ASCOBANS
Species Action Plan (SAP)

for
North-East Atlantic Common Dolphin
(*Delphinus delphis*)

August 2019

Adopted intersessionally in 2019, in line with ASCOBANS Resolution 8.4

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Executive Summary

The common dolphin population in the North-East (NE) Atlantic is facing ever-increasing anthropogenic pressures, the most significant of which is bycatch. Also of importance are chemical pollution and noise disturbance. The IUCN Red List of Threatened and Endangered Species lists common dolphin as 'Data Deficient' at the European regional level. This lack of data affects our abilities to fully evaluate the anthropogenic risks to the population. Following the 2013 Habitats Directive reporting round, the species is considered to have an 'Unfavourable-Inadequate' conservation status for the European Atlantic. ASCOBANS has noted the need for monitoring the NE Atlantic common dolphin population and subsequently adopted a resolution for the conservation of common dolphins in September 2016[1], with the aim of restoring the population to a favourable conservation status.

This Species Action Plan (SAP) identifies the pressures and threats affecting common dolphins in the ASCOBANS area, including an assessment of risk and priorities. The actions fall under the headings: Monitoring; Research or Mitigation and are broken down into tasks to identify key activities that need to occur in order to achieve the action objectives. A public awareness policy for the Species Action Plan, detailing how the work and the progress will be communicated beyond ASCOBANS is also included. To be effective, the SAP must be managed such that the proposed actions are implemented effectively, which include provision of adequate funding by Parties as well as regular assessment and reporting of progress. There is a need for Range States to collaborate on the actions identified in this plan in order to achieve a strategic approach to common dolphin conservation in the NE Atlantic region.

[1] https://www.ascobans.org/en/document/conservation-common-dolphins

Summary of actions

Priority	Action	Code
Essential	Identify the priority bycatch issues	RES-01
Essential	Improve estimates of bycatch rates to support development of conservation strategy	RES-02
Essential	Implement and assess gear modifications and mitigation measures to reduce bycatch	MIT-01
High	Implement a wide-scale surveillance programme to monitor trends in distribution and abundance in the NE Atlantic	MON-01
High	Improve understanding of causes of seasonal and annual variation in abundance and distribution, particularly in relation to human activities	RES-03
High	Monitor health and nutritional status, diet, life history parameters, and causes of mortality in the NE Atlantic	MON-02
Medium	Further our understanding on population structure by assessing and developing suitable techniques for these highly mobile small delphinids	RES-04
Medium	Improve understanding of and develop mitigation for the risks of anthropogenic sound	MIT-02
Medium	Ensure screening and assessment of the occurrence and effects of hazardous substances	MON-03
Low	Monitor for potential increases in anthropogenic activities that lead to incidences of death, injury or adverse health effects	MON-04

ASCOBANS Species Action Plan (SAP) for NE Atlantic Common Dolphin (*Delphinus delphis*)

1. Introduction

1.1. Necessity of a Species Action Plan

The short-beaked common dolphin (*Delphinus delphis*; hereafter referred to as the common dolphin) plays a key functional role within the ecosystem as a top predator. The most recent assessment (2013) of the conservation status for the European Atlantic population under Article 17 of the Habitats Directive was 'Unfavourable-Inadequate' (Table 1). This was due to an estimated two-thirds of the European Atlantic population being considered to be in an unfavourable condition following assessments of population trends, habitat for species and the future prospects[2]. France, Spain and Portugal all classified the species as having an unfavourable status, with the issue of bycatch being the main concern. Data availability was, however, an issue with assessments, which is also supported by the 'Data deficient' assessment on the IUCN Red list of Threatened Species[3] for the European region. This indicates the need to improve data collection for the species across the ASCOBANS range.

Table 1: Member State common dolphin Conservation Status Assessments undertaken for reporting under Article 17 of the Habitats Directive.

This table will be updated with the latest assessment once the 2019 Article 17 reporting round is completed and published.

Country	2007	2013	2019
UK	Unknown	Favourable	Pending assessment
Ireland	Favourable	Favourable	Pending assessment
France	Unknown	Unfavourable-Bad	Pending assessment
Spain	Unknown	Unfavourable-Bad	Pending assessment
Portugal	Favourable	Unfavourable-Inadequate	Pending assessment
Marine Atlantic	**"Unknown"**	**"Unfavourable-Inadequate"**	**Pending assessment**

Bycatch has been highlighted as the greatest anthropogenic threat to this species (Fernández-Contreras *et al.*, 2010; Mannocci *et al.*, 2012; Deaville, 2015; Peltier *et al.*, 2016), though the impact of this activity cannot be fully quantified due to a lack of data on incidental capture rates in some fisheries, and limited sampling in other fisheries (Murphy *et al.*, 2013). Even in the absence of a population bycatch rate, in 2016, ICES

[2] https://bd.eionet.europa.eu/activities/Reporting/Article_17/Reports_2013
[3] http://www.iucnredlist.org/details/6336/1

advised that a recent review of national reports under Regulation 812/2004 suggests that the bycatch of common dolphins may be unsustainable (ICES Advice, 2016b).

A substantially greater abundance of common dolphins has been reported for continental shelf and adjacent waters in 2016 (SCANS III survey) (Hammond *et al.*, 2017) compared to 2005/2007 (SCANS II/CODA surveys). The higher estimate cannot be explained by an increase in population size alone and may reflect a redistribution of animals into European seas from either more southern or offshore waters, or a mixture of the two. This apparent increase in the number of individuals in the ASCOBANS Agreement Area means that more animals are now exposed to anthropogenic activities occurring in those waters. Bycatch rates in particular, are influenced by a temporal and spatial overlap of animals and fishing gear, more so than purely specific characteristics of that gear (Mackay, 2011). The increase in numbers is also supported by the upward trend in reported strandings along French, UK and Irish Atlantic coastlines in recent years. Many of these stranded common dolphins have been reported as bycatch (Peltier *et al*., 2016; Deaville *et al*., in press).

It is essential to consider a trans-boundary approach to common dolphin conservation given the genetic understanding of the NE Atlantic population (Natoli *et al.*, 2006, 2008; Mirimin *et al.*, 2009; Moura, 2013; Murphy *et al.*, 2013). The common dolphin predominantly ranges from Norway to Portugal in the NE Atlantic. As such, the ASCOBANS agreement provides a platform within which to form a coordinated transboundary approach to the conservation of a species, although not all countries in the common dolphin range are signatories, e.g. Ireland, Spain, Portugal and Norway. Having an agreed Species Action Plan (SAP) in place offers a single point of reference from which to consider trans-boundary actions in order to strengthen the evidence base and make management decisions at an appropriate spatial scale for the species. Ensuring a SAP steering group exists will provide the forum for discussion and agreement on how to implement the plan at the relevant spatial scale. Further, a trans-boundary approach will enable effective development of Marine Strategy Framework Directive (MSFD) state and pressure indicators for the species; including effective monitoring for indicators and the implementation of a programme of measures. There is also opportunity to draw efficiencies by coordinating with wider initiatives for other species which support the achievement of tasks identified in this SAP.

1.2. Overall objective of the Species Action Plan

A conservation plan must have measurable objectives by which its success or failure can be evaluated regularly, and to ensure that required changes are identified and actioned promptly. Failure to monitor progress will result in inaction and subsequent failure of the SAP. Integral and essential to the plan are, therefore, monitoring of:

a) the NE Atlantic common dolphin population;

b) human activities identified to pose potential risk to the species;

c) implementation of mitigation measures and;

d) the assessment of effectiveness of those measures.

ASCOBANS intermediate conservation objective aims to ‘*restore and/or maintain biological or management stocks of small cetaceans at the level they would reach when there is the lowest possible anthropogenic influence’* with *‘a suitable short-term practical sub-objective to restore and/or maintain stocks/populations to 80% or more of* *the carrying capacity*' (ASCOBANS, 1997). To work towards achieving this intermediate goal and, ultimately, a favourable conservation status for the NE Atlantic common dolphin, the SAP identifies the key pressures and threats facing the population, gaps in evidence and information, and proposes actions necessary to achieve the goal of restoring the population to a favourable conservation status. These actions include coordination of monitoring programmes on direct and indirect pressures, including bycatch, marine pollution and anthropogenic noise, to allow a full assessment of the effects on the population(s). The actions in this SAP also complement and support wider measures for small cetaceans in the NE Atlantic.

1.3. Development of the Species Action Plan

The common dolphin SAP will be coordinated under a hierarchical structure clearly outlining roles and responsibilities (

Figure 1), designed to ensure effective implementation. A Steering Group (SG) will be formed to drive implementation of the plan. This plan was developed by an ASCOBANS SG, adopted intersessionally, and will be followed by a Resolution in 2020 at the 9th Meeting of the Parties. Co-operation and complementarity with the work of the ASCOBANS/ACCOBAMS joint working group on cetacean bycatch will be sought.

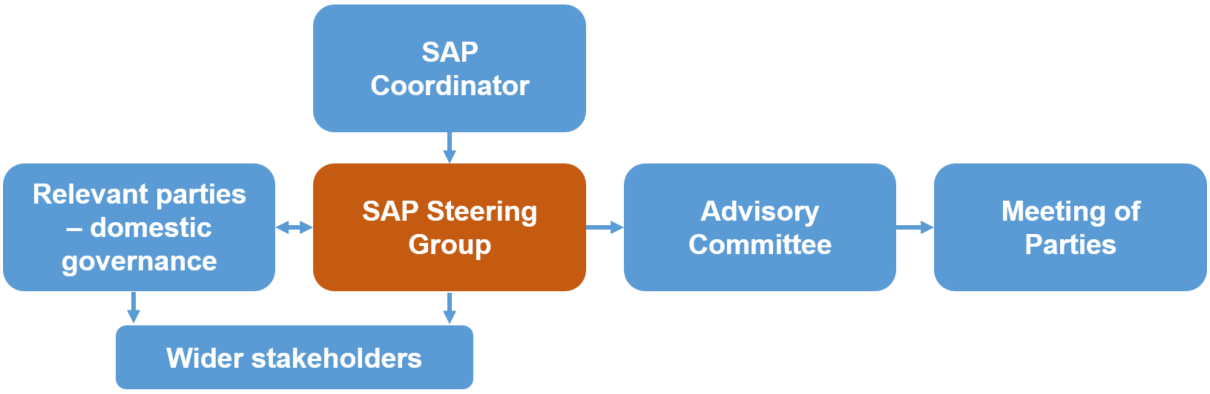

Figure 1: SAP communication structure.

1.4. Instigation of the Species Action Plan

The coordinator and SG will seek to develop the SAP with ACCOBAMS involvement with a view to creating a joint plan between ASCOBANS and ACCOBAMS (of which Spain and Portugal are signatories) and other Range States to ensure the spatial scale at which the actions are applied is relevant to the population. The coordinator and SG will ensure cooperation between all stakeholders including national governments in the NE Atlantic, European Commission, intergovernmental organisations including fisheries management authorities, ICES and OSPAR, Advisory Councils and other relevant bodies, such as NGOs, universities and institutes, and appropriate industry representatives. Their role specifically is to encourage countries to harmonise their national efforts, including allocation of funding. The SAP will be a dynamic document and subject to regular revision to ensure the information remains current.

1.5. Species Action Plan Governance Tasks

To ensure efficiency and to drive the plan forward, the following tasks have been identified:

1. The SG will appoint a coordinator (or chair) to oversee implementation of the plan. Together they will:
    - develop and maintain the Terms of Reference for the SG to ensure that the actions are implemented;
    - coordinate and drive the implementation of the SAP (including assessing funding options where appropriate) and promote the SAP to relevant stakeholders;
    - collate reports on the progress of implementation, effectiveness and issues encountered and report annually to the Advisory Committee on the progress of the SAP, establish further implementation priorities and make appropriate recommendations;
    - encourage cooperation between ASCOBANS, ACCOBAMS and other Range States.
2. Range States will report annually on implementation of the SAP.
3. The coordinator/SG will evaluate the SAP every six years and amend the document where required as agreed by the Advisory Committee.

2. Legal framework

There is a broad list of drivers behind common dolphin conservation which aim to address all aspects of anthropogenic impact on the species, either specifically for common dolphin, or as part of a wider strategy for cetaceans or marine mammals. A summary of the legal framework relevant to common dolphins including conventions and agreements can be found in Annex 1.

3. Biology and status of common dolphin

3.1. Summary of biology and ecology

The common dolphin has a worldwide distribution in oceanic and shelf-edge waters of tropical, subtropical and temperate seas, occurring in both hemispheres. It is abundant and widely distributed in the NE Atlantic, mainly occurring in deeper waters from Macaronesia and north-west Africa north to approximately 65°N latitude (although rare north of 62°N), west of Norway and the Faroe Islands (Reid *et al*., 2003; Murphy *et al*., 2008). It occurs westwards at least to the mid-Atlantic ridge (40°W) (Doksæter *et al*., 2008; Cañadas *et al*., 2009; Murphy *et al*., 2013; Ryan, 2013), but is variable to rare in the eastern English Channel, the North Sea, Danish Belt Seas, and the Baltic Sea (Kinze, 1995; Evans *et al*., 2003; Reid *et al*., 2003; Camphuysen & Peet, 2006; Kinze, 2010). On the basis of genetic and cranial morphometric analyses, common dolphins appear to form one large panmictic population in the NE Atlantic (Murphy *et al*., 2006; Quérouil *et al*., 2010; Amaral *et al*., 2012; Moura *et al*., 2013).

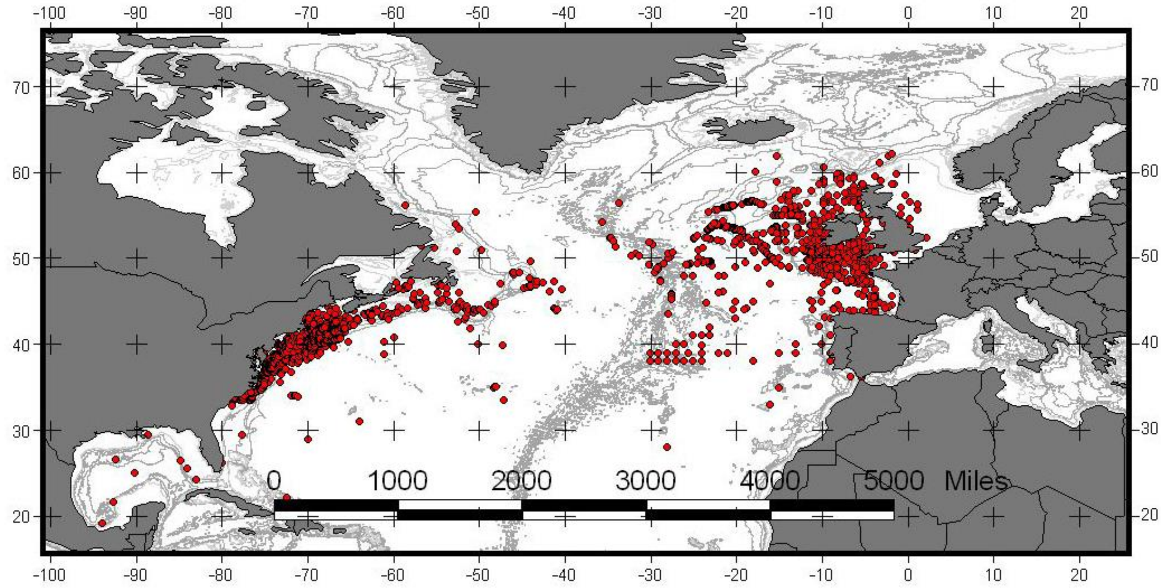

Figure 2: Range of short-beaked common dolphin in the North Atlantic using data obtained between 1963 and 2007.

Source: Murphy *et al*, 2009

Females mature at approximately 8 years and males at 12 years, whilst maximum age has been recorded as 30 years (Murphy *et al*., 2010). The calving and breeding period extends from April through to September, with a possibly more active period in July and August (Murphy *et al*., 2005; Murphy *et al.,* 2009). The population of the NE Atlantic appears to have an extended calving interval of approximately four years (Murphy *et al*., 2009) indicating a lifetime reproductive output of four to five calves per female. The mean generation time is estimated to be 13 to 14 years (Murphy *et al*., 2007; Taylor *et al*., 2007). Common dolphins eat a wide range of fish and cephalopods (e.g. Pusinieri *et al*., 2007; Brophy *et al*., 2009; Santos *et al*., 2013), with several studies pointing to an apparent preference for "fatty", i.e. higher calorific value, species (e.g. Meynier *et al*., 2008a; Spitz *et al*., 2010). This may be responsible for seasonal movements within the NE Atlantic, particularly in relation to the energetic demands of pregnant and lactating females (Brophy *et al*., 2009).

A detailed summary of the information available on the abundance, distribution, biology, ecology and pressures of common dolphin can be found in Annex 2. In addition, further information can be found in extensive reviews on the species in the NE Atlantic undertaken by Murphy et al. (2013; accepted).

4. Pressures

4.1. Summary of pressures

The most important anthropogenic pressure facing the common dolphin population is bycatch (Fernández-Contreras *et al*., 2010; Mannocci *et al.*, 2012; Deaville, 2015; Peltier *et al*., 2016). Other pressures include chemical pollution (Pierce *et al*., 2008; Murphy *et al*., 2010; Law *et al*, 2012; Deaville, 2015; Jepson *et al.,* 2016; Murphy *et al*., 2018); disturbance, primarily through introduction of noise into the marine environment (Goold, 1996; Stone, 2015; Culloch *et al*., 2016); depletion of prey sources and the effects of climate change (Evans & Bjørge, 2013; Murphy *et al.,* 2013); and vessel collisions (Deaville, 2015).

A summary of pressures, related activities, and current levels of evidence for pressures associated with common dolphins is presented in Table 2:. The pressures have been split into the following categories after Authier et al. (2017):

- **Primary** (direct mortality);
- **Secondary** (health degradation, with indirect effect on demography) and;
- **Tertiary** (behavioural disruption, with indirect effect on health and therefore demography).

A detailed summary of information on pressures including evidence gaps, can be found in Annex 3.

Table 2: Summary of actual and potential pressures on the population.

Actual/Potential Threat	Cause or related activity	Evidence	Possible Impact	Priority for Action
Primary pressures				
Bycatch – lethal entanglement in fishing gears	Commercial and recreational static nets and trawls	Strong	Mortality	High (Celtic Seas, Bay of Biscay and Iberian Peninsula); Medium (Macaronesia)
	Marine debris (including ghost nets)	Weak	Mortality and morbidity	Low (all regions)
Serious/fatal injury (not bycatch)	Ship strikes from commercial and recreational vessels	Weak	Mortality or compromising injury	Medium (Bay of Biscay Low (other regions)
	Collision with wet renewables	Weak	Mortality or compromising injury	Low (all regions)

Actual/Potential Threat	Cause or related activity	Evidence	Possible Impact	Priority for Action
Secondary pressures				
Mechanical destruction of habitat	Bottom trawls	Weak	Reduction in prey species	Low (all regions)
	Infrastructure construction, oil and gas development			
	Gravel extraction			
Prey depletion	Overfishing	Moderate	Loss of body condition/reduced nutritional status, suppression of reproduction, mortality	Medium (further evidence required)
	Habitat degradation due to pollution			
Chemical pollution	Atmospheric transportation, terrestrial industrial development, landfill, terrestrial run-off, harbours, ships, aquaculture, sewer discharges, aerial transport, oil spill	Strong	Immuno-suppression, increased disease risk, reproductive failure and dysfunction	Medium (all regions)
Tertiary pressures				
Noise Disturbance	Fishing vessels, maritime traffic, recreational activities	Moderate	Displacement or injury	Medium (all regions)
	Acoustic deterrent devices at fish farms, e.g. pingers			
	Military activities			
	Infrastructure construction, oil and gas development (including seismic),			
	Aggregate extraction			
Boat-based dolphin watching and other recreational activities		Moderate	Reduced foraging	Low (all regions)

Actual/Potential Threat	Cause or related activity	Evidence	Possible Impact	Priority for Action
Climate change	The global climate change is likely to affect marine conditions	Moderate	Change in distribution, availability of prey and habitat	Medium
Cumulative impacts	The cumulative impact of pressures will increase risk to the population	Moderate	Reduced resilience to pressures due to combined impacts	Medium

Some pressures are identified as medium or low priority in terms of action required when assessed in isolation. However, it should be noted that when acting in combination with other pressures, the risk to the species could increase. A strategic approach to conservation should be considered to account for the cumulative impacts of non-lethal (secondary and tertiary) pressures acting on the individuals and the combined demographic effects of all pressures on the population.

4.2. Attributes of the population for monitoring, mitigation and research

To address the pressures summarised above, there is a requirement for monitoring, mitigation and/or research. For example, bycatch has been identified as the greatest anthropogenic pressure on this species. There remains a degree of uncertainty in the assessment of population bycatch rates due to ambiguities in recording fishing effort, biases and unrepresentative sampling by gear type, and a lack of statutory reporting from some major fishing nations (ICES Advice, 2016a). Other pressures in the region include marine pollution and underwater noise, with major knowledge gaps in the extent of their effects which hinder the provision of robust scientific assessments.

The attributes that have been identified as requiring monitoring, mitigation or research are listed below. Measures by which to assess the success of actions will be developed alongside each action by the Steering Group.

Table 3: Attributes for monitoring, mitigation and research.

