposed activity, above natural ambient sound levels • Detail of the typical weather conditions and day length for the area during the proposed activity period • Identification of previous and simultaneous activities, their seasons and duration in the same or adjoining areas, existence and location of any marine protected areas, and a review of activity findings and implications
Description of the equipment and activity	• Noting that the scale of the noise needed to elicit a response (with respect to level and duration) may be much lower than in industry activities; and that noise can be controlled in order to affect only a small area or small number of individuals, the noise control measures of the experimental design should be described in detail. • Explanation of all technologies available for the activity and why each proposed technology is chosen • Description of the chosen technology including name and description of the vessel/s to be used • Specification of: a. lowest practicable sound intensity level required b. total duration of the proposed activity c. proposed timing of operations – season/time of day/during all weather conditions d. sound intensity level (dB peak to peak) in water @ 1 metre and all frequency ranges and discharge rate e. if an air gun technology is proposed refer to VI f. if explosives are proposed refer to VII • Specification of the activity including anticipated nautical miles to be covered, track-lines, speed of vessels, start-up and shut-down procedures, distance and procedures for vessel turns including any planned air gun power setting changes • Identification of other activities having an impact in the region during the planned activity, accompanied by the analysis and review of potential cumulative or synergistic impacts
Modelling of noise propagation loss	• Detail of independent, scientific modelling of noise propagation loss in the same season/weather conditions as the proposed activity accounting for local propagation features (depth and type of sea bottom, local propagation paths related to thermal stratification, SOFAR or natural channel characteristics) from point source out to a radius where the noise levels generated are close to natural ambient sound levels • Identification and mapping of proposed exclusion zones for species and description of how noise propagation into these zones will be minimized, taking into consideration the local propagation features

Component	Detail
Species impact	• General: a. Identification and density of species likely to be present that will experience sound transmission generated by the proposed activity above natural ambient sound levels; and calculated from this, the extent of the impact zones b. Specification of the type of impact predicted (direct and indirect) as well as direct and indirect impacts to prey species c. Information on the behaviour of each species group, and the ability to detect each of the species for mitigation purposes (e.g. for marine mammals this will include diving behaviour, vocal behaviour, and conspicuousness when at the surface). • For each species group, also detail of the following (refer to module B species summary): a. Species vulnerabilities: i. specific vulnerabilities to noise ii. lifecycle components of these vulnerabilities b. Habitat: i. specific habitat components considered ii. presence of critical habitat (calving, spawning, feeding grounds, resting bays etc.) c. Scientific assessment of impact: i. exposure levels ii. total exposure duration iii. determination of precautionary safe/harmful exposure levels (direct impact, indirect impact and disturbance) that account for uncertainty and avoids erroneous conclusions iv. how the experiment design will monitor target and non-target species and the steps that will be taken to halt sound emission if adverse response or behavioural changes are observed v. how exposures that are expected to elicit particular behavioural responses (e.g. responses elicited by predator sounds, conspecific signals) will inform specific mitigation and monitoring protocols. In such cases, impact assessment should also articulate what responses may not be related to the loudness of the exposure but to the behavioural significance of the signal/noise used.

Component	Detail
Mitigation and monitoring plans	• Detail of: a. Scientific monitoring programmes, conducted before, during and after the activity, to assess impact b. Transparent processes for regular real-time public reporting of activity progress and all impacts encountered c. Most appropriate methods of species detection (e.g. visual/acoustic) and the range of available methods, and their advantages and limitations, as well their practical application during the activity. d. Impact mitigation proposals: i. 24-hour visual or other means of detection, especially under conditions of poor visibility (including high winds, night conditions, sea spray or fog) ii. establishing exclusion zones to protect specific species, including scientific and precautionary justification for these zones iii. soft start and shut-down protocols iv. spatio-temporal restrictions • Quantification of the effectiveness of proposed mitigation methods
Reporting plans	• Detail of post operation reporting plans including verification of the effectiveness of mitigation
Consultation and independent review	• Description of consultation, prior to EIA submission: a. List of stakeholders consulted b. Detail of information provided to stakeholders, opportunities given for appropriate engagement and the timeframe for feedback c. Explanation of what amendments and changes have been made to the proposed activity in response to the comments, queries, requests and concerns d. Explanation of which comments, queries, requests and concerns have not been accommodated and why • Description of independent review of draft EIA: a. Detail of the independent reviewers (species experts) including affiliation and qualifications b. Description of the comments, queries, requests and concerns received from each reviewer c. Explanation of what amendments and changes have been made to the proposed activity in response to the comments, queries, requests and concerns d. Explanation of which comments, queries, requests and concerns have not been accommodated and why

X. EIA Guideline for Pingers (Acoustic Deterrent/Harassment Devices, Navigation)

This EIA Guideline should be used in combination with the appropriate modules on species and impact from the **Technical Support Information** (B.1-12, C and D) as required for individual regional and domestic circumstances.

Component	Detail
Description of area	• Detail of the spatial extent and nature of the activity – including seabed bathymetry and composition, description of known stratification characteristics and broad ecosystem descriptions – as well as the spatial area that will experience anthropogenic noise, generated by the proposed activity, above natural ambient sound levels. • Detail of the typical weather conditions and day length for the area during the proposed activity period • Identification of previous and simultaneous activities, their seasons and duration in the same or adjoining areas, existence and location of any marine protected areas, and a review of activity findings and implications
Description of the equipment and activity	• Explanation of all technologies available for the activity and why the proposed technology is chosen, including the description should also contain the consideration of alternatives • Specification of sound intensity level (dB peak to peak) in water @ 1 metre, frequency ranges and ping rate, sound exposure level (SEL), as well as proposed spacing of pingers • Identification of other activities having an impact in the region accompanied by the analysis and review of potential cumulative or synergistic impacts
Modelling of noise propagation loss	• Detail of independent, scientific modelling of noise propagation loss in the same season/weather conditions as the proposed activity accounting for local propagation features (depth and type of sea bottom, local propagation paths related to thermal stratification, SOFAR or natural channel characteristics) from point source out to a radius where the noise levels generated are close to natural ambient sound levels • Identification and mapping of proposed exclusion zones for species and description of how noise propagation into these zones will be minimized, taking into consideration the local propagation features

Component	Detail
Species impact	• General: a. Identification and density of species likely to be present that will experience sound transmission generated by the proposed activity above natural ambient sound levels; and calculated from this, the extent of the impact zones a. Specification of the type of impact predicted (direct and indirect) as well as direct and indirect impacts to prey species b. Information on the behaviour of each species group, and the ability to detect each of the species for mitigation purposes (e.g. for marine mammals this will include diving behaviour, vocal behaviour, and conspicuousness when at the surface). • For each species group, also detail of the following (refer to module B species summary): a. Species vulnerabilities: i. specific vulnerabilities to noise ii. lifecycle components of these vulnerabilities b. Habitat: i. specific habitat components considered ii. presence of critical habitat (calving, spawning, feeding grounds, resting bays etc.) c. Scientific assessment of impact: i. exposure levels ii. total exposure duration iii. determination of precautionary safe/harmful exposure levels (direct impact, indirect impact and disturbance) that account for uncertainty and avoids erroneous conclusions
Monitoring plans	• Detail of scientific monitoring programmes, conducted before, during and after the activity, to assess impact • Spatio-temporal restrictions • Quantification of the effectiveness of proposed mitigation methods
Reporting plans	• Detail of post operation reporting plans including verification of the effectiveness of mitigation
Consultation and independent review	• Description of consultation, prior to EIA submission: a. List of stakeholders consulted b. Detail of information provided to stakeholders, opportunities given for appropriate engagement and the timeframe for feedback c. Explanation of what amendments and changes have been made to the proposed activity in response to the comments, queries, requests and concerns d. Explanation of which comments, queries, requests and concerns have not been accommodated and why • Description of independent review of draft EIA: a. Detail of the independent reviewers (species experts) including affiliation and qualifications b. Description of the comments, queries, requests and concerns received from each reviewer c. Explanation of what amendments and changes have been made to the proposed activity in response to the comments, queries, requests and concerns d. Explanation of which comments, queries, requests and concerns have not been accommodated and why