Attribute	Relevant actions
Bycatch: High and medium risk fisheries and gear types, bycatch rates, effectiveness of mitigation measures including gear modifications	RES-01; RES-02; MIT-01; MON-01; RES-03; RES-04
Common dolphin health: Health status, contaminant levels (and possible sources) and life history parameters	MON-02; MIT-02; MON-03; MON-04; RES-04
Noise pollution: Risks and impacts of underwater noise	MON-01; RES-03; MIT-02;

Attribute	Relevant actions
Cumulative impacts: Impact of activities in combination	MON-04; RES-02; RES-03; MON-02; MON-03;
Emerging pressures: Climate change, pollutants of emerging concern, renewable energy developments	MON-01; RES-03; MON-02; MON-04
Conservation status: Population viability	RES-02; MON-01; RES-03; RES-04

In order to assess conservation status, not only is a good knowledge of the scale of important anthropogenic pressures required, but also the population context against which the effectiveness of management of those pressures can be judged. For the most part, individual countries have focused on monitoring to assess whether the population is attaining a favourable conservation status (Habitats Directive) or good environmental status (MSFD). Essentially, the parameters that require monitoring are population/management unit range, trends in distribution and abundance, condition of the habitat, the threats and pressures to which the species is exposed, and effectiveness of any mitigation measures put in place to alleviate those threats and pressures.

4.3. Dealing with inadequate data

While ideally, all conservation plans and associated management actions are based on full and adequate scientific data, there are occasions when the potential conservation consequences of waiting for confirmatory scientific evidence may mean that it is better to take action in the short term whilst collecting further evidence. This has become known as following the "Precautionary Principle"[4]. However, application of the precautionary principle must be carefully considered and adequately justified. One of the main challenges encountered in the process of developing the initial version of the SAP has been the lack of data available on which to base some decisions.

In response to this issue, the actions (Summary of actions) include a number of research and monitoring actions which work towards obtaining the necessary information for the establishment of adequate scientifically-based management actions. For example, improving understanding of causes of seasonal and annual movements; improved estimates of bycatch rates; and monitoring of health and nutritional status. These actions need to be given some priority to ensure management or mitigation is based on robust data and therefore likely to be effective.

[4] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=LEGISSUM%3Al32042

5. Actions

5.1. Summary of actions

Below is a list of the identified actions, with an indication of priority and likely constraints of achieving each. Actions are categorised under Monitoring (MON); Mitigation (MIT) and Research (RES) codes.

Priority	Action	Code	Constraints
Essential	Identify the priority bycatch issues	RES-01	Political will influenced by societal desire to support
Essential	Improve estimates of bycatch rates to support development of conservation strategy	RES-02	Metrics used to record fishing effort; ambiguous definitions for some gear types; insufficient funding to support the extent of monitoring needed for robust estimates
Essential	Implement and assess gear modifications and mitigation measures to reduce bycatch	MIT-01	Cooperation from fishing industry; enforcement measures
High	Implement a wide-scale surveillance programme to monitor trends in distribution and abundance in the NE Atlantic	MON-01	Commitment of funding
High	Improve understanding of causes of seasonal and annual variation in abundance and distribution, particularly in relation to human activities	RES-03	Inadequate spatio-temporal survey coverage; difficulties in mapping some human activities
High	Monitor health and nutritional status, diet, life history parameters, and causes of mortality in the NE Atlantic	MON-02	Commitment of funding; access to samples; development of suitable methods
Medium	Further our understanding on population structure by assessing and developing suitable techniques for these highly mobile small delphinids	RES-04	Development of non-invasive sampling methods; discrimination ability of different techniques.

Priority	Action	Code	Constraints
Medium	Improve understanding of and develop mitigation for the risks of anthropogenic sound	MIT-02	Challenges of attributing sound to impacts
Medium	Ensure screening and assessment of the occurrence and effects of hazardous substances	MON-03	Effective identification of emerging hazards; addressing impacts on common dolphin specifically
Low	Monitor for potential increases in anthropogenic activities that lead to incidences of death, injury or adverse health effects	MON-04	Availability and accessibility of information

5.2. Actions and Tasks

The actions are detailed below setting out the priority, constraints to achieving the action objectives, specific associated tasks and who is responsible. Monitoring actions identify key tasks in developing monitoring for the species, similarly with Mitigation actions. Research actions identify tasks essential for providing adequate management advice. The tasks identified within each action will formulate the basis on which countries will report progress to ASCOBANS and if identified under the MoU, to ACCOBAMS.

The SG will be responsible for developing detailed plans for tasks where required to coordinate implementation and identify a way forward. As stated in 1.5, the SG will collate reports on the progress of implementation, effectiveness and issues encountered and report annually to the Advisory Committee on the progress of the SAP, identifying further implementation priorities and make appropriate recommendations. The reporting will be concise and efficient to reduce burden and maintain up to date information on application and progress of tasks.

Action RES-01: Identify the priority bycatch issues

Priority: ESSENTIAL **Research action**

Constraints: depends on political will, influenced by public support

Description of action

There is a need to identify the highest risk fisheries for common dolphins in terms of activities and spatial extent regarding bycatch, in order to effectively direct effort of potential monitoring and mitigation. There is then opportunity to:

- prioritise mitigation measures, management and innovation to address the target of 'reducing bycatch to less than 1% of the best available population estimate' with an ultimate aim of zero;
- improve understanding of the factors which influence bycatch levels; e.g. age, gender, time of day of capture, hydro-meteorological condition, associated prey species, gear specifications and usages etc.;
- facilitate further development of a management framework procedure to support collaborative approaches at an appropriate spatial scale.

Tasks

1. Identify and monitor medium-to-high-risk fisheries activities with a high risk of common dolphin bycatch in order to ascertain more accurate assessments of bycatch rates in order to meet the agreed objective of Resolution 3 MOP 3 and Resolution 5 MOP 8.
2. Progress development of a management framework procedure for common dolphin in order to meet the agreed objectives of Resolution 5, MOP 8.
3. Facilitate the identification of factors influencing bycatch rates; including an assessment of temporal (seasonal) and spatial, gear characteristics, fishing practices and target/non-target species.
4. Facilitate research in order to assess evidence of bycatch selectivity of age-sex groups in different fishing operations (e.g. gears, target species, seasons).
5. Monitor causes of death in the population through strandings programmes for aiding assessments of spatio-temporal relationships and trends in bycatch, aiding implementation of the agreed objectives of Resolution 10, MOP 8 on strandings.

Actors

Coordinator/Steering Group, national authorities, other stakeholders including OSPAR and scientists (e.g. By-catch Inference from Stranding Working Group of IWC).

Action RES-02: Improve estimates of bycatch rates to support development of conservation strategy

Priority: ESSENTIAL **Research action**

Constraints: Potential constraints are the current metrics used to record fishing effort, ambiguous definitions for some gear types, insufficient funding or inefficient use of available funding to support the extent of monitoring needed for robust estimates.

Description of action

Bycatch estimates across the Agreement Area are hampered by some low sampling effort and the difficulties to quantify effort adequately due to the format of recorded information from relevant fisheries. Currently, effort is logged as days at sea rather than more accurate measures that take account of net dimensions and soak times. Bycatch rates are determined from visual observers aboard a small fraction of active vessels. Although EU Range States are required to report bycatch rates on an annual basis, some do not. Efforts are needed at international, national and regional levels to improve the level & frequency of provision of information.

Tasks

1. Ensure that existing regulations with respect to bycatch reduction measures are being effectively implemented and to collect data on their efficacy in reducing bycatch to meet the agreed objectives of Resolution 3, MOP 3 and Resolution 5, MOP 8.
2. Drive coordination of bycatch monitoring observer programmes across Parties and non-Party Range States.
3. Increase reliability of fishing effort data, particularly for medium-to-high risk activities, supporting the wider work of ICES.
4. Support innovation and further monitoring methods, e.g. remote electronic monitoring (REM) and liaise with the newly created By-catch Inference from Stranding Working Group of IWC, to improve bycatch estimates in high risk fisheries.
5. Support OSPAR in the development of a pressure-state indicator for bycatch in order to meet the requirements of MSFD[5].

Actors

SAP Coordinator/Steering Group with support from Range States/Parties to ASCOBANS.

[5] The revised Commission Decision on criteria and methodological standards for Good Environmental Status ((EU) 2017/848) clarified the assessment process for species biodiversity Descriptor 1 of MSFD. Of primary concern is mortality as a result of bycatch (criterion D1C1), followed by abundance (D1C2), population demographic characteristics (D1C3), distribution (criterion D1C4) and habitat (criterion D1C5). The latter 4 criteria are largely assessed as part of the favorable conservation status assessments required through the Habitats Directive.

Action MIT-01: Implement and assess gear modifications and other mitigation measures to reduce bycatch

Priority: ESSENTIAL **Mitigation Measure Action**

Constraints: Willingness of industry to collaborate, political will, requirement for incentives and penalties, and socio-economic cost

Description of action

There is extensive evidence that particular gear types are distinctly more likely to result in common dolphin bycatch. Thus, there should be no reason to delay research on, and implementation of, gear modifications that could reduce bycatch. Range states should be urged to prioritise working with the industry to develop and test mitigation measures (both modifications to fishing gear and fishing practices).

Tasks

1. Evaluation of current gear modification and mitigation measures to identify effectiveness in the reduction of bycatch in high and medium-risk fisheries to meet the agreed objectives of Resolution 5, MOP 8.
2. Implement proven mitigation measures for all high and medium-risk fisheries that are appropriate to the nature of the vessels and their size, with subsequent monitoring to ensure effectiveness and the ongoing need to meet the agreed objectives of Resolution 5, MOP 8.
3. Identification of funding and collaboration for further gear innovation and/or other measures for medium to high-risk fisheries, and implementation of monitored trials of promising mitigation measures, in collaboration with the fishing industry.

Actors

Range States/Parties to ASCOBANS, fisheries authorities, ICES, policymakers, SAP Coordinator/Steering Group, contractors.

Action MON-01: Implement a wide-scale surveillance programme to monitor trends in distribution and abundance in the NE Atlantic

Priority: HIGH **Monitoring Action**

Constraints: Availability of funding which may be driven, in part, by political will and support for the SAP

Description of action

The fundamental basis for determining changes in common dolphin status within the Agreement Area is a programme of regular wide-scale standardised surveys. Given the cost, the term 'regular' would need to be identified based on sufficiency for reporting trends. These surveys provide 'snapshots' of the abundance and distribution within the area surveyed. Given the temporal limitations, complimentary regional data collection is required for consideration of e.g. seasonal changes in distribution. These surveys should be part of a wider strategic data collection programme for cetacean populations and should be integrated into combined analysis such as those completed as part of the Joint Nature Conservation Committee's 'Joint Cetacean Protocol' (JCP)[6] or the Marine Ecosystems Research Project (MERP)[7].

Tasks

1. Encourage Parties and non-Party Range States to collaborate and fund regular systematic wide-scale surveys in order to establish trends in abundance and distribution relevant for transboundary reporting of conservation status in order to meet the agreed objectives of Resolution 7, MOP 4 and Resolution 7, MOP 5.
2. Develop a mechanism for collation of all relevant, standardised data at a relevant spatial scale (e.g. JCP or MERP), including complimentary standardised data collection protocols, to enable seasonal trends to be evaluated to meet the agreed objectives of Resolution 7, MOP 4
3. Ensure that the outputs of this action provide a suitable mechanism to enhance transboundary reporting of conservation status and good environmental status.

Actors

SAP Coordinator/Steering Group with support from Range States/Parties to ASCOBANS.

[6] JNCC Joint Cetacean Protocol: http://jncc.defra.gov.uk/page-5657
[7] MERP: http://www.marine-ecosystems.org.uk/Home

Action RES-03: Improve understanding of causes of seasonal and annual variation in abundance and distribution, particularly in relation to human activities

Priority: HIGH **Research action**

Constraints: Inadequate spatial or temporal coverage for cetacean surveys, difficulties in mapping some human activities/impacts.

Description of action

In addition to adequate implementation of MON-01 (Implement a wide-scale surveillance programme to monitor trends in distribution and abundance in the NE Atlantic), analyses should investigate relationships between the distribution and trends regarding relevant human activities (e.g. bycatch) and climate-related indicators. Consideration of indirect impacts of change e.g. availability of prey, should be considered where possible.

Tasks

1. Review the collection and collation of appropriate standardised data on anthropogenic activities, and display in a format that will facilitate use in a geographic information system (GIS). This should aim to support implementation of the MSFD and assessment of good environmental status through OSPAR.
2. Complete seasonal risk assessment/risk mapping of relevant human activities and common dolphin distribution in order to meet the agreed objectives of Resolution 7, MOP 4, Resolution 7, MOP 5 and Resolution 5, MOP 8.
3. Collate and monitor data on important prey species of common dolphins to identify spatial areas of concern for fisheries management measures to meet the agreed objectives of Resolution 7, MOP 4 and Resolution 7, MOP 5.
4. Regularly review of evidence for potential impacts of climate change on common dolphins to inform on appropriate mitigation measures.

Actors

Range States/Parties to ASCOBANS; scientists and managers especially those involved in the monitoring component of SCANS, Data collectors, fisheries authorities, ICES, policymakers, SAP Coordinator/Steering Group, contractors.

Action MON-02: Monitoring of health and nutritional status, diet, life history parameters, and causes of mortality in the NE Atlantic

Priority: HIGH **Monitoring Action**

Constraints: Funding; access to sufficient samples across the region; development of methods to assess health, nutritional status and diet.

Description of action

Information on diet and various health and life history parameters has historically been obtained from dead animals that have stranded or in some cases, been recovered as bycatch, which remains the primary source of these data. Given the limitations of sampling dead animals, methods of gaining data from live animals should be considered.

Tasks

1. Funding of national stranding and bycatch observer programmes for collection of carcasses, assessment of health status, cause of death, diet analysis and life history parameters to meet the agreed objectives of Resolution 10, MOP 8.
2. Ensure implementation the ASCOBANS/ACCOBAMS[8]/IWC[9] strandings protocol to achieve standardised, comparable datasets.
3. Support strandings programmes to enable the analysis of diet, including tissue samples for fatty acids/stable isotope analysis, and life history parameters.
4. Support expansion of drift prediction modelling capabilities for determining the origin of stranded common dolphins, e.g. MOTHY (Peltier *et al.,* 2016) to identify potential bycatch high risk areas/seasons.
5. Explore opportunities to sample live animals (e.g. photo analysis, swabs), in addition to samples from stranded animals, facilitating agreed objectives of Resolution 7, MOP 8 to help determine population structure species. Such information is fundamental to the development of the management procedure outlined in Action RES – 01 (Identify the priority bycatch issues).

Actors

Range States, EC, International Whaling Commission Scientific Committee, ASCOBANS, ACCOBAMS, Coordinator/SG, other stakeholders including scientists and strandings programme coordinators.

[8] Agreement on the Conservation of Cetaceans in the Black Sea, Mediterranean Sea and Contiguous Atlantic Area: http://www.accobams.org/
[9] International Whaling Commission: https://iwc.int/iwcmain

Action RES-04: Further our understanding on population structure by assessing and developing suitable techniques for these highly mobile small delphinids.

Priority: MEDIUM **Research action**

Importance: Medium

Constraints: Potential constraints are the discrimination ability of different techniques, practicalities of introducing a well-designed sampling procedure, and development of acceptable non-invasive methods to collect the appropriate information.

Description of action

Information on population structure may be obtained by a variety of means, including, amongst others, DNA analysis (mtDNA, microsatellite, MHC and SNP markers, whole genomic studies by new generation technologies), morphometric studies, stable isotope signatures, fatty acid profiles, and comparisons of life history parameters. Each is characterised by having different powers of discrimination over different time scales. Traditionally, most information on the population has come opportunistically from strandings, though bycaught animals have been extensively sampled through European observer programmes. Strandings data offer valuable insight, however have limitations when used insolation. Therefore, methods to reduce these limitations (e.g. improved drift modelling) and methods of collecting more representative samples should be explored.

Tasks

1. To identify funding and develop a programme which can involve existing or potential new samples.
   This programme will identify areas from which we require improved information on population structure, e.g. differentiating groups within and beyond the continental shelf, and work required to delineate the population range. Strategic sampling approaches (i.e. temporal and spatial) and statistical power analysis should be undertaken to determine level of sampling required to detect appropriate units to conserve.
2. Actively support and encourage development of suitable techniques for discriminating population structure in highly mobile small delphinids.
3. Facilitate the provision of dead bycaught animals for population structure assessment and other appropriate studies. This may require repeal of national legislation to facilitate landing of bycaught common dolphins for research.

Actors

Range States, Coordinator/SG, other stakeholders including scientists, fisheries authorities and strandings programme coordinators.

Action MIT-02: Improve understanding of and develop mitigation for the risks of anthropogenic sound

Priority: MEDIUM **Mitigation Measure Action**

Constraints: Difficulty in attributing sound exposure to physical or behavioural consequences at both the individual and population level.

Description of action

There remains uncertainty as to the extent to which noise producing activities such as seismic and sonar surveys impact on the species at an individual and population level. More attention needs to be given to characterising sound signals to investigate what features may be important for mitigation purposes. This includes not only the frequency spectra and energy levels but also rise times, signal duration and kurtosis. Parties and non-Party Range States should encourage research in those areas which can then be applied to a variety of marine mammal species including common dolphin.

Tasks

1. Parties and non-Party Range States should coordinate and support research on the effects of underwater noise on common dolphins to meet the agreed objectives of Resolution 4, MOP 5, Resolution 2, MOP 6 and Resolutions 6, 8 and 9, MOP 8.
2. Parties and non-Party Range States should introduce precautionary guidance on measures and procedures for all activities surrounding the development of renewable energy production and other noise-producing industry to minimise risks to populations and mitigate possible effects following current best practice as agreed in Resolution 2, MOP 6.
3. Annually monitor and assess knowledge of the effects of anthropogenic sound through review of literature, including behavioural responses of common dolphins and the effectiveness of mitigation technologies as agreed in Resolution 2, MOP 6 and Resolution 6, MOP 8.
4. Where suitable samples exist, monitor the physical effects of exposure to anthropogenic sound, i.e. acoustic trauma, where access to stranded animals within the required timeframe is possible.
5. Parties and non-Party Range States should engage with OSPAR and other relevant fora to encourage noise data provision appropriate for the assessment of good environmental status[10].

Actors

SAP Coordinator/Steering Group, national authorities, other stakeholders including OSPAR and scientists.

[10] Following Commision Decision 2017/848, Criteria D11C1 aims to ensure the spatial distribution, temporal extent, and levels of anthropogenic impulsive sound sources do not exceed levels that adversely affect populations of marine animals and Criteria D11C2 aims to ensure that the spatial distribution, temporal extent and levels of anthropogenic continuous low-frequency sound do not exceed levels that adversely affect populations of marine animals.

Action MON-03: Ensure screening and assessment of the occurrence and effects of hazardous substances

Priority: MEDIUM **Monitoring Action**

Constraints: Identifying new products as hazardous; assessing impacts that apply specifically to common dolphin.

Description of action

Programmes currently exist in the Agreement Area that monitor a suite of hazardous chemicals. However, the impacts that some of these may have specifically on common dolphins has not been fully assessed. In addition, assessment of levels of new emerging contaminants of concern on the EU watchlist for emerging pollutants is ongoing (Commission Implementing Decision (EU) 2015/495). This is particularly relevant for those pollutants identified as endocrine disrupting chemicals, which are known to effect population health (Law *et al.*, 2012; Jepson *et al.,* 2016; Murphy *et al*., 2018).

Tasks

1. Continue to monitor and assess emerging chemical pollutants and marine litter (including macro-, micro- and nanoplastics) in common dolphins through review of literature to progress agreed objectives of Resolution 4, MOP 7, Resolution 7, MOP5 and Resolution 7, MOP 8.
2. Monitor effects from exposure to legacy pollutants on immune, endocrine and reproductive functions in common dolphins against agreed thresholds, through continued analysis of strandings data to meet agreed objectives of Resolution 7, MOP 8.
3. Encourage Parties and non-Party Range States to work through OSPAR and other relevant fora to aid the development of an indicator of GES to meet Criteria D8C2 in order to ascertain that the health of the species is not adversely affected due to contaminants including cumulative and synergetic effects.

Actors

Range states, other stakeholders including scientists, SAP Coordinator/Steering Group.

Action MON-04: Monitor for potential increases in anthropogenic activities that lead to incidences of death, injury or adverse health effects including cumulative effects.

Priority: LOW **Monitoring Action**

Constraints: Availability of and access to the necessary information.

Description of action

Where current exposure of some pressures may be viewed as sustainable with regards to common dolphin populations, increases in exposure of either a single pressure, or cumulative increases, may have a negative impact and requires monitoring to enable early detection of risk, and subsequent development of management. A number of human activities known to have negative impacts upon marine mammals can be monitored from information gathered as part of other surveillance and monitoring programmes and, therefore, a strategic approach to data collection should be explored.

Tasks

1. Encourage Parties and Range States to continue to give their full support to the activities related to applying an ecosystem approach to the management of human activities under the frameworks of OSPAR, HELCOM, the European Union and the Convention in Biological Diversity as agreed in Resolution 9, MOP8.
2. Requests that Parties and Range States ensure that cross-sectoral and transboundary consultations take place as early as the planning stage of activities in marine areas (marine spatial planning) with the aim of identifying potential impacts and minimising or mitigating such impacts effectively as agreed in Resolutions 6 and 9, MOP8.
3. As part of the annual reporting for this plan, collect and review information to monitor changes in exposure to key anthropogenic pressures.
4. Identify emerging pressures (e.g. wet renewables and ecotourism) and ensure monitoring is in place to establish risk.