XI. EIA Guideline for Other Noise-generating Activities (Acoustic Data Transmission, Wind, Tidal and Wave Turbines and Future Technologies)

This EIA Guideline should be used in combination with the appropriate modules on species and impact from the **Technical Support Information** (B.1-12, C and D) as required for individual regional and domestic circumstances.

All commissioning and decommissioning activities should also follow these guidelines.

Component	Detail
Description of area	• Detail of the spatial extent and nature of the activity – including seabed bathymetry and composition, description of known stratification characteristics and broad ecosystem descriptions – as well as the spatial area that will experience anthropogenic noise, generated by the proposed activity, above natural ambient sound levels • Detail of the typical weather conditions and day length for the area during the proposed activity period • Identification of previous and simultaneous activities, their seasons and duration in the same or adjoining areas, existence and location of any marine protected areas, and a review of activity findings and implications
Description of the equipment and activity	• Explanation of all technologies available for the activity • Specification of sound intensity level (dB) in water @ 1 metre, and frequency ranges. This should include dB peak to peak for acoustic data transmission for example, dB_{rms} for wind, tidal and wave turbines and future technologies categorized accordingly • Identification of other activities having an impact in the region during the planned activity, accompanied by the analysis and review of potential cumulative or synergistic impacts
Modelling of noise propagation loss	• Detail of independent, scientific modelling of noise propagation loss in the same season/weather conditions as the proposed activity accounting for local propagation features (depth and type of sea bottom, local propagation paths related to thermal stratification, SOFAR or natural channel characteristics) from point source out to a radius where the noise levels generated are close to natural ambient sound levels • Identification and mapping of proposed exclusion zones for species and description of how noise propagation into these zones will be minimized, taking into consideration the local propagation features

Component	Detail
Species impact	• General: a. Identification and density of species likely to be present that will experience sound transmission generated by the proposed activity above natural ambient sound levels; and calculated from this, the extent of the impact zones b. Specification of the type of impact predicted (direct and indirect) as well as direct and indirect impacts to prey species c. Information on the behaviour of each species group, and the ability to detect each of the species for mitigation purposes (e.g. for marine mammals this will include diving behaviour, vocal behaviour, and conspicuousness when at the surface). • For each species group, also detail of the following (refer to module B species summary): a. Species vulnerabilities: i. specific vulnerabilities to noise ii. lifecycle components of these vulnerabilities b. Habitat: i. specific habitat components considered ii. presence of critical habitat (calving, spawning, feeding grounds, resting bays etc.) c. Scientific assessment of impact: i. exposure levels ii. total exposure duration iii. determination of precautionary safe/harmful exposure levels (direct impact, indirect impact and disturbance) that account for uncertainty and avoids erroneous conclusions • Quantification of the effectiveness of proposed mitigation methods
Monitoring plans	• Explanation of ongoing scientific monitoring programmes to assess impact • Most appropriate methods of species detection (e.g. visual/acoustic) and the range of available methods, and their advantages and limitations, as well their practical application during the activity. • Spatio-temporal restrictions
Consultation and independent review	• Description of consultation, prior to EIA submission: a. List of stakeholders consulted b. Detail of information provided to stakeholders, opportunities given for appropriate engagement and the timeframe for feedback c. Explanation of what amendments and changes have been made to the proposed activity in response to the comments, queries, requests and concerns d. Explanation of which comments, queries, requests and concerns have not been accommodated and why • Description of independent review of draft EIA: a. Detail of the independent reviewers (species experts) including affiliation and qualifications b. Description of the comments, queries, requests and concerns received from each reviewer c. Explanation of what amendments and changes have been made to the proposed activity in response to the comments, queries, requests and concerns d. Explanation of which comments, queries, requests and concerns have not been accommodated and why

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CONVENTION ON MIGRATORY SPECIES

Distribution: General
UNEP/CMS/Resolution 12.14
Original: English

ADVERSE IMPACTS OF ANTHROPOGENIC NOISE ON CETACEANS AND OTHER MIGRATORY SPECIES

Adopted by the Conference of the Parties at its 12th Meeting (Manila, October 2017)

Recalling that in Resolution 9.19 and Resolution 10.24[1] the CMS Parties expressed concern about possible "adverse anthropogenic marine/ocean noise impacts on cetaceans and other biota",

Recognizing that anthropogenic marine noise, depending on source and intensity, is a form of pollution, composed of energy, that may degrade habitat and have adverse effects on marine life ranging from disturbance of communication or group cohesion to injury and mortality,

Aware that, over the last century, anthropogenic noise levels in the world's oceans have significantly increased as a result of multiple human activities,

Recalling the obligations of Parties to the United Nations Convention on the Law of the Sea (UNCLOS) to protect and preserve the marine environment and to cooperate on a global and regional basis concerning marine mammals, paying special attention to highly migratory species, including cetaceans listed in Annex I of UNCLOS,

Recalling that the United Nations General Assembly Resolution A/RES/71/257 on *Oceans and the Law of the Sea* adopted in 2016 "[n]otes with concern that human-related threats, such as marine debris, ship strikes, underwater noise, persistent contaminants, coastal development activities, oil spills and discarded fishing gear, together may severely impact marine life, including its higher trophic levels, and calls upon States and competent international organizations to cooperate and coordinate their research efforts in this regard so as to reduce these impacts and preserve the integrity of the whole marine ecosystem while fully respecting the mandates of relevant international organizations",

Recalling CMS Resolution 10.15 on *Global Programme of Work for Cetaceans*, which urges Parties and non-Parties to promote the integration of cetacean conservation into all relevant sectors by coordinating their national positions among various conventions, agreements and other international fora and instructs the Aquatic Mammals Working Group of the Scientific Council to develop advisory positions for use in Environmental Impact Assessments at the regional level and to provide support to governments and regional bodies for assessing and defining appropriate standards for noise pollution,

[1] Both now consolidated as Resolution 12.14

Recalling that other international fora recognize anthropogenic marine noise as a potential threat to marine species conservation and welfare, and have adopted related decisions and resolutions or issued guidance, including:

a) the Convention on Biological Diversity (CBD) through Decision X.29 concerning marine and coastal biodiversity and in particular its paragraph 12 relating to anthropogenic underwater noise and Decision XIII.10 addressing impacts of anthropogenic underwater noise on marine and coastal biodiversity and in particular paragraphs 1-2 relating to anthropogenic underwater noise,

b) the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS) through Resolution 2.16 on *Impact Assessment of Man-Made Noise*, Resolution 3.10 on *Guidelines to Address the Impact of Anthropogenic Noise on Marine Mammals in the ACCOBAMS Area*, Resolution 4.17 on *Guidelines to address the impact of anthropogenic noise on cetaceans in the ACCOBAMS area*, Resolution 5.15 on *Addressing the Impact of Anthropogenic Noise* and Resolution 6.17 on *Anthropogenic Noise*,

c) the Agreement on the Conservation of Small Cetaceans in the Baltic, North East Atlantic, Irish and North Seas (ASCOBANS) through Resolution 5.4 on *Adverse Effects of Sound, Vessels and other Forms of Disturbance on Small Cetaceans*, Resolution 6.2 on *Adverse Effects of Underwater Noise on Marine Mammals during Offshore Construction Activities for Renewable Energy Production* and Resolution 8.11 on *CMS Family Guidelines on Environmental Impact Assessments for Marine Noise-generating Activities*,