Actors

Range States national authorities, International Maritime Organisation (IMO), International Whaling Commission (IWC), SAP Coordinator/Steering Group.

6. Public awareness and capacity building

This Species Action Plan has been developed to collate knowledge and information on the species and develop a set of relevant actions to implement in order to conserve the species and aim to restore the whole population to favourable conservation status. Wider awareness of both the pressures and the activities which cause them, and also any successes of the plan, will support achievement of the aims. Education and awareness may also contribute to better reporting of sightings and impacts, leading to better data for decision making.

The common dolphin is a species which regularly interacts with humans when encountered. There is therefore interest from both stakeholders and the general public in continuing to be able to observe the species and thus in its conservation status. Additionally, there is the capacity for misinformation through media following events such as strandings; bycatch discard and other impacts such as vessel strikes. The outreach proposed for this plan could be effectively undertaken by better use of the media, including the internet (e.g. through ASCOBANS and Range State webpages), and activities such as public lectures and education programmes. It is important to continue communication particularly with stakeholders who have an impact on the species (e.g. through activities such as fishing, wildlife watching, etc.) to maintain communication channels and support action of relevant tasks, as well as work with other interested parties to publicise the work ongoing to conserve the species.

6.1. Public awareness tasks

1. All key milestones (e.g. timetables for actions; assessment of progress against objectives etc.) to be publicised through ASCOBANS and Range State media outlets in a coordinated manner agreed through the SG.
2. ASCOBANS webpages to host key documents and updates, to be publicised by SG members.
3. Presentation of the progress at relevant events and conferences.
4. Identification and publication of papers through journals and list servers/webpages to publicise lessons learned and successes.
5. Wider circulation of articles and news items through the media/social media to support the dissemination of factual information to the wider public.
6. Coordination with relevant NGO’s with an interest in common dolphins, to join up approaches for public information campaigns.

Annex 1: International conventions and agreements

In the NE Atlantic, common dolphins are discussed under a wide variety of legislation including national, European and international statutes and conventions, all with aims to protect, conserve, manage and study the species. In addition, there is other international legislation aimed at specific industries.

Full Title	Acronym/shorthand
1.1 United Nations Convention on the Law of the Sea	UNCLOS
1.2 Convention on Biological Diversity	CBD
1.3 Convention on International Trade in Endangered Species of Wild Fauna and Flora	CITES
1.4 The Convention on the Conservation of Migratory Species of Wild Animals & the Agreement on the Conservation of Small Cetaceans of the Baltic, NE Atlantic, Irish and North Seas	CMS & ASCOBANS
1.5 Convention on the Protection of the Marine Environment of the NE Atlantic	OSPAR
1.6 The Bern Convention	
1.7 European Directive of Natural Habitats and Wild Fauna and Flora (92/43/EEC)	Habitats Directive
1.8 International Convention for the Regulation of Whaling	IWC
1.9 Common Fisheries Policy	CFP
1.10 EC Council Regulation 812/2004	The Fisheries Regulation
1.11 Marine Strategy Framework Directive	MSFD
1.12 Environmental Impact Assessment Directive	EIA
1.13 Strategic Environmental Assessment Directive	SEA

Below is an overview of each convention or agreement relating to common dolphin conservation.

1.1. United Nations Convention on the Law of the Sea (UNCLOS)

UNCLOS governs all aspects of ocean space: Specifically, the convention states that contracting parties “shall cooperate with a view to the conservation of marine mammals and in the case of cetaceans shall in particular work through the appropriate international organisations for their conservation, management and study” and that signatories must take measures “necessary to protect and preserve rare or fragile ecosystems as well as the habitat of depleted, threatened or endangered species and other forms of marine life" (United Nations, 2001).

1.2. Convention on Biological Diversity (CBD)

The vision of the CBD Strategic Plan for Biodiversity 2011–2020 is "by 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people" (CBD, 2010). As part of these requirements, the European Commission developed and, in 2011, adopted the EU biodiversity strategy (European Commission 2011), a target of which is "to halt the deterioration in the status of all species and habitats covered by EU nature legislation and achieve a significant and measurable improvement in their status so that, by 2020, compared to current assessments, 100% more habitat assessments and 50% more species assessments under the Habitats Directive show an improved conservation status".

1.3. Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

CITES aims to regulate international trade in species that are endangered or may become endangered if their exploitation is not controlled (CITES, 2012). CITES is implemented within Europe through two EC regulations (338/97 and 865/06 as amended). Species covered under CITES are listed in three appendices, with common dolphins listed in Appendix 2. This means that trade in the species is permitted as long as the authorities have ascertained that it will not be detrimental to the survival of the species; that the specimen was not obtained in contravention of the laws of that state for the protection of fauna and flora; and that any living specimen will be so prepared and shipped that it minimizes the risk of injury, damage to health or cruel treatment.

1.4. The Convention on the Conservation of Migratory Species of Wild Animals (CMS) and the Agreement on the conservation of small cetaceans of the Baltic, NE Atlantic, Irish and North Seas (ASCOBANS)

The Convention on Migratory Species (CMS), or Bonn Convention, sets out general provisions for the protection and conservation of certain migratory marine mammals (CMS Secretariat, 2012). Common dolphins in the North Atlantic are not listed, whilst those in the North and Baltic Seas (where the species is largely absent) are listed in Appendix II. Appendix II includes species that have an unfavourable conservation status and that require international agreements for their conservation and management, as well as those that have a conservation status that would significantly benefit from the international cooperation that could be achieved by an international agreement.

One such agreement is the Agreement on the Conservation of Small Cetaceans in the Baltic, NE Atlantic, Irish and North Seas (ASCOBANS) and another the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS).

A conservation plan (Bearzi *et al,* 2004) has been developed for common dolphins in the Mediterranean Sea by ACCOBAMS which identifies bycatch and pollution as the two key pressures on the species.

1.5. Convention on the Protection of the Marine Environment of the NE Atlantic (OSPAR)

The OSPAR Convention (replacing the Oslo and Paris Conventions) is the mechanism by which 15 governments of the coastal states of NW Europe, together with the European Commission, cooperate to protect the marine environment of the NE Atlantic with a particular focus on marine pollution, as well as providing for the conservation and protection of habitats and species.

Article 2(1)(a) states "the Contracting Parties shall, in accordance with the provisions of the Convention, take all possible steps to prevent and eliminate pollution and shall take the necessary measures to protect the maritime area against the adverse effects of human activities so as to safeguard human health and to conserve marine ecosystems and, when practicable, restore marine areas which have been adversely affected" (OSPAR, 2007). Although common dolphins are not listed by OSPAR as a threatened and declining species, the MSFD Intermediate Assessment includes the species under the Biodiversity Indicator M4 on cetacean abundance.

1.6. The Bern Convention

The Convention on the Conservation of European Wildlife and Natural Habitats (or the Bern Convention) is covers most of the natural heritage of the European continent and extends to some states of Africa (European Union 1979). Common dolphins in the North Atlantic are listed in Appendix 2 'strictly Protected Fauna Species', for which the following activities (relevant to common dolphin) are prohibited:

- all forms of deliberate capture and keeping and deliberate killing;
- the deliberate damage to or destruction of breeding or resting sites;
- the deliberate disturbance of wild fauna, particularly during the period of breeding, rearing and hibernation, insofar as disturbance would be significant in relation to the objectives of this Convention;
- the possession of and internal trade in these animals, alive or dead, including stuffed animals and any readily recognisable part or derivative thereof, where this would contribute to the effectiveness of the provisions of this article.

There is also a requirement for contracting parties to coordinate "efforts for the protection of the migratory species specified in Appendices II and III whose range extends into their territories". For Member States of the European Union, the provisions of the Bern Convention are largely taken up in the 1992 Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC), otherwise known as the 'Habitats Directive'.

1.7. European Directive of Natural Habitats and Wild Fauna and Flora (92/43/EEC) (commonly known as the Habitats Directive) 1992

The Habitats Directive transposes the Bern Convention in EU law. Common dolphins are listed in Annex IV of the Habitats Directive as 'Animal and Plant Species of

Community Interest in Need of Strict Protection'. Article 11 requires Member States to monitor the conservation status of the habitats and species listed in the annexes; Article 17 requires an assessment of conservation status to be sent to the European Commission every 6 years. In the Directive, conservation status is defined as "the sum of the influences acting on the species that may affect the long-term distribution and abundance of its populations". Conservation status can be considered favourable if:

- population dynamics data indicate that the species is maintaining itself on a long-term basis as a viable component of its natural habitats;
- the natural range of the species is neither being reduced nor is likely to be reduced in the foreseeable future, and;
- there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Under Article 12, Member States shall take the requisite measures to establish a system of strict protection for the animal species listed in Annex IV(a) in their natural range, prohibiting: (a) all forms of deliberate capture or killing of specimens of these species in the wild (i.e. bycatch); (b) deliberate disturbance of these species, particularly during the period of breeding, rearing, hibernation and migration; and (d) deterioration or destruction of breeding sites or resting places. Member States are required to undertake further research or introduce conservation measures to ensure that incidental capture and killing does not have a significant negative impact on the species concerned. This is specifically relevant for common dolphins.

1.8. International Convention for the Regulation of Whaling 1946

The International Whaling Commission (IWC) was set up under the International Convention for the Regulation of Whaling, which was signed in Washington, D.C., in December 1946 (IWC, 2012). The purpose of the convention is to "provide for the proper conservation of whale stocks and thus make possible the orderly development of the whaling industry". Each year, the IWC Scientific Committee, through its Sub--Committee on Small Cetaceans, identifies priority species/regions for consideration by a review. Topics considered include distribution, stock structure, abundance, seasonal movements, life history, ecology, and directed and incidental takes. In 2009, the Sub--Committee on Small Cetaceans undertook a worldwide review of the common dolphin (IWC, 2009).

1.9. Common Fisheries Policy (CFP)

One of the objectives of Regulation EU 1380/2013 of the European Parliament and of the Council on the Common Fisheries Policy (CFP) is that the CFP shall implement the ecosystem-based approach to minimize negative impacts of fishing activities on the marine ecosystem. For this purpose, conservation measures such as modifications or additional devices to reduce incidental capture of endangered, threatened and protected species, or limitations on the use of certain fishing gears, shall be adopted. Also, highly relevant is the request that Member States should collect data on fleets and their fishing activities. Member States should manage the collected data and make them available to end-users and other interested parties. The data include biological, environmental, technical and socio-economic aspects, for example data on the impact of fisheries on biological resources and the marine ecosystem.

1.10. EC Council Regulation 812/2004

The aim of Council Regulation EC 812/2004 on measures concerning incidental catches of cetaceans in fisheries is to mitigate incidental catches of cetaceans by fishing vessels in specific areas. The measures pertinent to common dolphins in the North Atlantic are the coordinated monitoring of cetacean bycatch for given fisheries and the mandatory use of acoustic deterrent devices ('pingers') in certain fisheries. In 2016 the European Parliament proposed amendments to this regulation[11], replacing it with a Technical Measures Framework which includes a Data Collection Framework (DCF) through which bycatch monitoring would be required. ASCOBANS does not consider this to be sufficient, and has proposed a new or an amended regulation focusing specifically on cetacean conservation objectives, coupled with the incorporation of the monitoring requirements and mitigation measures under the DCF for fisheries and the technical measures framework (ASCOBANS, 2015b).

1.11. Marine Strategy Framework Directive (MSFD) 2008

The Marine Strategy Framework Directive (MSFD, Directive 2008/56/EC) requires Member States of the European Union to develop marine strategies that apply an ecosystem-based approach to the management of human activities while enabling a sustainable use of marine goods and services. Priority should be given to achieving or maintaining good environmental status in the community's marine environment, continuing its protection and preservation, and preventing subsequent deterioration (European Union, 2008). To determine Good Environmental Status (GES), 11 qualitative descriptors have been selected. In 2017, OSPAR published its intermediate assessment for the 11 Descriptors which include common dolphin in biodiversity indicator M4 Cetacean abundance and distribution. Following the Commission Decision 2017/848, there is an urgent need to develop a bycatch indicator for common dolphin.

1.12. Environmental Impact Assessment (EIA) Directive (85/337/EEC) 1985

The EIA Directive (85/337/EEC) calls for assessment of the impacts on the environment of certain public and private projects which are defined in Annexes I and II of the Directive. A mandatory EIA is required of all projects listed under Annex I, which are considered to have significant effects on the environment. Projects listed under Annex II are at the discretion of Member States and subject to consideration by the national authorities as to whether an EIA is required, taking criteria detailed in Annex III into account. The majority of projects that may impact common dolphins, such as offshore renewable development, are listed under Annex II.

1.13. Strategic Environmental Assessment (SEA) Directive (2001/42/EC) 2003

The SEA Directive calls for an environmental report in which the likely significant effects on the environment and the reasonable alternatives of the proposed plan or programme are identified. The public and the environmental authorities are informed and consulted on the draft plan or programme and the environmental report prepared.

As regards plans and programmes which are likely to have significant effects on the environment in another Member State, the Member State in whose territory the plan or programme is being prepared must consult the other Member State(s).

[11] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52016PC0134

The SEA and EIA differ as follows:

- the SEA requires the environmental authorities to be consulted at the screening stage;
- scoping (i.e. the stage of the SEA process that determines the content and extent of the matters to be covered in the SEA report to be submitted to a competent authority) is obligatory under the SEA;
- the SEA requires an assessment of reasonable alternatives (under the EIA the developer chooses the alternatives to be studied);
- under the SEA Member States must monitor the significant environmental effects of the implementation of plans/programmes to identify unforeseen adverse effects and undertake appropriate remedial action.
- the SEA obliges Member States to ensure that environmental reports are of a sufficient quality.

  The SEA Directive applies to a wide range of public plans and programmes. An SEA is mandatory for plans/programmes which are:

- prepared for agriculture, forestry, fisheries, energy, industry, transport, waste/ water management, telecommunications, tourism, town & country planning or land use and which set the framework for future development consent of projects listed in the EIA Directive.

  OR

- have been determined to require an assessment under the Habitats Directive.

  Broadly speaking, for the plans/programmes not included above, the Member States have to carry out a screening procedure to determine whether the plans/programmes are likely to have significant environmental effects. If there are significant effects, an SEA is needed. The screening procedure is based on criteria set out in Annex II of the Directive.

Annex 2: Biology and ecology of common dolphin

2.1. Population range and structure

Common dolphins are an oceanic species that is widely distributed in tropical to cool temperate waters of the Atlantic and Pacific. In the NE Atlantic, common dolphins are distributed from coastal waters to the mid-Atlantic ridge and from south of the Azores and the Strait of Gibraltar to around 70°N, west of Norway, but are mainly found south of 60°N (Evans *et al.*, 2003; Reid *et al.,* 2003; Murphy, 2004; Cañadas *et al*., 2009; Murphy *et al.*, 2009; Murphy *et al*, 2013). Their range therefore extends well beyond the ASCOBANS area. Common dolphins are infrequent visitors to the North Sea, with movements into these waters related to climate variability on decadal time scales (Evans & Scanlan 1989; Murphy, 2004; Murphy *et al.,* 2013). The species may in fact be distributed across the whole North Atlantic Ocean, between 35°N and 55°N (partially covering a region strongly influenced by the Gulf Stream/North Atlantic Current); however, due to a lack of observer effort west of the mid-Atlantic ridge (approximately 30–40°W), the full range of the species is not known (Murphy *et al.,* 2013).

Morphometric and genetic assessments indicate that there is only one common dolphin population in the NE or European Atlantic, ranging from Scotland to Portugal (Murphy *et al.*, 2006; Natoli *et al.*, 2006; Amaral *et al.*, 2007; Mirimin *et al.*, 2009), with separate populations reported in the Mediterranean Sea and North-west (NW) Atlantic (Natoli *et al.,* 2006, 2008; Westgate 2007; Mirimin *et al.*, 2009). Low levels of genetic differentiation were reported between the NE and NW Atlantic populations, which could result from a recent population split or a high level of gene flow in the North Atlantic (Mirimin *et al.*, 2009). There is also a lack of population genetic structure in the European Atlantic (Scotland to Madeira) and a lack of evidence of isolation by distance (Quérouil *et al.,* 2010, 2013; Moura *et al*., 2013). Low levels of genetic differentiation will impact the scale at which management needs to be considered, supporting the need for a coordinated approach to management across the ASCOBANS area.

Application of Management Units (MU) or similar large-scale units such as the Regional Sea Divisions for MSFD assessments is key to ensuing monitoring and assessment occurs at an appropriate scale; therefore, the applied MUs should be regularly reviewed in light of relevant data. Currently a single MU for common dolphin has been proposed for OSPAR Regions II, III and IV based (Figure 3) on genetic and cranial morphometric data (ICES, 2014). Although common dolphins have been observed in OSPAR Region V, due to a lack of sampling of individuals for genetic analysis within this OSPAR region it is not known to what population(s) those individuals pertain. Thus, the actual range of the NE Atlantic population is unknown (Murphy *et al.,* 2009; Murphy *et al.*, 2013).

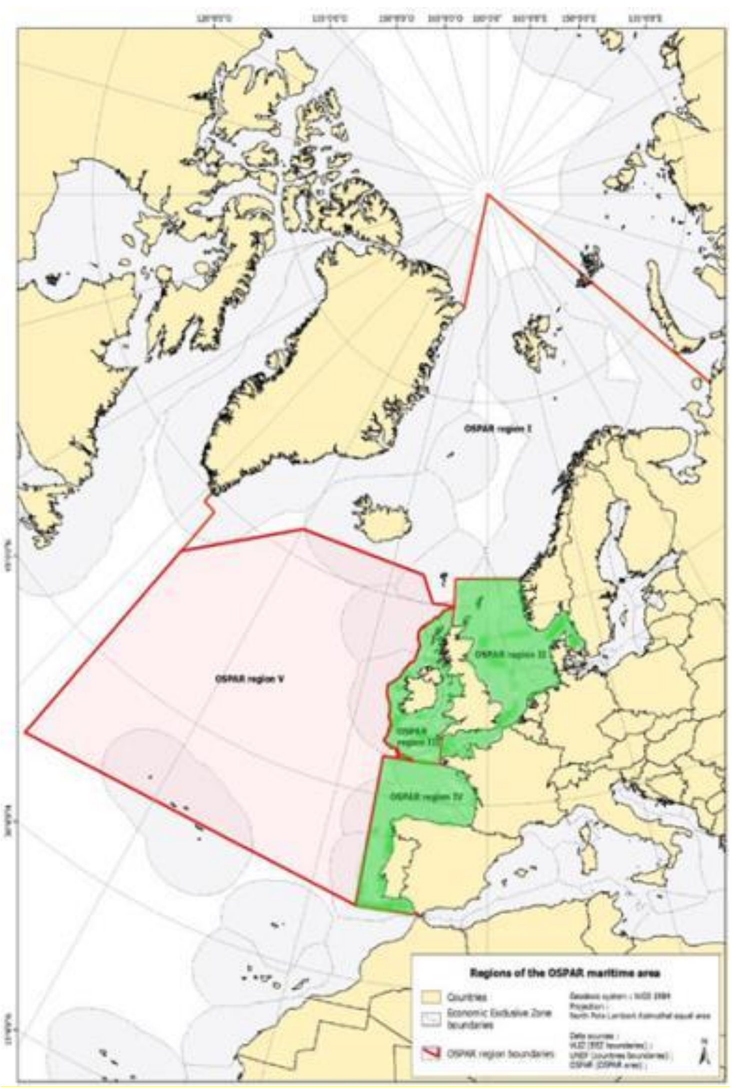

Figure 3: Proposed Management Unit for common dolphins in the NE Atlantic.

Source: ICES WGMME, 2014

The ASCOBANS/HELCOM Small Cetacean Population Structure Workshop considered a few generations (equivalent to low tens of years) as the appropriate time frame for defining a Management Unit, with different lines of complementary evidence suggesting reduced exchange (migration/dispersal) rates between groups of individuals (Evans and Teilmann, 2009). As low (non-significant) genetic variation has been observed in this species across the NE Atlantic, the ASCOBANS/HELCOM Small Cetacean Population Structure Workshop (Murphy *et al.*, 2009) and the ICES WGMME (2009) proposed that we should manage 'ecological stocks' of common dolphins in the NE Atlantic that have been identified using various ecological markers, such as assessing 'elemental profiles' of pollutants, stable isotopes, fatty acids, etc. As only a few such studies have been undertaken (e.g. Lahaye *et al.*, 2005; Caurant *et al.*, 2009; Quérouil *et al.*, 2013) with, for the most part, small sample sizes, the presence of ecological stocks within the NE Atlantic has not been ascertained although there are indications that some differentiation does exist.

Evidence gaps:

The range of the NE Atlantic population is unknown, and thus for the purposes of delineating population range there may be a need for skin and blubber biopsy sampling of offshore common dolphins (i.e. inhabiting water beyond the continental shelf) for genetic analysis and also markers focusing on evaluation of ecological stocks/management units. Whereas, sampling of common dolphins inhabiting shelf waters will enable an assessment of possible movements of offshore or more southerly distributed animals into these waters in recent years. Sampling will be augmented by the continued collection of samples by European stranding and observer bycatch programmes. Where possible, the provenance of samples needs to be ascertained.

For evaluation of ecological stocks, markers/tracers showing an integration of tens of years (i.e., a few generations) should be explored (Evans & Teilmann, 2009). Strategic sampling approaches (temporal and spatial) should be employed which requires sampling different age-sex-maturity classes, as well as statistical power analysis to determine appropriate sample sizes required to detect the existence of ecological stocks (Evans & Teilmann, 2009; Murphy *et al.*, 2013).

2.2. Distribution and movements

Available spatial and temporal monitoring of distribution and movements has revealed a 6-10-fold increase in density of common dolphins in the western English Channel during the wintertime, with larger summertime aggregations reported in the northern Bay of Biscay primarily along the shelf edge (Kiszka *et al*., 2007; Macleod *et al*., 2009; Murphy *et al*., 2013; Paxton *et al*., 2016; Lambert *et al.*, 2017).Records of sightings of common dolphins made systematically have been collated through the UK's Joint Cetacean Protocol[12] (JCP) and also for the Marine Ecosystems Research Programme (MERP) work on top predators. These provide a recent assessment of seasonal movements (Figure 4). Such movements are thought to be driven by prey availability (ICES WGMME, 2005). As can be observed in Figure 5 an increased occurrence of common dolphins was observed off the Irish coast during the months July to October. This northward movement was also apparent in Figure 4. In contrast a recent aerial survey off the Irish coast in 2016 by the ObSERVE project reported a five-fold increase in abundance (0.169 individuals/km2; CV = 23.4%) in winter compared with the summer (0.037; CV=46.7%) (Rogan et al. 2017).

[12] Joint Cetacean Protocol: http://jncc.defra.gov.uk/page-5657

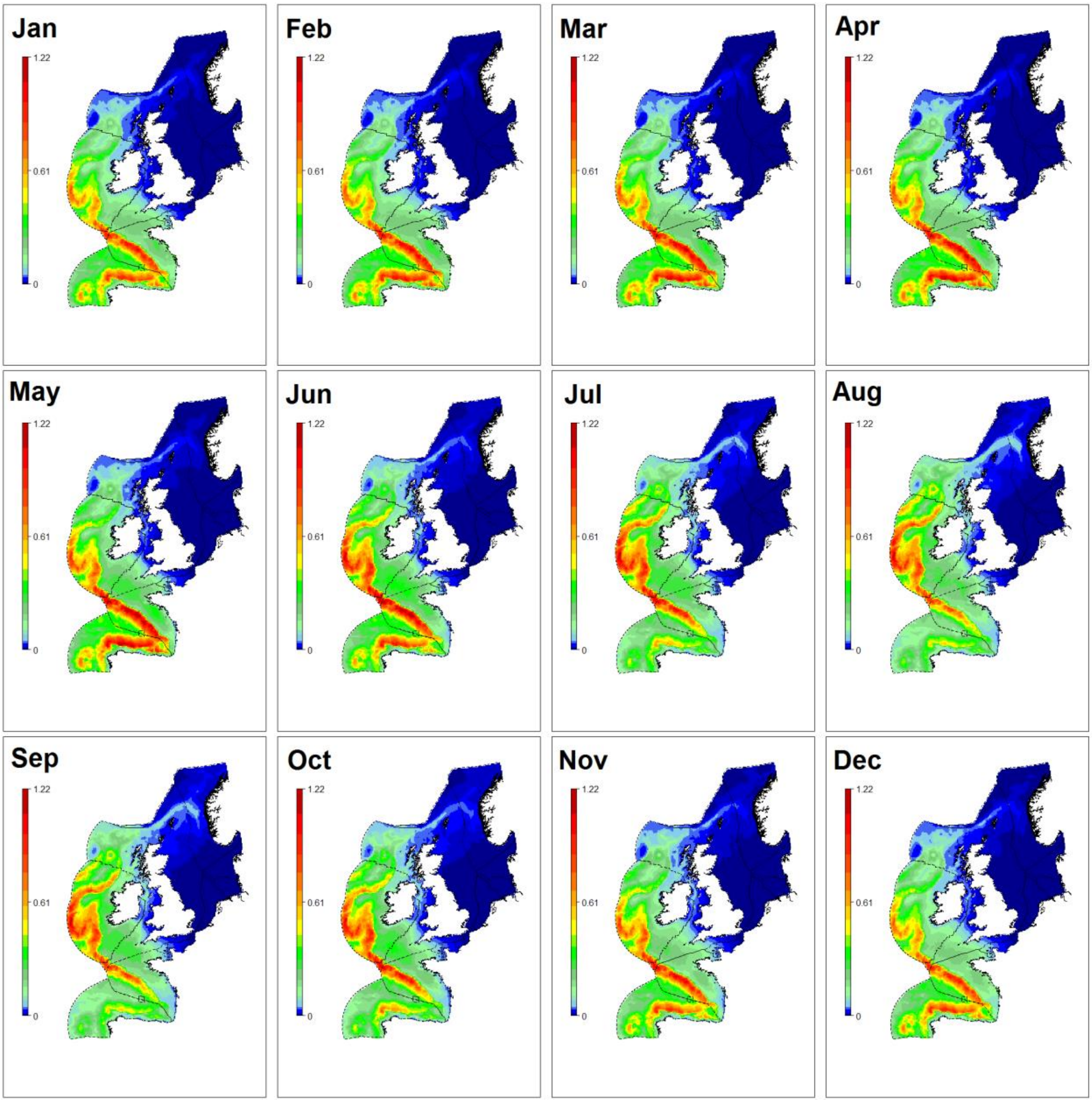

Figure 4: Predicted density maps of common dolphin abundance for the NW European region based on 32 years of data (1985-2017).

Source: PGH Evans & JJ Waggitt, Marine Ecosystems Research Programme[13]

[13] The NERC/Defra funded MERP (Marine Ecosystem Research Programme) project provides a synthesis and analysis of common dolphin survey data covering an area from Portugal to Norway, from which monthly and annual distributions and abundance estimates have been derived. Those results will be formally published in 2018/2019.

Delphinus delphis

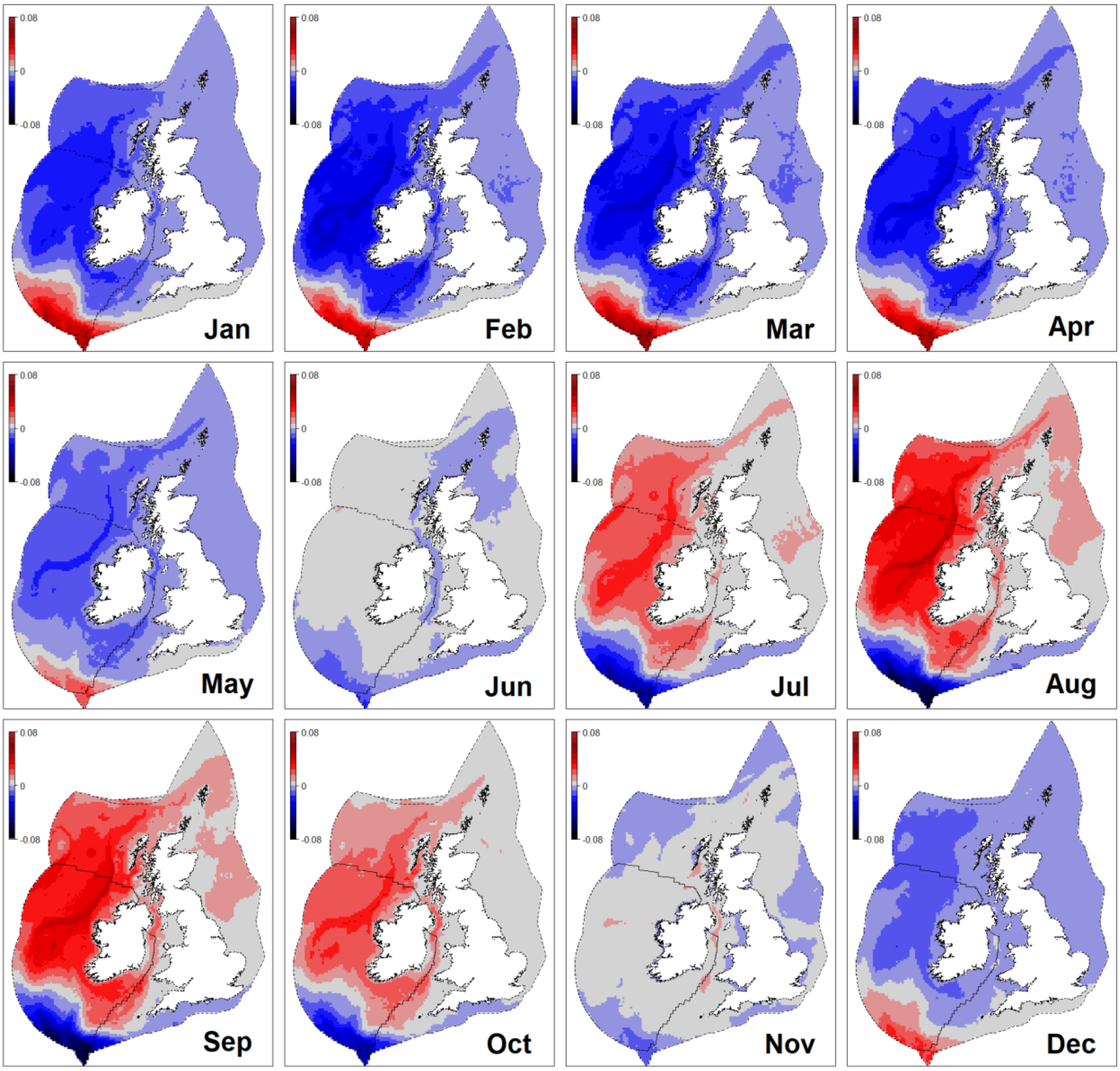

Figure 5: Monthly plots of percentage deviation from the annual average for common dolphin abundance in the NW European region.

Source: MERP

2.3. Basic biology

Social structure: Common dolphins are a social species, often found in large groups, sometimes numbering in the thousands of individuals. There have been instances of mass strandings recorded (groups of two or more cetaceans, excluding cow and calf pairs, stranding at the same time and place) (Murphy, 2004; Viricel *et al.,* 2008; Jepson *et al.,* 2013), which have elucidated the existence of age-sex segregation in the population, particularly during winter, i.e. outside the breeding period (Murphy *et al*., 2013). These include the existence of nursery groups and weaned juvenile/sub-adult groups. Further evidence exists for fisheries selectivity of age-sex maturity classes in some regions, with a predisposition to capturing juvenile and young adults in the UK bass fishery, and nursery groups and sexually mature male bachelor groups in the Irish and French tuna drift net fishery (Goujon *et al*., 1994; Murphy & Rogan, 2006; Murphy *et al*., 2007; Fernández-Contreras *et al*., 2010; Murphy *et al*., 2013). It is important to identify what age-sex class of individuals is incidentally captured by each fishery in the NE Atlantic. High mortality of mature (especially pregnant) females, calves and individuals approaching maturity will have a more detrimental effect on the common dolphin population than a high mortality rate of mature males (Murphy *et al*., 2013).

Collection of data and samples through national stranding programmes has enabled assessments of life-history parameters, dietary analysis, and the effect of stressors such pollutants (Zhou *et al.,* 2001; Viricel *et al.,* 2008; Murphy *et al.,* 2009, Murphy *et al.,* 2010; Deaville and Jepson, 2011; Murphy *et al.,* 2018).

Life history: Primary reproductive activity (mating and a unimodal calving) occurs between April and September, with a possible peak during July and August (Murphy *et al*, 2005; 2009; Read, 2016). Gestation lasts up to almost one year in the population (Murphy *et al*., 2009). Dietary studies indicate that weaning can commence between 3 and 6 months after birth (Brophy *et al*., 2009), although females may lactate for up to 10 months after parturition (Murphy, 2004). A large-scale study assessing reproductive parameters in female common dolphins in the NE Atlantic (n=248 mature females) revealed a low pregnancy rate of 26% and an extended calving interval of four years (Murphy *et al*., 2009). There was no significant difference in the proportion of pregnant females between different geographical areas (Ireland, UK, France, NW Spain) of the NE Atlantic, or when compared to a control group sample of 'healthy' individuals, that is, individuals not suffering from any infectious or non-infectious disease that may inhibit reproduction. Thus, sampling of stranded common dolphins (that were composed largely of bycaught individuals) was deemed adequate for estimating population reproductive parameters. Female common dolphins in the NE Atlantic population attain sexual maturity at average age of 8.2 years and the species' longevity was 30 years; although 98% of the female aged sample was less than 20 years (Murphy *et al*., 2009). Read (2016) found similar results at attainment of sexual maturity (8.4 years and 187 cm, respectively) for common dolphins stranded and bycaught in Galicia, North-west Spain, although the annual pregnancy rate was higher (36.4%). This all suggests a low lifetime reproductive output of four-to-five calves in the NW Atlantic. Lack of significant differences were observed when comparing reproductive parameters from the 1990s to data collected during the 2000s, though comparisons with all other available data for this species showed that the NE Atlantic had lower pregnancy rates than populations in the NW Atlantic, South Africa, the Western Pacific and New Zealand (Murphy *et al*., 2009; Murphy unpublished data, Read, 2016, see Table 4).

Average age at the attainment of sexual maturity was estimated at 11.9 years in males, based on examination of common dolphins sampled by the Irish and French stranding and bycatch observer programmes between 1991 and 2003 (Murphy *et al*., 2005). Average age and length at attainment of sexual maturity in males stranded and bycaught in Galicia were estimated to be around 10.5 years (*n*=216) and 204 cm (*n*=266). In the NE Atlantic, mature male common dolphins developed large testes, relative to their body size, with combined testes weight ranging from 415.9 to 5000 g. Male gonadal tissue in this region also exhibits seasonality, evidenced by reduced testis weights and testicular cellular activity outside the mating period (Collet & Saint-Girons, 1984; Murphy *et al*., 2005, Murphy & Rogan 2006, Read, 2016). The presence of enlarged testes and the existence of moderate sexual dimorphism in the species suggest post-mating competition among males (i.e., sperm competition), resulting from a promiscuous mating system (Murphy *et al*., 2005).

Exposure to endocrine-disrupting pollutants has been proposed as a contributing factor to the lower reproductive output and also cases of reproductive failure and dysfunction in the NE Atlantic population (Murphy *et al*., 2010; 2013; 2018). Reproductive failure occurred in 30% or more of mature females in a control sample composed of bycaught females (n=23). Within a larger sample of stranded and bycaught females (control and non-control samples), 16.8% (18 out of 107) of individuals displayed reproductive system pathologies including conditions such as vaginal calculi (5.6%), suspected precocious mammary gland development (5.6%), and ovarian tumours (2.8%). Other abnormalities included an ovarian cyst, atrophic ovaries in a sexually immature individual, and the first reported case of an ovotestis in a cetacean species (Murphy *et* al, 2011).

Feeding: Several distinct feeding strategies have been observed in the species including high speed pursuit and physical strikes (Neumann & Orams 2003, Burgess 2006), as well as cooperative feeding including bubble clouding and synchronous diving to exploit shoals. Common dolphins have also been observed in mixed feeding aggregations comprising other cetaceans (e.g., *Stenella frontalis*, and *Tursiops truncatus*), large tunas and seabirds (Evans, 1980; Evans 1982; Clua & Grosvalet, 2001). In the NE Atlantic, the diet of common dolphins includes a wide variety of fish and squid species (Table 5). Dietary preferences display strong interannual and seasonal variations as areas where preferred prey species are in high abundance, common dolphins tend to select those species (Berrow & Rogan, 1995; Couperus, 1995; Hassani *et al*., 1997; Santos *et al*., 2004, 2013, 2014; Lahaye *et al*., 2005; Pusineri *et al*., 2007; Brophy *et al*., 2008; Meynier *et al*., 2008a; Spitz *et al*., 2010; Fernández-Contreras *et al*., 2010; Murphy *et al*., 2013). Inshore movements of common dolphins into the Celtic Sea and western English Channel in winter have been attributed to feeding opportunities on shoaling pelagic fish species (ICES WGMME 2005). Whereas during the summertime, sampling of mature individuals incidentally captured in tuna drift nets operating along or off the continental shelf during the 1990s revealed that they were predominantly feeding at night, when the migrating deep scattering layer approaches the surface (Hassani *et al*., 1997, Pusineri *et al*., 2007, Brophy *et al*., 2009).

Table 4: Published data on mating/calving period, annual pregnancy rate (APR), calving interval (CI), average age (ASM) and average body length (LSM) in common dolphin. NA: not analysed.

Area	Climate	Sample Period	Mating/ calving period	APR (presence of foetus only)	APR (mature sample, n)	CI (yr) (1/APR)	ASM (yrs) (n)	LSM (cm) (n)	Source
Eastern North Atlantic	Temperate	1990–2006	May to September	26%	248	3.79	8.22[d] (379)	188.8[a] (597)	Murphy *et al*. (2009)
Eastern North Atlantic (Galicia, north-west Spain)	Temperate	1990–2009	May to September	36.4%	89	2.75	8.4 (168)	187 (221)	Read (2016)
Western North Atlantic	Temperate	1989–1998	July to August	28%[e]	39	3.57	8.33[a] (64)	NA	Westgate and Read (2007)
Eastern Tropical Pacific	Tropical	1979–1993	Calve all year round	47%[f]	440	2.14	7.8[a] (405)	187[a] (700)	Danil and Chivers (2007)
North Pacific	Temperate	1990–1991	May to June	NA	NA	NA	8[b]	172.8[a]	Ferrero and Walker (1995)
South Africa	Temperate	1969–1988	Austral Summer	40.2%[c]	93	2.5[c]	~8-9[b]	NA	Mendolia (1989) Murphy *et al*., (2009) *(Delphinus capensis)*
New Zealand	Temperate	1992-2012	Primarily Austral Summer	36%	17	2.8	NA		Institute of Zoology (2015)

[a] Using adjusted SOFI method
[b] Only an approximate ASM; SOFI method not used
[c] Calculated using data presented in Mendolia (1989)
[d] GLM approach
[e] Did not exclude females that died during the mating period
[f] Abundance of 2,963,00 common dolphins in the whole ETP

The energy requirement of (pregnant and) lactating common dolphins and their calves may contribute to the offshore movement of some mature individuals (and calves) during the spring and summer to take advantage of nutrient-rich prey at times when neritic prey are nutrient poor (or have dispersed to/from spawning grounds) (Brophy *et al*., 2009). Spitz *et al*. (2010) confirmed that common dolphins in the Bay of Biscay selected high-quality foods during summer. Surveys of the epi- to mesopelagic oceanic fish community off the Bay of Biscay in October 2002, 2003 and 2008 revealed that the alepocephalid *Xenodermichtys copei*, a low-energy prey that was not consumed by common dolphins, was the most abundant species, whereas common dolphins targeted the myctophid *Notoscopelus kroyeri*, a high-energy prey species (Spitz *et al*., 2010).

There was a general absence of juveniles/subadults bycaught in Irish and French tuna drift nets which suggests that they were not present in the area where this fishery operated (Murphy & Rogan 2006), and thus may show a different feeding strategy during the summer (Murphy *et al*., 2013). Off Portugal, immature male common dolphins were found to consume blue whiting and showed a tendency to be caught in pelagic trawls targeting that species during the summer (Fernández-Contreras *et al*., 2010). See Murphy *et al*., (2013) for a review of dietary preferences.

Table 5: Consumption of piscivorous species in the diet of common dolphins inhabiting European Atlantic waters.

Ireland	**UK**	**French channel**	**French Bay of Biscay**	**Spain**	**Portugal**
Argentina sp.; Blue whiting; Gobies (winter); Hake; Herring; Horse mackerel; Mackerel; Myctophids (offshore); Pearlsides; Sprat; *Trisopterus* sp; Whiting	Horse mackerel; Mackerel; Sardine; *Trisopterus* sp.; Whiting	Gobies; Mackerel; *Trisopterus* sp.	Anchovy; cephalopods (offshore) Gobies; Horse mackerel; Sardine; Sprat; Myctophids (offshore)	Blue whiting; Gobies; Sardine; Scad	*Atherina* sp.; Blue whiting; Horse mackerel; Sardine
Key references					
Couperus 1995; Brophy *et al*., 2003 2009)	(Gosselin 2001; Learmonth *et al*., 2004)	(De Pierrepont *et al.,* 2005)	(Pusineri *et al*., 2007; Meynier *et al*., 2008b)	(Santos *et al*., 2004)	(Silva 1999; Santos *et al*., 2004)

Evidence Gaps:

There is a need to assess contemporary population reproductive parameters and evidence of age-sex bycatch selectively in all high and medium risk fisheries; including the recovery and necropsy of stranded and bycaught common dolphins.

Within the Marine Strategy Framework Directive, the indicator ‘*assessing changes in demographic characteristics*’ should be employed (Murphy *et al*., 2013). Temporal variations in reproductive parameters can occur due to alterations in the availability of prey resources and population density (Murphy *et al*., 2009). Additionally, disease as well as exposure to anthropogenic toxins, can alter reproductive rates by decreasing fertility and causing abortions, premature parturition, and neonatal mortality (Murphy *et al*., 2009; 2013; 2018). The conservation target for the demographic indicator is no statistically significant deviation from long-term variation (Murphy *et al*., 2013). An initial assessment of temporal trends in population reproductive parameters used data and samples collected up to 2006 from UK, Irish, French, Galician and Portuguese stranding and bycatch observer programmes. This project should now be extended to incorporate the latest post mortem data and samples collected by standardised procedures.

Assessment of reproductive failure and dysfunction in both female and male common dolphins should be undertaken throughout the range of the NE Atlantic population. Male common dolphins are unable to rid themselves of their lipophilic pollutant burden and accumulate high polychlorinated biphenyls (PCB) concentrations through reproduction in the same way as females, the effect of which is not fully understood as very few studies have been undertaken (Murphy *et al*., 2018).