d) the International Maritime Organization (IMO), which in 2008 established in its Marine Environmental Protection Committee a high priority programme of work on minimizing the introduction of incidental noise from commercial shipping operations into the marine environment, and which in 2014 issued MEPC.1/Circ.833 *Guidelines for the Reduction of Underwater Noise from Commercial Shipping to Address Adverse Impacts on Marine Life*,

e) the Convention for the Protection of the Marine Environment of the North-East-Atlantic (OSPAR) Guidance on environmental considerations for offshore wind farm development,

f) the International Union for Conservation of Nature (IUCN) Resolution 3.068 concerning undersea noise pollution (World Conservation Congress at its 3rd Session in Bangkok, Thailand, 17–25 November 2004),

g) following International Whaling Commission (IWC) Resolution 1998-6, the IWC Scientific Committee has investigated the impacts of military sonar, seismic surveys, masking and shipping noise; it has concluded that, in addition to some instances of severe acute effects (e.g. from military sonar and similar noise sources), existing levels of ocean noise can have a chronic effect, and agreed that action should be taken to reduce noise in parallel with efforts to quantify these effects; and the IWC has identified the importance of continued and increased collaboration on this issue with other organizations including ACCOBAMS, ASCOBANS, IMO and IUCN, *Recalling* that according to Article 236 of UNCLOS, that Convention's provisions regarding the protection and preservation of the marine environment do not apply to warships, naval auxiliary and other vessels or aircraft owned or operated by a State and used, for the time being, only on governmental non-commercial service; and that each State is required to ensure, by the adoption of appropriate measures not impairing operations or operational capabilities of such vessels or aircraft owned or operated by it, that such vessels or aircraft act in a manner consistent, so far as is reasonable and practicable, with UNCLOS,

Noting that the Convention on Biological Diversity (CBD) decision VI/20 recognized CMS as the lead partner in the conservation and sustainable use of migratory species over their entire range,

Acknowledging the ongoing activities in other fora to reduce underwater noise such as the activities within NATO to avoid negative effects of sonar use,

Noting Directive 2014/52/EU of the European Parliament and of the Council, amending Directive 2011/92/EU on the *Assessment of the Effects of Certain Public and Private Projects on the Environment*,

Noting the EU Marine Strategy Framework Directive and its implementing act, where Member States in European Union marine waters shall take necessary measures by 2020 to achieve or maintain their determined good environmental status, including on underwater noise, established by each of them and in coordination at Union, regional and sub-regional levels,

Grateful for the invitation of ACCOBAMS and ASCOBANS, accepted in 2014, that CMS participate in the Joint Noise Working Group, which provides detailed and precautionary advice to Parties, particularly on available mitigation measures, alternative technologies and standards required for achieving the conservation goals of the treaties,

Aware that some types of marine noise can travel faster than other forms of pollution over more than hundreds of kilometres underwater unrestricted by national boundaries and that these are ongoing and increasing,

Taking into account the lack of data on the distribution and migration of some populations of marine species and on the adverse human-induced impacts on CMS-listed marine species and their prey,

Aware that incidents of stranding and deaths of some cetacean species have coincided with and may be due to the use of high-intensity mid-frequency active sonar,

Reaffirming that the difficulty of proving possible negative impacts of acoustic disturbance on CMS-listed marine species and their prey necessitates a precautionary approach in cases where such an impact is likely,

Noting the draft research strategy developed by the European Science Foundation on "*the effects of anthropogenic sound on marine mammals*", which is based on a risk assessment framework,

Noting the OSPAR *Code of Conduct for Responsible Marine Research in the Deep Seas and High Seas of the OSPAR Marine Area* and the ISOM *Code of Conduct for Marine Scientific Research Vessels*, providing that marine scientific research is carried out in an environmentally friendly way using appropriate study methods reasonably available,