With the development of an ecosystem approach to fisheries management, further integration of dietary data on common dolphins into ecosystem models will not only allow further elucidation of ecosystem dynamics but will also enable investigation of the effects of prey depletion, climate change, as well as ecosystem and regime shifts on the local common dolphin population (Murphy *et al*., 2013). There has been an increased occurrence of starvation cases in stranded common dolphins inhabiting both the Irish and UK waters in recent years which requires further investigation (Murphy *et al*., accepted).

2.4. Abundance and trends

There is limited information to inform population trends for common dolphin in the NE Atlantic. Two large areas were surveyed in 1995 by the North Atlantic Sightings Survey (NASS-east and NASS-west) to the west of Ireland and Scotland. The estimated abundance of common dolphin in NASS-west was 273,159 (CV = 0.26; 95% CI = 153,392–435,104) (Cañadas *et al*., 2009). An abundance of 77,547 common dolphin was estimated for NASS-east, but due to limitations of the survey, this estimate was not considered reliable (Cañadas *et al*., 2009; Figure 5). In 2005, SCANS II surveyed the European Atlantic continental shelf areas, reporting an abundance estimate of 54,955 (CV=0.21, CI=36,607–82,498; see Hammond et al., 2017[14]). Subsequently, the Trans North Atlantic Sightings Survey (T-NASS) was carried out at the same time as Cetacean Offshore Distribution and Abundance in the European Atlantic (CODA) in 2007, both surveying waters to the north and off the continental shelf (Lawson *et al*., 2009; Figure 5). Few short-beaked common dolphins were sighted in areas where animals were seen in high abundance during the NASS 1995 survey (Figure).

The Survey in Western Irish Waters and the Rockall Trough (SIAR; 2000) covering waters over the shelf break to the north and west of Ireland estimated much lower numbers of common dolphins (4496) (Ó Cadhla *et al*., 2003) compared to that reported for NASS-east (77,547). The CODA (2007) reported an abundance of 118,264 (CV=0.38, CI=56,915–246,740) off the continental shelf to the west of Ireland and the UK. In the area equivalent to the NASS-east, numbers were similarly much lower (4216 individuals (add in CI)).

[14]SCANS II was reanalysed alongside SCANS III results. See https://synergy.st-andrews.ac.uk/scans3/files/2017/05/SCANS-III-design-based-estimates-2017-05-12-final-revised.pdf

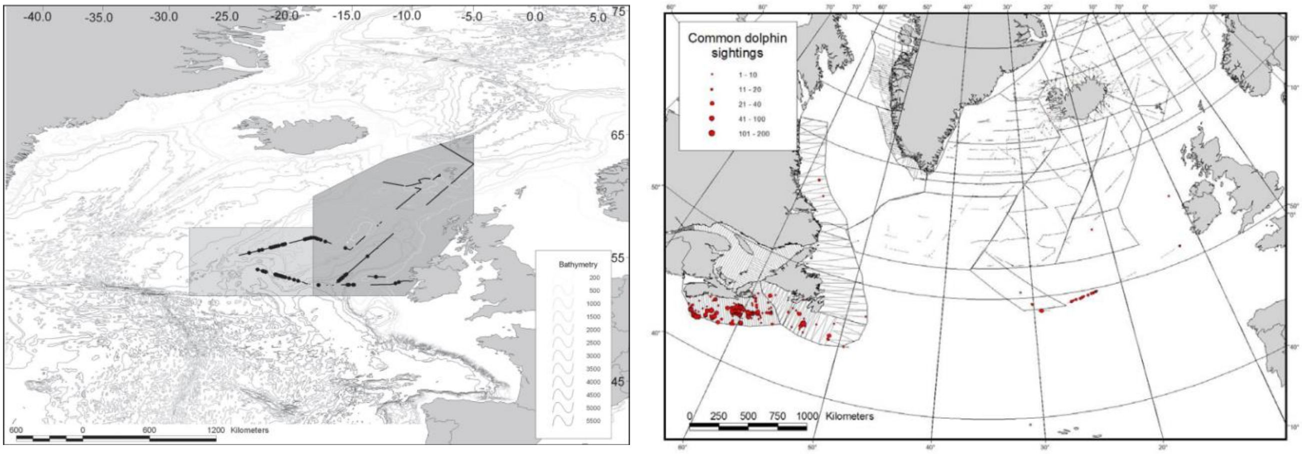

Figure 6: Distribution of common dolphin sightings in Survey blocks NASS-east and NASS-west (Cañadas et al., 2009; data collected in 1995); and (b) T-NASS (Lawson et al., 2009; data collected in 2007).

More recently, SCANS III was undertaken in 2016 and indicated an abundance of 467,673 (CV = 0.264, CI = 281,129-777,998) across the continental shelf and offshore waters[15] (Hammond *et al*., 2017). This is a substantially higher abundance estimate, which likely reflects variations in distribution and movements of common dolphin groups resulting from either latitudinal or offshore-inshore movements, or a mixture of the two. As a result, more animals are now exposed to anthropogenic activities on continental shelf and contiguous waters. The observed distributions of common dolphins in 2016 were relatively similar to those observed in SCANS-II and CODA in 2005/07 (Hammond *et al*., 2013; CODA 2009) and in the SAMM surveys in the Channel and French waters of the Bay of Biscay in summer 2012 (Laran *et al*., 2017) (Figure 6).

[15] Approximately equivalent to the SCANS II ad CODA areas combined but excluding Irish waters. The latter were surveyed in the same year through the ObSERVE programme for which the results have not yet been published.

A **B**

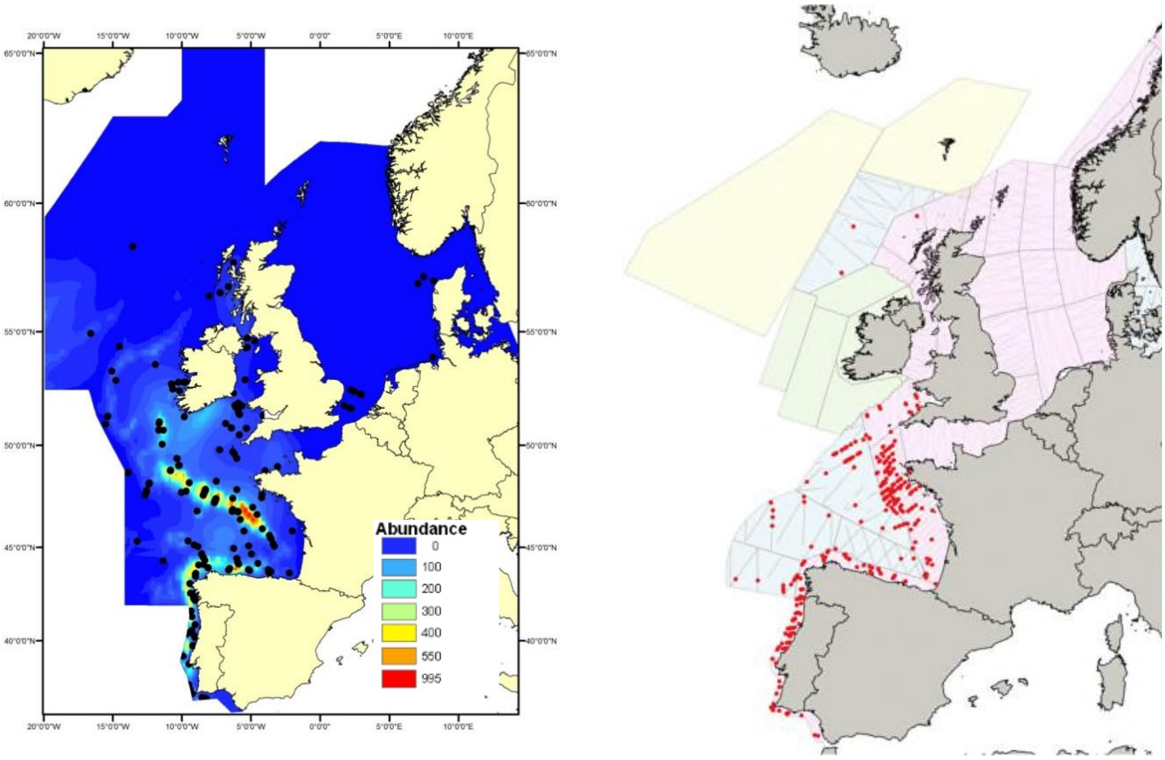

Figure 7: (A) Predicted density surface for common dolphin from CODA, SCANS-II and T-NASS data. (B) Distribution of sightings of common dolphins obtained during SCANS III. Underlying effort is also used in that analysis: aerial survey - good and moderate conditions; ship survey - Beaufort 0-4. Note that the data for the Irish Observe surveys are not included (green blocks).

Population status of cetaceans can be assessed through estimating temporal trends in abundance; although due to the different types of data and the nature of the species in question (e.g. attraction to vessels) there are inherent issues with this process. The OSPAR Intermediate Assessment (IA) outlined definitions for declining, increasing and stable abundance trends – declining by a decreasing trend of ≥5% over 10 years ($p<0.05$); increasing by an increasing trend of ≥5% over 10 years ($p<0.05$); and stable by population changes of <5% over 10 years. The percentage (i.e. 5%) was derived from the IUCN criterion to detect a 30% decline over three generations for a species, which equates to slightly less than 0.5% per year for odontocetes. However, no assessment of trends was possible for common dolphin in the IA indicator ‘abundance and distribution of cetaceans’ due to insufficient data.[16] At least three population estimates are required to ascertain trends. Additionally, power analysis based on the SCANS III results indicates that there is an 80% power to detect a trend of 30% decline over three generations only after 5 decadal surveys have been undertaken (K. Macleod pers. com.). This does not meet the IA definition of trend. It is only with annual surveys that short term declines of ≤1% per year over a 12-year period can be detected, although the minimum decline detectable in any 10-year period is 8.3% (K. Macleod pers. com.), i.e. even with annual surveys detection of a decline meeting the IA definition is not possible for common dolphin.

[16] https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/biodiversity-status/marine-mammals/abundance-distribution-cetaceans/abundance-and-distribution-cetaceans/

Therefore, other supplementary population monitoring approaches, such as use of data obtained from stranding programmes, are essential for monitoring the health of the NE Atlantic population and for understanding the causes of change which is fundamental for designing and implementing conservation and management measures. A more detailed consideration of, for example, movements within the population, could influence how the species should be assessed in terms of spatial scale.

Evidence Gaps:

Further spatial and temporal data are required for the range of the population in order to identify temporal and seasonal trends. Initiatives such as the JCP and MERP enable the collection of data from multiple sources and a variety of temporal and spatial scales. Development of long-term systematic data collation initiative will be essential if we are to further our understanding of common dolphin distribution and abundance.

Annex 3: Summary of pressure information

3.1. Primary Pressures

Primary pressures result in direct additional mortality to the population

3.1.1. Bycatch

Entanglement and subsequent fatality in commercial and recreational fishing gears, predominantly static nets and trawl nets.

Evidence base: **STRONG**

Monitoring of marine mammal bycatch has been incorporated within the Common Fisheries Policy Data Collection Framework (DCF) following the anticipated repeal of Regulation (EC) 812/2004. While progress was made in the reporting of bycatch by Member States since Regulation 812 was implemented, the quality of data on bycatch rates of common dolphins from some countries was poor, thus preventing estimation of an accurate population bycatch rate (ICES WGBYC, 2017*; Read et al., 2017)*. This was due to a lack of reliability in fishing effort data, poor (low) coverage of relevant fisheries, and a lack of reporting for vessels <10m and driftnets operating in coastal areas, including recreational fisheries, i.e. those fisheries not covered by Regulation 812 (ASCOBANS, 2015b). Further, with the incorporation of marine mammal bycatch monitoring within the DCF, the overall suitability and appropriateness of this approach needs to be continuously assessed and monitored, particularly in fisheries where there are no dedicated marine mammal observers. Member States of the European Union have obligations under Article 12 of the Habitats Directive to monitor the impact of bycatch to determine whether it is having a negative impact on conservation status. However, such monitoring has rarely been implemented or the legal requirement enforced (Read *et al*., 2017).

A full review of fisheries bycatch rates in the NE Atlantic for the period 2006 to 2014 is provided in Read *et al*. (2017). Common dolphins were caught incidentally in pelagic trawls, drift nets (surface gill nets), static gear and seine nets, with the highest annual bycatch number of 2,317 dolphins reported in 2009. These available estimates, however, should be used with caution as they provide an incomplete assessment due to low and uneven sampling coverage, and data presented were only for those fisheries where bycatch was actively observed and recorded.

Based on the available data (bycatch rate and total fishing effort, total annual removals of common dolphins in European fisheries) for the period 2009 to 2013, ICES advised that bycatches of common dolphins (2,509 individuals) may be unsustainable as they may exceed the 1.7% threshold limit established by ASCOBANS for 'unacceptable interactions' which has been used in previous ICES advice (ICES Advice, 2016a). The ICES Working Group on Bycatch (WGBYC) reviews and collates information from annual reports submitted by Member States and for the period 2009-2013, higher than previous bycatch rates (animals/days at sea) were reported in some midwater pair trawls, and purse seine gear (ICES WGBYC, 2016b). It is noted that again these estimates of common dolphin mortality are based upon information that is not complete, and therefore this advice cannot yet be regarded as definitive (ICES Advice, 2016a). Fisheries of concern in the NE Atlantic include mid water pair trawls, targeting hake, bass and tuna (but not those targeting anchovy), and vertical high opening trawls targeting hake (ASCOBANS, 2015a). Although highest bycatch rates were reported by ICES Advice (2016a) to be in pelagic trawl fisheries, the lower bycatch rates observed in static net fisheries may be equally significant as they could result in similar levels of total bycatch due to their higher fishing effort. Additionally, monitoring of pelagic trawl fisheries was strategically targeted towards those métiers that had previously shown highest bycatch rates (ICES Advice, 2016a; Read *et al*., 2017). However, operational difficulties in implementing the monitoring programme have drastically reduced its capacity to provide unbiased estimates of annual by-catch numbers.

ICES advice from 2016 was based on the abundance estimate from the combined SCANS II and CODA surveys. A significantly higher abundance estimate is now available for the population inhabiting continental shelf and adjacent waters, due to possible re-distribution of animals in the NE Atlantic. Bycatch rates of common dolphins in bottom-set nets is partly driven by a temporal and spatial overlap of animals and fishing gear, rather than specific characteristics (e.g., soak time, mesh size) of that gear (Mackay, 2011). An increased abundance means that more animals are now exposed to anthropogenic activities such as fisheries, and this may be contributing to the large-scale increase in common dolphin strandings along the French and UK coastlines (Figure) with discernible evidence of bycatch (Peltier *et al.,* 2016; 2017). A trend that may continue in the future.

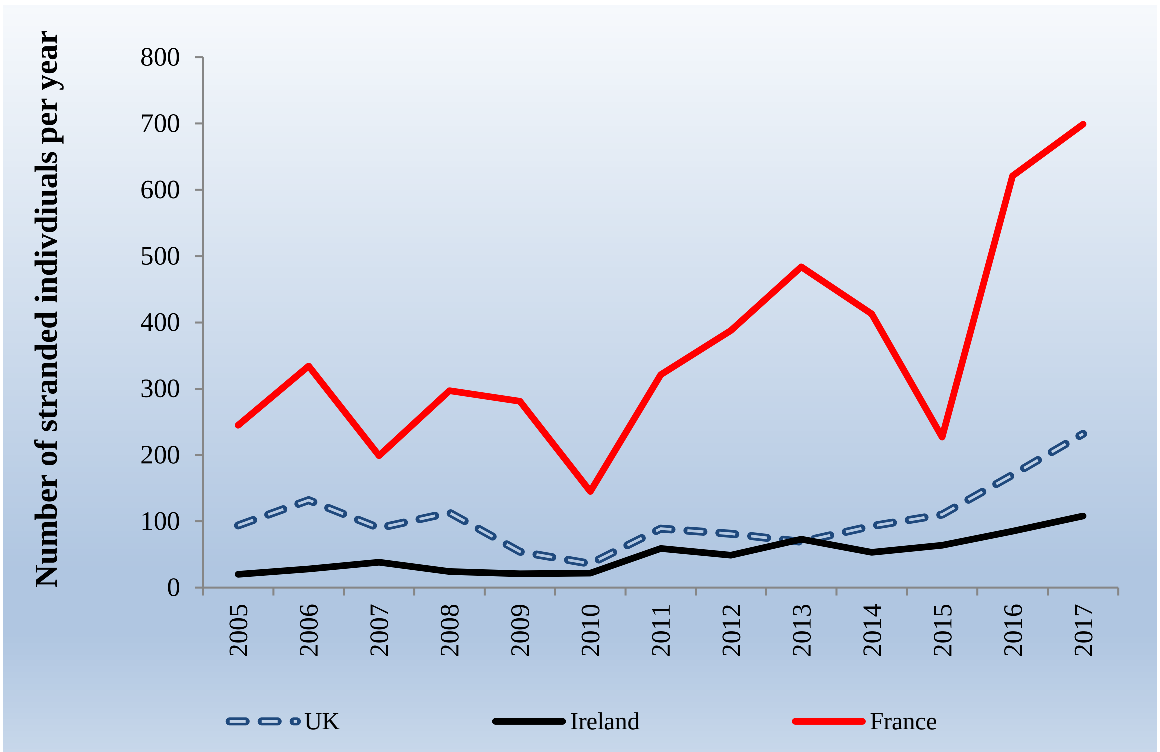

Figure 8: Inter-annual variation in strandings of short-beaked common dolphins in North-west Europe (2005–2017).

Data provided by the UK Cetacean Strandings Investigation Programme; Irish Whale and Dolphin Group; and *Observatoire Pelagis*, Université de La Rochelle, France.

Source: Murphy *et al* (accepted)

Evidence gaps:

There is good evidence that this pressure is occurring where monitoring exists from observer programmes and analysis of stranded animals identifying causes of death (ICES, 2016a; Peltier *et al.*, 2016). However, gaps in these data within the NE Atlantic region have resulted in difficulties in quantifying the level of risk with any degree of certainty (ICES, 2016b). Small species such as common dolphin may also have a low probability of stranding following mortality from bycatch depending on where they occur in relation to land, and the other driving forces such as wind and current which determine whether they make landfall. For example, a previous French study reported that approximately 17,9% (min. 9.3%, max 28.8%) of dead common dolphins released by fisheries in the Bay of Biscay would float and be able to strand on shore after allowing for drift (Peltier et al., 2016).

The legal requirements of Regulation 812/2004 and the Habitats Directive have been poorly implemented by some Member States and consequently there is still a lack of data on contemporary incidental capture rates in a number of fisheries (ICES WGBYC, 2016). More comprehensive information on fishing effort in relevant fisheries is required to more accurately estimate population bycatch rates and thus enable an effective assessment to be carried out to inform management.

Within the MSFD, OSPAR is developing a common bycatch indicator for harbour porpoises, although an assessment value/threshold has not yet been decided upon[17]. This common indicator should be extended to include the common dolphin, with the production of bycatch triggers and limits undertaken using a management framework procedure.

Management and mitigation:

ASCOBANS Contracting Parties proposed to the European Commission: (1) The creation of an overarching regulation for the protection of cetaceans that outlines specific conservation objectives, while leaving decisions on bycatch monitoring and mitigation requirements and technical details on how to achieve these objectives under the CFP; (2) Implementation of a management framework defining the threshold of ‘unacceptable interactions’ or ‘bycatch limits’, to help safeguard the favourable conservation status of European cetaceans in the long term, and drive toward the ASCOBANS overall aim of zero bycatch; and (3) A risk-based regional approach to the revision of Regulation 812/2004 accounting for regional differences in species composition, density and spatial distribution of cetaceans and the different types of fisheries operating (ASCOBANS, 2015a).

A management framework procedure producing robust triggers and limits should enable specified conservation objectives to be met by allowing the impact of anthropogenic removal within and across Member States to be more fully assessed and effectively managed. Use of tools such as Potential Biological Removal (PBR) and Catch Limit Algorithm (CLA) would enable the development of thresholds from which to base monitoring. This approach would determine anthropogenic removal (bycatch) triggers (signalling a need for more urgent and stronger management action) and anthropogenic removal (bycatch/environmental) limits (i.e. ‘critical’ or ‘unacceptable’

[17]https://oap.ospar.org/en/ospar-assessments/intermediate-assessment-2017/biodiversity-status/marine-mammals/harbour-porpoise-bycatch/

point) using a population-dynamics integrated modelling framework (ASCOBANS, 2015b). At the outset, research and monitoring programmes are required to obtain the scientific information necessary to inform management - e.g. assessment of the existence of ecological stocks and estimation of population bycatch rates, abundance and life history parameters, and development of bycatch mitigation measures.

In order to undertake this approach:

I. Continued and improved data collection is required to strengthen the datasets, particularly where significant gaps are identified in order to obtain:
   - better understanding of level of bycatch and subsequent risk to population levels, informing the environmental limits of bycatch for the species and triggers for management/mitigation (ASCOBANS, 2015b);
   - information to identify trends and establish if the current level of management is appropriate;
   - more detailed information on which gears are medium-to-high risk (net type, soak times, placement and subsequently, where these gears are operating in order to effectively target management) regarding bycatch.

II. Dedicated observer programmes are required to monitor bycatch levels for informing the required level of management. Remote Electronic Monitoring (REM) has also been identified as a useful tool in monitoring/predicting bycatch rates when used in combination with other data such as fishing effort and population density (Scheidat and Königson, 2015; Kindt-Larsen *et al.*, 2016).

III. Strandings analysis data indicate cause of death and identify possible risk of bycatch in relation to risk of other identified causes. The UK strandings programme consistently identified bycatch as a major cause of death in examined common dolphins (CSIP, 2010; in press). There are also examples where mass (dead) strandings of common dolphins in an area have been linked to bycatch as the cause (Kuiken *et al.*, 1994; Peltier *et al.*, 2016, 2017, Read, 2016). However, these data have limitations due to the nature of the sample population and therefore should be used in conjunction with other monitoring methods (Peltier *et al.,* 2016).

IV. Acoustic deterrent devices (pingers) may be required in fisheries identified as medium-to-high risk. However, evidence is required to determine if it is a suitable measure, before implementation; appropriate monitoring is required in order to assess effectiveness against the objective as well as considering the resulting impacts on other species using the area (Cox *et al.,* 2007; Berrow *et al.*, 2008; Dawson *et al.*, 2013).

V. Monitoring common dolphin abundance in relation to stock assessments of important prey species for inclusion of data in spatial-based bycatch risk assessments, i.e. identify spatial areas of concern for fisheries management measures.

Level of Risk: Given the good evidence for this pressure and the risk of population level impact, this pressure should have **VERY HIGH PRIORITY**.

3.1.2. Serious or fatal injury (not bycatch)

Ship strike from commercial and recreational vessels

Evidence Base: WEAK

Data are gathered through strandings analysis and observation. However, small species such as common dolphin may have a low probability of stranding following a vessel strike depending on where it occurs in relation to land, and the other driving forces such as wind and current which determine where they end up.

Evidence gaps:

As the evidence base is weak, further research is required in order to identify the risk and establish the parameters which are likely to increase the risk of collision with vessels. Relying on strandings data limits the conclusions which may be drawn, given the limitations of sampling the population.

Management and mitigation:

Speed restrictions, area avoidance and onboard observers have been considered for larger species (e.g. Vanderlaan *et al*., 2008; Vanderlaan & Taggart, 2009; David *et al.*, 2011; Silber *et al*., 2013). However, evidence of risk is lower for smaller cetaceans such as common dolphin. There are examples of mitigation for smaller cetaceans, such as the Aberdeen Harbour (UK) Code of Conduct for bottlenose dolphins[18], but without more evidence to support the need, these types of mitigation are less likely to be implemented or enforced effectively.

Level of risk: Given the scale of evidence for vessel collision, this is considered to be **MEDIUM PRIORITY**.

Collision with sub marine structures such as wet renewables

Evidence Base: WEAK

As with vessel collision, data are collected primarily through strandings analysis of cause of death, with some small-scale work on projects trialling wet renewables. However, evidence of impact on common dolphins is scarce, with a focus to date on species such as seals and harbour porpoise, given their proximity to wet renewable energy developments.

Evidence gaps:

As the evidence base is weak, further research is required in order to identify the risk and establish the parameters which are likely to impact the risk of collision with wet

[18] http://d80a69bd923ff4dc0677-b849429a75dd6216be63404a232a877c.r8.cf3.rackcdn.com/Dolphin_Code_Leaflet.pdf

renewable structures. Relying on strandings data limits the conclusions which may be drawn, given the limitations of adequately sampling the population.

Management and mitigation:

Currently a 'deploy and monitor' approach has been adopted for the further development of wet renewables by some Member States, for example the Scottish-commissioned guidance on monitoring of wet renewables in situ[19].

Level of risk: Given the scale of evidence for wet renewable collision, this is considered to be **LOW**.

3.2. Secondary pressures

Secondary pressures result in health degradation, with indirect effect on demography.

3.2.1. Mechanical destruction of habitat

Reduction in quality or availability of habitat through destructive activities such as bottom trawling, infrastructure construction, oil and gas development, gravel extraction, etc.

Evidence Base: WEAK

There is no direct evidence of the impact of habitat destruction on common dolphins although there is for other species (Evans, 2017). However, there is understanding of the general impact activities cause to habitat integrity (Harwood, 2001), which can be used to make some judgements on how activities may indirectly affect common dolphins.

Evidence gaps:

Research has not yet been prioritised towards the impacts of destruction of habitat on common dolphins, and thus research into establishing the level of risk of habitat change (deterioration) regarding the species is required. Further work considering how common dolphins use habitat (e.g. feeding, reproduction, etc.) to inform how activities may impact these behaviours will enable management discussion.

Management and mitigation:

As the direct risk is considered low, any management of this threat will depend on evidence of the need. Restriction of activities and/or adaptation of methods based on Environmental Impact Assessments may be an option if evidence of an increased risk is forthcoming.

[19] https://www.nature.scot/professional-advice/planning-and-development/renewable-energy-development/types-renewable-technologies/marine-renewables/wave-and-tidal-energy

Level of risk: Given the weak evidence for this pressure (and therefore a need for further research) and the uncertainty as to its effects on the species, attention to this threat should have **LOW PRIORITY**.

3.2.2. Prey depletion

Reduction in availability of prey species due to overfishing, habitat degradation from pollution or destruction, or potential effects of climate change.

Evidence Base: MODERATE

Some of the key prey species include oily fish such as sardine, mackerel and sprat and blue whiting and cephalopods (Table 5). In NW European seas, their diet is predominately composed of a few main species that vary with season & region. Common dolphins consume an energy-rich diet (Meynier *et al*., 2008; Spitz *et al*., 2010), and a decline in suitable prey from either a decline in occurrence or change in distribution may impact animal condition and reproductive output, with extreme cases leading to starvation and death (Certain *et al*., 2011; Murphy *et al*., 2013). A study on the impact of fisheries on top predators in the Bay of Biscay noted that interactions with fishing gear was a higher risk to the common dolphins than localised resource depletion (Lassalle *et al.,* 2012). Between 1990 and 2016, 4.5% (32 of the 694) of necropsied common dolphins died as a result of starvation in the UK, however this rose to 9.7% (10 of 103 post mortem investigations) for the period 2012 to 2016[20]. Whereas in Ireland, a recently re-established cetacean stranding necropsy programme reported starvation/hypothermia as the cause of death in 21% (4/19) of necropsied common dolphins for the period June to November 2017, and this includes one case of starvation/hypothermia in a neonate (Levesque et al., 2018).

Evidence gaps:

Evidence exists as to the prey species which are important to common dolphins, although evidence as to the risk of prey depletion as a result of overfishing or habitat destruction is limited. Research is required to strengthen evidence regarding the contemporary feeding ecology of common dolphins, through continued collection of stomach contents and tissue samples for fatty acid/stable isotope analysis, in addition to a regular review of changes in key prey species distribution and abundance. Continued ongoing evaluation of the impacts of fishing activities on common dolphins through inclusion of those species in ecosystem models, and an evaluation of the functional role of common dolphins in the ecosystem, are also required. Investigations need to be undertaken into how activities may change favoured habitats and subsequently impact prey species, to establish the level of risk to common dolphins.

Management and mitigation:

Further evidence is required to understand the complex relationship between common dolphin feeding ecology, spatial and temporal distribution of prey species and the effects of activities resulting in prey depletion. Effective fishery regulations based on

[20] http://ukstrandings.org/csip-reports/

good science may be the most effective management tool as opposed to mitigation of habitat change, unless risk is established.

Level of risk: Attention to this threat should have **MEDIUM PRIORITY**.

3.2.3. Chemical pollution

Introduction of chemical pollution to the marine environment through terrestrial industrial development, terrestrial run-off, and from harbours, ships, aquaculture, sewer discharges, re-suspension, etc.

Evidence Base: STRONG

There is clear evidence that PCBs and other similar chemicals are an issue within the NE Atlantic, for marine mammals (Law *et al.*, 2012; Jepson *et al.,* 2016). Although common dolphins carry lower levels of PCBs than some other fish-eating species in European waters such as the bottlenose dolphin and striped dolphin (Jepson *et al*., 2016), the effects of exposure to lower doses of endocrine disrupting chemicals may not be of a magnitude less, particularly when exposure occurs during critical periods of development (Murphy *et al*., 2018).

Endocrine disrupting chemicals (EDC) (e.g. chemicals with hormone-like properties) have the ability to act at low doses, show delayed effects (of sexual dysfunction and physical abnormalities) that are not evident until later in life or until future generations, and have the potential to show combination effects when exposed to multiple pollutants (Bergman *et al*., 2013; Ingre-Khans *et al*., 2017; Murphy *et al.*, 2018).

Mean concentrations of ΣPCBs for male and female common dolphins in the NE Atlantic are shown in Figure . 76% of sexually immature males and females had ΣPCB levels above the 9 mg/kg threshold (Jepson *et al*, 2016), and 17% had levels greater than 41 mg/kg threshold. What is apparent, is the higher mean levels in sexually mature male compared to sexually mature females (Murphy *et al.,* 2018). Males were unable to rid themselves of their lipophilic pollutant burden and accumulated high PCB concentrations; the effect of which is not fully understood in male cetaceans as very few studies have been undertaken and none on common dolphins.

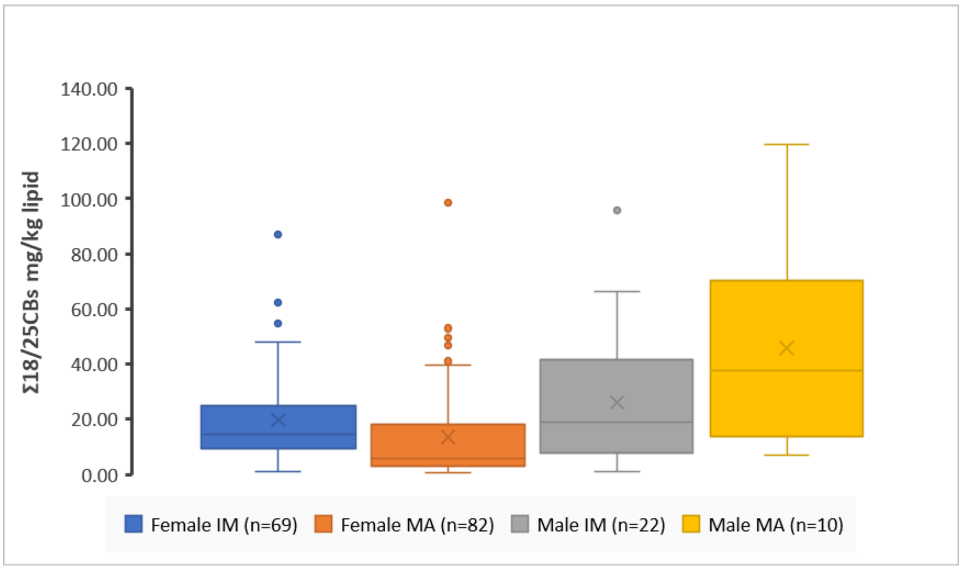

Figure 9: Box plots of male and female common dolphin reproductive status (IM = sexually immature, MA = Sexually Mature) and ΣPCB from stranded and bycaught common dolphins in the NE Atlantic (1990-2013, n = 183).

The dark horizontal line indicates the median, x-markers indicate the mean and outliers are highlighted by circles.

Source: Murphy *et al*., 2018

Work undertaken to date on common dolphins in the NE Atlantic suggested that high PCB burdens did not inhibit ovulation, conception or implantation although there may be an impact on the foetal survival rate (Murphy *et al.,* 2012). Further work has reported that reproductive failure and reproductive dysfunction in common dolphins inhabiting UK waters may be possibly linked to exposure to PCBs (Murphy *et al*., 2018; see Annex 2, 2.3). Where pollutant data were available, all observed cases of reproductive tract pathologies were reported in females with ΣPCB burdens >22.6 mg/kg lipid (i.e. twice the threshold for the onset of adverse health effects in marine mammals). Combined effects from exposure to multiple pollutants was not ruled out, including (low doses of) DDT and other legacy and emerging pollutants of concern, which require further investigation.

Evidence gaps:

The effects from exposure to legacy and emerging pollutants on health and reproductive status (in both sexes) should be extended to cover the known range of the species. So far, investigations into the effects of pollutants on reproduction in male common dolphins is lacking. Geographic areas in the NE Atlantic where pollutant levels in common dolphins are higher than elsewhere (e.g. "PCB hotspots") should be assessed through maintaining data-flow from strandings networks and collaborative studies across the population range. To date, monitoring of pollutants in common dolphins has been largely restricted to legacy pollutants (known to be EDCs), and monitoring should be initiated on other EDC of emerging concern, including those described on the EU Watchlist[21].

[21] https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/development-first-watch-list-under-environmental-quality-standards-directive

Management and mitigation:

A number of conventions and directives address aspects of chemical pollution (e.g. Stockholm Convention) which need to be fully implemented. The Stockholm Convention held an assessment of implementation[22] in 2016 to evaluate the implementation of the Convention. A framework has been adopted in order to assess the progress of Parties in relation to the Convention targets. Further evidence to support mitigation beyond the conventions and directives should be actioned where appropriate, for example increasing active removal of PCBs to achieve a reduction rather than stabilisation of PCB levels.

The ICES WGMME proposed a PCB blubber pollutant indicator for cetaceans within the Marine Strategy Framework Directive (ICES, 2014). In order to further develop this indicator for monitoring if the population is at a good environmental status, continued time-series analysis of trends in PCBs and other contaminants, wherever possible using stranded and bycaught animals, is required. Indicator development also requires key data-flow from strandings networks across the ASCOBANS range.

Level of risk: Given evidence to suggest some contaminants are still posing an issue for common dolphin, this pressure has **MEDIUM PRIORITY**.

3.3. Tertiary pressures

Tertiary pressures result in behavioural disruption, with indirect effect on health and therefore demography.

3.3.1. Noise disturbance

Disturbance/displacement or damage due to noise disturbance in the marine environment

Evidence Base: MODERATE

Under the Marine Strategy Framework Directive (MSFD), there is a commitment under Descriptor 11 to ensure that ‘introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment’. Noise can be generated by a variety of different sources including oil and gas development (including seismic), fishing vessels and other maritime traffic, military activities, infrastructure construction (including pile driving), aggregate extraction, acoustic deterrent devices and recreational activities.

There is general evidence regarding the impact of noise on small cetaceans (e.g. Goold, 1996, Dähne *et al*., 2013, Bergström *et al*., 2014; Williams *et al*., 2015; Culloch *et al*., 2016), and comparisons can be drawn to inform management of risk to common dolphins. Strandings analysis is the primary source of information regarding auditory damage, and offshore industry impact assessment reports for displacement and

[22] http://chm.pops.int/Default.aspx?tabid=5323

behavioural changes. For example, investigation into the mass stranding of common dolphins in the UK drew conclusions of probable causation of acoustic disturbance, although not conclusive (Jepson *et al.,* 2013). Common dolphins have also been found to show a compensatory strategy to maintain threshold levels favourable for communication when experiencing increasing background noise (Papale *et al*., 2015).

Evidence gaps:

A review of data on the acoustic parameters of common dolphins should be considered during assessment of risks from noise disturbance. For modelling the effects of anthropogenic noise on common dolphin behaviour, and evaluating the population consequences of disturbance, a number of criteria are required including the development of appropriate metrics (e.g. source energy levels & frequency, signal duration, rise times, kurtosis) to assess impacts of different noise sources, as well as actual studies assessing the effects (behavioural responses) around noisy anthropogenic activities. Through European stranding programmes, effects of exposure to anthropogenic sound, i.e. acoustic trauma or injury, can be assessed (where access to the samples can be achieved within the required timeframe). An evaluation of the effectiveness of mitigation methods around loud noise sources, including other noise sources is required.

Overall, there is a need to develop more effective and efficient regulations for noisy activities at a European level, including but not limited to seismic surveys, pile driving, dredging, military activities, and ensuring effective application of guidance and legal requirements at an appropriate spatial scale, taking into account cumulative impacts.

Parties and non-Party Range States should participate in the development/maintenance of a noise register under MSFD Descriptor 11 to collate data on marine noise generation to inform management of cumulative stressors. In addition, maintain participation in the Joint ASCOBANS/ACCOBAMS Noise Working Group in order to collaborate on mitigation of noise impacts at suitable spatial scales.

Management and mitigation:

Effort should be directed at better assessment of impact of various noise sources on common dolphins. A number of mitigation measures have been identified to reduce the impact of activities producing noise e.g. for mitigating noise from pile driving for windfarms (Thompson *et al*., 2010; JNCC, 2010a, b; Bellmann, 2014; Nehls *et al*., 2016) and JNCC published guidelines for minimising the risk of injury and disturbance to marine mammals from geophysical surveys (JNCC, 2017). There is evidence to suggest that a soft-start approach to acoustic operations can reduce the impact on cetacean species, including common dolphins (Stone, 2015). Monitoring of any measures is essential to ensure effectiveness in meeting the objectives.

Level of risk: Given evidence to suggest that noise may have been a contributing factor to some mass stranding events (MSE) of common dolphins (Jepson *et al,* 2003; Weilgart, 2007a, b; Jepson *et al*, 2013) as well as concerns over introduction of noise with regards to impacts on communication, navigation and displacement, this pressure has **MEDIUM PRIORITY**.

3.3.2. Climate change

Changes to ocean temperatures, conditions and therefore species movements which has a knock-on effect to predator/prey interactions and ecosystem functions

Evidence Base: MODERATE

There is clear evidence that climate change is occurring and will impact the NE Atlantic. However, the details of possible impacts upon cetaceans remain speculative. In the NE Atlantic, there is evidence for both seasonal movements and long-term distributional patterns in common dolphins, possibly reflecting changes in resource availability (Evans & Bjørge, 2013; Murphy *et al*., 2013). Therefore, it is expected that in the future common dolphins will adapt to effects of climate change. Some studies have already shown changes in contemporary distribution and occurrence related to environmental factors (e.g., MacLeod *et al*., 2005; Bairstow, 2017).

Although it has been suggested that temperature is a key limiting factor at the northern limit of common dolphins in western European waters, and individuals may shift their distribution to stay within their thermal niche (Lambert *et al*., 2011), changes in temperature are more likely to affect prey species of the common dolphin, influencing physiological and ecological processes in a number of direct, indirect and complex ways (Graham & Harrod 2009; Evans & Bjørge, 2013). Thus, common dolphins may shift distribution to remain within their ecological niche. Long-term changes in the distribution of the common dolphin in western European waters during the 20th century have been linked to the effects of the Russell Cycle and the North Atlantic Oscillation (NAO) (Evans & Scanlan, 1989; Murphy *et* al., 2006; Murphy *et* al., 2013). Changes in the NAO have had wide-scale effects on the North Atlantic ecosystem, influencing SST and winds—both linked to variation in the production of zooplankton—as well as fluctuations in several important fish stocks across the North Atlantic (e.g. Planque & Taylor, 1998; O'Brien *et al*., 2000; Hurrell *et al*., 2003; Iles & Hegerl, 2017).

The challenge is to relate changes in distribution and occurrence to the impacts of climate change as there are many confounding effects (e.g., natural climate variability, human exploitation of the prey resource) and any changes observed could simply be the result of the cetacean species responding to short-term regional variability in the prey resource rather than long-term anthropogenically driven climate change.

Evidence gaps:

Understanding of the effects of climate change on the global natural environment are poorly known, given the large number of variables and limitations of data to extract necessary conclusions. Application of all relevant data and trends observed in common dolphins will need to be assessed against reported changes in climate, in order to begin to identify links and potential risks regarding the species viability. Parties should maintain a watching brief on range shifts in the species in the NE Atlantic in relation to the impacts of climate change.

Management and mitigation:

A number of international and intergovernmental organisations and conventions are dealing with climate change and considering approaches to mitigate the potential effects on our marine environment, for example the European Climate Change Programme[23].

Level of risk: This pressure is considered **MEDIUM PRIORITY**.

3.3.3. Cumulative impacts

The combined impact of pressures reduces resilience to any one pressure and is therefore an important consideration when developing management approaches

Evidence Base: MODERATE

Multiple activities affect the marine environment simultaneously, yet current management primarily considers activities independent of one another. A shift towards a more comprehensive management of these activities requires a means for evaluating their interactive and cumulative impacts (Halpern *et al*., 2008; Nabe-Nielsen *et* al., 2014; National Academies of Science, Engineering and Medicine, 2017). This therefore calls for communication between Member States within the range of common dolphins regarding pressures operating over a wider spatial extent, both at a national and international level (ASCOBANS, 2016b).

Evidence gaps:

Currently, with the possible exception of bycatch, we lack good evidence of the impacts of different human pressures upon common dolphins in the NE Atlantic, let alone how those pressures interact. The US National Academies of Science, Engineering and Medicine (2017) has developed a procedure for measuring impacts and how they may interact, and such an approach is recommended here.

Management and mitigation:

A pre-requisite to any management proposals is the mapping of human activities believed to impact upon common dolphins so as to establish the extent to which they overlap dolphin abundance spatially and temporally, and to investigate further the conservation implications so that appropriate action can be taken.

Level of risk: This pressure is considered **MEDIUM PRIORITY**

[23] https://ec.europa.eu/clima/policies/eccp_en

Annex 4: References

Amaral, A. R., Beheregaray, L. B., Bilgmann, K., Boutov, D., Freitas, L., Robertson, K. M., . . . Moller, L.M. (2012). Seascape genetics of a globally distributed, highly mobile marine mammal: The short-beaked common dolphin (*Delphinus*). *PLoS ONE, 7*(2), e31482. doi:10.1371/journal.pone.0031482 .