Aware of the calls on the IUCN constituency to recognize that, when there is reason to expect that harmful effects on biota may be caused by anthropogenic marine noise, lack of full scientific certainty should not be used as a reason for postponing measures to prevent or minimize such effects, *Recognizing* with concern that cetaceans and other marine mammals, reptiles and fish species, and their prey, are vulnerable to noise disturbance and subject to a range of human impacts,

The Conference of the Parties to the
Convention on the Conservation of Migratory Species of Wild Animals

1. *Reaffirms* that there is a need for ongoing and further internationally coordinated research on the impact of underwater noise (including inter alia from offshore wind farms and associated shipping) on CMS-listed marine species and their prey, their migration routes and ecological coherence, in order to give adequate protection to cetaceans and other marine migratory species;

2. *Confirms* the need for international, national and regional limitation of harmful anthropogenic marine noise through management (including, where necessary, regulation), and that this Resolution remains a key instrument in this regard;

3. *Urges* Parties and invites non-Parties that exercise jurisdiction over any part of the range of marine species listed on the appendices of CMS, or over flag vessels that are engaged within or beyond national jurisdictional limits, to take special care and, where appropriate and practical, to endeavour to control the impact of anthropogenic marine noise pollution in habitats of vulnerable species and in areas where marine species that are vulnerable to the impact of anthropogenic marine noise may be concentrated, to undertake relevant environmental assessments on the introduction of activities that may lead to noise-associated risks for CMS-listed marine species and their prey;

4. *Strongly urges* Parties to prevent adverse effects on CMS-listed marine species and their prey by restricting the emission of underwater noise; and where noise cannot be avoided, *further urges* Parties to develop an appropriate regulatory framework or implement relevant measures to ensure a reduction or mitigation of anthropogenic marine noise;

5. *Calls* on Parties and *invites* non-Parties to adopt whenever possible mitigation measures on the use of high intensity active naval sonars until a transparent assessment of their environmental impact on marine mammals, fish and other marine life has been completed and as far as possible aim to prevent impacts from the use of such sonars, especially in areas known or suspected to be important habitat to species particularly sensitive to active sonars (e.g. beaked whales) and in particular where risks to marine species cannot be excluded, taking account of existing national measures and related research in this field;

6. *Urges* Parties to ensure that Environmental Impact Assessments take full account of the effects of activities on CMS-listed marine species and their prey and consider a more holistic ecological approach at a strategic planning stage;

7. *Endorses* the "CMS Family Guidelines on Environmental Impact Assessments for Marine Noise-generating Activities" attached as Annex and *welcomes* the Technical Support Information contained in UNEP/CMS/COP12/Inf.11[2];

8. *Invites* Parties to ACCOBAMS and ASCOBANS to consider adopting these Guidelines, in the elaboration of which they were fully involved, at their next Meetings of the Parties;

9. *Further invites* Signatories to relevant Memoranda of Understanding concluded under CMS to consider using these Guidelines as guiding documents;

10. *Recognizes* that the work done in relation to marine noise is rapidly evolving, and *requests* the Scientific Council, in collaboration with the Joint Noise Working Group of CMS, ACCOBAMS and ASCOBANS, to review and update these Guidelines regularly;

[2] also provided online at http://www.cms.int/guidelines/cms-family-guidelines-EIAs-marine-noise

11. *Urges* Parties and *encourages* non-Parties to disseminate these Guidelines, where necessary translating the Guidelines into different languages for their wider dissemination and use;

12. *Invites* the private sector and other stakeholders to make full use of these Guidelines in order to assess, mitigate and minimize negative effects of anthropogenic marine noise on marine biota;

13. *Welcomes* the efforts of the private sector and other stakeholders to reduce their environmental impact and *strongly encourages* them to continue making this a priority;

14. *Recommends* that Parties, the private sector and other stakeholders apply Best Available Techniques (BAT) and Best Environmental Practice (BEP) including, where appropriate, clean technology, in their efforts to reduce or mitigate marine noise pollution;