ASCOBANS (1997) MOP 2: Resolution on Incidental Take of Small Cetaceans (Bonn 1997).2nd Meeting of the Parties, Bonn, Germany 17-19 November 1997. Online. https://www.ascobans.org/en/document/indicidental-take-small-cetaceans

ASCOBANS (2015a) Workshop on 'Unacceptable Interactions' – Part I London, United Kingdom, 10 July 2015. Online. https://www.ascobans.org/en/document/report-ascobans-workshop-further-development-management-procedures-defining-threshold- .

ASCOBANS (2015b). ASCOBANS Recommendations on the requirements of legislation to address monitoring and mitigation of small cetacean bycatch. http://www.ascobans.org/sites/default/files/basic_page_documents/ASCOBANS_Recommendations_EUBycatchLegislation_Final.pdf.

ASCOBANS (2016a) 8th Meeting of the Parties to ASCOBANS. Resolution No. 9: Managing Cumulative Anthropogenic Impacts in the Marine Environment. Helsinki, Finland, 30 August - 1 September 2016. Online. https://www.ascobans.org/en/document/managing-cumulative-anthropogenic-impacts-marine-environment-0.

ASCOBANS (2016b) 8th Meeting of the Parties to ASCOBANS. Draft Resolution: Conservation of Common Dolphins. MOP8/Doc.6.1.2b Helsinki, Finland, 30 August - 1 September 2016 Dist. 24 May 2016.

Authier, M., Spitz, J., Blanck, A., Ridoux, V. (2017) Conservation science for marine megafauna in Europe: historical perspectives and future directions. Deep-Sea Research part-II. Deep-Sea Research Part II 141 (2017) 1–7. http://dx.doi.org/10.1016/j.dsr2.2017.05.002 .

Bairstow, A. (2017) The effects of climate change on Northwest European cetaceans. MSc Thesis, University of Bangor. 35pp.

Bearzi, G., Notarbartolo di Sciara, G., Reeves, R.R., Cañadas, A., and Frantzis, A. (2004) Conservation Plan for short beaked common dolphins in the Mediterranean Sea. ACCOBAMS, Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area. 90pp.

Bellmann, M. (2014) Overview of existing Noise Mitigation Systems for reducing Pile-Driving Noise. Inter-Noise, Australia. Available at: https://www.acoustics.asn.au/conference_proceedings/INTERNOISE2014/papers/p358.pdf.

Bergman, A., Heindel, J. J., Jobling, S., Kidd, K. A., & Zoeller, R. T. (2013). State of the Science of Endocrine Disrupting Chemicals - 2012. WHO (World Health Organization)/UNEP (United Nations Environment Programme).

Bergström, L., Kautsky, L., Malm, T., Rosenberg, R., Wahlberg, M., Capetillo, N.Å., and Wilhelmsson, D. (2014) Effects of offshore wind farms on marine wildlife—A generalized impact assessment. *Environ. Res. Lett.*, 9: 034012.

Berrow, S., Cosgrove, R., Leeney, R.H., O'Brien, J., McGrath, D., Dalgard, J., and Gall, Y.L. (2008) Effect of acoustic deterrents on the behaviour of common dolphins (Delphinus delphis). *J. Cetacean Res Manage*, 10: 227−233.

Berrow, S.D. and Rogan, E. (1995) Stomach contents of harbour porpoise and dolphins in Irish waters. *European Research on Cetaceans*, 9: 179-181.

Brophy, J. 2003. Diet of the common dolphin *Delphinus delphis*. MSc thesis, University College Cork, Ireland.

Brophy, S., Murphy, S., and Rogan, E. (2009) The diet and feeding ecology of the short-beaked common dolphin (*Delphinus delphis)* in the northeast Atlantic. IWC SC/61/SM 14. 18pp.

Burgess, E.A. (2006) Foraging ecology of common dolphins *(*Delphinus *sp.)* in the Hauraki Gulf, New Zealand. MSc thesis, Massey University, Auckland, New Zealand.

Camphuysen, C. J., & Peet, G. (2006). Whales and dolphins in the North Sea. Fontaine Uitgevers, Kortenhoef, The Netherlands.

Cañadas, A., Donovan, G. P., Desportes, G., & Borchers, D. L. (2009). A short review of the distribution of short beaked common dolphins (*Delphinus delphis*) in the central and eastern North Atlantic with an abundance estimate for part of this area. *North Atlantic Sightings Surveys. NAMMCO Scientific Publications, Volume 7*, 201-220.

Caurant, F., Chouvelon, T., Lahaye, V., Mèndez-Fernandez, P., Rogan, E., Spitz, J., Ridoux, V. 2009. The use of ecological traceers for discriminating dolphin population structure: the case of short-beaked common dolphin *Delphinus delphis* in European Atlantic waters. 18th ASCOBANS Advisory Committee Meeting AC18/Doc.5-02 (P) UN Campus, Bonn, Germany.

Certain, G., Masse, J., Van Canneyt, O., Petitgas, P., Doremus, G., Santos, M. & Ridoux, V. 2011. Investigating the coupling between small pelagic fish and marine top predators using data collected from ecosystem-based surveys. *Marine Ecology Progress Series* 422, 23–39.

CITES (2012). Convention on International Trade in Endangered Species of Wild Flora and Fauna. Signed at Washington, DC, on 3 March 1973. Amended at Bonn on 22 June 1979. Geneva, Switzerland: CITES Secretariat. Online. https://cites.org/eng/disc/text.php.

Clua, E. and Grosvalet, F. (2001) Mixed-species feeding aggregation of dolphins, large tunas and seabirds in the Azores. *Aquatic living Resources*,14, 11–18.

Collet, A. and Saint Girons, H. (1984) Preliminary study of the male reproductive cycle in common dolphins, *Delphinus delphis,* in the eastern North Atlantic. In: Reproduction in Whales, Dolphins and Porpoises (Eds W.F. Perrin, R.J. Brownell and D.P. DeMaster). *Rep. Int. Whal. Commn* (Special Issue) 6: 355-360.

Convention on Biological Diversity (CBD) (2010) COP 10 decision X/2. Strategic Plan for Biodiversity 2011– 2020. Montreal: Convention on Biological Diversity. Online. http://www.cbd.int/decision/cop/?id=12268.

Convention on Migratory Species (CMS) Secretariat. 2012. Convention on Migratory Species. Bonn, Germany: UNEP/CMS Secretariat. Online. http://www.cms.int/sites/default/files/instrument/CMS-text.en_.PDF.

Couperus, A.J. (1995) By-catch and discarding in the Dutch Pelagic Trawl Fishery. In: Morizur. Y, Tregenza. N.J.C, Heessen. H, Berrow. S.D, and Pouvreau. S. (eds) By-catch and discarding in pelagic trawl fisheries. Report to the European Union DGXIV – C – 1, Study contract BIOECO/93/017.

Cox, T.M., Lewison, R.L., Žydelis, R., Crowder, L.B., Safina, C. and Read, A.J. (2007), Comparing Effectiveness of Experimental and Implemented Bycatch Reduction Measures: The Ideal and the Real. *Conservation Biology*, 21: 1155–1164. Online. http://onlinelibrary.wiley.com/wol1/doi/10.1111/j.1523-1739.2007.00772.x/abstract.

CSIP, 2010. UK Cetacean Strandings Investigation Programme Final Report for the period 1st January 2005 – 31st December 2010. Online.

http://randd.defra.gov.uk/Document.aspx?Document=12562_Final_UK_CSIP_Annual_Report_2014.pdf.

CSIP, in press. UK Cetacean Strandings Investigation Programme Final Report for the period 1st January 2011 – 31st December 2015.

Culloch, R., Anderwald, P., Brandecker, A., Haberlin, D., McGovern, B., Pinfeld, R., Visser, F., Jessopp, M., and Cronin, M. (2016) Effect of construction-related activities and vessel traffic on marine mammals. *Marine Ecology Progress Series*, 549: 221-242. doi: 10.3354/meps11686.

Danil, K., & Chivers, S. J. (2007). Growth and reproduction of female short-beaked common dolphins, *Delphinus delphis*, in the eastern tropical Pacific. *Canadian Journal of Zoology, 85*, 108-121.

David, L., Alleaume, S., and Guinet, C., 2011. Evaluation of the potential of collision between fin whales and maritime traffic in the north-western Mediterranean Sea in summer, and mitigation solutions. Journal of Marine Animals and Their Ecology Vol 4, No 1, 2011. Online. http://www.vliz.be/imisdocs/publications/253862.pdf.

Dawson, S., Northridge, S.P., Waples, D. and Read, A. 2013, ' To ping or not to ping: the use of active acoustic devices in mitigating interactions between small cetaceans and gillnet fisheries. *Endangered Species Research*, 19(3): 201-221. DOI: 10.3354/esr00464.

Deaville, R. & Jepson, P.D. (compilers) 2011. UK Cetacean Strandings Investigation Programme. Final report for the period 1st January 2005–31st December 2010. (Covering contract numbers CR0346 and CR0364.) Bristol, UK: Department for Environment, Food and Rural Affairs

Deaville, R. 2015. Annual report for the period 1st January – 31st December. UK Cetacean Strandings Investigation programme. 2015. Available: http://randd.defra.gov.uk/Document.aspx?Document=14001_FINALUKCSIPAnnualReport2015.pdf

Deaville, R. (compiler) In press. UK Cetacean Strandings Investigation Programme. Final report for the period 1st January 2011–31st March 2017. UK: Department for Environment, Food and Rural Affairs.

Doksæter, L., Olsen, E, Nøttestad, L. and Fernö, A. (2008) Distribution and ecology of dolphins along the Mid-Atlantic ridge between Iceland and the Azores. Deep Sea Research II – Topical studies in Oceanography 55, 243-253.

Dähne, M., A. Gilles, K. Lucke, V. Peschko, S. Adler, K. Krügel, J. Sundermeyer, and U. Siebert. 2013. Effects of pile-driving on harbour porpoises (*Phocoena phocoena*) at the first offshore wind farm in Germany. *Environmental Research Letters* 8:025002.

European Commission. 2011. Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee, and the Committee of the Regions. Our life insurance, our natural capital: an EU biodiversity strategy to 2020. Brussels: European Commission. Online. http://ec.europa.eu/environment/nature/biodiversity/comm2006/pdf/2020/1_EN_ACT_part1_v7%5b1%5d.pdf.

European Union (1979). Summary of treaty. convention on the conservation of European Wildlife and Natural Habitats (No. 104, council of Europe). Brussels: European union. online. http://www.coe.int/en/web/conventions/full-list/-/conventions/treaty/104.

Evans, P.G.H. (1980) Cetaceans in British Waters. *Mammal Review*, 10: 1-52.

Evans, P.G.H. (1982) Associations between Seabirds and Cetaceans - a review. *Mammal Review*, 12: 187-206.

Evans, P. G. H., & Scanlan, G. M. (1989). *Historical review of cetaceans in British and Irish waters*.

Evans, P. G. H., Anderwald, P., & Baines, M. E. (2003). UK Cetacean Status Review. Report to English Nature and Countryside Council for Wales. Sea Watch Foundation, Oxford. 160pp.

Evans, P. G. H., & Teilmann, J. (2009). *Report of ASCOBANS/HELCOM small cetacean population structure workshop*. Retrieved from Bonn, Germany.

Evans, P.G.H. and Bjørge, A. (2013) Impacts of climate change on marine mammals. *Marine Climate Change Impacts Partnership (MCCIP) Science Review 2013*: 134-148. Published online 28 November 2013 doi:10.14465/2013.arc15.134-148.

Evans, P.G.H. (2017) Habitat pressures. Pp. 441-446. In: *Encyclopedia of Marine Mammals* (Editors B. Würsig, J.G.M. Thewissen and K.M. Kovacs). 3rd Edition. Academic Press, San Diego. 1,157pp.

Fernández-Contreras, M. M., Cardona, L., Lockyer, C. H. and Aguilar, A. (2010). Incidental bycatch of short-beaked common dolphins (Delphinus delphis) by pairtrawlers off northwestern Spain. – ICES Journal of Marine Science, 67: 1732–1738.

Ferrero, R. C., & Walker, W. A. (1995). Growth and reproduction of the common dolphin, *Delphinus delphis Linnaeus*, in the offshore waters of the North Pacific Ocean. *Fishery Bulletin, 93*(3), 483-494.

Goold, J.C. (1996) Acoustic assessment of populations of common dolphin (*Delphinus delphis*) in conjunction with seismic surveying. *Journal of the Marine Biological Association of the United Kingdom*, 76: 811-820.

Gosselin, M.P. (2001) Aspects of the biology of common dolphins (Delphinus delphis) subject to incidental capture in fishing gears in the Celtic Sea and Channel. MS dissertation, Heriot-Watt University, Edinburgh

Goujon, M., Antoine, L., Collet, A. and Fifas, S. (1994). A study of the ecological impact of the French tuna driftnet fishery in the North-east Atlantic. European Research on Cetaceans, 8: 47–48.

Graham, C.T. & Harrod, C. 2009. Implications of climate change for the fishes of the British Isles. *Journal of Fish Biology* 74, 1143–1205.

Halpern, B., McLeod, K., Rosenberg, A. Crowder, L., (2008). Managing for cumulative impacts in ecosystem-based management through ocean zoning. *Ocean & Coastal Management, Volume 51, Issue 3, 2008, Pages 203-211.*

Hammond, P. S., Macleod, K., Berggren, P., Borchers, D. L., Burt, M. L., Canadas, A., . . . Vazquez, J. A. (2013). Cetacean abundance and distribution in European Atlantic shelf waters to inform conservation and management. *Biological Conservation, 164*, 107-122.

Hammond, P. S., Lacey, C., Gilles, A., Viquerat, S., Börjesson, P., Herr, H., Macleod, K., Ridoux, V., Santos, M. B., Scheidat, M., Teilmann, J., Vingada, J., Øien, N. (2017). Small Cetaceans in the European Atlantic and North Sea (SCANS-III) 2016. Estimates of cetacean abundance in European Atlantic waters in summer 2016 from the SCANS-III aerial and shipboard surveys. Online: https://synergy.st-andrews.ac.uk/scans3/files/2017/05/SCANS-III-design-based-estimates-2017-05-12-final-revised.pdf

Harwood, J, (2001). Marine mammals and their environments in the twenty-first century' *Journal of* Mammalogy, vol 82, no. 3, pp. 630-640.

Hassani, S., Antoine, L., and Ridoux, V. (1997). Diets of albacore, *Thunnus alalunga*, and dolphins, *Delphinus delphis* and *Stenella coerulaeoalba*, caught in the Northeast Atlantic albacore drift-net fishery: a progress report. *Journal of Northwest Atlantic Fishery Science*: 119-123.

Hurrell, J.W., Kushnir, Y., Visbeck, M. & Ottersen, G. 2003. An overview of the North Atlantic Oscillation. In *The North Atlantic Oscillation: Climate Significance and Environmental Impact, Geophysical Monograph Series 134*, J.W. Hurrell et al. (eds). Washington, DC: American Geophysical Union, 1–35.

ICES (2014). Special request, Advice 1.6.6.1. May 2014 ECOREGION General advice: OSPAR request on implementation of MSFD for marine mammals. 2014. Available: http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2014/Special%20Requests/OSPAR_Implementation_of_MSFD_for_marine_mammals.pdf

ICES (2016a). Special Request Advice: Northeast Atlantic and adjacent seas ecoregions, 2016 Bycatch of small cetaceans and other marine animals – review of national reports under Council Regulation (EC) No. 812/2004 and other information. Online. http://www.ices.dk/sites/pub/Publication%20Reports/Advice/2016/2016/Protected_species_bycatch.pdf.

ICES (2016b). Working Group on Bycatch of Protected Species (WGBYC), 1–5 February 2016, ICES HQ, Copenhagen, Denmark. ICES CM 2016/ACOM:27. 82 pp.

ICES WGMME (2009). Report of the Working Group on Marine Mammal Ecology (WGMME), 2-6 February 2009. Vigo, Spain.

ICES WGBYC (2017). Report of the Working Group on Bycatch of Protected Species (WGBYC), 12–15 June 2017, Woods Hole, Massachusetts, USA. ICES CM 2017/ACOM:24. 82 pp.

ICES WGMME (2005). Report of the Working Group on Marine Mammal Ecology, (WGMME), 9-12 May 2005, Savolinna, Common dolphin (*Delphinus delphis*) United Kingdom Third Report by the United Kingdom under Article 17 on the implementation of the Directive from January 2007 to December 2012 Produced on 09/10/2013 10:24 Page 8 Finland.

Iles, C. and Hegerl, G. (2017) Role of the North Atlantic Oscillation in decadal temperature trends. *Environmental Research Letters*, 12 114010. https://doi.org/10.1088/1748-9326/aa9152

Ingre-Khans, E., Agerstrand, M., & Ruden, C. (2017). Endocrine disrupting chemicals in the marine environment. ACES report number 16. Department of Environmental Science and Analytical Chemistry, Stockholm University.

Institute of Zoology. (2015). Cetacean-Stressors: The independent and interactive effects of multiple stressors on reproduction and development in cetaceans. Second periodic report to Marie Curie Actions. Project Number: 276145.

International Whaling Commission (IWC), (2009). Annex I. Report of the Sub-Committee on Small Cetaceans 2009. Report of the International Whaling Commission, IWC/61/Rep 1. Annex I. Cambridge, UK: International Whaling Commission.

International Whaling Commission (IWC). (2012). International Whaling Commission. Cambridge, UK: online. http://iwcoffice.org/.

Jepson, P.D., Arbelo, M., Deaville, R., Patterson, I.A.P., Castro, P., Baker, J.R., Degollada, E., Ross, H.M., Herraez, P., Pocknell, A.M., Rodriguez, F., Howie, F.E., Espinosa, A., Reid, R.J., Jaber, J.R., Martin, V., Cunningham, A.A. & Fernandez, A. (2003). Gas-bubble lesions in stranded cetaceans. Nature 425, 575–576.

Jepson, P.D., Deaville, R., Acevedo-Whitehouse, K., Barnett J, Brownlow A, Brownell Jr. RL, et al., (2013) What Caused the UK's Largest Common Dolphin (*Delphinus delphis*) Mass Stranding Event? PLoS ONE 8(4): e60953.

Jepson, P.D. *et al.,* (2016). PCB pollution continues to impact populations of orcas and other dolphins in European waters. *Sci. Rep.* **6**, 18573 (2016).

JNCC, (2010a). Joint Nature Conservation Committee (JNCC). UK priority species data collation Delphinus delphis. Version 2. Peterborough, UK: Online: http://jncc.defra.gov.uk/_speciespages/258.pdf.

JNCC, (2010b). Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise. August 2010. Peterborough, UK. Online: http://jncc.defra.gov.uk/pdf/jncc_guidelines_piling%20protocol_august%202010.pdf

JNCC, (2017). Joint Nature Conservation Committee (JNCC). JNCC guidelines for minimising the risk of injury and disturbance to marine mammals from geophysical surveys (2017). Available: http://jncc.defra.gov.uk/pdf/jncc_guidelines_seismicsurvey_aug2017.pdf

Kindt-Larsen, L., Berg, C. W., Tougaard, J., Sørensen, T. K., Geitner, K., Northridge, S., ... & Larsen, F. (2016). Identification of high-risk areas for harbour porpoise Phocoena phocoena bycatch using remote electronic monitoring and satellite telemetry data. *Marine Ecology Progress Series*, *555*, 261-271.

Kinze, C. C. (1995). Danish whale records (1991) (Mammalia, Cetacea). *Steenstrupia, 21*, 155-196.

Kinze, C. C., Jensen, T., Tougaard, S., & Baagoe, H.J. (2010). Danske hvalfund i perioden 1998-2007

1662 [Records of cetacean strandings on the Danish coastline during 1998-2007]. *Flora og Fauna, 116*(4), 91-99.

Kiszka, J., Macleod, K., Van Canneyt, O., Walker, D. & Ridoux, V. 2007. Distribution, encounter rates, and habitat characteristics of toothed cetaceans in the Bay of Biscay and adjacent waters from platform-of- opportunity data. *ICES Journal of Marine Science* 64,1033–1043.

Kuiken, T., Simpson, V.R., Allchin, C.R., Bennett, M., Codd, G.A., Harris, E.A., Howes,G.J., Kennedy, S., Kirkwood, J.K., Law, R.J., Merrett, N.R and Phillips, S. (1994). Mass mortality of common dolphins (Delphinus delphis) in south-west England due to incidental capture in fishing gear. Veterinary Record, 134: 81-89. Online. https://www.cefas.co.uk/cefas-data-hub/publication-abstract/?id=853.

Lahaye, V., Bustamante, P., Spitz, J., Dabin, W., Das, K., Pierce, G., J., Caurant, F. (2005). Long-term dietary segregation of common dolphins Delphinus delphis in the Bay of Biscay, determined using cadmium as an ecological tracer. Marine Ecology Progress Series, 305 : 275-285.

Lambert, C., Pettex, E., Dorémus, G., Laran, S., Stephan, E., Van Canneyt, O., Ridoux, V. (2017) Marine top predators adjust their ecological preferences in response to the ocean seasonality. Part II: the example of the north-east Atlantic. *Deep-Sea Research II 141 (2017) 133–154*.

Laran, S., Authier, M., Blanck, A., Dorémus, G., Falchetto, H., Monestiez, P., Pettex, E., Stephan, E., Van Canneyt, O., and Ridoux, V. (2017) Seasonal distribution and abundance of cetaceans within French waters: Part II: The Bay of Biscay and the English Channel. *Deep-Sea Research II*, 14: 31-40.

Lassalle, G., Gascuel, D., Le Loc'h, F., Lobry, J., Pierce, G. J., Ridoux, V., . . . Niquil, N. (2012). An ecosystem approach for the assessment of fisheries impacts on marine top predators: the Bay of Biscay case study. *ICES Journal of Marine Science: Journal du Conseil, 69*(6), 925-938. doi:10.1093/icesjms/fss049.

Law, R.J., Barry, J., Barber, J.L., Bersuder, P., Deaville, R., Reid, R.J., Brownlow, A., Penrose, R., Barnett, J., Loveridge, J., Smith, B., Jepson, P.D. (2012). Contaminants in cetaceans from UK waters: Status as assessed within the Cetacean Strandings Investigation Programme from 1990 to 2008. Marine Pollution Bulletin 64 (2012) 1485–149.

Lawson, J., Gosselin, J.-F., Desportes, G., Acquarone, M., Heide-Jorgensen, M. P., Mikkelsen, B., . . . Oien, N. (2009). A note on the distribution of short-beaked common dolphins, *Delphinus delphis*, observed during the 2007 T-NASS (Trans North Atlantic Sightings Survey). *Report to the International whaling Commission Report, SC/61/SM35*, 4.

Learmonth JA, Santos MB, Pierce GJ, Moffat CF, Rogan E, Murphy S, Ridoux V, Meynier L, Lahaye V, Pusineri C, Spitz J (2004) Dietary Studies on Small Cetaceans in the NE Atlantic Using Stomach Contents and Fatty Acid Analyses. BIOCET workpackage 6-final report. Project Reference: EVK3- 2000–00027. 99 pp.

Mackay, A. I., (2011). An investigation of factors related to the bycatch of small cetaceans in fishing gear. A Thesis Submitted for the Degree of PhD at the University of St. Andrews, 2011. Available at: http://research-repository.st-andrews.ac.uk/

MacLeod, C. D., Bannon, S.M., Pierce, G.J., Schweder, C., Learmonth, J.A., Herman, J.S., Reid, R.J., (2005). Climate change and the cetacean community of north-west Scotland. Biological Conservation, 124 (4), 477-483.

MacLeod, C., Brereton, T., & Martin, C. (2009). Changes in the occurrence of common dolphins, striped dolphins and harbour porpoises in the English Channel and Bay of Biscay. Journal of the Marine Biological Association of the United Kingdom, 89(5), 1059-1065. doi:10.1017/S0025315408002828

Mannocci L, Dabin W, Augeraud-Véron E, Dupuy J-F, Barbraud C, Ridoux V (2012) Assessing the Impact of Bycatch on Dolphin Populations: The Case of the Common Dolphin in the Eastern North Atlantic. PLoS ONE 7(2): e32615.

Mendolia, C. (1989). *Reproductive biology of common dolphins (Delphinus delphis Linnaeus) off the south-east coast of southern Africa.* (MSc thesis), University of Port Elizabeth, Port Elizabeth.

Meynier, L., Lahaye, V., Pusineri, C. & Spitz, J. (2004) Dietary studies on small cetaceans in the NE Atlantic using stomach contents and fatty acid analyses. BIOCET workpackage 6—final report. Project reference: EVK3-2000-00027. Aberdeen, UK: University of Aberdeen.

Meynier, L., Pusineri, C., Spitz, J., Santos, M.B., Pierce, G.J., Ridoux, V. (2008a) Diet and feeding ecology of the common dolphin, *Delphinus delphis*, in the Bay of Biscay: importance of fat fish. *Marine Ecology Progress Series*, 354: 267-276.

Meynier, L., Pusineri, C., Spitz, J., Santos, MB., Pierce, GJ and Ridoux, V. (2008b). Intraspecific dietary variation in the short-beaked common dolphin *Delphinus delphis* in the Bay of Biscay: importance of fat fish. Mar Ecol Prog Ser 354:277-287. https://doi.org/10.3354/meps07246.

Mirimin, L., Westgate, A., Rogan, E., Rosel, P., Read, A., Coughlan, J., and Cross, T. (2009). Population structure of short-beaked common dolphins (Delphinus delphis) in the North Atlantic Ocean as revealed by mitochondria and nuclear genetic markers. Marine Biology, 156: 821–834.

Moura, A.E., Natoli, A., Rogan, E., and Hoelzel, A.R. (2013) Atypical panmixia in a European dolphin species (*Delphinus delphis*): implications for the evolution of diversity across oceanic boundaries. *Journal of Evolutionary Biology*, 26: 63-75.

Murphy, S. (2004). Stock structure in the common dolphin *Delphinus delphis* in the NorthEast Atlantic. A report for the EU NECESSITY project. 20pp

Murphy, S., Collet, A., & Rogan, E. (2005). Mating strategy in the male common dolphin *Delphinus delphis*: what gonadal analysis tells us. *J Mammal, 86*(6), 1247-1258.

Murphy, S., Herman, J.S., Pierce, G.J., Rogan, E. & Kitchener, A.C. (2006). Taxonomic status and geographical cranial variation of common dolphins (*Delphinus*) in the eastern North Atlantic. *Marine Mammal Science* 22, 573–599.

Murphy, S., Dabin, W., Ridoux, V., Morizur, Y., Larsen, F., & Rogan, E. (2007). *Estimation of Rmax for the common dolphin in the Northeast Atlantic. NECESSITY Contract 501605 Periodic Activity Report* Murphy, S., Northridge, S., Dabin, W., Van Canneyt, O., Ridoux, V., Rogan, E., . . . Morizur, Y. (2007). *Biological parameters of common dolphin population resulting from stranded or bycaught animals in the Northeast Atlantic. NECESSITY Contract 501605 Periodic Activity Report No 2 - Annex 6.2*. *No 2 – Annex 8.4*.

Murphy, S., Evans, P.G.H. & Collet, A. (2008). Common Dolphin *Delphinus delphis*. In Mammals of the British Isles: handbook. S. Harris & D.W. Yalden (eds). Southampton, uk: mammal Society, 4th edition, 719–724.

Murphy, S. (2009). Environmental and anthropogenic factors linked to influencing or controlling cetacean population growth rates. Task 3 Deliverable 'cetacean stock assessment in relation to exploration and production industry sound'. JIP cetacean Stock assessment. St. Andrews, UK: Sea Mammal Research Unit (SMRU).

Murphy, S., Winship, A., Dabin, W., Jepson, P. D., Deaville, R., Reid, R. J., . . . Northridge, S. P. (2009). Importance of biological parameters in assessing the status of *Delphinus delphis*. *Marine Ecology Progress Series, 388*, 273-291. doi:10.3354/meps08129.

Murphy, S., Pierce, G. J., Law, R. J., Bersuder, P., Jepson, P. D., Learmonth, J. A., . . . Boon, J. P. (2010). Assessing the effect of persistent organic pollutants on reproductive activity in common dolphins and harbour porpoises. NAFO/ICES/NAMMCO symposium "The Role of Marine Mammals in the Ecosystem in the 21st Century". *Journal of Northwest Atlantic Fishery Science, 42*, 153-173.

Murphy, S., R. Deaville, R. J. Monies, N. Davison, and P. D. Jepson. (2011). True hermaphroditism: first evidence of an ovotestis in a cetacean species. Journal of Comparative Pathology 144:195-199.

Murphy, S., Jepson, P.D. & Deaville, R. (2012). Effects of contaminants on reproduction in small cetaceans, phase II. Final report of Phase II to ASCOBANS. St. Andrews, UK: Sea Mammal Research Unit.

Murphy, S., Pinn, E., and Jepson, P. (2013). The short-beaked common dolphin (*Delphinus delphis*) in the North-eastern Atlantic: distribution, ecology, management and conservation status. In: Hughes RN, Hughes DJ, Smith IP, eds. CRC Press. Oceanography and Marine Biology Vol 51: 193-280.

Murphy, S., & Rogan, E. (2006). External morphology of the short-beaked common dolphin, Delphinus delphis: growth, allometric relationships and sexual dimorphism. Acta Zoologica, 87(4), 315-329.

Murphy, S., Herman, J.S., Pierce, G.J., Rogan, E. & Kitchener, A.C. 2006. Taxonomic status and geographical cranial variation of common dolphins (Delphinus) in the eastern North Atlantic. Marine Mammal Science 22, 573–599.

Murphy, S., Natoli, A., Amaral, A. R., Mirimin, L., Viricel, A., Caurant, F., . . . Evans, P. G. H. (2009). Short-beaked common dolphin *Delphinus delphis*. Report of ASCOBANS/HELCOM small cetacean population structure workshop. 8-10 October 2007, UN Campus, Hermann-Ehlers-Str. 10, 53113 Bonn, Germany. 111-130.

Murphy, S., R. J. Law, R. Deaville, J. Barnett, M. W. Perkins, A. Brownlow, N. Davison, R. Penrose, J. L. Barber, and P. D. Jepson. (2018). Chapter 1 - Organochlorine Contaminants and Reproductive Implication in Cetaceans: A Case Study of the Common Dolphin. In M. C. Fossi & C. Panti (Editors), Marine Mammal Ecotoxicology: Academic Press. 3-38.

Murphy, S., P. G. H. Evans, E. Pinn, and G. J. Pierce. accepted. Conservation management of common dolphins: lessons learned from the North-east Atlantic. Aquatic Conservation: Marine and Freshwater Ecosystems.

Nabe-Nielsen, J., Sibly, R.M., Tougaard, J., Teilmann, J., and Sveegaard, S. (2014) Effects of noise and by-catch on a Danish harbour porpoise population. *Ecological Modelling,* 272: 242-251.

National Academies of Sciences, Engineering, and Medicine (2017) *Approaches to Understanding the Cumulative Effects of Stressors on Marine Mammals*. The National Academies Press, Washington, DC. doi: https://doi.org/10.17226/23479.

Natoli, A., Cañadas, A., Peddemors, V. M., Aguilar, A., Vaquero, C., Fernandez-Piqueras, P and Hoelzel, A. R. (2006), Phylogeography and alpha taxonomy of the common dolphin (Delphinus sp.). Journal of Evolutionary Biology, 19: 943-954. doi:10.1111/j.1420-9101.2005.01033.x.

Natoli, A., Cañadas, A., Vaquero, C., Politi, E., Fernandez-Navarro, P. & Hoelzel, A.J. (2008). Conservation genetics of the short-beaked common dolphin (Delphinus delphis) in the Mediterranean Sea and in the eastern North Atlantic Ocean. Conservation Genetics 9, 1479–1487.

Nehls, G., Rose, A., Diederichs, A., Bellmann, M and Pehlke, H., (2016). Noise Mitigation During Pile Driving Efficiently Reduces Disturbance of Marine Mammals. Adv Exp Med Biol. 2016; 875:755-62.

Neumann, D.R. & orams, m.b. (2003). Feeding behaviour of short- beaked common dolphins, Delphinus delphis, in New Zealand. Aquatic Mammals 29, 137–149.

O'Brien, C.M., Fox, C.J., Planque, B. & Casey, J. 2000. Climate variability and North Sea cod. *Nature* 404, 142.

O Cadhla, O., Mackey, M., Aguilar de Soto, N., Rogan, E., & Connolly, N. (2003). *Cetaceans and Seabirds of Ireland's Atlantic Margin. Volume II – Cetacean distribution & abundance. Report on research conducted under the 1997 Irish Petroleum Infrastructure Programme (PIP): Rockall Studies Group (RSG) projects 98/6, 99/38 and 00/13. 83pp.*

OSPAR (2007). Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) Convention text 2007. Online http://www.ospar.org/site/assets/files/1290/ospar_convention_e_updated_text_in_2007_no_revs.pdf.

Papale, E., Gamba, M., Perez-Gil, M., Martin, V.M., Giacoma, C (2015). Dolphins adjust species-specific frequency parameters to compensate for increasing background noise (2015) PLoS ONE, 10 (4), art. no. e121711.

Paxton, C.G.M., Scott-Hayward, L., Mackenzie, M., Rexstad, E & Thomas, L. (2016) Revised Phase III Data Analysis of Joint Cetacean Protocol Data Resource JNCC Report No.517 Online. http://jncc.defra.gov.uk/pdf/Report_517_web.pdf.

Peltier, H., W. Dabin, P. Daniel, O. Van Canneyt, G. Dorémus, M. Huon, and V. Ridoux. (2012). The significance of stranding data as indicators of cetacean populations at sea: Modelling the drift of cetacean carcasses. Ecological Indicators 18:278-290.

Peltier, H., Authier, M., Deaville, R., Dabin, W., Jepson, P.D., Van Canneyt, O., Daniel, P and Ridoux, V. (2016). Small cetacean bycatch as estimated from stranding schemes: The common dolphin case in the northeast Atlantic. *Environmental Science & Policy*, 63, 7-18. Online. http://www.sciencedirect.com/science/article/pii/S1462901116301514.

Peltier, H., Van Canneyt, O., Dabin, W., Dars, C., Demaret, F., and Ridoux, V. (2017) New Fishery-related Unusual Mortality and stranding events of Common Dolphins in the Bay of Biscay, February-March 2017, France. IWC SC-67A-HIM-WP-08. 6pp.

Pierce, G.J., Santos, M.B., Murphy, S., Learmonth, J.A., Zuur, A.F., Rogan, E., Bustamante, P., Caurant, F., Lahaye, V., Ridoux, V., Zegers, B.N., Mets, A., Addink, M., Smeenk, C., Jauniaux, T., Law, R.J., Dabin, W., Lopez, A., Alonso Farre, J.M., Gonzalez, A.F., Guerra, A., G arcia-Hartmann, M., Reid, R.J., Moffat, C.F., Lockyer, C. & Boon, J.P. (2008). Bioaccumulation of persistent organic pollutants in female common dolphins (*Delphinus delphis*) and harbour porpoises (*Phocoena phocoena*) from western European seas: geographical trends, causal factors and effects on reproduction and mortality. *Environmental Pollution* 153, 401–415.

Planque, B. & Taylor, A.H. 1998. Long term changes in zooplankton and the climate of the North Atlantic. *ICES Journal of Marine Science* **55**, 644–654.

Pusineri, C., Magnin, V., Meynier, L., Spitz, J., Hassani, S., & Ridoux, V. (2007). Food and feeding ecology of the common dolphin (*Delphinus delphis*) in the oceanic northeast Atlantic and comparison with its neritic areas. *Marine Mammal Science, 23*(1), 30-47

Quérouil S, Freitas L, Cascão I, Alves F, Dinis A, Almeida JR, Prieto R, Borràs S, Matos JA, Mendonça D, Santos RS (2010) Molecular insight on the population structure of common and spotted dolphins inhabiting the pelagic waters of the Northeast Atlantic. Marine Biology, 157: 2567–2580

Quérouil, S., Kiszka, J., Cordeiro, A.R., Cascão, I., Freitas, L., Dinis, A., Alves, F., Santos, R.S., Bandarra, N.M. (2013). Investigating stock structure and trophic relationships among island-associated dolphins in the oceanic waters of the North Atlantic using fatty acid and stable isotope analyses. Marine Biology, 160: 1325- 1337

Read, F.L. 2016. Understanding cetacean and fisheries interactions in the north-west Iberian Peninsula. PhD thesis, Universidade de Vigo, Spain. 309 pp.

Read, F.L., Evans, P.G.H. and Dolman, S.J. (2017). Cetacean Bycatch Monitoring and Mitigation under EC Regulation 812/2004 in the Northeast Atlantic, North Sea and Baltic Sea from 2006 to 2014. A WDC Report. 68 pp.

Reid, J.B., Evans, P.G.H., & Northridge, S.P., (2003), Atlas of Cetacean distribution in north-west European waters, 76 pages, colour photos, maps. Paperback, ISBN 1 86107 550 2

Rogan, E. et al. 2017. A hazy shade of winter: contrasting seasonal occurrence of cetaceans in offshore NE Atlantic waters. SMM abstract Haifax.

Ryan, C., Boisseau, O, Cucknell, A, Romagosa, M, Moscrop, A., & McLanaghan, R. (2013). Final report for trans-Atlantic research passages between the UK and USA via the Azores and Iceland, conducted from RV Song of the Whale 26 March to 28 September 2012. Report to the International Fund for Animal Welfare. Marine Conservation Research International, 20pp.

Santos, M.B., Pierce, G.J., Lopez, A., Martínez, J.A., Fernández, M.T., Ieno, E., Mente, E., Porteiro, C., Perrera, P., and Meixide, M. (2004) Variability in the diet of common dolphins

(*Delphinus delphis*) in Galician waters 1991–2003 and relationships with prey abundance. ICES conference and meeting (cm) Document 2004/Q:09. Copenhagen, Denmark: International Council for the Exploration of the Sea.

Santos, M., German, I., Correia, D., Read, F.L., Martinez Cedeira, J., Caldas, M., López, A., Velasco, F., and Pierce, G. (2013). Long-term variation in common dolphin diet in relation to prey abundance. *Marine Ecology Progress Series*, 481, 249-268.

Santos, M.B., Saavedra, C., and Pierce, G. J. (2014). Quantifying the predation on sardine and hake by cetaceans in the Atlantic waters of the Iberian peninsula. *Deep Sea Research Part II: Topical Studies in Oceanography, 106*, 232-244.

Scheidat, M and Königson, S. (2015). ASCOBANS Workshop on Remote Electronic Monitoring. The Hague, Netherlands, 2 October 2015. Report: Workshop on Remote Electronic Monitoring with Regards to Bycatch of Small Cetaceans Steering Group. Online. https://www.ascobans.org/en/document/report-workshop-remote-electronic-monitoring-regards-bycatch-small-cetaceans.

Silber, G.K., Angelia S.M. Vanderlaan, A.S.M., Tejedor Arceredillo, A., Johnson, L., Taggart, C.T., Brown, M.W., Bettridge, S., and Sagarminaga, R. (2013) The role of the International Maritime Organization in reducing vessel threat to whales: Process, options, action and effectiveness. Marine Policy, 36: 1221-1233.

Silva, M. A., (1999). Diet of common dolphins, *Delphinus delphis,* off the Portuguese continental coast. J. Mar. Biol. Ass. U.K. (1999), 79, 531-540. UK. Available: http://www.horta.uac.pt/projectos/Cetamarh/Artigos/artigo4.pdf.

Spitz, J., Mourocq, E., Leauté, J. P., Quéro, J. C., & Ridoux, V. (2010). Prey selection by the common dolphin: fulfilling high energy requirements with high quality food. *Journal of Experimental Marine Biology and Ecology, 390*, 73-77

Stone, C.J. (2015). Marine mammal observations during seismic surveys from 1994-2010. JNCC report, No. 463a.

Taylor, B., Chivers, S. J., Larese, J. and Perrin, B. 2007. Generation length and percent mature estimates for IUCN assessments of cetaceans. Southwest Fisheries Science Center. Administrative report LJ-07–01, 18pp.

Thompson, P.M., Lusseau, D., Barton, T., Simmons, D., Rusin, J. and Bailey, H., (2010). Assessing the responses of coastal cetaceans to the construction of offshore wind turbines. *Marine pollution bulletin*, *60*(8), pp.1200-1208.

United Nations. (2001). Convention on the Law of the Sea of 10 December 1982. New York: Division for Ocean Affairs and the Law of the Sea, Office of Legal Affairs, United Nations. Online. http://www.un.org/Depts/los/convention_agreements/texts/unclos/unclos_e.pdf.

Vanderlaan, A.S.M., Corbett, J.J., Green, S.L, Callahan, J.A., Wang, C., Kenney, R.D., Taggart, C.T., and Firestone, J. (2009). Probability and mitigation of vessel encounters with North Atlantic right whales. Endangered Species Research 6, 273–285.

Vanderlaan, A.S.M., Taggart, C.T., Serdynska, A.R., Kenney, R.D., and Brown, M.W. (2008). Reducing the risk of lethal encounters: vessels and right whales in the Bay of Fundy and on the Scotian Shelf. Endangered Species Research 4, 283-297.

Viricel, A., Strand, A.E., Rosel, P.E., Ridoux, V. & Garcia, P. (2008). Insights on common dolphin (Delphinus delphis) social organization from genetic analysis of a mass-stranded pod. Behavioral Ecology and Sociobiology 63, 173–185.

Weilgart, L.S. (2007a). The impacts of anthropogenic ocean noise on cetaceans and implications for management. Canadian Journal of Zoology 85, 1091–1116.

Weilgart, L.S. (2007b). A brief review of known effects of noise on marine mammals. International Journal of Comparative Psychology 20, 159–168.

Westgate, A., & Read, A. (2007). Reproduction in short-beaked common dolphins (*Delphinus delphis*) from the western North Atlantic. *Marine Biology, 150*(5), 1011-1024.

Williams, R., Wright, A. J., Ashe, E., Blight, L. K., Bruinties, R., Canessa, R., Clark, C. W., Cullis-Suzuki, S., Dakin, D. T., Erbe, C., Hammond, P. S., Merchant, N. D., O'Hara, P. D., Purser, J., Radford, A. N., Simpson, S. D., Thomas, L and Wale, M. A (2015). *Impacts of anthropogenic noise on marine life: publication patterns, new discoveries, and future directions in research and management*. *Ocean Coast. Manag.* 115, 17–24 (2015).

Zhou, J.L., Salvador, S.M., Liu, Y.P. & Sequeira, M. (2001). Heavy metals in the tissues of common dolphins (Delphinus delphis) stranded on the Portuguese coast. Science of the Total Environment 273, 61–76.