15. *Further recommends* that Parties, the private sector and other stakeholders use, as appropriate, noise reduction techniques for offshore activities such as: air-filled coffer dams, bubble curtains or hydro-sound dampers, or different foundation types (such as floating platforms, gravity foundations or pile drilling instead of pile driving);

16. *Stresses* the need of Parties to consult with any stakeholder conducting activities known to produce anthropogenic marine noise with the potential to cause adverse effects on CMS-listed marine species and their prey, such as the oil and gas industry, shoreline developers, offshore extractors, marine renewable energy companies, other industrial activities and oceanographic and geophysical researchers recommending, how best practice of avoidance, diminution or mitigation of risk should be implemented. This also applies to military authorities to the extent that this is possible without endangering national security interests. In any case of doubt the precautionary approach should be applied;

17. *Encourages* Parties to integrate the issue of anthropogenic noise into the management plans of marine protected areas (MPAs) where appropriate, in accordance with international law, including UNCLOS;

18. *Invites* the private sector to assist in developing mitigation measures and/or alternative techniques and technologies for coastal, offshore and maritime activities in order to minimize anthropogenic noise pollution of the marine environment to the highest extent possible;

19. *Encourages* Parties to facilitate:

- regular collaborative and coordinated temporal and geographic monitoring and assessment of local ambient noise (both of anthropogenic and biological origin);
- further understanding of the potential for sources of noise to interfere with long-range movements and migration;
- the compilation of a reference signature database, to be made publicly available, to assist in identifying the source of potentially damaging sounds;
- characterization of sources of anthropogenic noise and sound propagation to enable an assessment of the potential acoustic risk for individual species in consideration of their auditory sensitivities;
- studies on the extent and potential impact on the marine environment of high- intensity active naval sonars and seismic surveys in the marine environment; and the extent of noise inputs into the marine environment from shipping and to provide an assessment, on the basis of information to be provided by the Parties, of the impact of current practices; and
- studies reviewing the potential benefits of "noise protection areas", where the emission of underwater noise can be controlled and minimized for the protection of cetaceans and other biota;

whilst recognizing that some information on the extent of the use of military sonars (e.g. frequencies used) will be classified and would not be available for use in the proposed studies or databases;

20. *Recommends* that Parties that have not yet done so establish national noise registries to collect and display data on noise-generating activities in the marine area to help assess exposure levels and the likely impacts on the marine environment, and that data standards are made compatible with regional noise registries, such as the ones developed by the International Council for the Exploration of the Sea (ICES) and ACCOBAMS;

21. *Urges* all Parties to endeavour to develop provisions for the effective management of anthropogenic marine noise in CMS daughter agreements and other relevant bodies and Conventions;

22. *Invites* the Parties to strive, wherever possible, to ensure that their activities falling within the scope of this Resolution avoid harm to CMS-listed marine species and their prey;

23. *Requests* the Scientific Council, supported by the Joint Noise Working Group of CMS, ACCOBAMS and ASCOBANS, to continue monitoring new available information on the effects of underwater noise on marine species, as well as the effective assessment and management of this threat, and to make recommendations to Parties as appropriate;

24. *Requests* the Secretariat and *calls upon* Parties to contribute to the work of the IMO MEPC on noise from commercial shipping;

25. *Invites* Parties to provide the CMS Secretariat, for transmission to the Scientific Council, with copies of relevant protocols/guidelines and provisions for the effective management of anthropogenic noise, taking security needs into account, such as those of relevant CMS daughter agreements, OSPAR, IWC, IMO, NATO and other fora, thereby avoiding duplication of work; and

26. *Repeals*

    a) Resolution 9.19, *Adverse Anthropogenic Marine/Ocean Noise Impacts on Cetaceans and Other Biota*; and

    b) Resolution 10.24, *Further Steps to Abate Underwater Noise Pollution for the Protection of Cetaceans and Other Migratory Species*.